

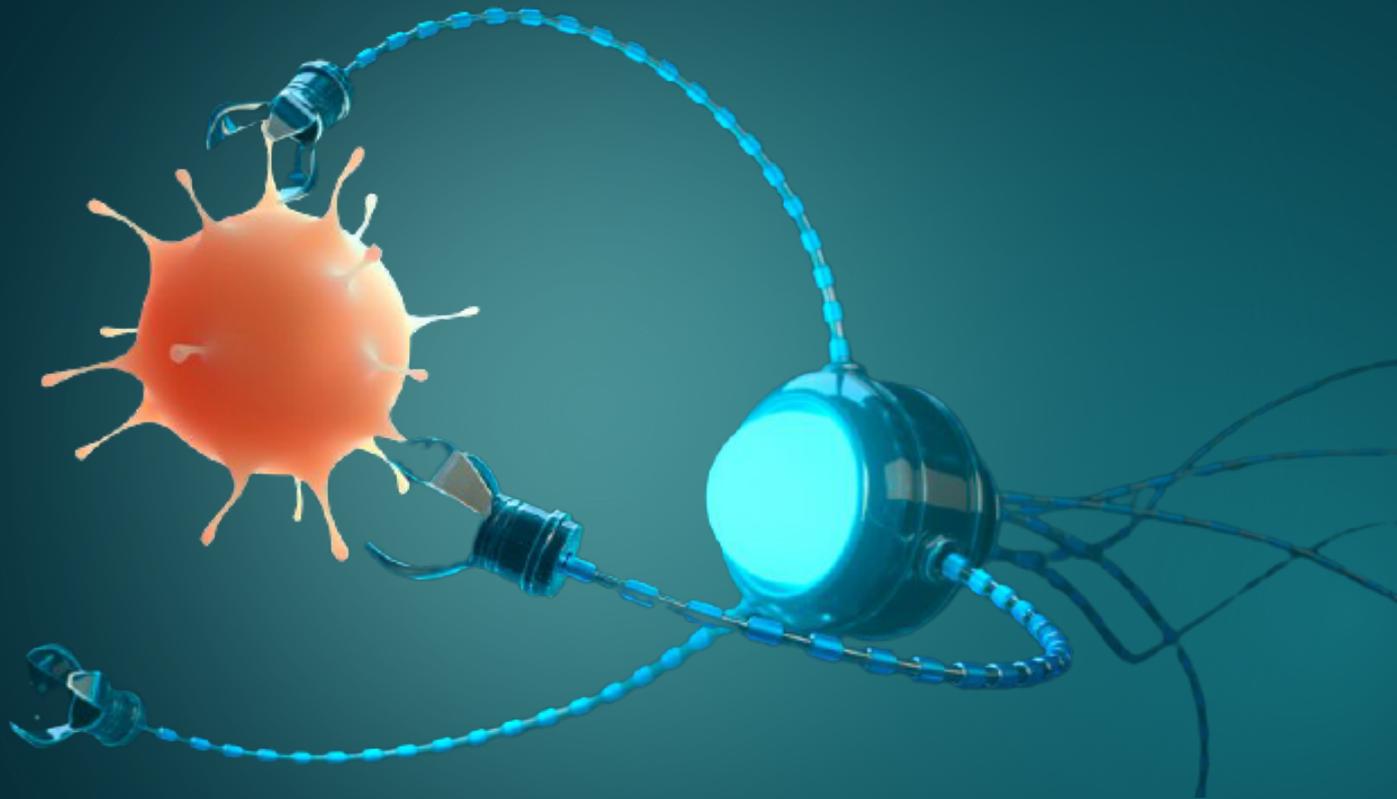
MOUNT CARMEL COLLEGE

BIOGENEAC ASSOCIATION

BIOGENESIS

FEBRUARY ISSUE

NANOBIOTECHNOLOGY



ROBOTS CAN REPRODUCE!?

Learn about Xenobots, created from the stem cells of the African clawed frog

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NO MORE CRYING OVER SPOILT MILK!

Read about biosensors that can spot contamination of milk

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Check out these incredible developments made with the help of nanotechnology!

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BIOGENESIS

THE OFFICIAL NEWSLETTER OF BIOGENE IAC ASSOCIATION
MOUNT CARMEL COLLEGE

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Role of Nano-Biotechnology In Drug Discovery And Development

ADRIZA GHOSH | 2ND YEAR BTCZ

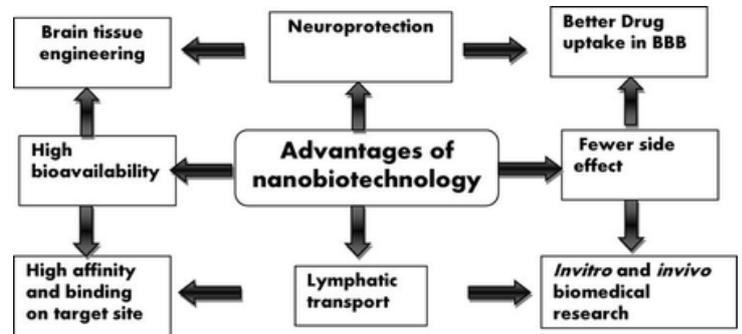
The word “nano-biotechnology” is a combined study of the nanotechnology aspect of it as well as the biotechnology aspect. The former includes design, development and application of nano materials and the co related devices while the latter includes function of various biological site like microorganisms.

This technology has the capacity to build bridges among different branches of sciences, providing newer challenges and opening new doors in the field of research and diagnostics.

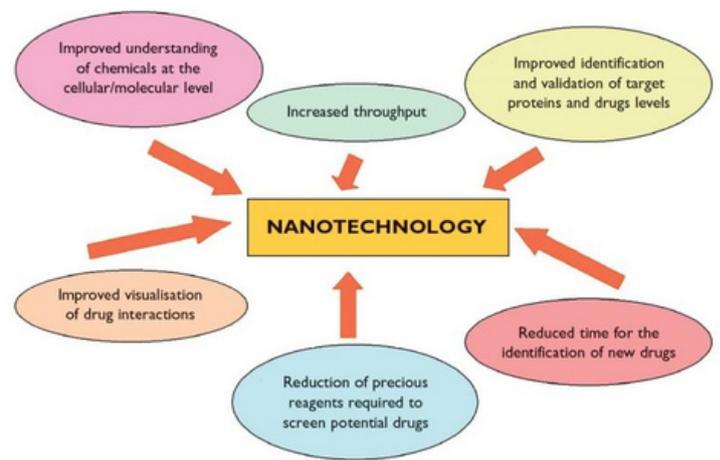
In terms of drug discovery and development, the role of nano biotechnology currently lies in improving diagnostic methods, developing improved drug formulations and drug delivery systems for disease therapy. This breakthrough format offers innovative solutions, giving the researchers greater analytical capacity, improved data quality while at the same time providing lesser sampling volume storage of molecular, cell and tissue libraries.

Drug designing at the nanoscale has been studied extensively and is by far the most advanced technology in the area of nanoparticle applications because of its potential advantages like the possibility to modify properties like solubility, drug release profiles, bioavailability and immunogenicity. This usually leads to the development of convenient administrative routes, lower toxicity and extended drug life cycle.

