



2ND EDITION

JIVANAM

Science magazine

March 2023

FUNGUS THAT
CAN OVERTAKE
HUMANS?

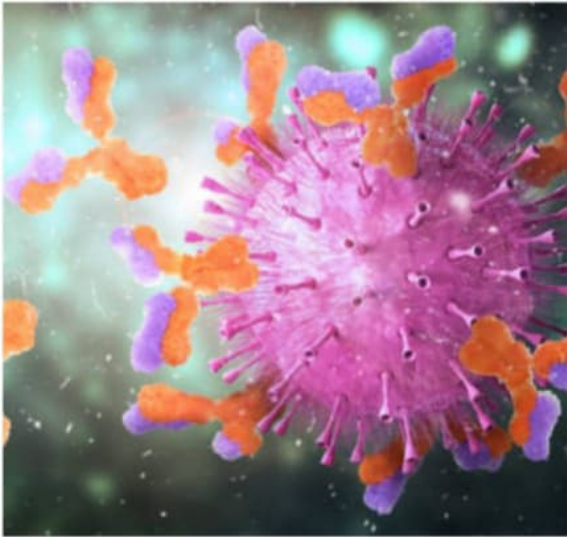
Can Genes be edited?

ASTROBIOLOGY
AT A GLANCE

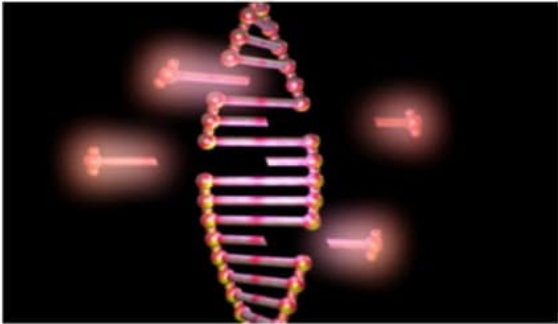
*Biochemistry department of
M.G.science institute*

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From Teacher's Desk

It gives us immense pleasure to express our views on the release of second edition of our departmental magazine. Our students have expressed their thoughts, ideas, hopes, feelings, aspirations and convictions in a creative way.

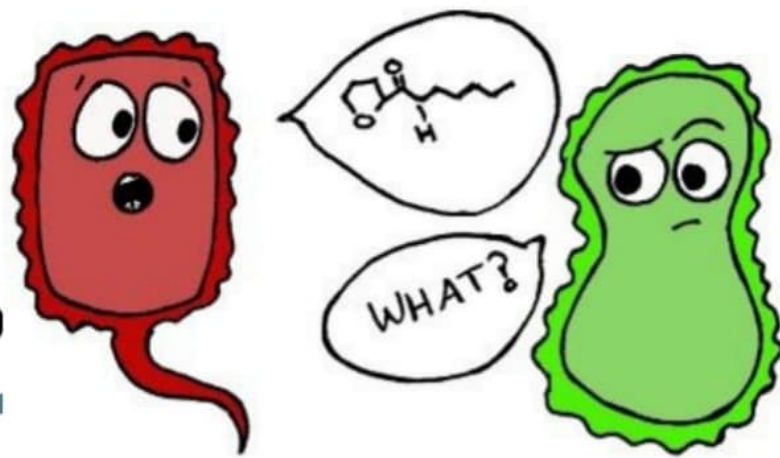
The magazine is created and conceived by the students to ignite scientific temperament and to develop the art of scientific writing. The process of learning is extremely important in life. What you learn, and how you learn, play a crucial role in developing one's intellectual capability, besides career.

The motive of our Department since last 31 years is to provide quality education and a holistic overall development of students.

We really appreciate the initiative and enthusiasm of our students and wish them success in all their future endeavours. We acknowledge Ms.Jyotiben Pandya our laboratory assistant for her cooperation in all curricular and co-curricular activities.

Dr.Harshang Pandya
Prof.Diti Chokshi
Prof.Sunita Jha
Dr.Vijaya Nadagauda

TELEPATHY IN MICROBES



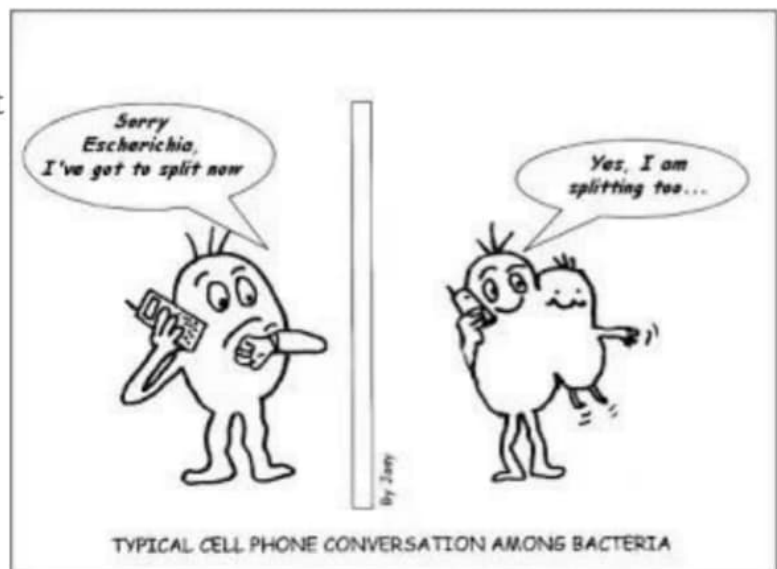
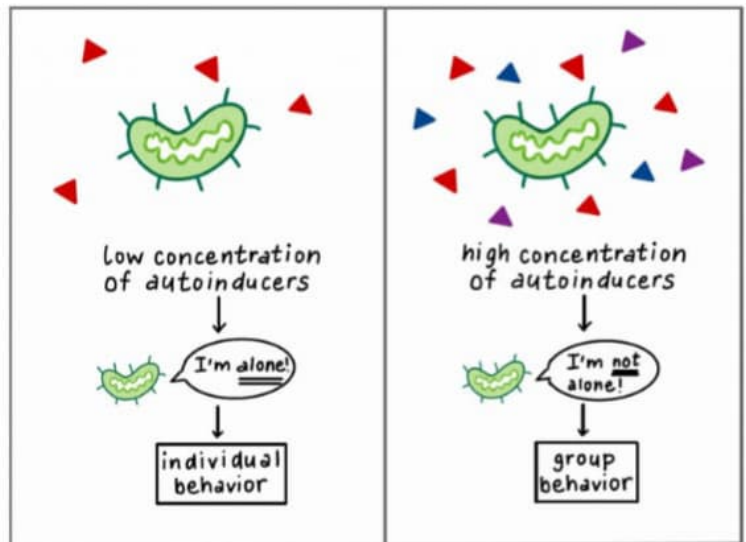
By Aditi Baluni
(Sem-6 Biochemistry)

Homosapiens, Sapiens interact with each other by means of communication. But, have you ever thought about how in the microbial world, microbes interact with each other?

