Ahmedabad University

Illustrated Science

Monsoon 2023

COM210 Science Communication Using Digital Media

Illustrated Science

Editor

Bhumi Shah
Fellow, Centre for Learning Futures, Ahmedabad University

Cover

Aarohi Desai
Student, Integrated MS

Edition

Monsoon 2023

Digital Curve
Centre for Learning Futures
Ahmedabad University
digitalcurve.online

From *the* Instructors

Dear Readers,

Welcome to the first edition of our magazine *Illustrated Science*. It chronicles the semester long efforts of the students from the COM210 Science Communication using Digital Media course at Ahmedabad University.

In an era where scientific advancements significantly impact our lives, the role of effective science communication is more crucial than ever. This course trains students to bridge the gap between complex scientific concepts and popular understanding of science through explanatory science illustrations created using digital tools and software.

Join us in celebrating the dedication of these emerging science communicators and illustrators from across different disciplines as they contribute to the ongoing dialogues in Science.

Bhumi Shah & Tana Trivedi

Inside

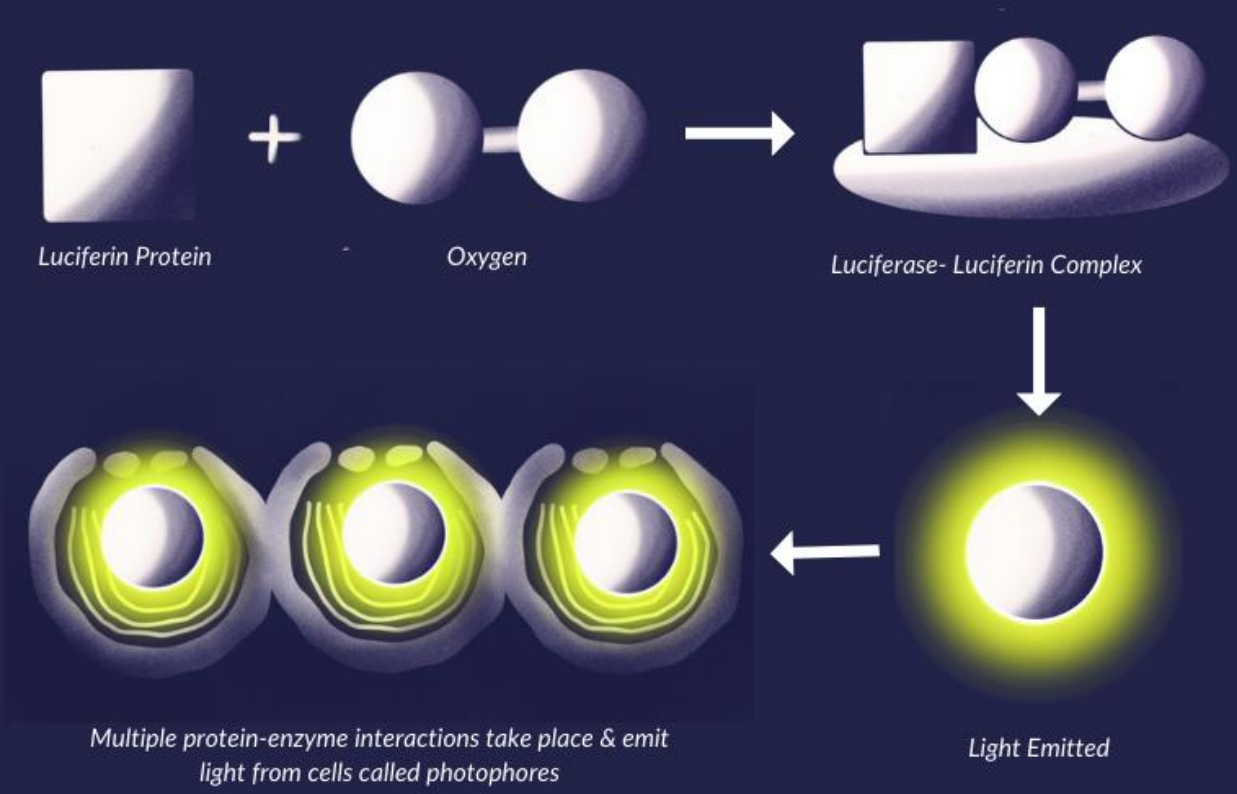
Curating Constellations

The Wonders of Aquatic Bioluminiscence

Illustrated by Aarohi Desai, Fourth Year, Integrated MS

Sailors in the 1800s described it as looking like clouds from horizon to horizon, sailing through a field of snow. This mesmerizing spectacle defies the notion that darkness begets lifelessness, as it transforms into a realm of hauntingly beautiful illumination. This deep-sea phenomena dates back as the 3rd Century BCE, when Aristotle observed striking the sea surface with a rod produced a vivid blue flash of light. Amidst the crushing pressures and frigid temperatures of the deep sea, an enigmatic phenomenon awaits discovery: deep-sea bioluminescence.

Simply put, it is the ability of several marine animals to produce their own light energy, illuminating the inky darkness of the sea. From microscopic plankton to colossal sea creatures, this extraordinary adaptation has evolved as a tool for survival, communication, and wonder! But, what is the science behind this spectacle?



Bioluminescence is a result of an interaction between luciferin (protein) and luciferase (enzyme). In a chemical reaction, the protein is the reactant that binds with the enzyme to emit visible light. The luciferase allows oxygen to bind with luciferin which produces photons of light energy within the animal's body. This chemical reaction takes place in glandular spots called photophores present on body surfaces of deep sea animals. These animals can accurately regulate their body chemistry to produce a specific level of color intensity for various survival and mating strategies.

Bioluminiscent Adaptations

The Green Bomber Worm

Swima bombiviridis

Emitting bursts of greenish bioluminescence, the green bomber worm startles predators or potentially warns them of its toxic nature. This worm's adaptation involves releasing glowing secretions as a defense mechanism, deterring threats and ensuring its safety. Through its bioluminescent defense, the green bomber worm effectively wards off predators, aiding its survival in marine environments.

The Anglerfish

Lophius americanus

Equipped with a bioluminescent lure dangling above its mouth, the anglerfish attracts unsuspecting prey in the darkness of the deep sea. This adaptation serves as a hunting strategy, luring smaller fish towards the anglerfish's jaws for easy capture. The anglerfish's bioluminescent lure aids in securing food in the abyssal environment, ensuring its sustenance and survival in the depths.

Dinoflagellates

Dinoflagellata

Dinoflagellates emit flashes of light when disturbed, utilizing bioluminescence as a defensive measure to evade predation. Their adaptation involves producing sudden bursts of light via chemical reactions, startling predators and diverting attention away from themselves. Bioluminescence in dinoflagellates plays a crucial role in survival by creating distractions and increasing their chances of survival in the competitive marine ecosystem.

The Vampire Squid

Vampyroteuthis infernalis

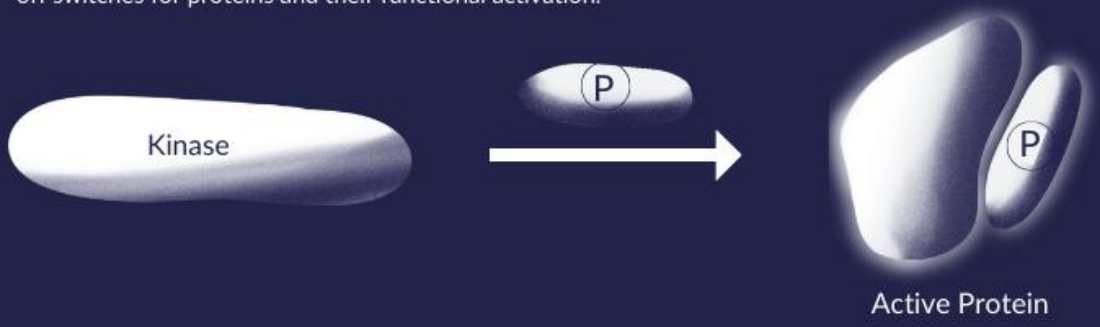
The vampire squid uses bioluminescent photophores to create light displays, camouflaging itself in the deep sea's dim glow and confusing potential threats. Its adaptation involves emitting pulsating light or turning itself into a glowing ball, enabling evasion from predators in the dark depths. Bioluminescence helps the vampire squid survive by providing a clever defense mechanism, allowing it to thrive in the abyssal zone.

Journey To The Brain

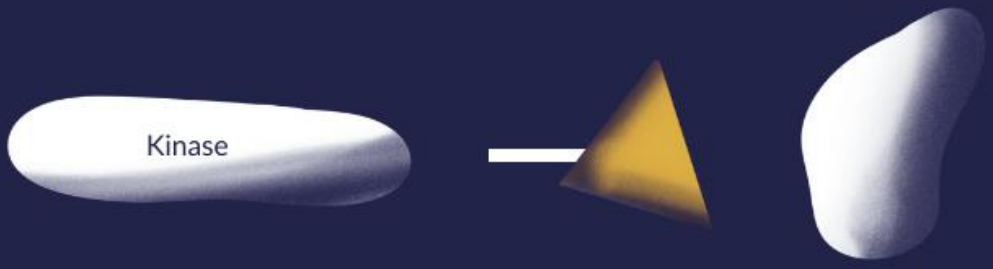
A study group at Stanford Medicine, led by Dr. Michael Lin and his lab members have engineered an elegant, non-invasive bioluminescent indicator that makes the brain tissue glow when a certain type of brain cancer drug is active and has crossed the tightly structured blood-brain barrier. How does this actually work?

Kinase Activity

Proteins called 'Kinases' alter protein structure by adding a phosphate molecule (P) .They act like on and off switches for proteins and their functional activation.



Active Protein



Inactive Protein

NanoLuc

Scientists have engineered a special kind of protein derived from deep-sea shrimp- which glows bright enough to be seen in the brain called NanoLuc.

By modifying the shrimp-derived protein, scientists were able to create an indicator that glows when a drug, a kinase inhibitor is active.