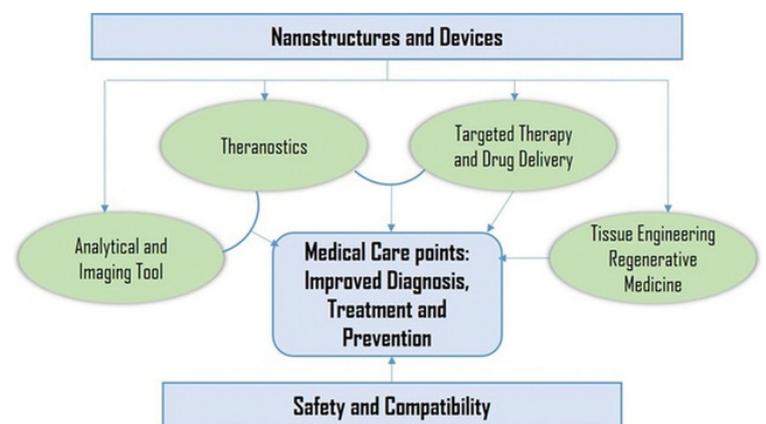
There are basically two ways through which nanostructures deliver drugs- passive and self delivery. In the former process, drugs are incorporated into the inner cavity of the



Credits: www.intechopen.com



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structure via hydrophobic effect. In this, the nanostructure materials are targeted to a particular site and the intended amount of the required drug is released because of the low content of the drug in the hydrophobic environment. However in the latter process, the drugs intended for release are directly conjugated to the carrier nanostructure material for easy delivery. In this case, the time of release is crucial as the drug does not reach the target site and it dissociates from the carrier molecule very quickly, and its bioefficacy and activity will be decreased if it isn't released at the exact time.

Currently, most nano biotechnology mediated drug delivery systems are targeted towards cancer and its cure.

For the last decade, the Office of Testing and Research (OTR) has been conducting research to adhere to better understanding of the manufacturing and quality issues associated with drug products containing nanomaterials with the aim to inform and review the concerned agencies. Current studies are focused on identifying the critical processes and material properties that can impact quality and thereby drug efficacy.

Nanomedicine: The COVID Vaccine's Mother

ANYA VACHA | BTCZ 2ND YEAR

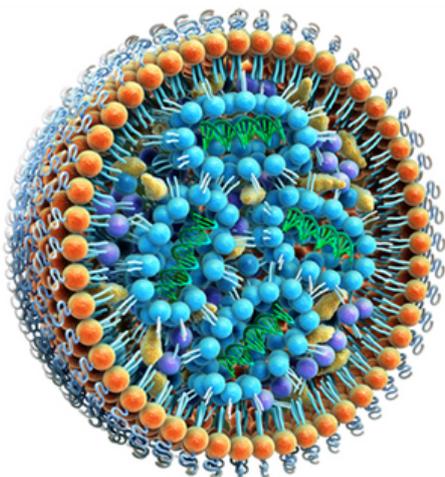
In the past 2 years, our daily newsfeeds have been dominated, much like the world as a whole, by COVID. At the start of this pandemic, people held on to the hope of the mighty vaccine, which had the power to turn life into a semblance of what it once was. Though it usually takes years, the timeline for an effective Covid vaccine was shortened greatly by the rapid documentation of the SARS-CoV-2 genome and structural data. At the forefront stood Pfizer-BioNTech and Moderna with something relatively unheard of: mRNA-based vaccines using nanomedicine.

In the past, Nanotechnology-based drug carriers have been used primarily in cancer treatment, but have newfound potential in vaccine development due to a very simple principle: viruses and nanoparticles exist in the same scale. Viruses are just naturally-occurring nanoparticles. The success of the Pfizer-BioNTech and Moderna vaccines is greatly attributed to the benefits of using nanoparticles,

more specifically, nanoscale lipid vesicles (also known as nanoliposomes). Their ability to efficiently deliver antigens comes from abilities of progressive release, active targeting and capability to transport both hydrophilic and lipophilic antigens due to their 4-part structure. It is this specific type of nanoparticle that is responsible for the 95% efficacy that the Pfizer-BioNTech and Moderna vaccines possessed in their phase 3 clinical trials.

We are only at the beginning in this field of research, and improvements in cost and stability are constantly building up. There is a lot left to be understood, but right now nanotechnology has been able to quell a global pandemic.

Looking at mRNA vaccines alone, they are vastly different from conventional vaccines containing inactivated or deceased viruses. Conventional vaccines are still commonplace because despite the need for multiple doses and high cost per dose, they are easy to transport and distribute whilst also creating



Credits: www.precisionnanosystems.com



Credits: www.statnews.com

desired strong immune responses from the recipient. mRNA vaccines took time to catch on because of key difficulties that nanotechnology, encouraged by a pandemic, managed to solve. The hydrophilic, negatively charged nature of mRNA means it is difficult to simply diffuse through lipophilic, negatively charged cell membranes and take action. Not to mention, mRNA being immediately identified as foreign genetic material in any cell means imminent destruction by ribonucleases of the host cell.

How do nanoliposomes solve this problem? Essentially, they package the mRNA within their rigid morphology, which is also neutrally charged, and carry them through the cell membrane by mimicking it. This mimicry allows the fat droplets to fuse with the cell then mRNA to code for the virus-fighting protein, and also prevents possibility of an immune response because it is untraceable. These fatty particles are then broken down in the way that all lipids are, which means the nanoparticle

itself is completely harmless to the body. It is a non-viral delivery system that safely transports nucleic acids without damage, something that used to be a common problem that hindered the use of genetic medicine.

The advantage of nanoparticle-based vaccination is not only in the fact that it is efficiently transforms nucleic acids and is harmless to the host cell, it is also safer because they are non-infectious. The greatest advantage right now is that they can be produced rapidly, which is crucial when dealing with a pandemic. They also have a higher surface area, and a tailored drug release profile. The list goes on: small size, simple method of synthesis that allows large-scale manufacture and controlled cellular delivery and bio distribution. However, we are only at the beginning in this field of research, and improvements in cost and stability are constantly building up. There is a lot left to be understood, but right now nanotechnology has been able to quell a global pandemic.

Progressive Pesticides Using Nanoporous Materials

MEENA LALITHA CHANDAR | BTCB 3RD YEAR

Fraunhofer Institute for Ceramic Technologies and Systems IKTS

With the sky-rocketing population and demand for food, pesticide use has peaked. After learning the effects of pesticides on soil and human health, efforts have been made to curb the unbridled use. Excessive use is due to the loss by degradation or run-off of pesticide. “European Commission in 2019”

To ameliorate the efficacy, nano porous* particles to deliver the active ingredients* precisely to the target site, have been developed. This was studied by researchers of ‘Journal of Controlled Release’.