The best means of interaction is Quorum Sensing or Quorum Signaling.

Quorum sensing is the ability of some species of bacteria to detect and respond to cell population density by gene regulation.

In simple words, quorum sensing [QS] is the ability of some bacterial species to respond to the changes that take place in the surrounding environment, depending upon the concentration of bacterial cells. Some chemical compounds or molecules are released by the cells due to which stimulation occurs within the cell and results in changes in the gene expression, which in turn change the phenotype in a most beneficial way.



Importance of Quorum Sensing

1. Bacteria use quorum sensing to regulate certain phenotype expressions, which in turn, coordinate their behaviors.
 2. Aids in biofilm formation, sporulation, virulence, motility etc.
 3. Certain bacteria are able to use quorum sensing to regulate certain vital processes.
- E.g. Bioluminescence, nitrogen fixation, sporulation etc.

For the bacteria to use quorum sensing, it must possess three abilities:

1. Secretion of a signaling molecule
2. Secretion of an auto inducer, to detect the change in concentration of signaling molecules
3. Regulation of gene transcription as a response.

Both Gram Positive and Gram Negative Bacteria use quorum sensing but both have different mechanism.

Gram-positive bacteria use auto inducing peptides (AIP) as their auto inducers

Gram-positive bacteria detect high concentration of AIPs in their environment that happens by way of AIPs binding to a receptor to activate a kinase. The kinase phosphorylates a transcription factor, which regulates gene transcription. This is called a two-component system.

Another possible mechanism is that AIP is transported into the cytosol, and binds directly to a transcription factor to initiate or inhibit transcription.

Gram-negative bacteria produce N-acyl homoserine lactones (AHL) as their signaling molecule. Usually AHLs do not need additional processing, and bind directly to transcription factors to regulate gene expression.

Some gram-negative bacteria may use the two-component system as well.

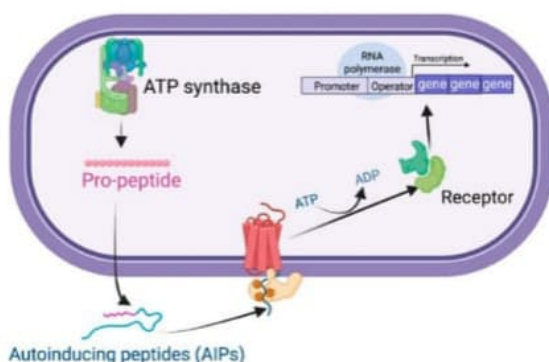
Examples of some bacterial Species showing Quorum Sensing.

Aliivibrio fischeri

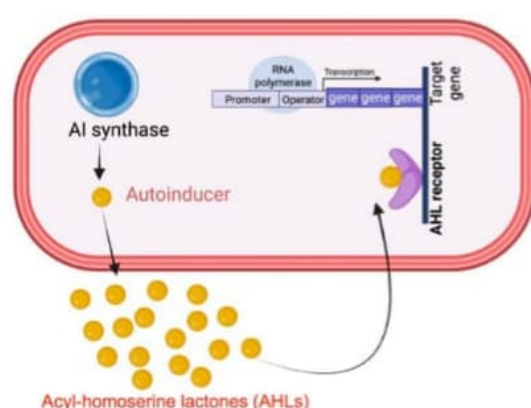
Curvibacter sp

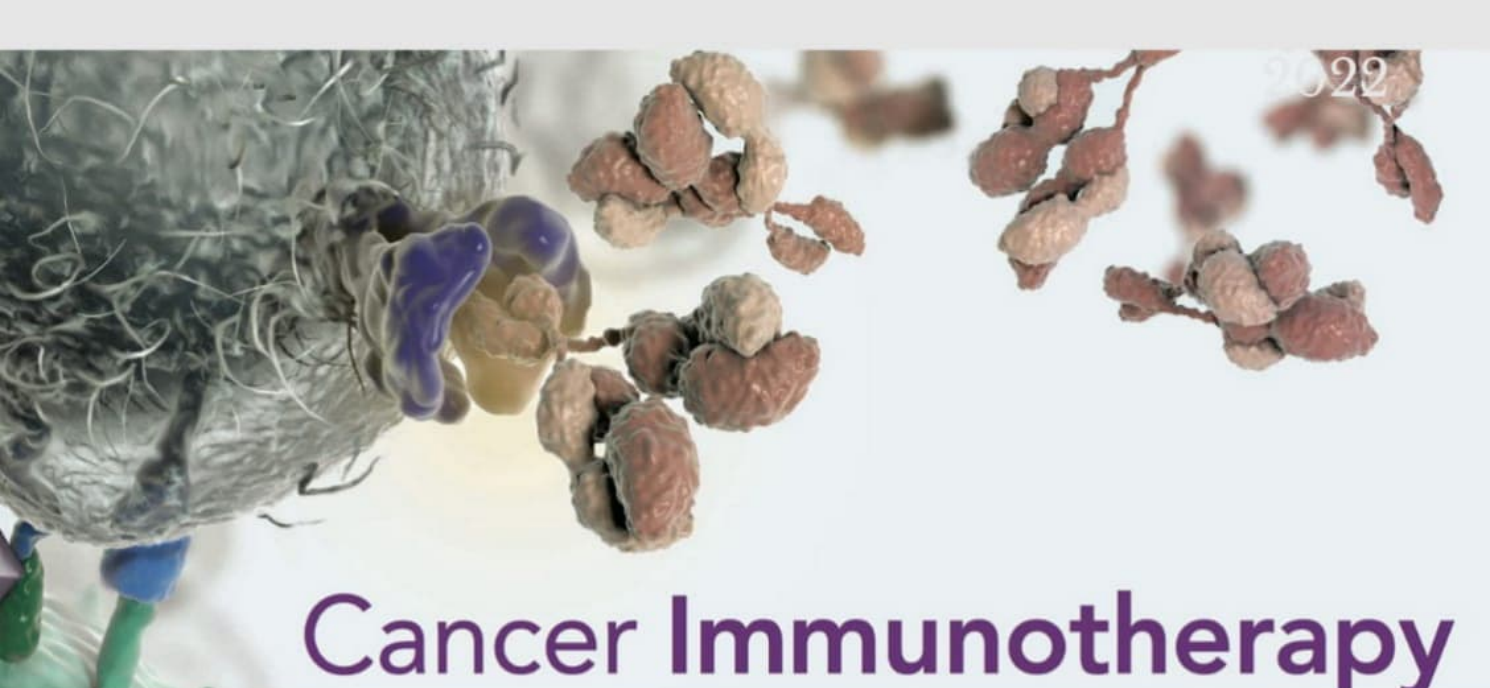
Escherichia coli

Gram-positive



Gram-negative





Cancer Immunotherapy

By Kebba L Darboe
(sem 4, Biochemistry)

