

THE CATALYST



Academic Co-ordinators
Monthly Science
Research Corner
CRISPR

#EDITION 1



Dear Readers,

It gives us immense pleasure in bringing out the 1st edition of our very first departmental magazine 'The Catalyst'.

When you have a dream, you've got to grab it and never let go.

This magazine is a small initiative on our behalf, the students of Dr. Ambedkar College, Nagpur.

We have endeavored to ensure that this magazine helps you to feel the connection between you and science. To inform and bring you up to date on new technologies and discoveries in the field of Biochemistry and Biotechnology.

Science is the process of gaining knowledge and investigating by making observations, posing questions and testing through experiments. As it is well said, 'Everything is theoretically impossible, until it is done'. The world without science would mean that we would still be living in a very different way to that we live today.

We express our sincere gratitude to our honorable principal Dr. (Mrs.) B.A. Mehere mam for her enduring faith in us for conscientious guidance and encouragement to accomplish this magazine.

Let us all wish and hope that the theme chosen for the magazine is ingrained in our mind and also hope this venture of ours will find a special place in the heart of the readers.

Wishing everyone great success and happiness.

Happy Reading....!

TEAM CATALYST

*#beinnovative
#thecatalyst*

However
difficult life
may seem,
there is always
something you
can do and
succeed at.

- Stephan Hawking

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"We want that education by which character is formed, strength of mind is increased, the intellect is expanded, and by which one can stand on one's own feet"

- Swami Vivekananda

History echoes to us that those who have courage to imagine the impossible are the few unique personalities who broke all human limitations of thought and action. The biggest challenge we are facing today is to prepare students for a globalized world. In today's world knowledge is not limited to classroom. Genuine concern of our institution is to ensure students emotional growth along with intellectual excellence. It gives me an immense pleasure as Department of Biochemistry and Biotechnology, Dr. Ambedkar College, Deekshabhoomi, Nagpur is bringing out its first departmental magazine "Catalyst" exclusively meant for latent writing talents with invaluable potential. I congratulate all the contributors and editorial board for this revolutionary creation. I am sure that the activities associated with the launch of the magazine will improve organizational skills and leadership qualities of student which are essential for their career development.

"Education is the most powerful weapon which you can use to change the world."

-Nelson Mandela

PRINCIPAL'S DESK



STAR OF THE DEPARTMENT



Mr. Priyal Dhunde, a 2nd-year M.Sc student at Dr. Ambedkar College, Nagpur has done remarkable work along with his studies. His dedication to work truly makes him the "Star of the Department." As it is said, "when an opportunity doesn't knock, build a door". With his focused, curious mind and extremely hard work, at the age of 19, he founded a company named 'Neo Agrotech.' At such a young age, when we're dealing with our own problems, he was manufacturing products to solve farmers' problems.

Being a proud farmer's son, he noticed that, there was a rapidly growing fungal infection on eggplant crops in his farm. Through research, he found out that, this particular fungal infection is caused by Bactrocera family and the solution to this is - Pheromone Traps. A Pheromone is a chemical that is released by males or females to attract opposite sex for the purpose of mating. He developed these pheromone traps to capture the insect and prevent them from mating. By doing this, the number of insects automatically decreased and his experiment was a success.

To help other farmers and to provide the best quality products in Agriculture market, he established his own company "Neo Agrotech" on 16th of December 2020. From then, he is investing his time, knowledge, and efforts to build a successful empire of Neo Agrotech. Till now, the company has produced 6 different products for the welfare of farmers with 25 stock-keeping units. Priyal won the Global Student Entrepreneur Award (GSEA 2022) organised by EO Nagpur. His company was recognised as best Startup by EO Nagpur. He pitched his company Neogrotech in National level GSEA competition which was held in Vishakhapatnam. There he was recognised as "best startup" by Student Entrepreneur. Till date, he has 200 retail counters and 4 prominent dealers. His last year's turnover was around 50 Lakhs INR and this graph of success is keep on increasing exponentially.

A successful entrepreneur, M.Sc student, a State level elocution champion, an excellent anchorer, a writer, a poet and a profound reader.. Priyal Dhunde has proven that "Nothing is Impossible if you're determined". His valuable and important message to all of us through this magazine is "Don't be judgmental towards others; focus on improving yourself first". Through this short interview, we may all learn that, if you truly want to do something, the whole universe will conspire to make it happen but, you must have that level of dedication within yourself first.