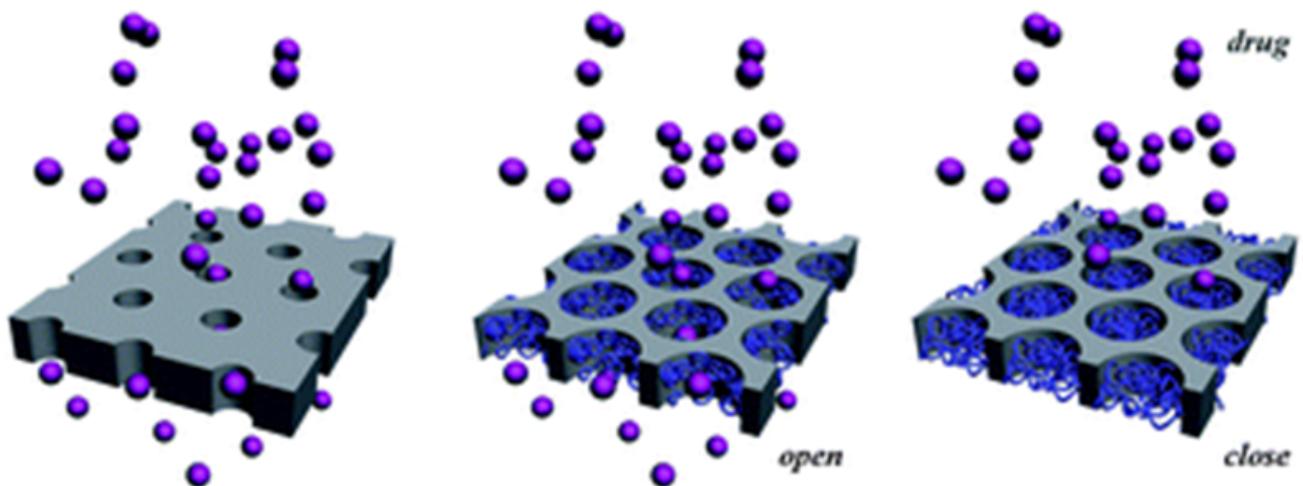
In a nutshell, materials like clay, lignin or starch are made into a polymeric membrane. Then the pesticide will be either adsorbed, encapsulated or entrapped by the membrane. When sprayed onto the crops, it will slowly release the drug and act precisely.

This is due to the properties of high surface area, large pore-volume, and tunable pore size. Innovations and advancements like these could pave the way to a brighter and greener future where copious amounts of chemicals need not be our entrée.



Pesticide Use

Credits: David Moreno Hernandez/Shutterstock.com



Sustained drug release by controlling pore size of nanoporous membranes

On-demand drug release by using responsive nanoporous membranes

Nanoporous membrane

Credits: pubs.rsc.org

Nadrian Seeman

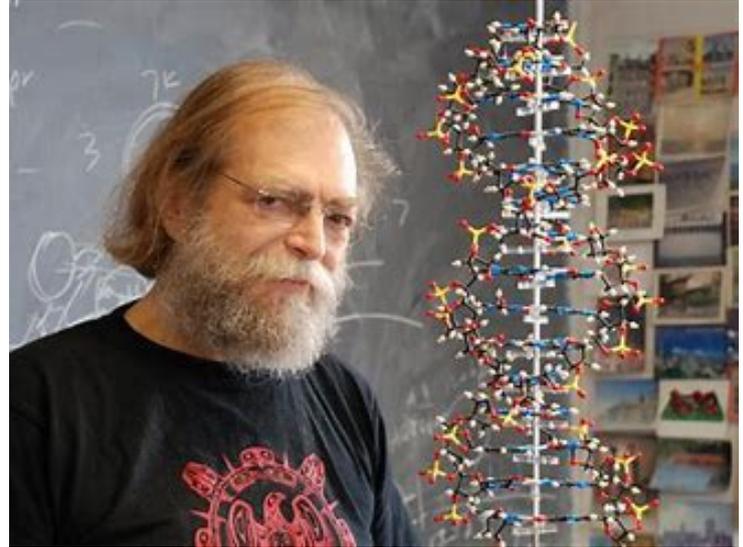
PEMA LHAMU | BTCB 2ND YEAR

Nadrian Charles "Ned" Seeman was born in Chicago, IL, USA, on December 16, 1945. He studied biochemistry at the University of Chicago and received his Ph.D. in biochemistry and X-ray crystallography from the University of Pittsburgh, in 1970. He was a Postdoctoral Fellow at Columbia University and the Massachusetts Institute of Technology (MIT). Seeman then joined the faculty at the State University of New York at Albany, USA, and in 1988, he became Professor of Chemistry at New York University.

Nadrian Seeman has received numerous awards, including the 1995 Feynman Prize in Nanotechnology, the 2010 Kavli Prize in Nanoscience, and the 2016 Benjamin Franklin Medal from the Franklin Institute. In 2017, he was elected to the American Academy of Arts and Sciences. He also was a Fellow of the Royal Society of Chemistry and the American Association for the Advancement of Science and a Member of the Norwegian Academy of Science and Letters.

He founded and developed the field of DNA nanotechnology. DNA nanotechnology involves the design and construction of nanostructures from nucleic acids, i.e., DNA is used as a "building material" for nanostructures. The method relies on base pairing: The DNA used is designed in such a way that complementary base sequences bind together in specific places and connect DNA strands. Thus, the DNA selectively assembles to form the target nanostructures.

Seeman built, for example, nanocubes, nanotubes



Optical clearing tech to image thick brain tissue

Credits: www.eurekalert.com

lattices, and other structures using DNA strands. The approach has also been used to build nanorobots and other machines, as well as knotted DNA molecules, and has applications in DNA computing.

As a professor at New York University since 1988, Seeman has trained more than 50 Ph.D. students, many of whom are developing and extending the work he began.

He demonstrated that DNA can be used as a construction material that can *spontaneously* form sub-microscopic structures of diverse shapes and functions. This concept has potential applications in disease treatment.

Professor Nadrian Seeman passed away on November 16, 2021. A ubiquitous description of him used by those who know him personally is "visionary." He has proven to be a scientist who gave us radical insights to lead us into an entirely new realm of scientific, engineering, and manufacturing possibilities that is only beginning to be explored.

UP NEXT



NEWS BRIEFING



The most exciting developments of the field in the month of February

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| ANIMAL BIOTECHNOLOGY |

| PLANT & AGRICULTURAL BIOTECHNOLOGY |

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Transgenic common bean lines show multiple resistance to 3 viruses

Researches from Brazil obtained genetically modified progenies of *Phaseolus vulgaris* (Common Bean) that were found to be resistant to the 3 most common plant viruses.

AMARA NICODEMUS | BTCZ 3RD YEAR

4 February, 2022

Harvard Medical school

This genetically modified common bean can decrease yield loss for the farmers and can also reduce virus spread.

Genetically modified (GM) crops: The DNA of these plants have been modified using genetic engineering. The possible benefits include nutritious food, protection from insects and diseases that result in less use of pesticides, faster growing plants, medicinal foods that could be used as vaccines, production of food with desirable traits like potatoes that produce less of a cancer - causing substance when fried.

The bean common mosaic virus (BCMV), Bean golden mosaic virus (BGMV), Cowpea mild mottle virus (CMMV) all severely affect the common bean.