1. NanoLuc, is a two-fragment protein which is held apart by a kinase induced phosphorylated (P)

2. If a drug is active after it has crossed the barrier, it will prevent the phosphorylation with (P)

3. The two fragments of NanoLuc join, enabling the protein to gobble the drug molecule.

4. The brain then glows signaling that the drug has successfully passed through the blood brain barrier & is active.

Blood-Brain Barrier

1 Wu Y, Walker JR, Westberg M, Ning L, Monje M, Kirkland TA, Lin MZ, Su Y. Kinase-Modulated Bioluminescent Indicators Enable Noninvasive Imaging of Drug Activity in the Brain. ACS Cent Sci. 2023 Mar 20;9(4):719-732. doi: 10.1021/acscentsci.3c00074. PMID: 37122464; PMCID: PMC10141594.

UNVEILING THE REEF CATASTROPHE

The Discord of Climate Change

Illustrated by Kirti Pishe, Fourth Year, BA (Hons)

Imagine being unable to appreciate the stunning views of the blue waters or the delightful experience of scuba diving, or witnessing marine biodiversity. This may seem like an extreme scenario, but it could become a devastating reality if we do not act now. Unfortunately, the anthropogenic and climate change impacts have taken a toll on the coral reefs' vital role in maintaining the aquatic environment. The intricate interrelatedness between everything in nature causes impacts like a chain reaction to other factors, like us, who depend on each other. Some may argue that coral reefs do not constitute a significant area of the ocean, but they play a crucial role in maintaining the marine ecosystem. Therefore, it is essential to protect and conserve them.

Coral and algae (food source) depend on each other to survive and corals use the minerals present in the water for protection.

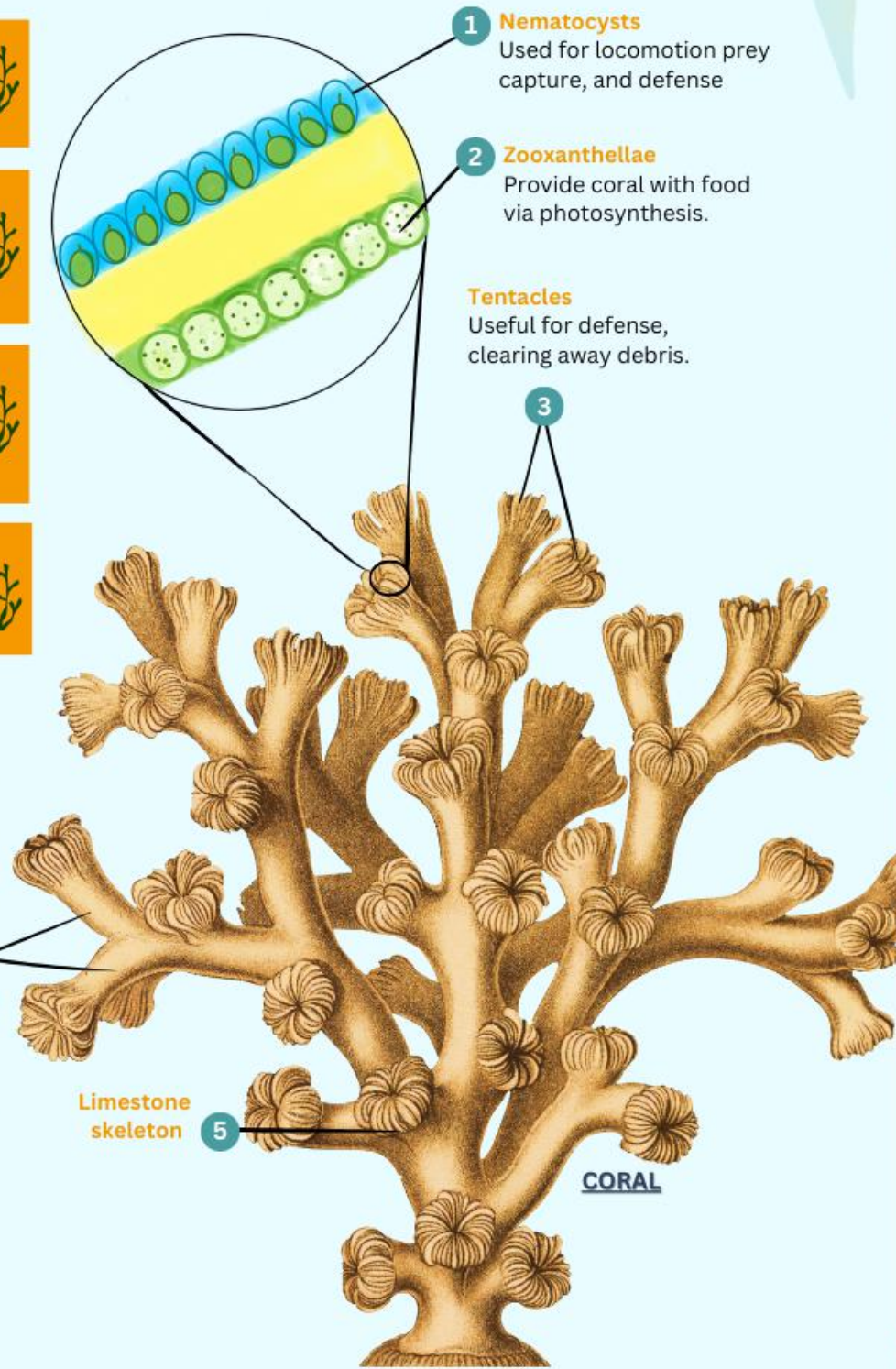
Humans also depend on the reefs because they become responsible for controlling the impact of waves and storms that might lead to erosion.

Coral reefs make up 0.1% > of the seafloor and about 1/4th of the aquatic life calls the reefs their home. They provide shelter, food, and a place to lay their babies.

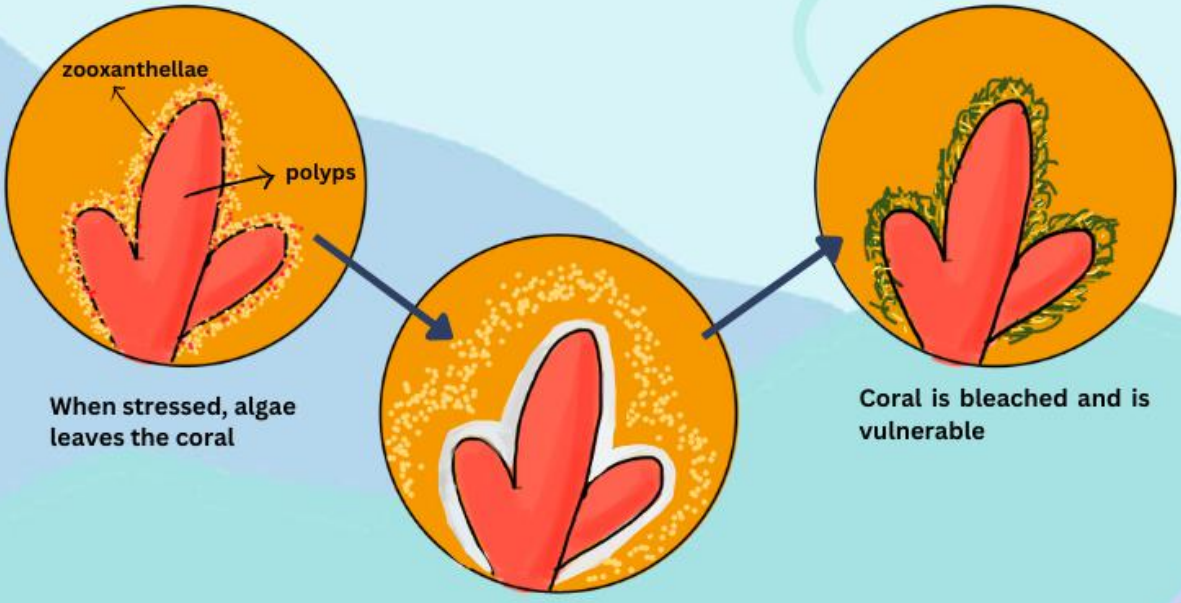
Oceans soak up 30% of carbon dioxide released by humans, which can lead the seas to increase acidity levels that result in coral corrosion.

IPCC report:

- the coral reefs bring greater diversity
- impacts the reproduction of the marine life
- is being used to develop new medicines that help with cancer, infections, arthritis
- Prevents loss of life and soil erosion, having a direct impact on humans
- By 2050, 90% of the corals are expected to be bleached



CORAL BLEACHING



When stressed, algae leaves the coral

Coral and algae (food source) depend on each other to survive

Coral is bleached and is vulnerable

CAUSES

Rise in temperature
Rise in temperature causes chemical changes in the water than harm the corals and aid in bleaching.

Overexposure to sunlight
Exessive sunlight casuses harm to the coral in shallow water.

Pollution
Storm reminants can dilute the water and sewage water's pollutants also effect coral health.

Low tide
Low tide exposecoral to air which can cause bleaching.

WHAT CAN YOU DO?

When you dive,
Don't touch the corals.

Clean your trash and pick up others' that was left behind.

Pick up after yourself

Practice Safe Boating
Place anchor in sand and not near corals.

Building Resistance
The capacity of the ecosystem to withstand changes without losing its ability to maintain function and structure. Coral reefs would have to not change into an algal state. This also helps to restructure the ecosystem to build resilience and better adapt. Resilience would mean they could "resist, survive, or recover" from bleaching.

Corals = Fish = Imbalance in the human world

Black Holes Unveiled: Einstein's theory to reality

Illustrated by Ayush Chaurasia, Second Year, BS (Hons) Physics

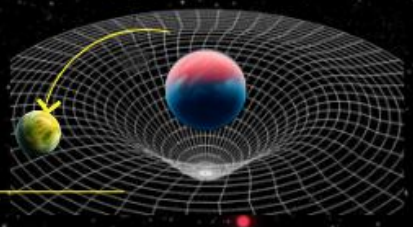
Black holes, the enigmatic cosmic monsters that devour light and distort time, are more than celestial curiosities. They reveal the secrets of gravity, challenge the laws of physics, and unlock the universe's deepest mysteries. But how do they originate? Let's find out!

In the 17th century Isaac Newton described gravity as a force of attraction that exists between all objects with mass. According to his law, every mass in the universe attracts every other mass with a force

Gravity (attraction) between two objects

Then in early 20th century Albert Einstein, a German physicist developed the theory of relativity, revolutionizing our understanding of space, time, and gravity

In Einstein's general relativity, space-time is a unified four-dimensional framework that combines three dimensions of space with one dimension of time. Gravity is the result of the curvature of space-time caused by massive objects. Therefore, the force of gravity as described by Newton is, in reality, a curvature in space and time.