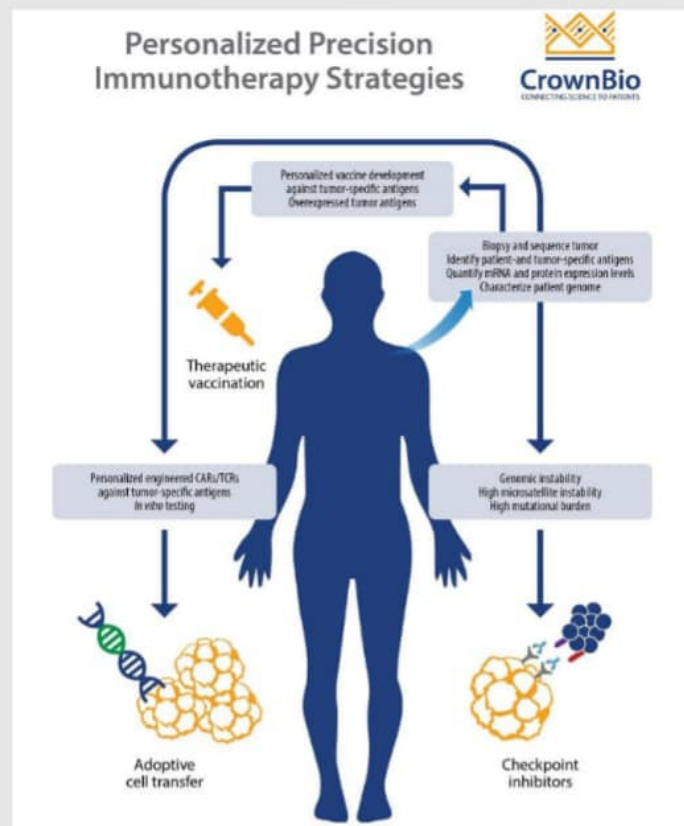
University of Southampton scientists have made a breakthrough in understanding why some cancers do not respond to immunotherapy treatment, bringing fresh hope that many more people could survive the disease.

Researchers, supported by Cancer Research UK, have identified a key cell protein that prevents the treatment from working and crucially, have found a drug that can overcome it. The findings were published in the American Association for Cancer Research (AACR) Journal on December 16, 2022.

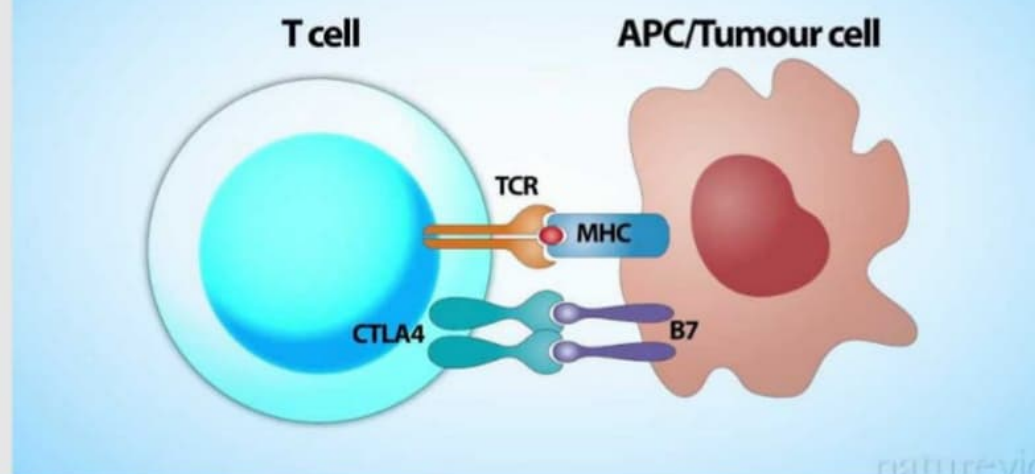
Immunotherapy works by triggering the body's immune system or T-cells to recognize and attack cancer cells and have been successful in treating many types of cancer. However, for a large number of patients, the treatment is ineffective due to a protective barrier of cells called Cancer Associated Fibroblasts (CAFs) sitting around the tumor that our T-cells cannot penetrate.

The six-year study, led by Southampton's Professor Gareth Thomas, revealed that the CAFs are regulated by a protein called Ataxia-telangiectasia Mutated (ATM) which normally controls DNA repair in cells. Blocking the ATM protein prevents the protective CAF barrier forming and therefore gives the patient's immune system a better chance of attacking the cancer cells while undergoing immunotherapy.

Gareth, a professor of experimental pathology at the university's Centre for Cancer Immunology, said: Immunotherapy for cancer has been a very exciting development but still doesn't work in most patients, our results suggest that in many cases, treatment resistance is caused by CAFs and this can be overcome by targeting ATM. Many patients have tumors that contain high levels of CAFs, which are preventing the T-cells from reaching the tumors. This includes around 50% of head and neck cancers, 95% of pancreatic cancers and 60%-70% of esophageal and colorectal cancers.



The 'blocked' immune cell response:



What makes this latest study even more significant is that researchers have already designed a drug that can block the ATM protein. Professor Thomas said the drug is very effective at getting T-cells into the tumor by targeting CAFs, which is a completely novel use for the drug. The team's next step will be to develop a clinical trial that will see the research translate from bench to bedside.

Chlamydia



CHLAMYDIA

How Chlamydia Guards Itself against the Immune System

By Mihir Parmar

(Sem 6, Microbiology)

Jörn Coers, an immunologist at Duke University, says the world is facing a silent pandemic: chlamydia. The US Centers for Disease Control and Prevention (CDC) estimates that 4 million people contracted the bacterial disease in 2018, making it the most commonly diagnosed sexually transmitted infection. Even so, most infections go undiagnosed, he says, and infections can persist for months. Chlamydia infections cause inflammation, which can lead to fibrosis in the reproductive tract. In men, symptoms are generally mild, but women face a risk of ectopic pregnancies and infertility.