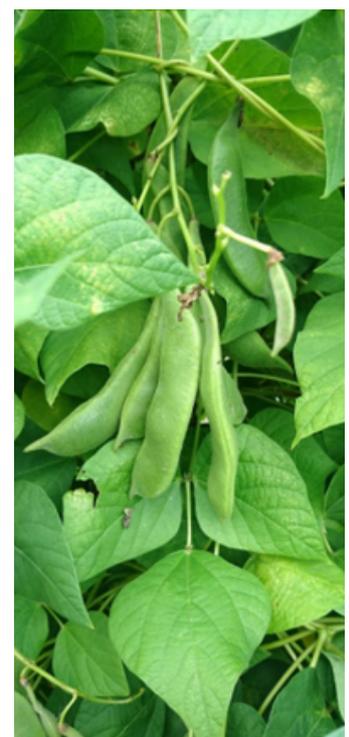
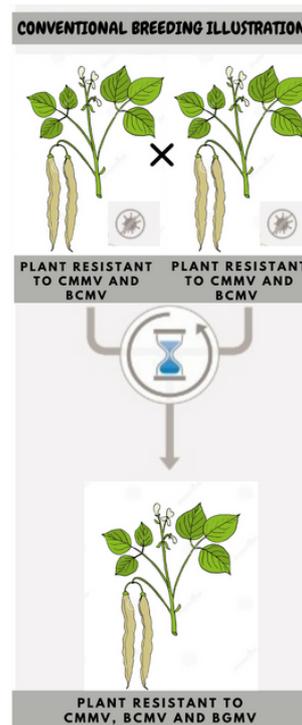
BCMV causes leaf curling, secondary leaf malformation and plant stunting*.

BGMV causes vein limited lines of yellow chlorosis* and is transmitted by whitefly.

CMMV causes severe mosaic* and/or necrosis (death) of leaves, stem and pods of beans and is also transmitted by whitefly.

GM common bean progenies (offspring) were developed through conventional breeding* and molecular tools with BRS Estilo and BRS sublime as the recurrent parents (the parent in which the gene required is present). Both these plants chosen as parents have moderate natural resistance to CMMV. They are resistant to BCMV but are affected by BGMV.

There were two field trials conducted to assess the performance and the disease severity of the plants.

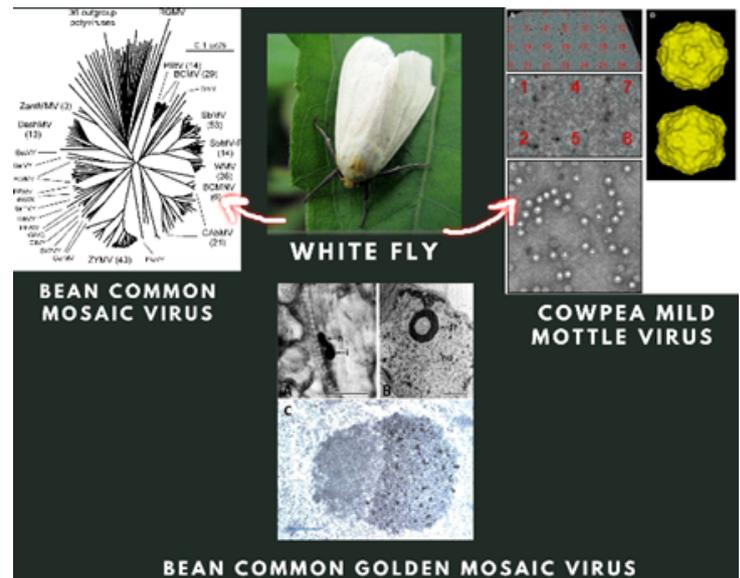


39 progenies out of 477 were selected and then subjected to molecular analysis to check the presence of genes that produced BCMV and BGMV resistance. Mechanical inoculation (bringing healthy plant parts, usually leaves into contact with a virus containing suspension) with scaling was used to measure CMMV resistance.

Result: 5 progenies that showed resistance to all 3 plant viruses were selected. These plants also showed:

- Upright plant architecture
- Resistance to plant lodging (bending of plant stem)
- Quality market class grains

They also have the potential for further development of a common bean variety with combined high yield, desirable agronomic and grain quality traits and multiple virus resistance.



Gene regulation: How long do proteins bind?

Researchers show how a DNA-binding protein can search the entire genome for its target sequence without getting held up on the way. The result contradicts our current understanding of gene regulation - the genetic code affects how often the proteins bind, but not for how long.

B. KAVYA | BTCB 2ND YEAR

27 January 2022

Uppsala University, Sweden

Over an organism's lifetime, its genome changes very little. What does change, constantly, are which proteins the cell produces in response to damage, changes in the environment, or stages in the reproductive cycle.

DNA binding proteins are responsible for protein production which have evolved the ability to turn different genes on or off. Adaptation is the key for the sudden changes occurring in the environment. Among millions of base pairs, the DNA binding protein must recognize the required DNA code and produce proteins.

To find the target sequence, DNA binding proteins search the genetic code by sliding along the DNA helix to speed up the process. The protein spots the recognized site and binds to it, the interaction between protein and genetic code prevents further sliding along DNA. The hypothesis of this searching mechanism has been accepted but it presents an annoying problem -- the DNA code is full of "almost correct" sequences. If the time a protein resides on a particular DNA motif was determined by the sequence, the searching proteins would constantly linger on sequences that resembled their target.

"If the textbook explanation was, the DNA-binding proteins would get stuck all the time off target. Gene regulation would be very

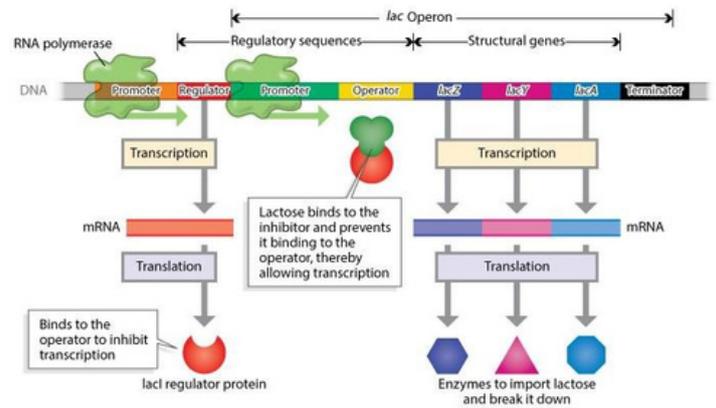
ineffective, but we know from previous studies that this is not the case. Our favourite protein, LacI, finds its target sequence among 4.6 million base pairs in a matter of minutes," says Emil Marklund, one of the researchers behind the discovery.

Experiment:

To resolve this paradox. The researchers worked on LacI. DNA-binding protein LacI was allowed to slide back and forth along thousands of DNA sequence mounted on a microchip. A fluorescent molecule was attached to the LacI protein and made it possible to measure how fast LacI adhered to the different sequences and how quickly it was released. The result was striking. Contradicting previous assumptions, the DNA sequence had little effect on how long LacI remained bound to the DNA. However, it was much more likely that the sliding LacI was held up briefly when the sequence was similar to the target sequence. In other words, DNA-binding proteins often leave also the sequence they are intended to regulate, but at the target site, they all but always make a very short journey before finding their way back again. On the macroscopic time scale, this looks like a stable interaction.

Result:

DNA-binding proteins bind often rather than protractedly, explains how LacI can slide on the DNA sequence in search of its target without getting held up unnecessarily. LacI regulates the uptake of lactose in bacteria, but is of course just an example. "The hundreds of different transcription factors that regulate our own genes likely act according to a similar principle," says Johan Elf, Professor at the Department of Cell and Molecular Biology at Uppsala University and the national research infrastructure SciLifeLab.