We hope this interview has inspired and motivated you..!

#beinnovative
#neogrotech

Interviewed by: Kanchan and Janvi
Written by: Kanchan Deoghare



Monday - 21st November 2022

DNA "Nanotransporters" Chemically Programmed To Treat Cancer

The DNA-based nanotransporter developed by Alexis Vallée-Bélisle and his team are 20,000 times smaller than a human hair. These Nanotransporters could improve how cancers and other diseases are treated. These molecular transporters can be chemically programmed to deliver an optimal concentration of drugs, making them more efficient than current methods. A major challenge in modern medicine is maintaining an optimal concentration of drugs in the blood. Also because each patient has a distinct pharmacokinetic profile, the concentration of the drug in their blood varies significantly. Observing that only about 50 percent of cancer patients get an optimal drug dosage during certain chemotherapy, Alexis Vallée-Bélisle – who holds a Canada Research Chair in bioengineering and bionanotechnology — and his research team started developing artificial drug transporters that mimic the natural effect of maintaining a precise concentration of a drug during treatment. UdeM PhD student Arnaud Desrosiers, the first author of the study, initially identified and developed two DNA transporters: one for quinine, and the other for doxorubicin. He also found that these nanotransporters could also be employed as a drug reservoir to prolong the effect of the drug and minimize its dosage during treatment. Another impressive feature of these nanotransporters is that they can be directed to specific parts of the body where the drug is most needed.

Researchers reveal how parasite injects protein into nucleus of immune cell, changes cell's identity

The majority of people on the planet are infected with the parasite *Toxoplasma*. Now, a study headed by scientists at Stockholm University demonstrates how this tiny parasite spreads so successfully throughout the body, including to the brain. Immune cells are hijacked by the parasite after they are infected. The study shows that the parasite injects the protein into the nucleus of the immune cell and thus changes the cell's identity. The parasite tricks the immune cell into thinking it is another type of cell. This changes the gene expression and behavior of the immune cell. *Toxoplasma* causes infected cells which normally should not travel in the body to move very quickly and in this way the parasite spreads to different organs. The *Toxoplasma* effector GRA28 promotes parasite dissemination by inducing dendritic cell-like migratory properties in infected macrophages. About the parasite *Toxoplasma* and the disease toxoplasmosis: Toxoplasmosis is probably the most common parasitic infection in humans globally. *Toxoplasma* is spread through food and contact with cats. In nature, the parasite spreads preferentially from rodents to cats to rodents and so forth. The parasites are "sleeping" in the rodent's brain and when the cat eats the mouse, they multiply in the cat's intestine and come out via the feces. When a person is infected for the first time, mild flu-like symptoms occur that can resemble a cold or a flu. After the first infection phase, the parasite transitions to a "sleeping" stage in the brain and begins a chronic silent infection that can last for decades or for life. The chronic infection usually causes no symptoms in healthy individuals. *Toxoplasma* can, however, cause a life-threatening brain infection (encephalitis) in people with a weakened immune system (HIV, organ transplant recipients, after chemotherapy) and can be dangerous to the fetus during pregnancy. Eye infections can occur in otherwise healthy individuals.

New method to estimate the contribution of each amino acid residue

Enzymes perform impressive functions, enabled by the unique arrangement of their constituent amino acids, but usually only within a specific cellular environment. Thus, a long-standing research goal has been to retain or even improve upon the function of enzymes in different environments. "The pertinent amino acids one should mutate in the enzyme might be only best-guesses," says Teppei Niide, co-senior author. "To solve this problem, we devised a methodology of ranking amino acids that depends only on the widely available amino acid sequence of analogous enzymes from other living species." The researchers focused on the amino acids that are involved in the specificity of the malic enzyme to the molecule that the enzyme transforms (i.e., the substrate) and to the substance that helps the transformation proceed (i.e., the cofactor). By identifying the amino acid sequences that did not change over the course of evolution, the researchers identified the amino acid mutations that are adaptations to different cellular conditions in different species. "By using artificial intelligence, we identified unexpected amino acid residues in malic enzyme that correspond to the enzyme's use of different redox cofactors. This helped us understand the substrate specificity mechanism of the enzyme and will facilitate optimal engineering of the enzyme in laboratories." -- Hiroshi Shimizu, Study Co-Senior Author, Osaka University. This work succeeded in using artificial intelligence to dramatically accelerate and improve the success of substantially reconfiguring an enzyme's specific mode of action, without fundamentally altering the enzyme's function. Future advances in enzyme engineering will greatly benefit fields such as pharmaceutical and biofuel production that require carefully tuning the versatility of enzymes to different biochemical environments -- even in the absence of corresponding enzymes' crystal structures.