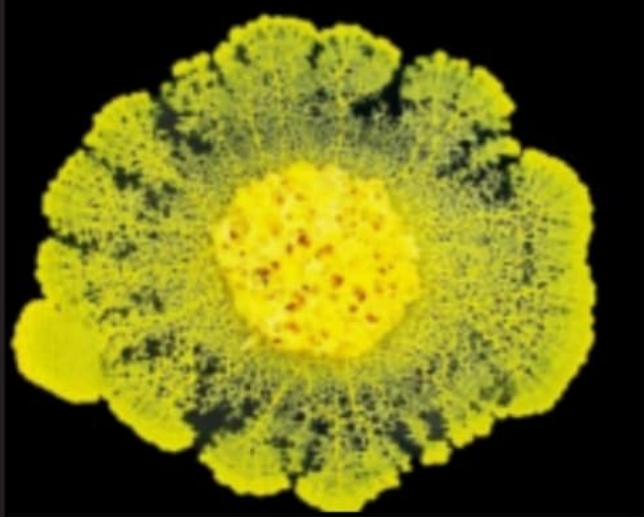
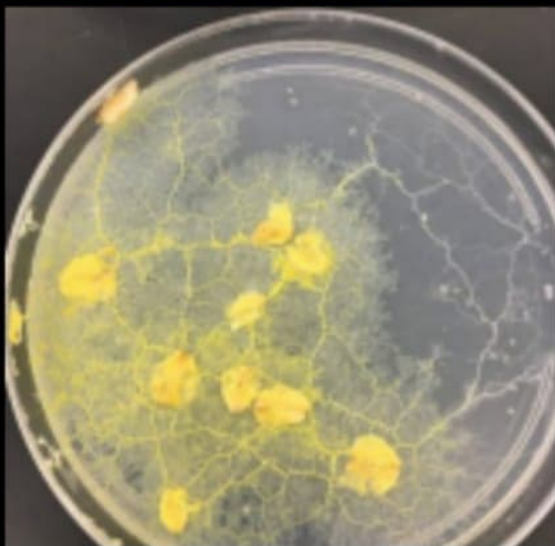
ALIEN FUNGUS WILL REPLACE THE HUMAN BRAIN?

By Vaibhavi Prajapati
(Sem 6, Biochemistry)

Now, for the first let's talk about the "Alien" the name alien makes our mind bloom and make us think about how do alien look like and what do they do?

In October 2019, in "Paris Zoology Museum" the people were very much shocked by seeing this. If this is showcased by zoology museum so, it has to be some kind of animal but it seems as some plants roots and its texture is kind of some fungus. When researchers seen this it seems as some fungus but when it's DNA has been analyzed it concluded that this living being is not fit in our Animal Classification it is something different almost which like an alien.

After that scientist concluded this organism as a *Physarum polycephalum* its community named as slimy molds. After studying this organism this confirmed that this organism is made up of one individual cell so, only nucleus division takes place. Its movement is just like an animal in a particular direction for its food and absorbing its food through its tendrils.



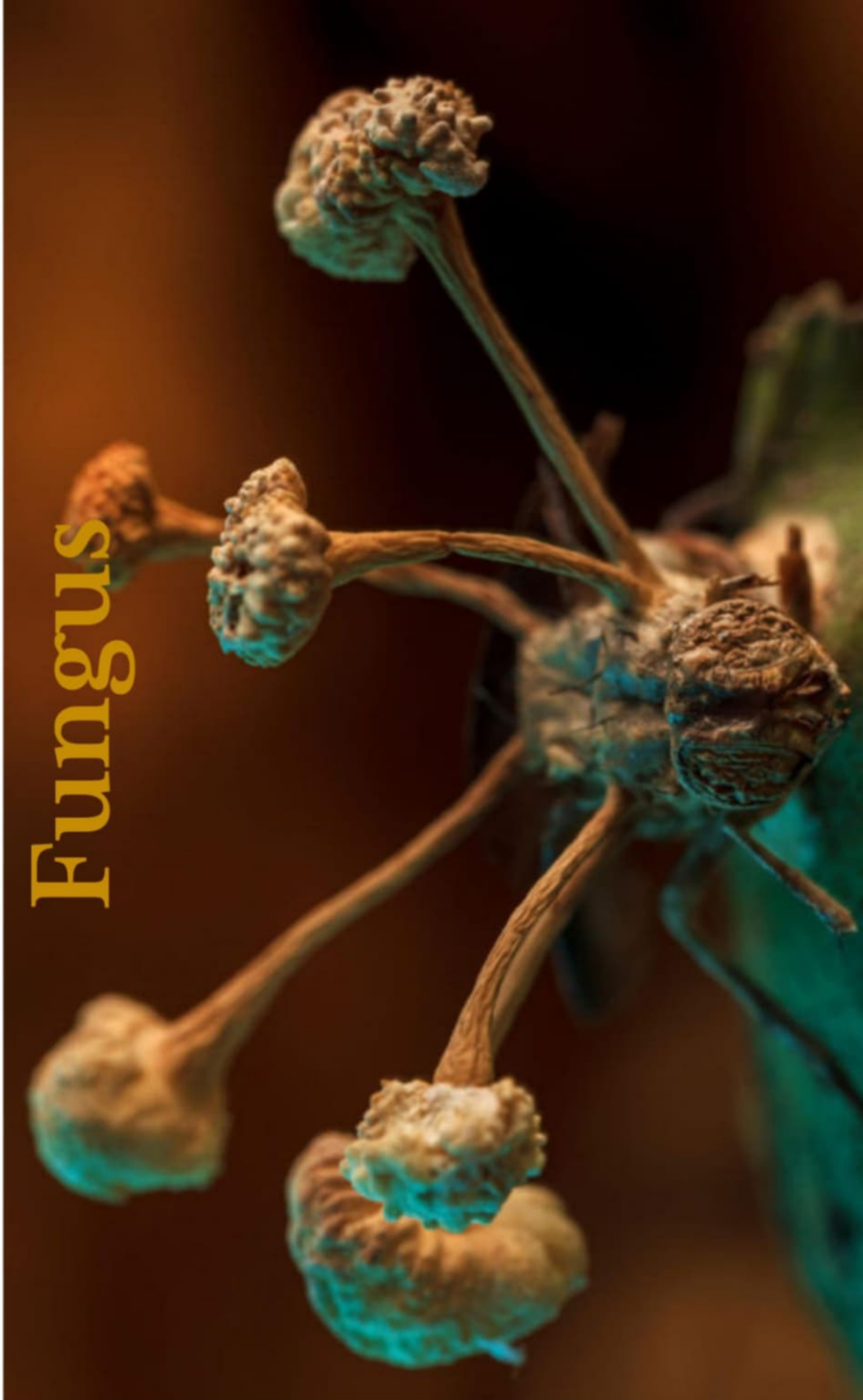


The director (Bruno David) of Museum of National History, Paris has said if two molds kept side by side to each other they can transfer the knowledge and communicate to each other, change their structure as per their wish and migrate from one place to other.

In future it could be possible we can make organic nano robots which can prevent the atherosclerosis in heart. If scientists made possible to find out the directional path we could even make organic gps chips using for auto movement and driving. By this Artificial Intelligence (AI) can be developed as a real human.

By all these characteristics we can conclude that this fungus is not less than human brain and its intelligence.

Zombie Fungus





THE ZOMBIE FUNGUS

OPHIOCORDYCEPS

UNILATERALIS

By Nirav Sadadiya
Sem6 Biochemistry

As we all know fungus is largely available in nature. It is almost everywhere in nature. More than 1,48,000 species of the fungus has been identified and described by taxonomists & estimated 2.2 to 3.8 million species of fungus available in nature.

Ophiocordyceps unilateralis is also called zombie fungus. It is a parasitic fungus that transforms ants into zombie ants. These manipulative little Micro-organisms can do everything from controlling movement of host's body to forcing host to commit suicide. It is an insect pathogenic fungus discovered by British naturalist Alfred Russel Wallace in 1859. This fungus is currently found in the tropical ecosystem.