The lac operon in E.coli

Credits: www.nature.com

Robots can Reproduce!?

UAB researchers tested for the first time the human preclinical model for transplanting genetically modified pig kidneys into humans.

P SHRUSTI SHENOY | BTCZ 2ND YEAR

3 January 2022

Harvard University

The tiny organisms were unveiled in 2020, after a group of scientists at the University of Vermont, Tufts University and Harvard University's Wyss Institute for Biologically Inspired Engineering found that they could move, work together in groups and self-heal.

Xenobots are sized less than a millimetre, created from the stem cells of the African clawed frog – scientifically known as *Xenopus laevis* – from where it derives the name. Stem cells are unspecialized cells that have the ability to develop into different cell types. To make the xenobots, the researchers scraped living stem cells from frog embryos and left them to incubate. There's no manipulation of genes involved.

"Most people think of robots as made of metals and ceramics but it's not so much what a robot is made from but what it does, which is act on its own on behalf of people," said Josh Bongard, a computer science professor and robotics expert at the University of Vermont and lead author of the study. "In that way it's a robot but it's also clearly an organism made from genetically unmodified frog cell."

They found that the xenobots, which were initially sphere-shaped and made from around 3,000 cells, could replicate. But it happened only in specific circumstances. The xenobots used "**kinetic replication**" - a process that is known to occur at the molecular level.

With the help of artificial intelligence, the researchers then tested billions of body shapes to make the xenobots more effective at this type of replication. The cells resembled Pac-Man. They found it was able to find tiny stem cells in a petri dish, gather hundreds of them inside its mouth, and a few days later the bundle of cells became new xenobots.

There is no worry that this may lead to the end of human civilization. The xenobots are small, only live in a laboratory and can be easily killed. The artificial intelligence being able to develop the ability for xenobots to reproduce may be beneficial to any problems living creatures face, such as birth defects, diseases and cancer.



Credits: Wyss.harvard.edu

Sonic Vibration For Species Conservation

New reproductive technology allows fast-tracked induction of pseudopregnancy in rats by the use of sonic vibration.

ANANYA KALLIANPUR | BTCZ 3RD YEAR

24 January 2022

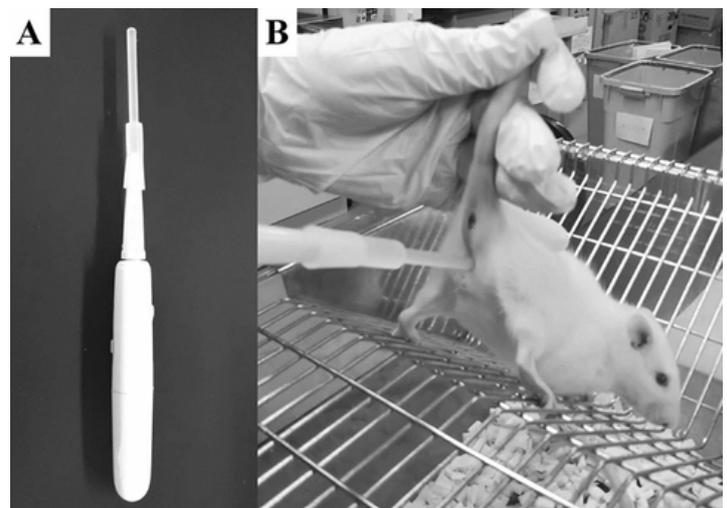
Iwate University and the Institute of Animal Breeding, Morioka, Japan.

At the mention of rats and mice, ‘vermin’ and ‘pest’ are words that come to mind along with unsavory images of rats in sewers and urban decay. Rats have long been vilified for having carried infected fleas that spread the black plague which decimated the global human population. Notwithstanding public perception of rats, they continue to serve as one of the preferred species in biomedical animal models and animal biotechnology since the very dawn of scientific research. We know that they have short life spans, are easy to maintain, and have a vast repertoire of genetic resources as well as being genetically similar to humans. All these factors make them an irreplaceable resource.

Reproductive technologies have been applied to produce new strains and in the maintenance of genetic resources in animals. Embryo transfer is one of these vital reproductive technologies developed to efficiently produce laboratory and livestock animals. Many of the genetically engineered animals, including those strains that have an edited genome, are used as human disease models for experiments involving gene analysis and gene function. Embryo transfer has contributed greatly to many fields of life science that rely on the constant supply of these laboratory animals. Now, in the case of female rodents, they require mating stimulation to induce and maintain a pregnancy.

This is commonly done by mating them with a vasectomized male before embryo transfer is performed. Although this is the standard protocol, we find that there are often unforeseen complications for instance pairs fail to mate which results in failed stimulation of pseudopregnancy. Additionally, the space required for breeding and the bare minimum costs necessary for an adequate number of thriving females and vasectomized males tends to be a strain of laboratory resources.

A research group headed by Associate Professor Taketo of Iwate University and the Institute of Animal Breeding took the initiative to expedite and enhance this process of induction of pseudopregnancy, to not only lessen the financial burden on laboratories but also for the



Scientists using sonic vibration to induce ovulation in female mice.

Credits: <https://rdcu.be/cGBzC>

possibility for its application in conservation efforts. This group had already successfully induced a pseudopregnancy in a female rat by the use of sonic vibration which had replaced the need for a vasectomized male. In their initial experiments, they had used sonic vibrations for 30seconds repeated 7 times at 5-minute intervals one day in advance. This protocol was time-consuming because it was meant to mimic natural mating behavior. They used both two-cell stage embryos, morulae, as well as pronuclear stage embryos for the embryo transfer at different stages of the oestrus cycle. Using this principle, they attempted to possibly shorten the period of artificial stimulation using what they called the Easy-Embryo-Transfer method.

In the longer method of 120s stimulation, they found that 64% of the two-cell embryos were able to implant successfully, and 48% of the implanted embryo developed into normal offspring. Whereas in the short-period induction, which was performed for the 30s twice with 30s intervals, 65%of the two-cell embryos were implanted, and then 62% developed normally.

Similarly, when pronuclear stage embryos were transferred to the females under similar conditions again at the proestrus stage, 52% implanted and 43% developed into young ones. Moreover, when they attempted this exact protocol at a later stage in the oestrus cycle, the results turned out to have exponentially higher success rates. Finally, they proved that their fast-tracked method of inducing pseudopregnancy was not only a success, but they also were able to show the very real applications of this technology, which could be reproduced at an industrial scale. It was proved that the newly improved sonic vibration technology can create an appropriate pregnancy environment for rats. This method can be applied in mice and can also apply to fertilized egg transfer protocol, as well as to the understanding of the mechanism of pregnancy, sterility research, and artificial reproduction of endangered species. Furthermore, this improved procedure could reduce the need for large breeding spaces and pain during treatment to induce pseudopregnancy and contribute to animal welfare.

Tomatos aid in curing eye diseases

The antioxidant and anti-inflammatory molecules from edible products such as tomatoes and *Crocus sativus* can be used to manufacture drugs to treat eye diseases.