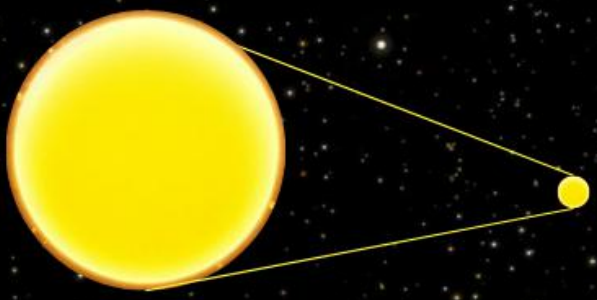
Curved space-time which appears to be force of gravity

But what if the curvature becomes so extreme that even light can not escape?

According to general relativity, a black hole is a region in space where the curvature of space-time has become so extreme due to the presence of a massive object that nothing, not even light, can escape its gravitational pull. This phenomenon occurs when the mass of an object is concentrated within a small enough volume. Black holes are not actually black in color but they appear to be black because no light is emitted or radiated from them.

The Schwarzschild radius is a theoretical limit at which an object's mass must be compressed to become a black hole, and not even light can escape it.

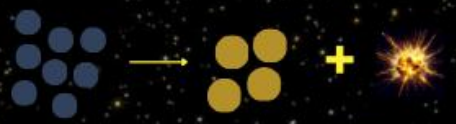
To create a black hole from the mass of our sun, it needs to be shrinked to the radius of around 3 km from its actually radius of 700,000km



Sun's actual radius: 700,000 km

Sun's radius for it to be black hole: 3km
(Figures not to scale)

How is a black hole formed?



In massive stars, lighter elements like Hydrogen combine to form atoms of heavier elements like Helium and energy. This is called nuclear fusion. Helium combines with other helium atoms to form heavier elements like carbon

The energy from the nuclear fusion and the gravitational force of star act in opposite directions.

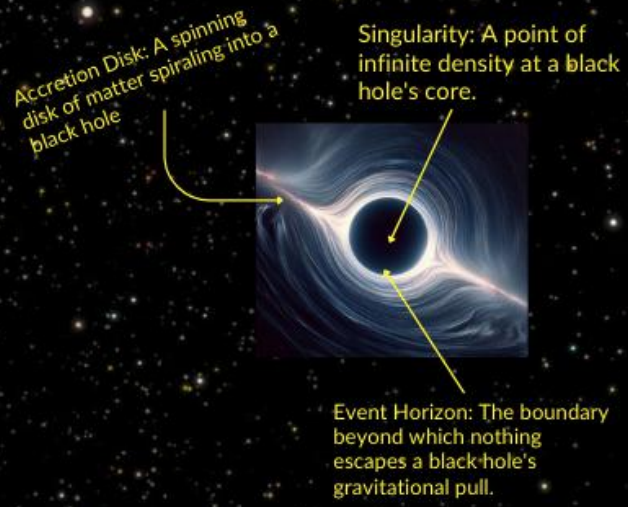
In time, heavier element iron is formed which is too heavy to fuse any further and nuclear fusion stops. This is called iron formation.

This leads to star's gravitational pull as the only force which collapses the star. The collapse results in a explosion, known as a supernova.

White dwarf is formed

A black hole is formed

Parts of a black hole

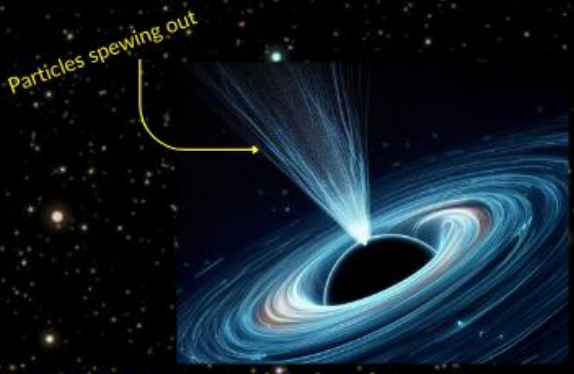


Are black holes real or just in theories?

Yes, blackholes are real. The first image of a black hole, was captured in 2019 by the Event Horizon Telescope. It depicted the supermassive black hole at the center of the galaxy M87, located about 55 million light-years away from Earth.

The first image of a black hole

Do black holes exist forever?



No, black holes are not permanent. According to Stephen Hawking, particle-antiparticle pair emerge spontaneously in vacuum. Occasionally, one of these particles falls into the black hole while the other escapes into space, leading to a gradual loss of mass and energy by the black hole. Therefore, in the long run, a black hole disappears completely.

Stem Cells: A New Frontier
In Heart Disease Treatment

Illustrated by Dhruvi Mewada, Third Year, Integrated MS

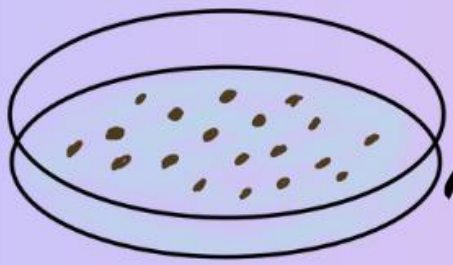
Introduction

Stem Cells are special cells that have the unique power to become many different types of cells. Think of them as the body's all-purpose repair kits. These remarkable cells can turn into things like heart cells, skin cells, or even bone cells. Because of this incredible ability, scientists are very interested in using them to help with various medical problems, like heart disease.
Stem cell therapy can lead to the restoration of heart function, improved pumping capacity, and reduction in heart failure symptoms in patients who have suffered a heart attack.

Process of stem cell therapy treatment for heart disease-

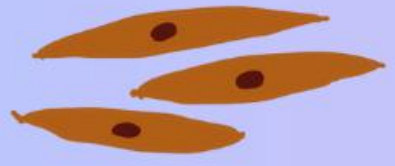
The initial step involves extracting stem cells from sources such as bone marrow, adipose tissue, and circulating blood. This extraction is typically carried out through a procedure called bone marrow aspiration. During this procedure, the targeted area is numbed, a needle is inserted into the hipbone or breastbone, and a bone marrow sample is collected. This sample is then processed to isolate stem cells for various medical treatments, such as stem cell therapy.

Bone Marrow



Stem cells extracted from bone marrow

Different types of stem cells that can be used for heart disease therapy:



Embryonic stem cells (ESCs)

ESCs are derived from early embryos and are the most versatile type of stem cell. However, their use is controversial due to ethical concerns.

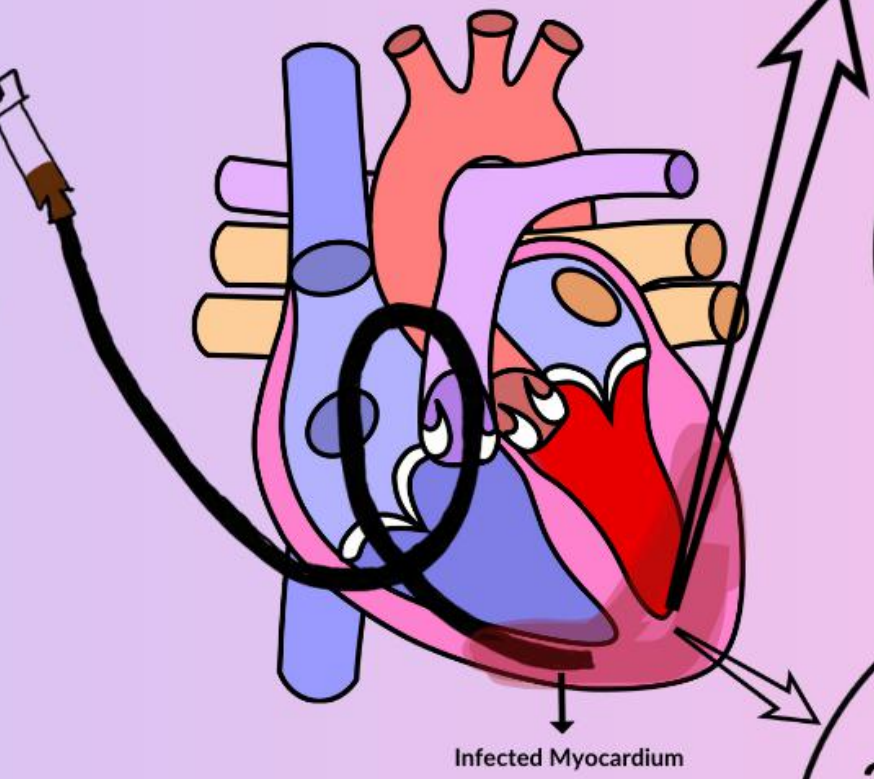
Induced pluripotent stem cells (iPSCs)

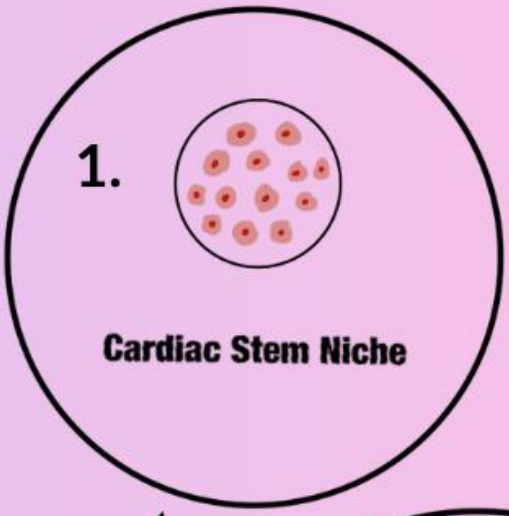
iPSCs are created from adult cells, such as skin cells, that are reprogrammed to become stem cells. iPSCs offer a promising alternative to ESCs, as they can be derived from the patient's own cells, reducing the risk of rejection.