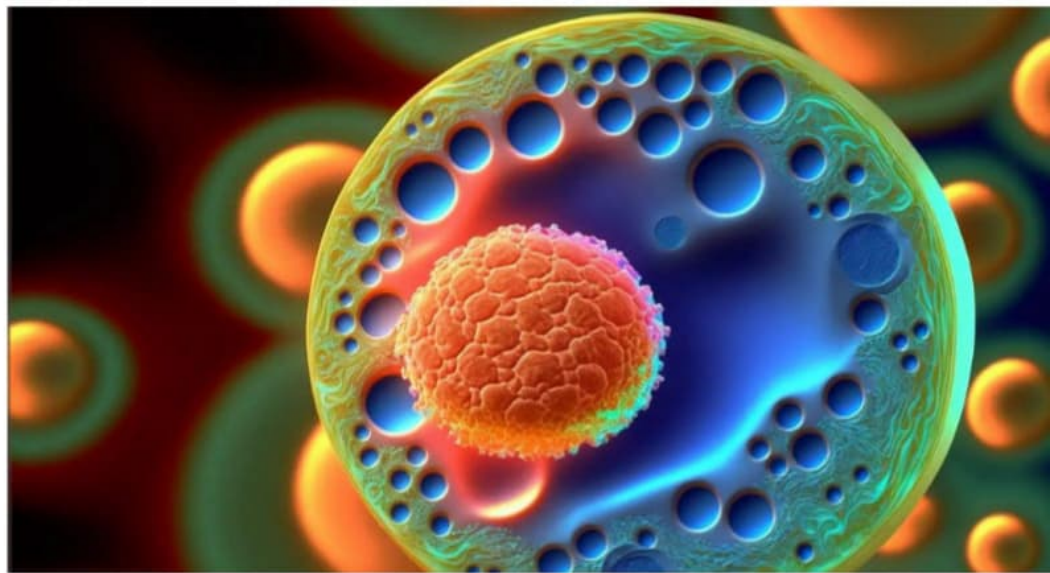
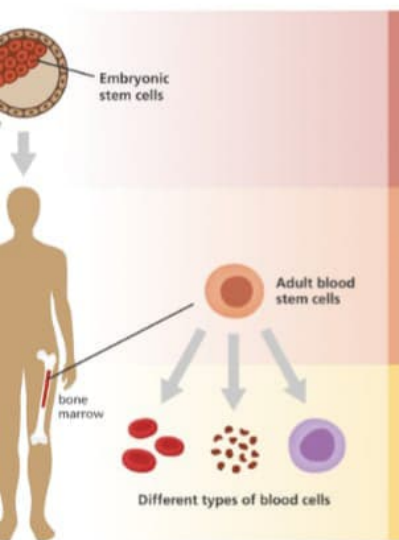


This fungus infects ants of the tribe camponotini. This fungus has just one goal: self-propagation and dispersal. This fungus infects ants through spores. Spores' penetrant exoskeleton of an ant's body and slowly takes control of its mind and behavior. As the infection advances the infected ants are compelled to leave its nest for a more humid microclimate, which is more favorable for fungus growth.

The ant is compelled by fungus to descend a vantage point about 10 inches off the ground, sink its jaws into a leaf vein on the north side of the plant and wait for death. This fungus feeds on victim's body until it is ready for the final stage and germinates spores. Several days after the ant died the fungus sends its fruiting body out through the base of the ant's head, turning its shriveled corpse into a launch pad from which it can spread its spores and infect new ants.

The Mother of all Cells

By Hirva Bhavsar
(Sem 4, Biochemistry)



Stem
cells

Volume 2

Did you know?

That, some people keep the umbilical cord and the placenta for some time after the birth of a child? Do you wonder why they would want to keep that?

It's because there are some specialized cells in the placental and cord blood that can divide over and over again to produce new cells. These cells are called the "STEM CELLS"

What are these stem cells?

So basically, they are the foundation of every organ and tissue in our body. Those cells from which all other cells, with all the specialized functions, originated.

Types of stem cells.

There are 3 main types of stem cells:

1. Embryonic stem cells (ESC)
2. Adult stem cells
3. Induced pluripotent stem cells

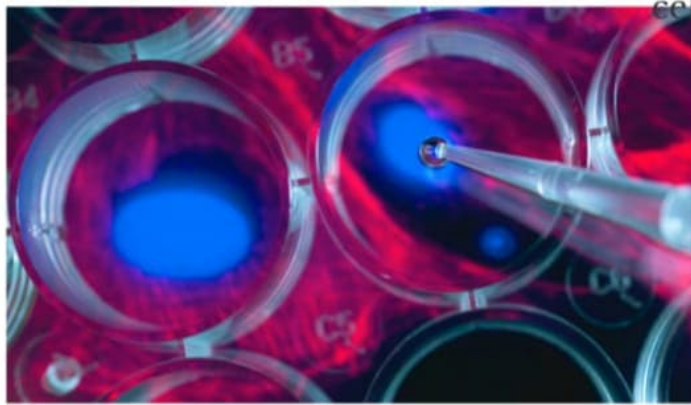
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Glance at 3 types of stem cells

1.EMBRYONIC STEM CELLS are derived from the inner cell mass of a mammalian embryo at the blastocyst phase.

These cells are pluripotent, i.e., they can give rise to every cell type, but not the Placenta and Umbilical cord because they lack the potential to organize into an embryo.

Human ESC has been derived primarily from blastocysts created in vitro fertilization for assisted reproduction that were no longer needed.



2.ADULT STEM CELLS are those cells which maintain and repair the tissue in which they are found.

They are also called somatic stem cells.

There are three known accessible sources of adult stem cells in humans. These are:

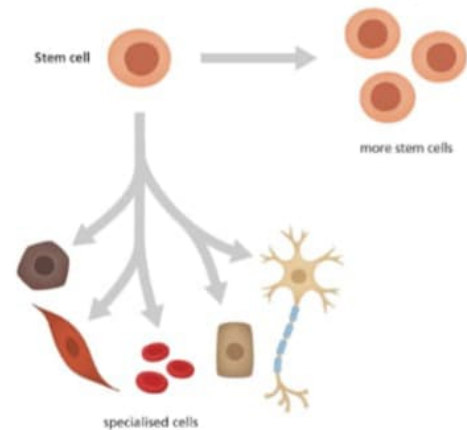
Bone marrow

Adipose tissue

Blood

3.INDUCED PLURIPOTENT STEM CELLS (IPS)

Are the cells that have been engineered in the laboratory by converting the tissue specific cells (such as skin cells) into cells which are behaving as embryonic stem cells?



Recent Trends in Stem Cell Technology

There are some areas in which there is active research getting done on this technology

Treating liver diseases with stem cells.

Stimulating an anti-brain tumor immune response via manipulated stem cells.