AKANKSHA C A | BTCZ 3RD YEAR

17 February 2022

ENEA Biotechnology Laboratory, Italy

Maculopathy or macular degeneration is a progressive disease that affects a part of the retina, called the macula. This region controls the ability to read, view finer details in objects, recognize colours and faces; therefore, degeneration of the macula can lead to loss of central vision. It is usually caused due to an inflammation or abnormal growth in the blood vessels that leak fluid into the retina and disrupt vision, this can be due to age or due to diabetes. The most common treatment is to stop the blood vessels from leaking, by using laser treatment and drugs known as anti-vascular endothelial growth factor (Anti-VEGF).

A group of researchers at ENEA Biotechnology Laboratory were capable of synthesizing certain molecules from edible products like tomatoes and saffron plants. These molecules belong to an important class of bioactive molecules like crocins, a found especially in the flowers of the saffron crocus and carotenoids, found in yellow, red and orange-coloured plants, vegetables and fruits. Carotenoids protect the millions of photoreceptor cells located in the macula region of the retina. These molecules have antioxidant and anti-inflammatory properties as well, this helps reduce oxidative stress on the retina caused by blue light.



The carotenoids in tomato provide protection against macular degeneration.

Credits: www.gardeningknowhow.com

"Our work opens up a new scenario on safe and low-cost production of these molecules, proving that biotechnology makes it possible to produce crocins in safe, edible products like yeast and tomato", explained Sarah Frusciante, lead researcher at ENEA.

No More Crying Over Spoilt Milk

MEENA LALITHA CHANDAR | BTCB 3RD YEAR

McMaster University, Ontario, Canada

Food waste is an embarrassingly weighty issue with over 1/3rd of total produce being scrapped. Dairy products are not only very prone to contamination but also are the second most thrown out food.

Of the myriad daunting diseases, food poisoning might not seem like grave threat but 48 million people fall sick every year. A few pathogens found in milk include *Campylobacter*, *E. coli*, *Salmonella*, *Listeria* and *Staphylococcus aureus*.

To combat this, a group of researchers from McMaster University alongside Toyota Tsusho Canada, Inc., have developed a method to spot contamination without having to open the containers. Essentially, there is a food-safe patch printed on to the inner surface of the

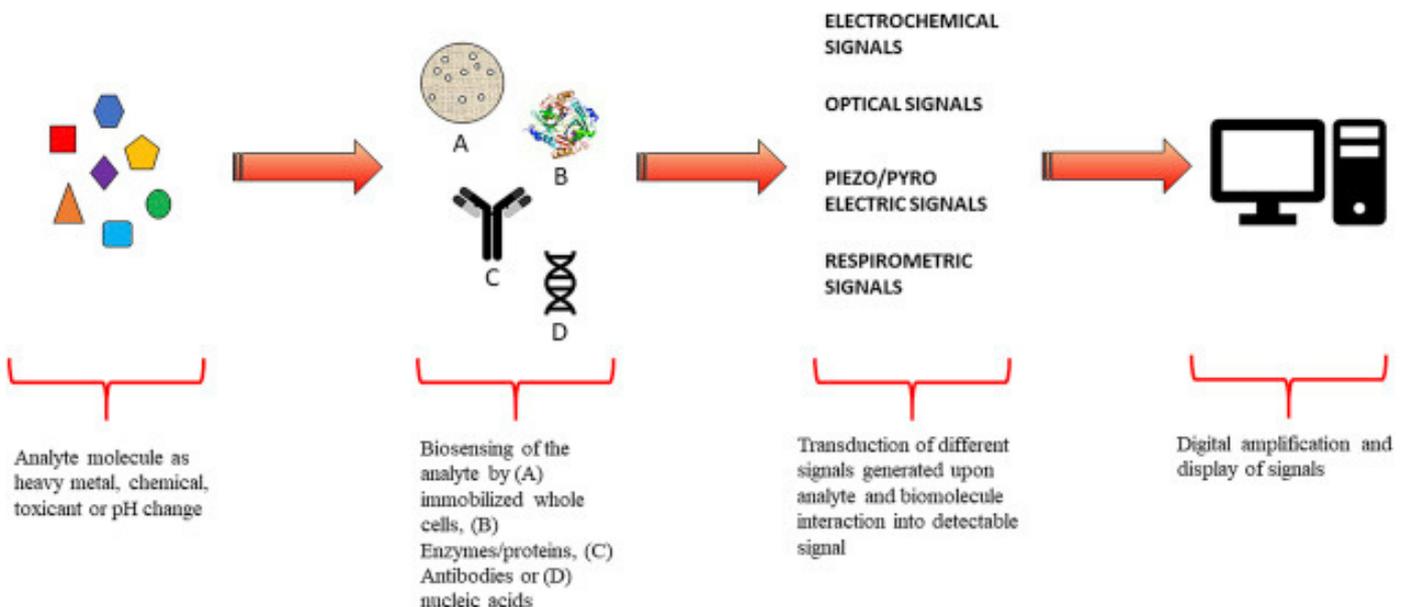
containers which acts as a biosensor*. This will change when it detects the target organisms.

This technology could pave the way for improved food safety and reduce food waste. As for now, research is still on-going. In the coming years, we may see this in our grocery stores.



Food poisoning due to pathogens in milk

Credits: www.thefederal.com

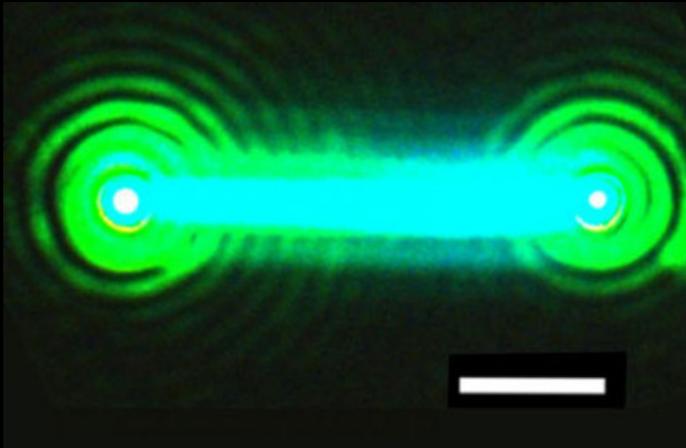


General Working Of A Biosensor

Credits: www.sciencedirect.com

GALLERY

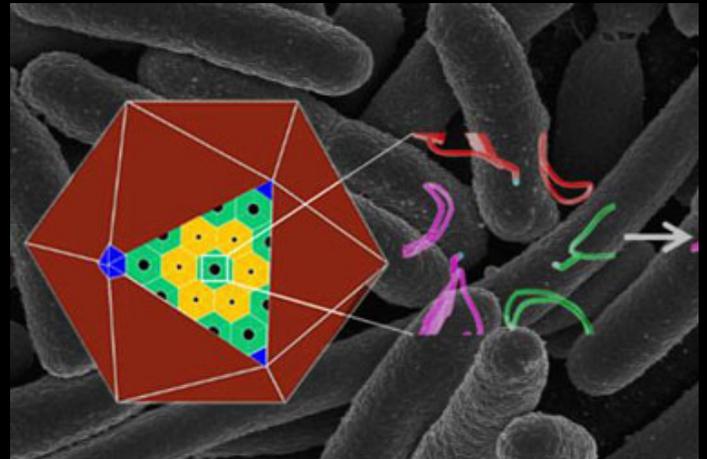
JANHAVI A | BTCB 2ND YEAR



NANOWIRES THAT MOVE DATA AT LIGHT SPEED

Nanotechnology researchers have found a new way to produce nanoscale wires that can serve as tiny, tunable lasers. The excellent performance of these tiny lasers is promising for the field of optoelectronics, which is focused on combining electronics and light to transmit data, among other applications.