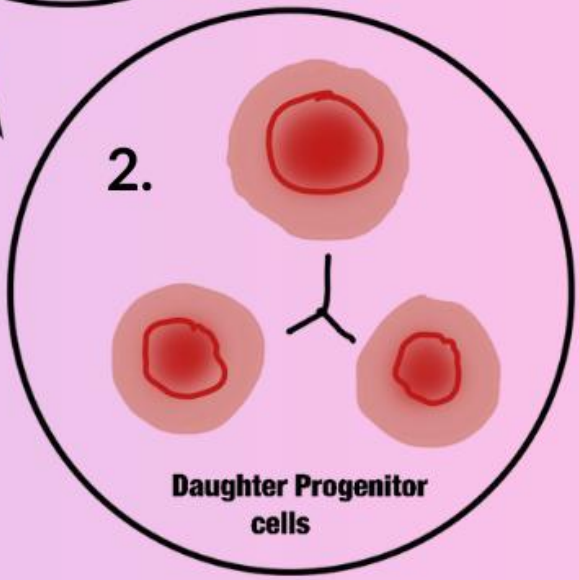
Mesenchymal stem cells (MSCs)

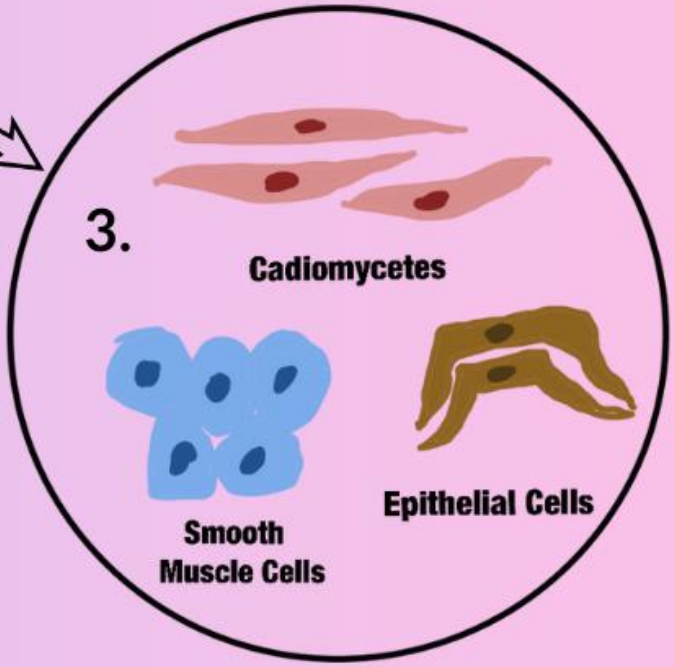
MSCs can be found in a variety of adult tissues, including bone marrow and fat. They are easy to harvest and have been shown to be safe and effective in clinical trials.

Stem cells is being taken to the injured heart by injecting them into the bloodstream, coronary arteries, or directly into the heart muscle. Once they reach the injury site, they need to become a part of the surrounding tissue, change into specific cell types, and help repair the damaged heart tissue.





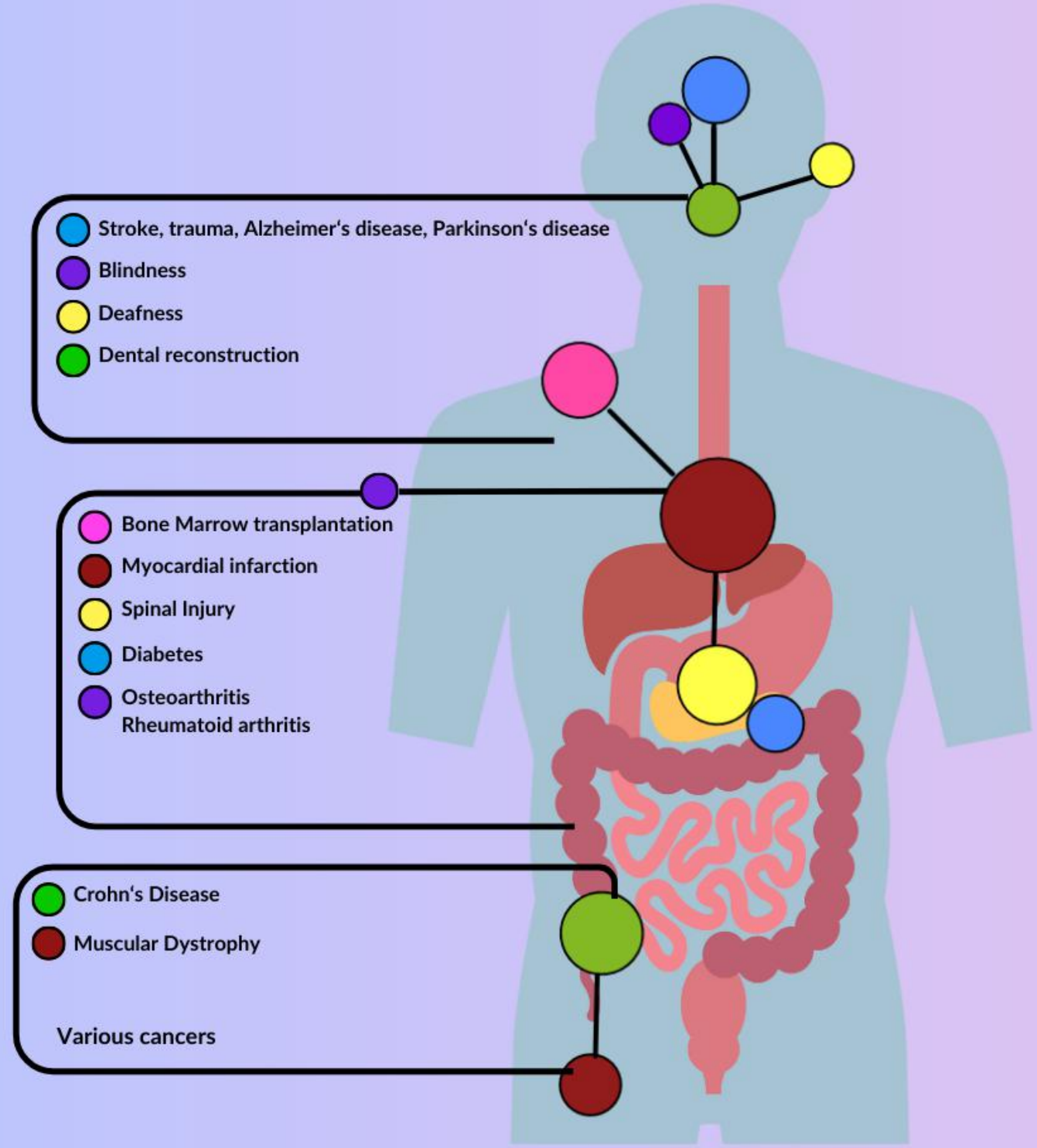




After injection, stem cells settle in the **cardiac stem niche**, where they receive signals to transform. In this niche, they become **daughter progenitor cells**, early-stage cell types. Over time, these daughter cells differentiate into **cardiomyocytes** (heart muscle cells), **smooth muscle cells**, and **epithelial cells**. These specialized cells work together to repair and regenerate damaged heart tissue.

Treatments

Stem cell-based treatments have the potential to revolutionize medicine by offering personalized therapies, regenerative solutions, and novel approaches to treat a wide range of diseases and injuries.



Stem Cell therapies

Latest developments

- **China was the first country to use stem cells (MSCs) to treat heart conditions and other cardiovascular diseases.**
- **Researchers at Duke-NUS Medical School have developed a stem cell therapy for heart failure. In tests on animals, these cells, when put into a damaged heart, repaired the tissue and improved heart function.**
- **A recent analysis of 23 clinical studies involving 1148 patients found that stem cells (MSCs) significantly improved heart function. While the mortality rate was lower in the group receiving MSCs, it didn't show a clear statistical difference compared to the control group. These findings suggest that MSCs could be a potential treatment for heart problems.**

Success Stories

Dave Randle, Heart Attack
After suffering a heart attack, Dave received stem cell therapy that involved encouraging the release of stem cells from his bone marrow into his bloodstream. These cells were then infused into his heart, resulting in significant improvements in his heart function and overall health.

George Norton, Acute Lymphoblastic Leukaemia
George Norton had a sickness called Acute Lymphoblastic Leukaemia. To make him better, doctors did a special treatment. They took healthy cells from another person and put them into George's body. This helped him have a strong immune system, and now he is not sick with leukemia anymore.

Deepan Shah, Crohn's Disease
Deepan participated in a clinical trial that used stem cells to reset his immune system and stop the attacks on his gut due to Crohn's disease. Following chemotherapy and stem cell injections, Deepan was able to reduce his medication and lead a more normal life.

Andrew Robinson, Arthritis
Andrew, suffering from knee arthritis, opted for a chondrotissue graft procedure using stem cells collected from his bone marrow. This procedure facilitated the growth of new cartilage, allowing Andrew to walk again and resume his active lifestyle within a short time.