Reprogramming tumor-specific immune cells from stem cells for cancer immunotherapy.

Manipulating stem cells to become bone and cartilage.

There are still a lot of research projects going on over this topic and a lot has already been found out. So, we all can have a great deal of knowledge in this area over a lot of things.

PARKINSON'S DISEASE



Parkinson's Disease

By Stavya Pathak
(Sem 4,Biochemistry)

Parkinson's disease is a chronic disorder that affects the brain's dopamine-producing neurons and progresses over time. It is linked to the gradual loss of neurons in the substantia nigra and other areas of the brain. Non-motor symptoms, particularly in advanced stages of illness, are common and include dementia and dysautonomia.¹ Parkinson's disease is not seen as a singular disease entity, and different clinicians and researchers around the world may have different definitions of the disease. Here, we use the term Parkinson's disease to describe a clinical condition, progressive parkinsonism of unknown source, responsive to dopaminergic therapy, and characterized by the loss of brainstem neurons and the presence of Lewy bodies in some of the remaining nerve cells.

Parkinson's disease is caused by the gradual loss or degeneration of dopaminergic neurons in the brain's Substantia Nigra (SN). Dopamine, a chemical that is ordinarily produced by these cells and serves as a messenger for typical muscle activity.





T Tremor: shaking, usually starting on one side

R Rigidity: stiffness of the limbs, neck, or trunk

A Akinesia: loss or impairment in power of voluntary movement

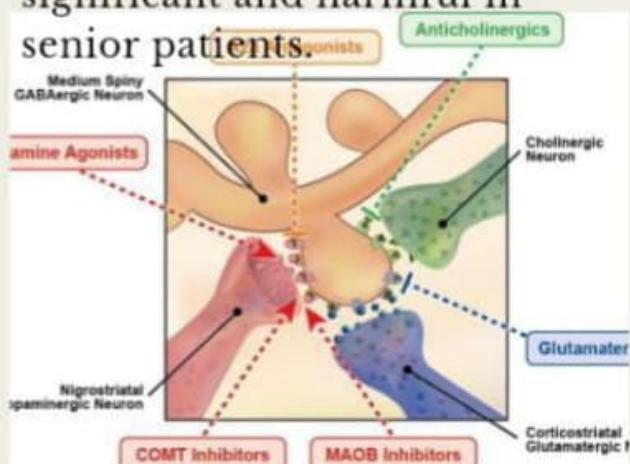
P Posture and balance

The development of PD has been linked to at least 11 autosomal dominant and 9 autosomal recessive gene mutations. SNCA, PARK3, UCHL1, LRRK2, GIGYF2, HTRA2, EIF4G1, TMEM230, CHCHD2, RIC3, and VPS35 are among the autosomal dominant genes. PRKN, PINK1, PARK7, ATP13A2, PLA2G6, FBXO7, DNAJC6, SYNJ1, and VPS13C are autosomal recessive genes.

As brain cells are lost, symptoms emerge as there is less dopamine in the synaptic cleft. A sense of weakness or stiffness in one limb, as well as a slight trembling in one hand while at rest, is the initial symptoms of the condition. Furthermore, sadness and other mental or emotional issues manifest, as do postural instability or poor balance and coordination.³ Bradykinesia (slowness of movement), tremor, and cogwheel rigidity are the three main clinical signs of Parkinson's disease. Other frequent features include postural instability, poor coordination, and poor balance.

These symptoms start slowly and progress is asymmetrical in Parkinson's disease.

Another prominent feature of Parkinson's disease is a motor symptom response to levodopa. Postural instability and irregular gait are later symptoms of Parkinson's disease that are particularly significant and harmful in senior patients.



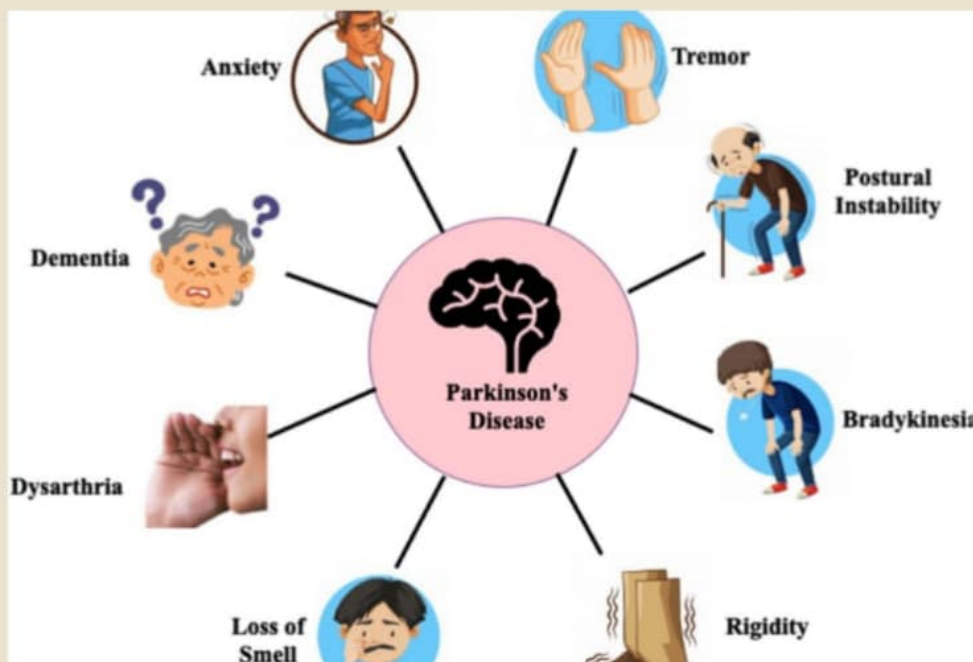
There is currently no cure, although there are several palliative treatments that can be used to manage the symptoms. Medicine, surgery, and cell therapy are all forms of treatment that can be used to keep dopamine levels at normal levels.⁴

Medication: L-Dihydroxyphenylalanine (L-Dopa), a precursor to dopamine, can be supplemented as part of PD treatment and is available as Levodopa and/or Carbidopa. The medication is absorbed by brain nerve cells, which transform it into dopamine. Levodopa's negative effects, such as nausea, are lessened with carbidopa, which stops digestive tract enzymes from destroying it.

Deep Brain Stimulation (DBS) surgery: Many PD symptoms, including tremor, rigidity, stiffness, delayed movement, and difficulty in walking, can be treated with this technique. The imbalance in the aforementioned motor circuitry of the basal ganglia can be reduced by pacemaker-assisted stimulation of stereotactically, millimeter-precisely positioned electrodes, either in the subthalamic nucleus or the internal section of the globus pallidus. Both advanced PD patients and those with early motor problems have shown to benefit from this therapy.

Cell Therapy: The most likely method for reestablishing nigrostriatal DA transmission is cell replacement therapy for Parkinson's disease (PD) using dopaminergic (DA) neurons. Currently being researched in Parkinson's patients is the transplantation of altered cells, including induced pluripotent stem cells (iPSCs), into the right side of the brain.