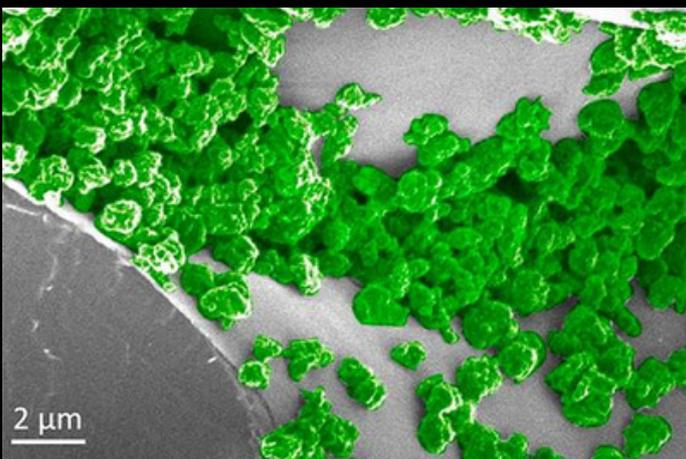
Credit: Sam Eaton/UC Berkeley



CUSTOM-MADE CHEMICAL FACTORIES

Scientists have recently reengineered a building block of a nanocompartment that occurs naturally in bacteria, greatly expanding the potential of nanocompartments to serve as custom-made chemical factories. Researchers hope to tailor this new use to produce high-value chemical products, such as medicines, on demand.

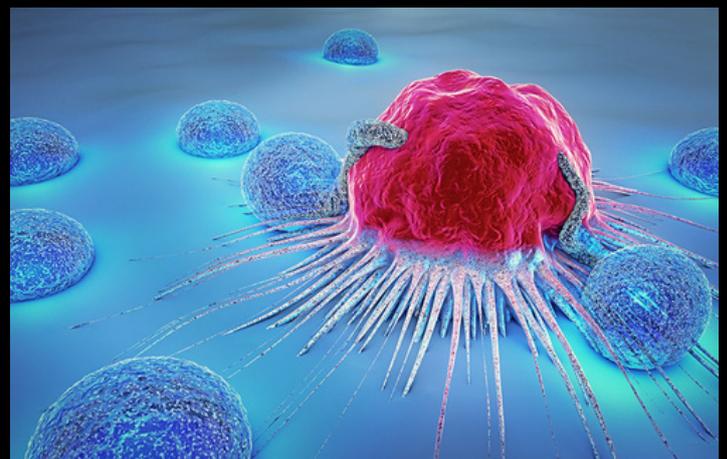
Credit: Berkeley Lab, National Institutes of Health



LIGHT-EMITTING PLANTS THAT CAN BE CHARGED REPEATEDLY

Using specialized nanoparticles embedded in plant leaves, MIT engineers have created a light-emitting plant that can be charged by an LED. After 10 seconds of charging, plants glow brightly for several minutes, and they can be recharged repeatedly.

Credit: Courtesy of the researchers at MIT



NANOBOTS

The term “robot” also applies to microscopic creatures that are not made of metal and electrical wires, but of organic matter—the DNA robot. The idea dates back to the 1980s with the biochemist Nadrian Seeman’s work on DNA nanotechnology, introducing the concept of DNA origami and the construction of life at this scale. Today, medicine wants to use these robots to fight incurable diseases.

Credit: www.substance.etsmtl.ca

WORD SEARCH PUZZLE

SHARON VERONICA | BTCZ 3RD YEAR

Given below are a few terms related to nanobiotechnology, let's see if you can spot them in the puzzle.

T	J	P	Y	A	S	J	A	O	D	X	O	W	O	S
S	C	I	D	I	U	L	F	O	R	C	I	M	T	M
R	A	Y	M	P	I	R	E	L	A	Y	C	O	A	L
O	Z	S	T	I	R	L	C	X	N	Z	D	S	V	S
S	S	A	H	O	H	E	Y	H	M	M	H	T	U	N
N	L	S	I	R	G	F	A	U	U	I	C	U	I	E
E	L	V	E	S	U	E	C	T	K	T	E	K	A	A
S	E	G	A	P	D	E	N	D	R	I	M	E	R	S
O	C	P	A	I	R	A	M	E	E	M	P	V	U	Y
I	E	H	T	H	U	R	I	N	T	E	I	F	N	A
B	S	I	X	Q	X	Z	E	D	X	I	H	O	N	R
U	R	U	M	Z	M	R	O	U	C	E	C	W	M	N
V	A	S	O	N	E	I	C	B	P	A	O	Y	D	X
I	P	R	H	L	A	A	K	Q	C	K	N	G	Z	B
E	S	R	L	K	A	M	F	R	J	V	A	A	N	L
N	O	U	H	A	S	E	R	O	P	O	N	A	N	X
V	F	S	N	O	P	N	T	I	W	X	A	G	I	B

VERTICAL:

1. They are sophisticated probes, which are used to investigate the existence and/or concentration of a biological analyte, say for example bio molecule, histology of biological material or any microorganism.
2. They both rare and physiologically distinct from their surrounding cells in normal physiological conditions (e.g. cancer cells, lymphocytes, fetal cells and HIV-infected T cells). They are significant in the detection and diagnosis of various genetic defects.
3. This technique helps in investigating DNA sequences or the pairing of separated strands of DNA with complementary DNA strands of the acknowledged collection that act as probes.

HORIZONTAL:

1. A modern science of fluids on the nanometer scale.
2. The emerging and well defined polymeric architectures that are known for their large, complex and well defined structures, versatility in drug delivery and high functionality whose properties resemble with biomolecules.
3. They are nanometer scale holes formed naturally by proteins or cells, for instance to allow ions to pass between nerve cells.

DIAGONAL:

1. A technique that has been used mainly to elaborate spatial arrangement of the chromosome and screening of abnormalities related to disease.
2. They are regarded as a unique class of fluorescent labels, with unique optical properties such as high brightness and long-term colloidal and optical stability; these are suitable for optical imaging, drug delivery and optical tracking, fluorescence immunoassay and other medicinal applications.
3. An allotrope whose molecule consists of carbon atoms connected by single and double bonds so as to form a closed or partially closed mesh, with fused rings of five to seven atoms. The molecule may be a hollow sphere, ellipsoid, tube, or many other shapes and sizes. It is used currently in fabricating nanomaterials.

GLOSSARY

Transgenic common bean line show multiple resistance to 3 viruses, *pg 11*

1. **Plant stunting** - Short plants that have low potential level of activity.
2. **Yellow chlorosis** - Insufficient production of chlorophyll (the pigment that makes the leaves green).
3. **Mosaic leaves** - Leaves with areas of dark and light coloration.
4. **Conventional breeding** - Developing new plant varieties using older tools and natural processes.