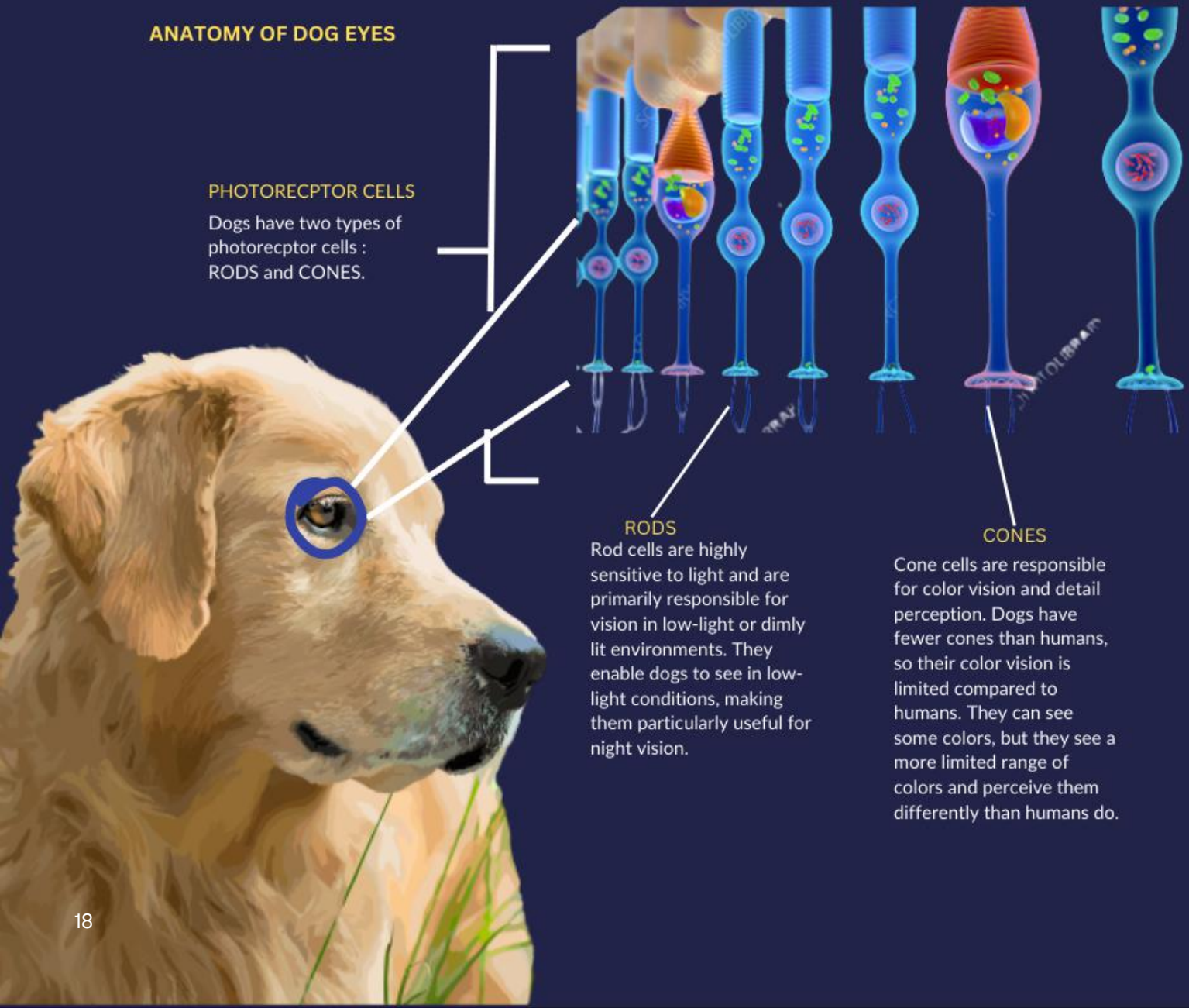
Seeing the Spectrum: A Canine's View of World

Illustrated by Tanvi K Mehta , Third Year, BBA (Hons)

WHY LEARN ABOUT DOG'S VISION ?

Understanding a dog's vision is crucial for scientific research for several reasons. Firstly, it helps us gain insights into their sensory perception and cognitive abilities, which can aid in designing more effective training and communication methods. Secondly, studying canine vision contributes to our knowledge of comparative biology, offering insights into the evolution of vision systems. Furthermore, it has practical applications in fields such as veterinary medicine, where understanding a dog's visual capabilities is vital for diagnosing and treating eye-related issues. Finally, this knowledge can also improve our comprehension of the broader ecosystem, as dogs interact with various wildlife, and understanding their visual adaptations can shed light on ecological dynamics.

ANATOMY OF DOG EYES



PHOTORECPTOR CELLS

Dogs have two types of photorecptor cells : RODS and CONES.

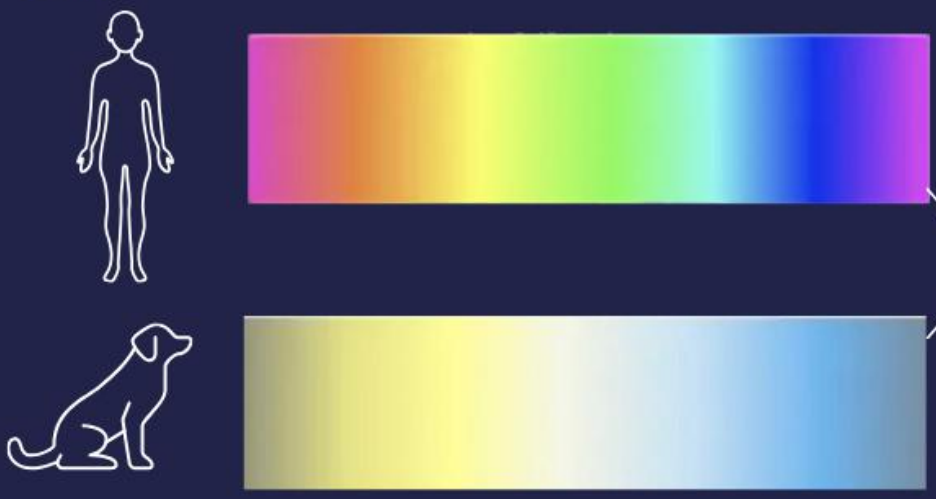
RODS

Rod cells are highly sensitive to light and are primarily responsible for vision in low-light or dimly lit environments. They enable dogs to see in low-light conditions, making them particularly useful for night vision.

CONES

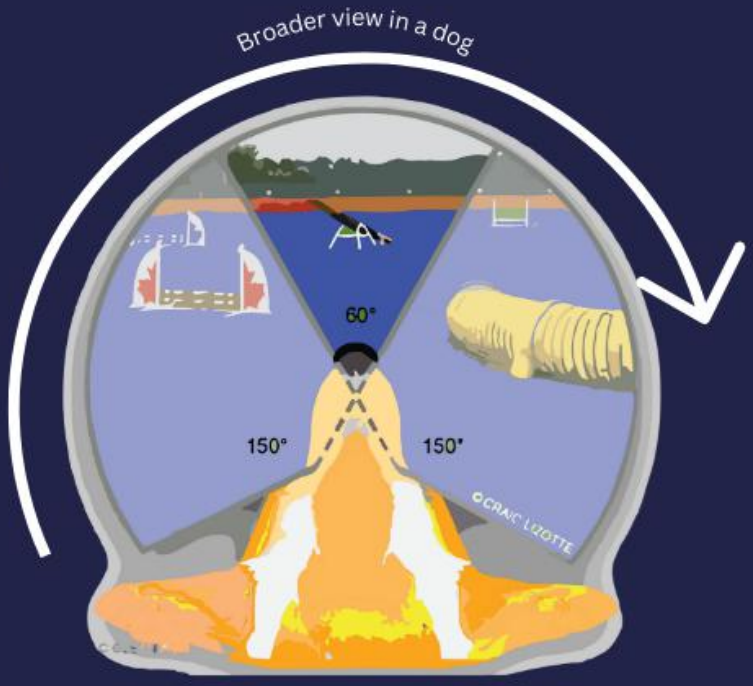
Cone cells are responsible for color vision and detail perception. Dogs have fewer cones than humans, so their color vision is limited compared to humans. They can see some colors, but they see a more limited range of colors and perceive them differently than humans do.

VISION

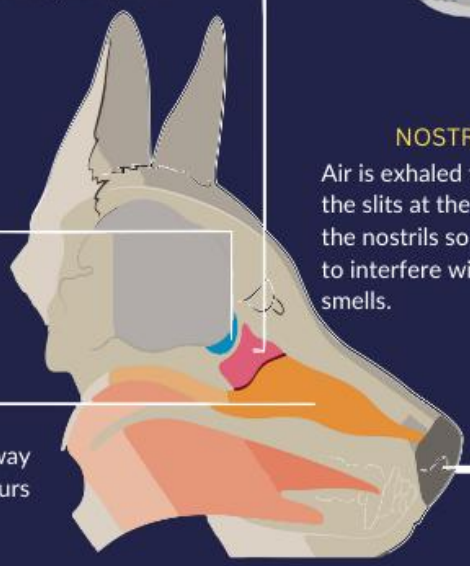


Colour Spectrum in human and dog eyes.

Dogs have a wider field of peripheral vision. Their eyes are more laterally positioned on their head, allowing for a broader field of view. This wider field of peripheral vision is beneficial for detecting movement and changes in their environment, which is essential for their survival instincts. Their visual system is finely tuned to notice even slight movements, making them excellent at tracking moving objects or potential prey. This is crucial for their hunting and chasing instincts.



THE ROLE OF SMELLING



OLFACTORY RECESS
Home to around 300 million olfactory receptors

OLFACTORY BULB
Processes odours in the brain.

LAMINA TRANSVERSA
This bone separating the main airway and the olfactory recess traps odours even when air is exhaled.

NOSTRILS
Air is exhaled through the slits at the side of the nostrils so as not to interfere with other smells.

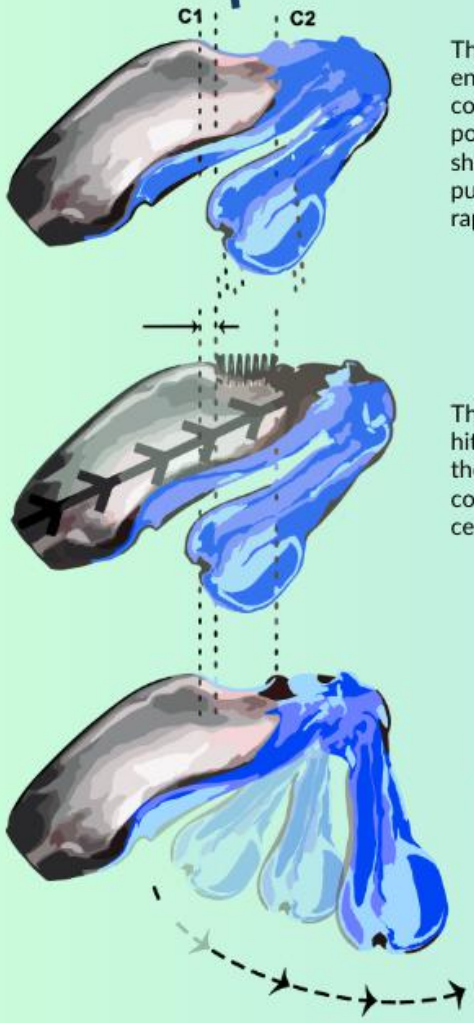
Dogs rely heavily on their olfactory senses to gather information about their environment. They 'see' their world through their NOSE, which provides them with a rich tapestry of scents, allowing them to identify objects, people, and even emotions.

The Mantis Shrimps: Precision and Speed

Illustrated by Malay Mehta, Third Year, BBA (Hons)

Mantis Shrimps are crustaceans, which are also known as Stomatopods. This Illustration summarises the mechanism and skills which the shrimp uses to attack its prey. It uses its eyes and dactyls to attack its prey. The speed and force of their attacks make them highly effective predators in their underwater habitats.

The mantis shrimp is a fascinating and highly specialised marine crustacean known for its incredible speed and power in hunting and attacking prey. recorded striking at over 50 miles per hour (80 km/hrs). The speed and force of their attacks make them highly effective predators in their underwater habitats.