Other therapies like Gene Therapy and Antibody Mediated Therapy are also used in treating patients of Parkinson's Disease



GENE EDITING

CRISPR

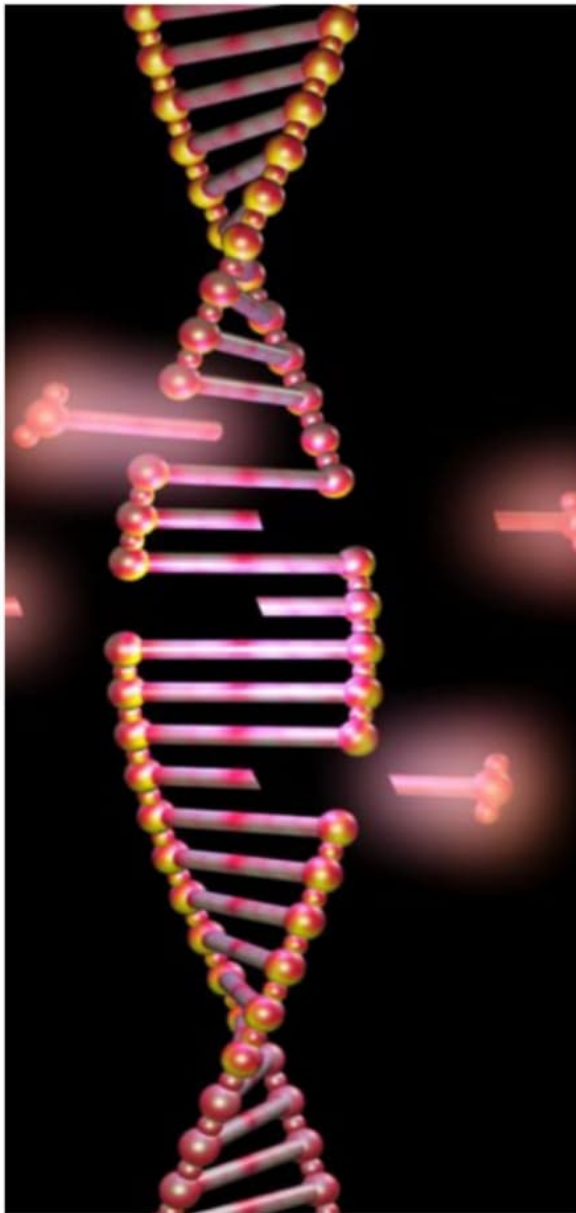


CRISPR

Ever since scientists realized that changes in DNA cause cancer, they have been searching for an easy way to correct those changes by manipulating DNA. Although several methods of gene editing have been developed over the years, none has really fit the bill for a quick, easy, and cheap technology.

But a game-changer occurred in 2013, when several researchers showed that a gene-editing tool called CRISPR could alter the DNA of human cells like a very precise and easy-to-use pair of scissors.

The new tool has taken the research world by storm, markedly shifting the line between possible and impossible. As soon as CRISPR made its way onto the shelves and freezers of labs around the world, cancer researchers jumped at the chance to use it.



What is CRISPR?

CRISPR is a family of DNA sequences found in the genomes of prokaryotic organisms such as bacteria and archaea. These sequences are derived from DNA fragments of bacteriophages that had previously infected the prokaryote. They are used to detect and destroy DNA from similar bacteriophages during subsequent infections.

Full form of CRISPR.

A CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats (pronounced “crisper”) which are the hallmark of a bacterial defence system that forms the basis for CRISPR-Cas9 genome editing technology.

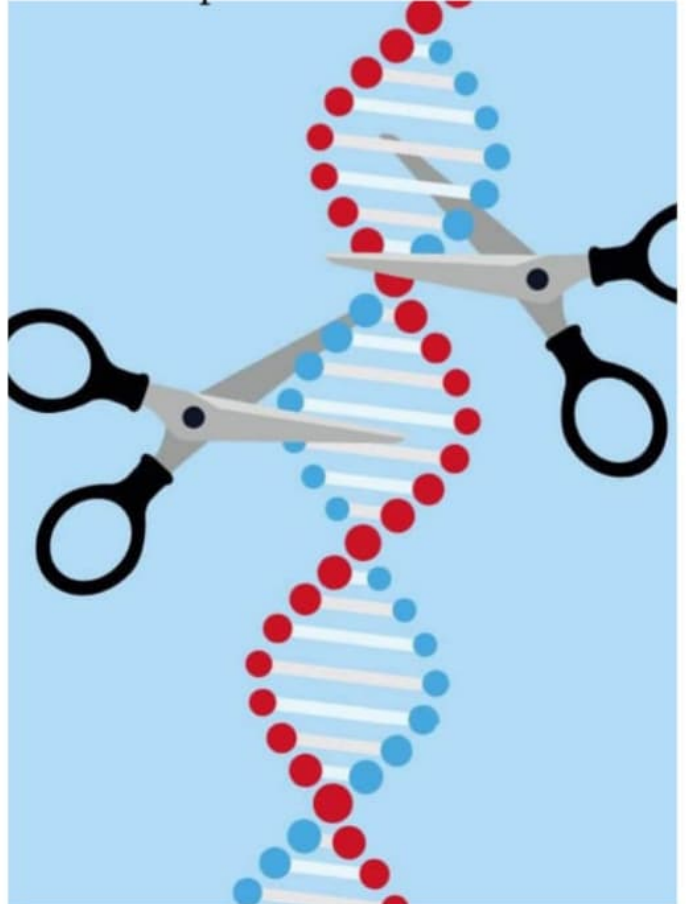
Components of CRISPR/Cas9.