Progressive pesticides using nanoporous materials, *pg 08*

1. **Active Ingredients** - An active ingredient is any component that provides pharmacological activity or other direct effect in the diagnosis, cure, mitigation, treatment, or prevention of disease, or to affect the structure or any function of the body of man or animals.
2. **Nanoparticles** - A nanoparticle is a small particle that ranges between 1 to 100 nanometres in size. $1 \text{ nm} = 10^{-9} \text{ m}$.
3. **Nanoporous Membrane** - Nanoporous membranes are characterized by pores with diameters in the range of nanometers and sub nanometers which are able to separate liquid or gaseous mixtures.

No More Crying Over Spoilt Milk, *pg 19*

1. **Biosensor** - A biosensor is an analytical device, used for the detection of a chemical substance, that combines a biological component with a physicochemical detector.

REFERENCES

Role of Nano-Biotechnology In Drug Discovery And Development, pg 04

1. <https://www.intechopen.com/chapters/72461>
2. <https://www.ddw-online.com/the-role-of-nanotechnology-in-drug-discovery-948-200604/>
3. <https://jnanobiotechnology.biomedcentral.com/articles/10.1186/s12951-018-0392-8>
4. <https://www.fda.gov/drugs/news-events-human-drugs/advancing-science-nanotechnology-drug-development>

Nanomedicine: The COVID Vaccine's Mother , pg 06

1. <https://www.mdpi.com/1999-4915/12/3/254>
2. <https://www.nature.com/articles/s41565-020-0737-y>
3. https://mdpi-res.com/d_attachment/encyclopedia/encyclopedia-01-00059/article_deploy/encyclopedia-01-00059.pdf
4. <https://www.sciencedirect.com/science/article/pii/S1567576920337140>
5. <https://pubs.acs.org/doi/10.1021/acsnano.0c04006>
6. <https://theconversation.com/the-nanoparticles-in-mrna-vaccines-are-nothing-to-fear-we-interact-with-many-useful-tiny-particles-every-day-168479>
7. <https://www.statnews.com/2020/12/01/how-nanotechnology-helps-mrna-covid19-vaccines-work/>
8. <https://www.precisionnanosystems.com/workflows/formulations/lipid-nanoparticles>

Progressive pesticides using nanoporous materials, pg 08

1. <https://www.azonano.com/news.aspx?newsID=38613>
2. *Research paper-* <https://www.sciencedirect.com/science/article/abs/pii/S0168365922000505?via%3Dihub>

Adrian Seeman, pg 10

1. <https://www.fi.edu/laureates/nadrian-c-seeman>
2. https://www.chemistryviews.org/details/ezone/10468397/Nadrian_C_Seeman_1945_2021.html

Transgenic common bean line show multiple resistance to 3 viruses, pg 11

1. *Plant Biotechnology Information Center – Plant biotechnology news*
2. *Genetically engineered food-* <https://medlineplus.gov/ency/article/002432.htm>
3. *GM plants-* <https://royalsociety.org/topics-policy/projects/gm-plants/what-is-gm-and-how-is-it-done/>
4. *Back cross breeding-* <https://pubmed.ncbi.nlm.nih.gov/19378006/>
5. *Conventional breeding and GM -*<https://royalsociety.org/topics-policy/projects/gm-plants/how-does-gm-differ-from-conventional-plant-breeding/#:~:text=Conventional%20breeding%20achieves%20it%20by,inherited%20from%20the%20two%20parents>

• **Image credits:**

1. *Image-1: Green bean character illustration, Lima bean Common Bean Green bean, cartoon coffee beans transparent background PNG clipart | HiClipart*
2. *Image-2: Plant Biotechnology Information Center – Plant biotechnology news*
3. *Image -3:* <https://royalsociety.org/topics-policy/projects/gm-plants/how-does-gm-differ-from-conventional-plant-breeding/#:~:text=Conventional%20breeding%20achieves%20it%20by,inherited%20from%20the%20two%20parents>

4. <https://pt.depositphotos.com/146358443/stock-illustration-common-bean-phaseolus-vulgaris.html>
5. *Image 4: https://www.researchgate.net/figure/The-bean-common-mosaic-virus-lineage-of-potyviruses-Neighbor-joining-tree-calculated_fig4_5289353*
6. <http://gardeningknowhow.com/plant-problems/pests/whitefly-control.htm>
7. <https://www.apsnet.org/edcenter/apsnetfeatures/Pages/GoldenMosaic.aspx>
8. *Image -5: [Leaf Veins Are Turning Yellow – What Causes Leaves with Yellow Veins](https://www.gardeningknowhow.com/leaf-veins-are-turning-yellow-what-causes-leaves-with-yellow-veins) (gardeningknowhow.com)*
9. <https://www.planetnatural.com/pest-problem-solver/plant-disease/leaf-curl/>
10. <http://blogs.ifas.ufl.edu/nfrec/2014/11/14/re-emergence-of-rose-mosaic-disease-in-florida-nurseries-and-landscapes/>
11. *Fig 2 [Intermediate stage of necrotic leaf blotch](https://www.cornell.edu/intermediate-stage-of-necrotic-leaf-blotch) (cornell.edu)*

Gene Regulation; How long do proteins bind, pg 13

1. <https://www.sciencedaily.com/releases/2022/01/220127141550.htm>

Robots Can Reproduce, pg 15

1. <http://wyss.harvard.edu/>

Sonic Vibration for species conservation, pg 16

1. <https://rdcu.be/cGBzC>
2. <https://univ-journal.jp/en/141593/>

Tomatos aid in curing eye diseases, pg 18

1. <https://www.hortidaily.com/article/9404414/molecules-in-tomato-and-yeast-help-cure-eye-disease/>
2. <https://www.enea.it/en/news-enea/news/innovation-enea-develops-new-method-to-sinthesize-molecules-in-tomato-and-yeast-to-cure-maculopathies>

No More Crying Over Spoilt Milk, pg 19

1. <https://nano-magazine.com/news/2021/12/7/researchers-create-contamination-test-for-dairy-products-using-technology-that-can-be-printed-inside-containers>
2. <https://www.mayoclinic.org/diseases-conditions/food-poisoning/symptoms-causes/syc-20356230>

Gallery, pg 20

1. <https://www.nanowerk.com/nanotechnology-news/newsid=44165.php>
2. <https://substance.etsmtl.ca/en/nanorobots-eradiquer-cancer>

Word Search Puzzle Answers

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O	Z	S	T	I	R	L	C	X	N	Z	D	S	V	S
S	S	A	H	O	H	E	Y	H	M	M	H	T	U	N
N	L	S	I	R	G	F	A	U	U	I	C	U	I	E
E	L	V	E	S	U	E	C	T	K	T	E	K	A	A
S	E	G	A	P	D	E	N	D	R	I	M	E	R	S
O	C	P	A	I	R	A	M	E	E	M	P	V	U	Y
I	E	H	T	H	U	R	I	N	T	E	I	F	N	A
B	S	I	X	Q	X	Z	E	D	X	I	H	O	N	R
U	R	U	M	Z	M	R	O	U	C	E	C	W	M	N
V	A	S	O	N	E	I	C	B	P	A	O	Y	D	X
I	P	R	H	L	A	A	K	Q	C	K	N	G	Z	B
E	S	R	L	K	A	M	F	R	J	V	A	A	N	L
N	O	U	H	A	S	E	R	O	P	O	N	A	N	X
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FEBRUARY 2022 ISSUE OF THE

Biogenesis

NANOBIOTECHNOLOGY

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