The mantis shrimp gets the power for its punches from elastic energy storage—that is, it stores energy in its muscles as they are compressed when cocking its dactyl club back into the locked position. A four bar mechanism within the club and body of the shrimp is used to hold the club back in place until it is ready to punch and a latch is released, transferring the stored energy into rapid motion of the club

The material composition of the mantis shrimp's shell enables it to hit so hard without damaging itself. The two layers of the shell on the club allow it to withstand large stresses in both tension and compression, which is uncommon of most shells since they are ceramic materials, which are very brittle.

The material composition of the mantis shrimp's shell enables it to hit so hard without damaging itself. The two layers of the shell on the club allow it to withstand large stresses in both tension and compression, which is uncommon of most shells since they are ceramic materials, which are very brittle.

The Magical Eyes

Mantis shrimps have three "pseudo-pupils" stacked one on the other. Each eye has independent depth perception. The crustaceans can see beyond humans on both ends of the light spectrum, peering into ultraviolet and infrared wavelengths. Mammals have three types of photoreceptor cells, whereas mantis shrimps use a dozen. They have a complex visual mechanism. Strikingly, the mantis shrimp has twelve to sixteen distinct receptors receiving colour input. Meanwhile, birds have four, humans have three, dogs have two, and squirrels only have one

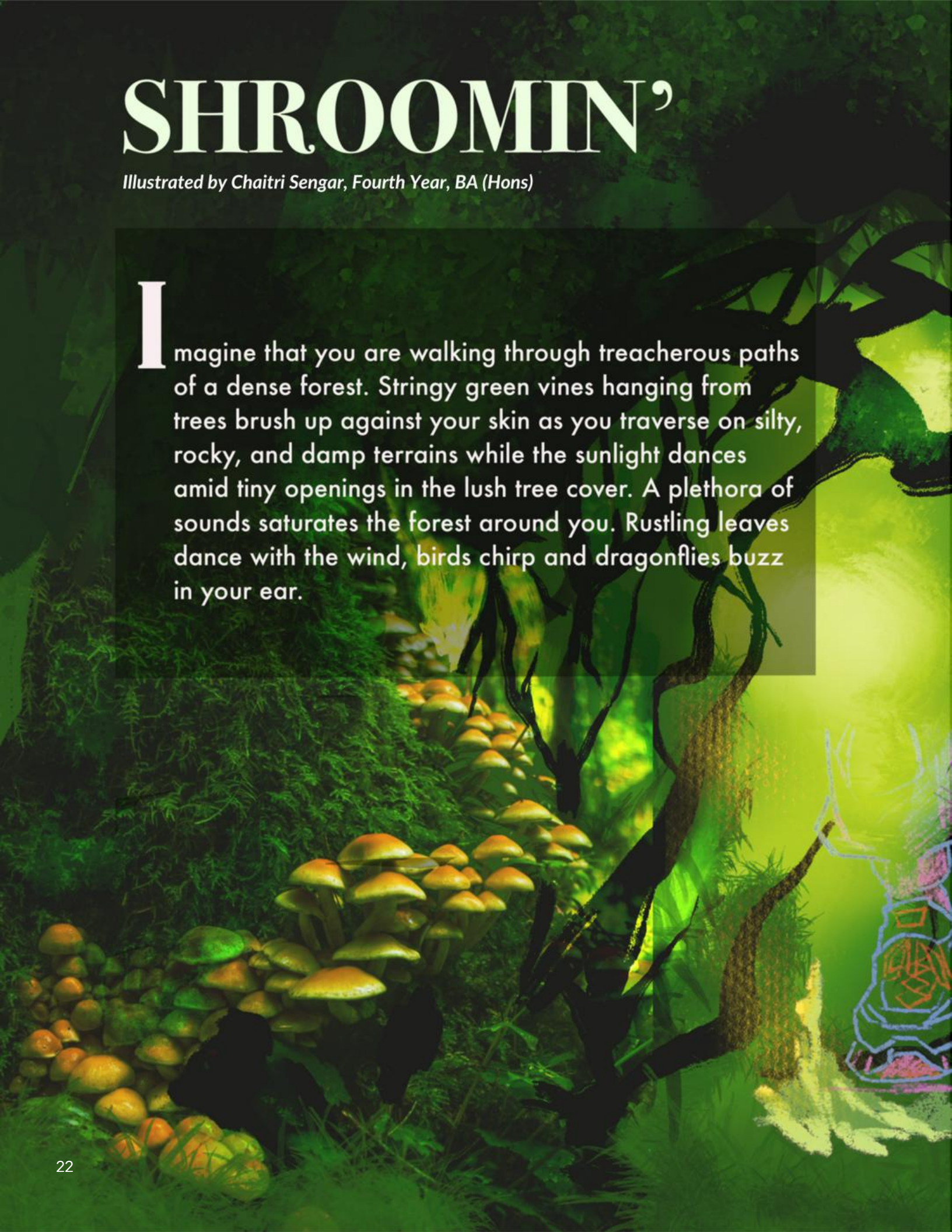
The Attack

Once they've pinpointed their prey, mantis shrimps employ incredible speed and precision, thrusting their club-like appendages or spear-like claws with lightning-fast strikes. These attacks are executed with such force that they can break through the hard shells of their prey, rendering them a formidable and highly efficient oceanic predator.

Beyond its vibrant exterior lies a creature that defies expectations, possessing unparalleled vision, formidable hunting skills, and a resilience that allows it to thrive in diverse oceanic environments. The mantis shrimp serves as a captivating example of nature's ingenuity, offering scientists and enthusiasts alike a glimpse into the intricacies of evolution and the incredible diversity that exists beneath the surface of our oceans. As we continue to explore and unravel the mysteries of these fascinating crustaceans, we deepen our appreciation for the extraordinary wonders that inhabit the underwater realms, reminding us of the endless surprises nature has in store.

SHROOMIN'

Illustrated by Chaitri Sengar, Fourth Year, BA (Hons)



Imagine that you are walking through treacherous paths of a dense forest. Stringy green vines hanging from trees brush up against your skin as you traverse on silty, rocky, and damp terrains while the sunlight dances amid tiny openings in the lush tree cover. A plethora of sounds saturates the forest around you. Rustling leaves dance with the wind, birds chirp and dragonflies buzz in your ear.

Fungi have brains!

As you take one step further...*squish*and a faint *crack*... catches your attention.

You look down and tilt your leg to meet your gaze, only to realize you have accidentally stepped on a coin-sized garden snail! You sigh, pluck a moss-covered leaf from a nearby weed, scrape off the snail and the remains of its cochlear shell from your shoe, and continue walking. Do you imagine yourself feeling ever-so-slightly remorseful for the living creature that got squished by your shoe? If so, why?

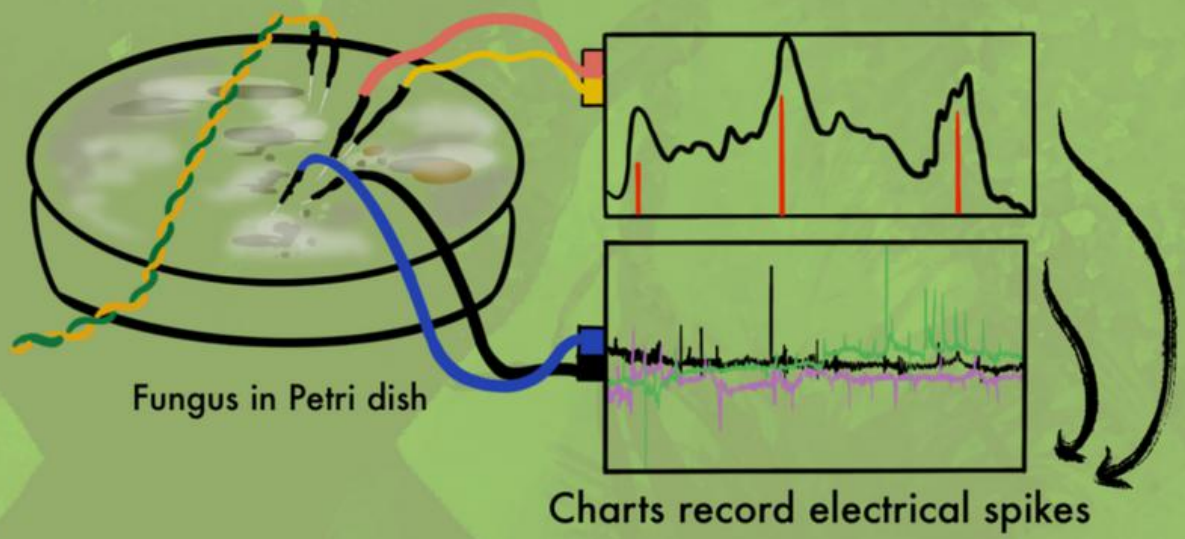
Uncovering Fungi Language

Promising advancements have been made in the body of work studying language on invertebrates and many creatures without a central nervous system. Adamatzky A, a Professor of unconventional computing from the University of the West of England in the UK, brings unusual, innovative experimentation to light, which indicates that fungi have the ability to communicate by exhibiting diverse patterns of electrical activity which consolidates a rich spectrum of networking.

He observed and recorded extracellular electrical activity in 4 different species of fungi- namely, ghost fungi (Omphalotus nidiformis), Enoki fungi (Flammulina velutipes), split gill fungi (Schizophyllum commune), and caterpillar fungi (Cordyceps militaris). From the patterns of electrical spiking detected, his team interpreted complex linguistic communication and networking in diverse species of fungi.

Linguistic considerations in the process of decoding electrical spiking were compatible with the characteristics seen in any other written human language. First was the type of characters used to code, second, the size of the character lexicon, third- grammar, and syntax (word order), and lastly, standardized spelling.

The following is a simplified representation of the variety of charts the researchers used in order to study sensory activity in the mushrooms. While some fungi were grown on tree barks, others were observed in a Petri dish. The wires connected to the mushrooms generated electrical signals which were recorded and translated. The different colours on the charts indicated high frequency recordings from different channels.