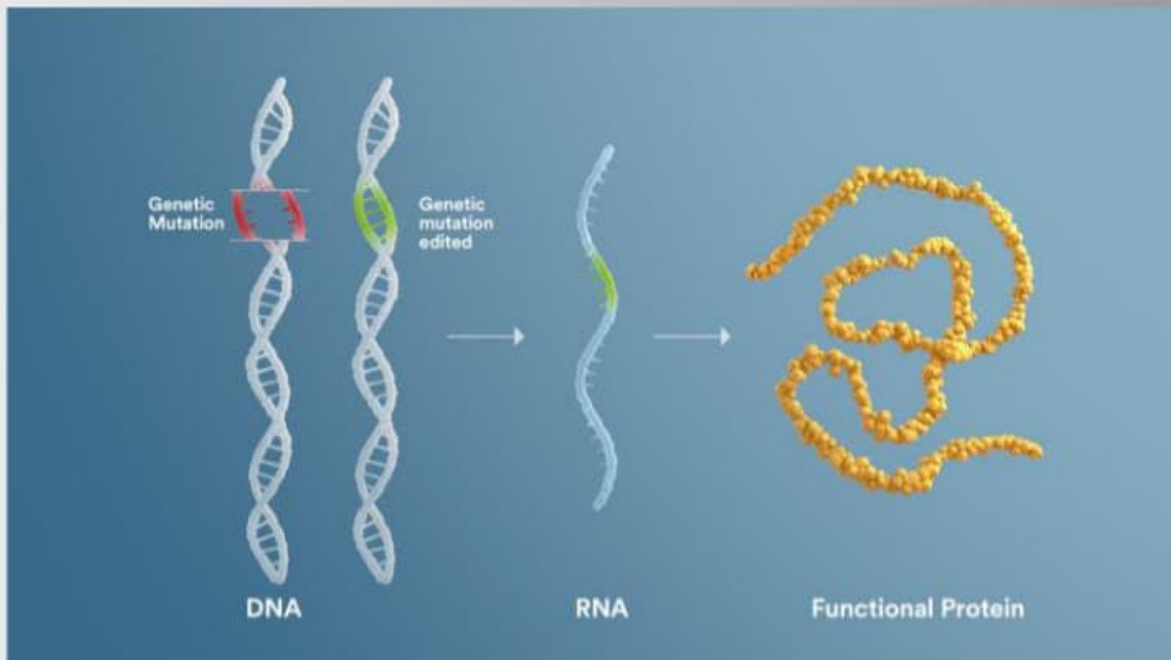
1. GuideRNA(gRNA)
 2. CRISPR-associated(Cas-9) proteins
- two essential components of CRISPR/Cas-9 system.



- Mechanism of Action.
- The mechanism of CRISPR/Cas-9 genome editing can be generally divided into three steps:
 - recognition, cleavage, and repair.
- The designed sgRNA directs Cas-9 and recognizes the target sequence in the gene of interest through its 5'crRNA complementary base pair component.
- The Cas-9 protein remains inactive in the absence of sgRNA. The Cas-9 nuclease makes double-stranded breaks (DSBs) at a site 3 base pair upstream to PAM. PAM sequence is a short (2–5 base-pair length) conserved DNA sequence downstream to the cut site and its size varies depending on the bacterial species.

- The most commonly used nuclease in the genome-editing tool, Cas-9 protein recognizes the PAM sequence at 5'-NGG-3' (N can be any nucleotide base). Once Cas-9 has found a target site with the appropriate PAM, it triggers local DNA melting followed by the formation of RNA-DNA hybrid.
- Then, the Cas-9 protein is activated for DNA cleavage. HNH domain cleaves the complementary strand, while the RuvC domain cleaves the non-complementary strand of target DNA to produce predominantly blunt-ended DSBs.
- Finally, the DSB is repaired by the host cellular machinery.





Role of CRISPR/Cas9 system.

CRISPR/Cas-9 gene editing has held the promise of curing most of the known genetic diseases such as sickle cell disease, β -thalassemia, cystic fibrosis, and muscular dystrophy. massive impact on the world in many areas including medicine, agriculture, and biotechnology.



By Disha Marothiya
Sem 6 Biochemistry
(GS)



GLANCE AT ASTROBIOLOGY

By Darshil Patel

Space Science

The pace of innovation in this era is so swift, that we might forget the count of newly emerging fields of research. One might think of 'Astrobiology' as one such field. But this term goes way back to 1953, termed by Gavrill Tikhov. But it wasn't for long before its potential caught the eyes of space giants. Former chairman of ISRO, Dr. K. Radhakrishnan, also stated that 'Astrobiology is the next big challenge in India's space mission.' But so far, only few countries have been successful in launching missions to explore chances of life and human survival on extraterrestrial planets. Here, we can have a look at some of the ongoing projects in this field.

Developmental, Reproductive & Evolutionary Biology Program

This NASA mission focuses to answer questions like, what happens to reproduction and the development of offspring across a lifespan and over multiple generations in space? What about differences in how males and females respond to the space environment? Keeping our goal of colonizing mars, these questions are must to be answered!



Battle against microbes

Must sound strange but yes, even in space, fungus is there, we transport them there. There are positive sides of cultivating edible microbes in space, like mushrooms for instance, which can provide nutritional food to crew. But we do carry harmful ones too, and in the absence of gravity spores can easily spread throughout the spacecraft. Bio-corrosive microbes that grow on metallic surfaces in spacecraft can damage both equipment and hardware. The launch project characterizes the mass, thickness, morphology and the associated gene expression of this space biofilm. Researchers will also look at the biochemical and RNA mechanism involved in the biofilm's formation in space, and will also introduce a novel material to test the surface's resistance to the sticky substance. Scientist Sharmila Bhattacharya notes that it will protect the health of crew on voyage and also the planet that we visit. This is big step forward in the direction of our mission of making human a "Multiplanetary species."

Food Production in space

The main aim of this and associated projects is to understand how the spaceflight environment affects how plants grow. Edible plants grown in space could be used to feed the crew of the ISS. It also reduces launch mass, providing opportunities for farther traveling and unlimited source of food for crew. The exposed Root On-Orbit Test System (XROOTS) investigation uses hydroponic and aeroponic tech. to grow plants without soil. Integrated with the existing Veggie hardware, it will evaluate nutrient delivery and recovery techniques from the plant's germination to its maturity. ORBITEC has developed custom lighting software allowing independent selection of red and blue light levels, with this much specifications, optimum conditions are found, which will help earthlings to enhance cultivation of plants in settings like Greenhouses.



**NOBEL
LAUREATE**

**PHYSIOLOGY OR
MEDICINE**

Noble Prize Winners

2022 Svante Pääbo “for his discoveries concerning the genomes of extinct hominins and human evolution

2021 David Julius and Ardem Patapoutian “for their discoveries of receptors for temperature touch.

2020 Harvey J. Alter, Michael Houghton and Charles M. Rice “for the discovery of Hepatitis C virus”.

2019 William G. Kaelin Jr, Sir Peter J. Ratcliffe and Gregg L. Semenza “for their discoveries of how cells sense and adapt to oxygen availability”

2018 James P. Allison and Tasuku Honjo “for their discovery of cancer therapy by inhibition of negative immune regulation

2017 Jeffrey C. Hall, Michael Rosbash and Michael W. Young “for their discoveries of molecular mechanisms controlling the circadian rhythm”

2016 Yoshinori Ohsumi “for his discoveries of mechanisms for autophagy”

2015 William C. Campbell and Satoshi Ōmura “for their discoveries concerning a novel therapy against infections caused by roundworm parasites”

Tu Youyou “for her discoveries concerning a novel therapy against Malaria”

Reference.

<https://www.nobelprize.org/prizes/lists/all-nobel-laureates-in-physiology-or-medicine/>

PHOTO GALLERY

LOOK FOR THE MAGIC

IN EVERY MOMENT







Magazine team members

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- Riya Jobanputra
- Stavya Pathak
- Hirva Bhavsar





*Actually,
the best gift
you could have
given her was
a lifetime of
adventures*

- LEWIS CARROLL