New biomarker could help diagnose Alzheimer's disease early

A definitive diagnosis of Alzheimer's disease (AD) was once only possible after someone had died, but recent biomarker studies have led to the development of imaging and spinal fluid tests for those still living. However, the tests can only monitor severe disease, differentiating advanced AD from related disorders. Researchers have now identified a biomarker that could help physicians diagnose AD earlier, as a patient transitions into mild cognitive impairment (MCI). When hunting for AD biomarkers, some researchers have turned to the study of subtle changes in a protein called tau. These changes can make the tau protein more likely to clump, which leads to neuron loss and impaired memory. Two such modifications involve the phosphorylation of tau at specific amino acids, resulting in versions called p-tau181 and p-tau217. These biomarkers have been shown to effectively differentiate AD tissues from those of people with other neurodegenerative diseases. Using post-mortem brain tissue from AD patients and non-AD subjects, the researchers identified several p-tau biomarkers selectively associated with tau aggregation. Like p-tau181 and p-tau217, several of these biomarkers differentiated AD tissues from healthy controls. One in particular -- p-tau198 -- also discriminated AD from two other neurodegenerative diseases in which tau is known to clump.

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**SOMEWHERE, SOMETHING INCREDIBLE IS
WAITING TO BE KNOWN**

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THERMAL CYCLER

It is used mostly for DNA sequencing, cloning, quantification of DNA and RNA and studying patterns of gene expression etc.,



SPECTROPHOTOMETER

Spectrophotometers measure light intensity as a function of wavelength and are commonly used to measure the concentration of a compound in an aqueous solution.

DID YOU KNOW ?



There exist a type of cat known as Chimera cat that is made up of two distinct sets of DNA



which occurs when one fetus reabsorbs it's fraternal twin while in the mother's womb. These cats have different colours on either side of their faces.

CURIOUS SEARCH

Update your knowledge by visiting these sites -

- PUBMED
- PLOS

CRISPR

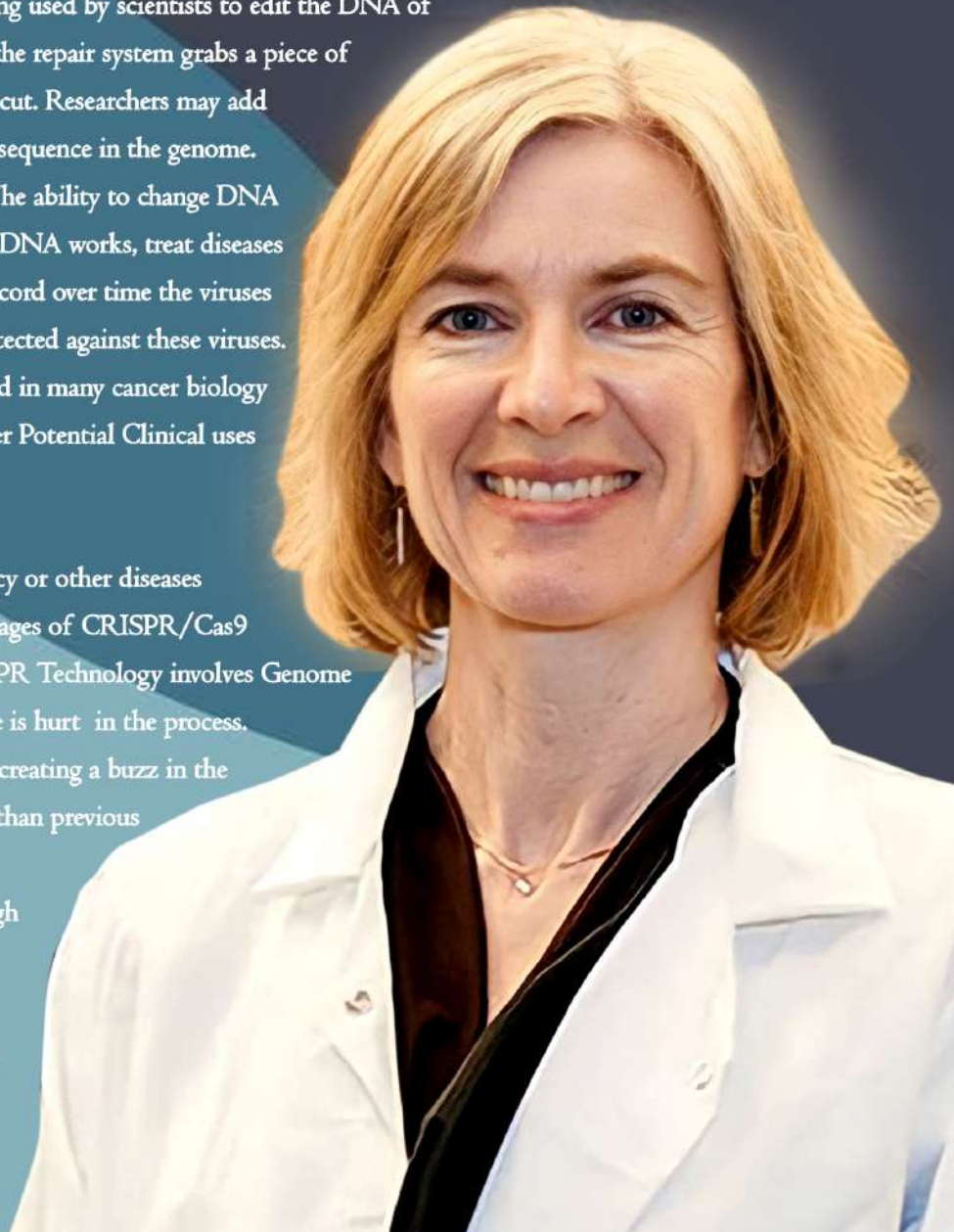
We all have heard at least once about CRISPR Technology. Through this article, Let's have a glance at the world of CRISPR. The name CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats. This sounds like a mouthful, but keep reading and you will know what exactly it is!