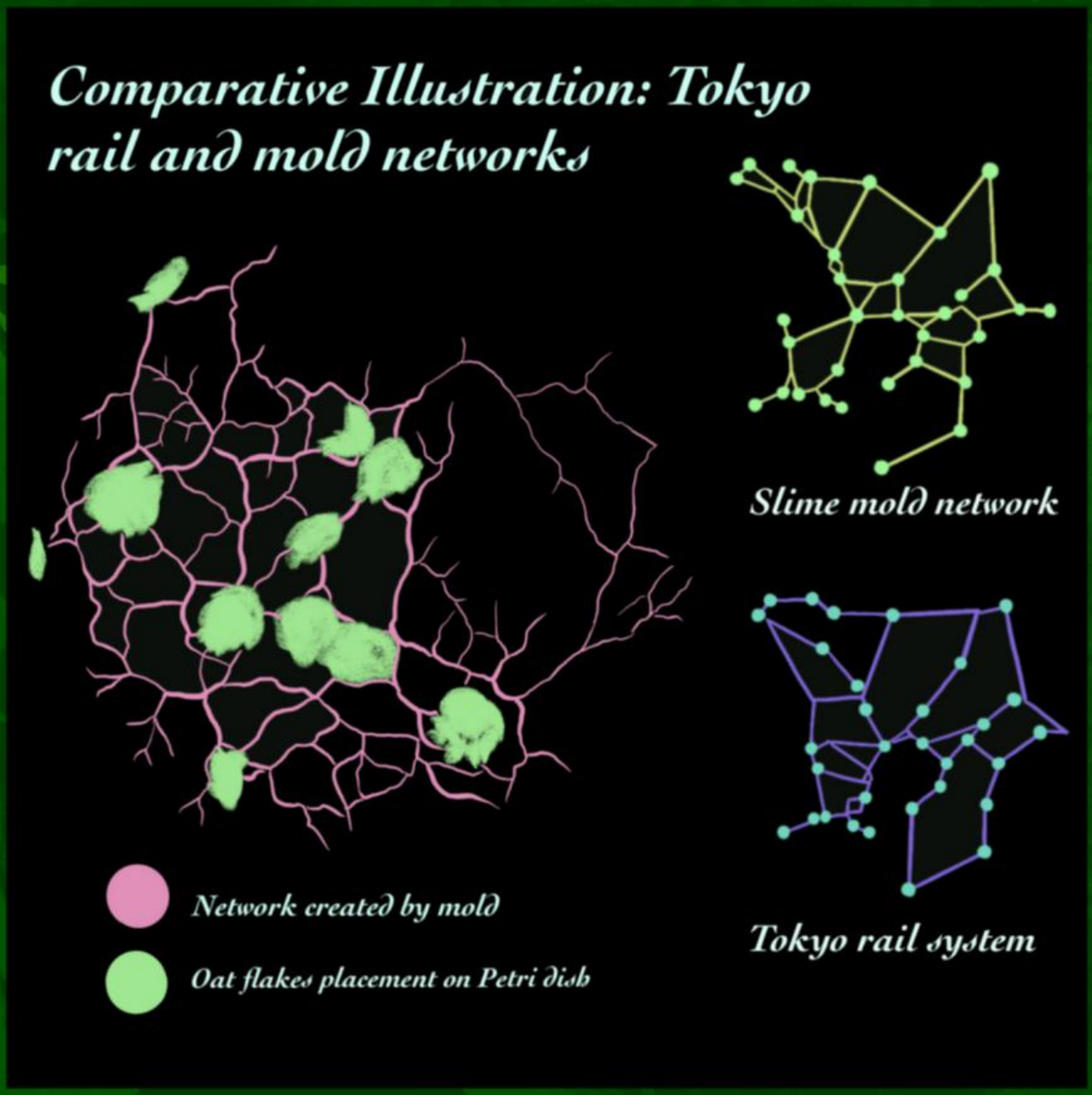
Through these experiments, Adamatzky and his team speculate that the electrical signals recorded reflect a manifestation of the information communicated between distant parts of the fungal colonies. When measured to the standard of human languages, the size of fungal lexicon can be up to 50 words! This opens up many possibilities in the field of coding and interpreting fungal grammar and derive a more rigorous classification of fungal words derived from the electrical spike trains.

Slime Mold: Nature's urban planners!

This interpretive experimentation gave us a small glimpse into mushroom communication across fungal colonies. What if we go beyond fungal colonies, and test fungal communication and 'spread' across man-made urban networks? To the banal understanding, unicellular organisms such as mold and fungus are hardly forms exemplifying 'life'. Toshiyuki Nakagaki, a Professor and mycologist from Japan specializes in physical ethology.

He was determined to challenge the popular (primitive) narrative by demonstrating a high sense of computing capacity heobserved in slime mold. For this, he placed Physarum polycephalum- a form of acellular yellow-green mold in a petri dish scattered with oat flakes. The flakes were deliberately placed to replicate the locations of some of the most visited sites in Tokyo.

He observed in awe as the mold size grew exponentially. Within a matter of days, the slime mold proliferated and branched out into a microcosm of a complex inter-connected network inside the petri dish.



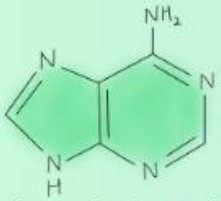
The network replicated the Tokyo subway system with astonishing likeness. It is remarkable that an organism, which does not hold the ability to form tissue or organ networks within its own body, has the ability to solve complex networking and computational problems of urban planning!

Unlocking the Power of Genetics with CRISPR

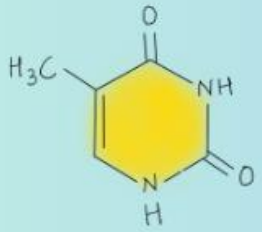
Illustrated by Sanjana Kataria, Fourth Year, BA (Hons)

Introduction to Genetics

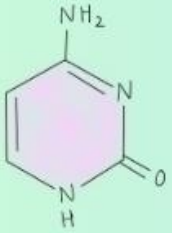
Genetics is the study of our genetic code, which is written in the language of DNA. DNA is shaped like a double helix. DNA contains all the instructions for building and operating every living organism. Our unique traits, from eye color to disease susceptibility, are determined by our DNA.



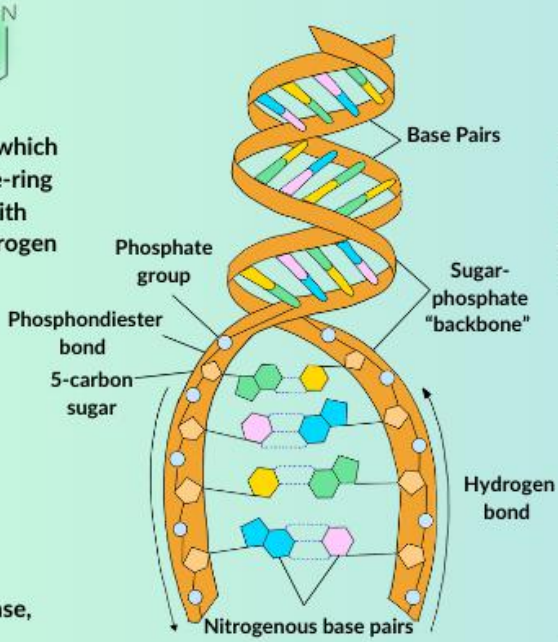
Adenine is a purine base, which means that it has a double-ring structure.Adenine pairs with thymine through two hydrogen bonds.

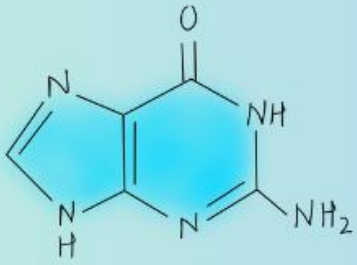


Thymine is a pyrimidine base, which means that it has a single-ring structure.Thymine pairs with adenine through two hydrogen bonds.



Cytosine is a pyrimidine base, which means that it has a single-ring structure. Cytosine pairs with guanine through three hydrogen bonds.

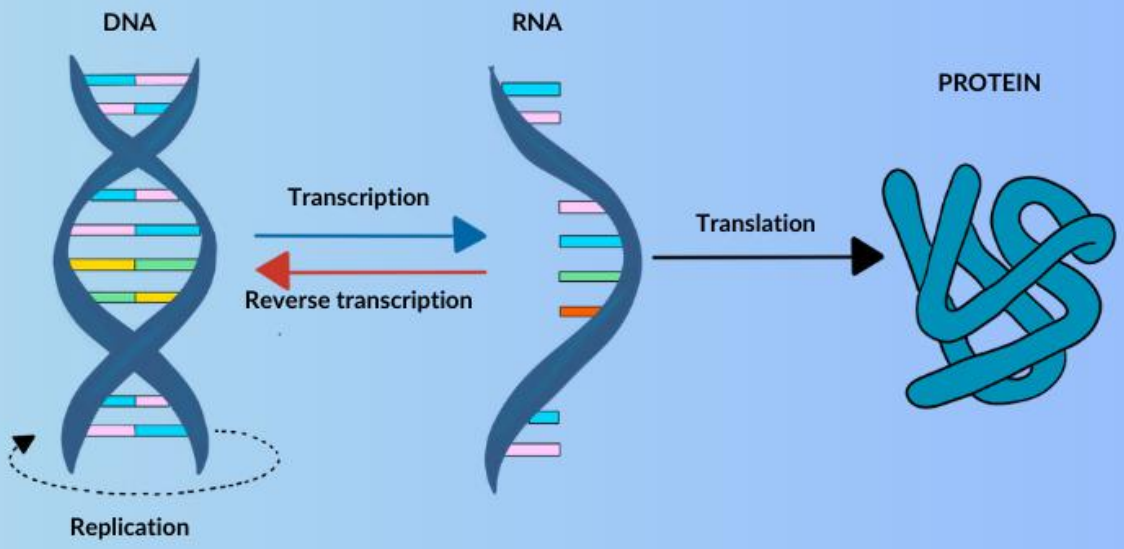




Guanine is a purine base, which means that it has a double-ring structure.Guanine pairs with cytosine through three hydrogen bonds.

Imagine genetics as a recipe for making you. The ingredients are tiny blocks called nucleotides, with names like adenine, thymine, cytosine, and guanine. These blocks create a special code in DNA, like a secret language holding all the info about you. This DNA is grouped into chapters called genes, each deciding something specific, like your eye color. Genes are made up of codes that act like instructions for making proteins, the workers in your body. Proteins are the doers—they fix things, make tissues, and help your body fight off sickness. So, in a nutshell, genetics is like a how-to guide that uses blocks and codes to build you!