Firstly, let's understand the term CRISPR. Viruses which infect bacteria are referred to as bacteriophages. Although it is quite different from the human immune system, bacteria also have a defense system that protects them against infections. This system is called CRISPR/Cas9. Here, the bacterium recognizes the invader, and with the help of CRISPR/Cas9, cuts the genetic material into pieces to stop the infection. In this way, CRISPR plays a very important role in the defence system of Bacteria. But, you must be wondering how this concept of CRISPR helps scientists to create such advanced Technology. The scientists discovered how the CRISPR/Cas9 system can be used to edit or change the DNA sequence. This discovery of how to use CRISPR/Cas9 in the laboratory was extremely important for the scientific community—so important that, in 2020, two researchers who helped and discovered CRISPR Genome Editing received the most important scientific award—"The Nobel Prize in Chemistry. " The name of those two scientists is - Emmanuelle Charpentier and Jennifer A. Doudna. Now, this CRISPR theory is being used by scientists to edit the DNA of organisms in the laboratory. When Cas9 cuts DNA, the repair system grabs a piece of complementary DNA, called a template to repair the cut. Researchers may add templates containing changes which alter the existing sequence in the genome. For example, correcting a disease causing mutation. The ability to change DNA in the laboratory enables us to learn more about how DNA works, treat diseases and develop new products. CRISPR allows cells to record over time the viruses to which they have been exposed, so that cells are protected against these viruses. CRISPR is becoming a mainstream methodology used in many cancer biology studies due to the convenience of the technique. Other Potential Clinical uses of CRISPR Technology are -

1. Correction of genetic disorders
 2. Engineering somatic cells ex vivo to treat malignancy or other diseases
 3. Treatment of HIV
- These are the numerous advantages of CRISPR/Cas9 technology only when used responsibly. But, as CRISPR Technology involves Genome Editing, we must follow ethical rules to ensure no one is hurt in the process. So, CRISPR/CAS-9 is a genome editing tool that is creating a buzz in the Science world. It is faster, cheaper and more accurate than previous techniques of editing DNA and has a wide range of potential applications. CRISPR is truly a breakthrough innovative in the field of Biochemistry and Biotechnology.

"THE MORE WE KNOW, THE MORE WE REALIZE THERE IS TO KNOW"

 <https://youtu.be/TdBAHexVYzc>



Our sincere efforts have made us to accomplish the task of completing this magazine. However, it would not have been possible without the kind support and help of many. We would like to express our sincere gratitude to our respected Principal Dr. B.A. Mehere Ma'am and college for providing us with facilities required for our magazine.

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