The Central Dogma



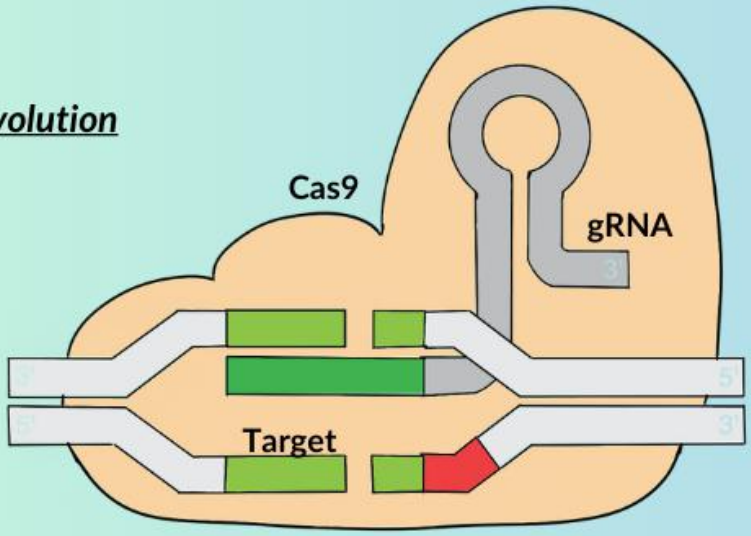
The central dogma of molecular biology is like a manual that shows how our body's instructions are passed along. It starts with DNA, which is like a masterplan. This plan gets turned into a similar thing called RNA, and even though it's a bit different, it still carries the same information. This RNA then becomes a guide for building proteins, which are like the workers in our body. Ribosomes, which are like little construction workers, read this guide and put together the proteins we need for everything—like fixing things, building stuff, and making sure our body works smoothly. So, the central dogma explains how our body follows these steps, from DNA to RNA to proteins, to keep us alive and kicking!

Genetic Variation

Genetic diversity comes from differences in our DNA, making each of us unique. Mutations and genetic mixing create distinctions between individuals. Whether someone is a girl or a boy is determined by their sex chromosomes—girls have two X chromosomes, while boys have one X and one Y chromosome. The Y chromosome contains the SRY gene, triggering the development of male characteristics like beards and deep voices. So, our special DNA mix gives us our own individual traits!

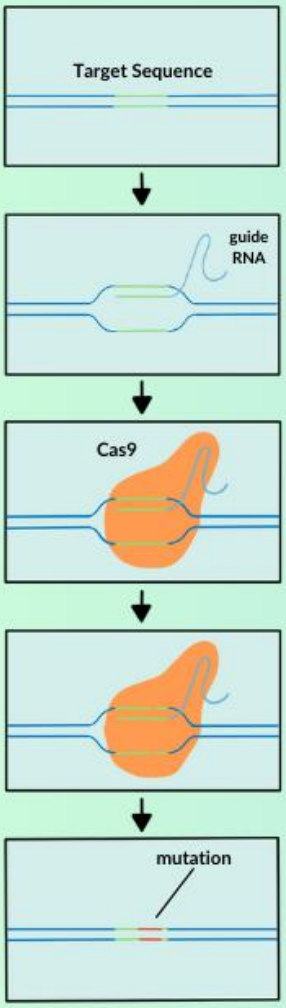
CRISPR-Cas9: Gene Editing Revolution

Meet CRISPR-Cas9, a game-changing tool letting scientists edit DNA with incredible precision. Think of it like genetic scissors, precisely cutting DNA at specific spots, allowing for the addition, removal, or modification of genetic instructions.



This revolutionary gene-editing tech is inspired by a natural system bacteria use to defend against viruses. CRISPR-Cas9 has two key parts: a guide RNA (gRNA), like a genetic GPS, and a Cas9 enzyme, working as molecular scissors to cut DNA at the chosen spot. It's like a genetic tailor helping scientists make precise changes to our DNA blueprint.

How CRISPR Works



Guide RNA binds to target sequence

Cas9 enzyme binds to guide RNA

Cas9 enzyme cuts both strands of DNA

The cut is repaired introducing mutation

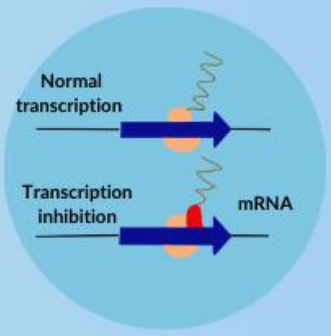
Step 1: Recognition
Imagine a book that contains all your genetic instructions. This book is called DNA. CRISPR-Cas9 is like a special search engine that can find a specific spot in this book. It uses a guide RNA, which is like a bookmark, to tell it exactly where to go.

Step 2: Binding
Once CRISPR-Cas9 finds the right spot, it attaches itself to the DNA. It's like a scissor getting ready to cut a piece of paper.

Step 3: Repair
After cutting the DNA, CRISPR-Cas9 leaves a gap. The cell's repair machinery is like a quick fix-it crew. It tries to fill in the gap, but sometimes it makes mistakes, like adding extra words or changing the order of words. These mistakes can change the meaning of the book, just like they can change the genetic instructions.

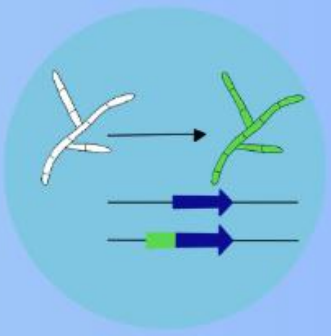
Potential Applications of CRISPR

Gene silencing



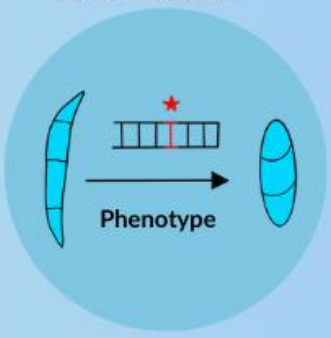
Gene silencing: CRISPR can be used to turn off specific genes by introducing mutations that prevent them from being expressed. This approach has potential for treating genetic disorders and developing new therapies for cancer and other diseases.

Gene tagging



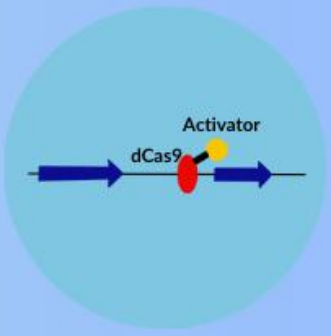
Gene tagging: CRISPR can be used to attach fluorescent tags or other molecules to specific genes. This technique allows researchers to track the movements of genes within cells and to study their interactions with other molecules.

Gene mutants



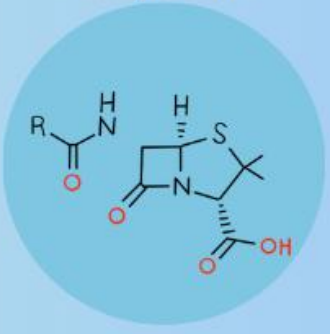
Generating mutants: CRISPR is a powerful tool for creating mutants in plants, animals, and other organisms. By carefully selecting the target gene and the type of mutation introduced, researchers can study the effects of gene function and identify new drug targets.

Gene over-expression



Gene over-expression: CRISPR can be used to increase the expression of specific genes. This approach has potential for treating genetic disorders and for developing new agricultural products with enhanced traits.

Secondary metabolite modification



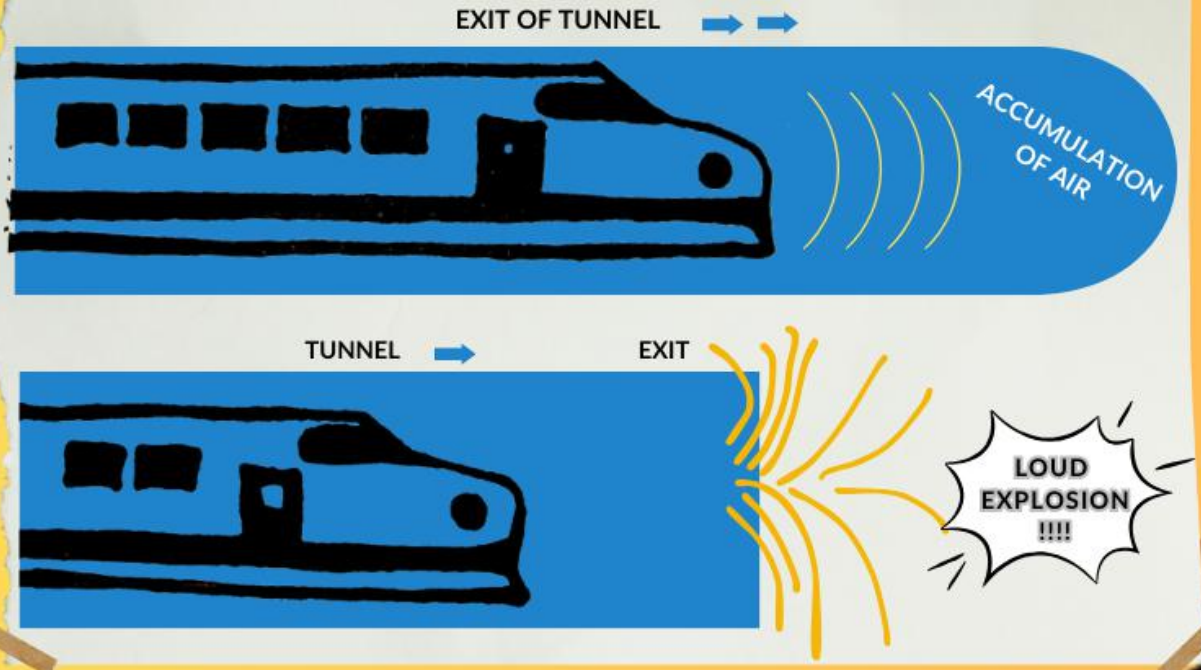
Secondary metabolite modification: CRISPR can be used to modify the production of secondary metabolites, which are natural products that have a wide range of biological activities. This approach has potential for developing new drugs and other valuable products.

BIOMIMICRY

The influence of a silent dive

Illustrated by Shraddha Chaplot, Fourth Year, BBA (Hons)

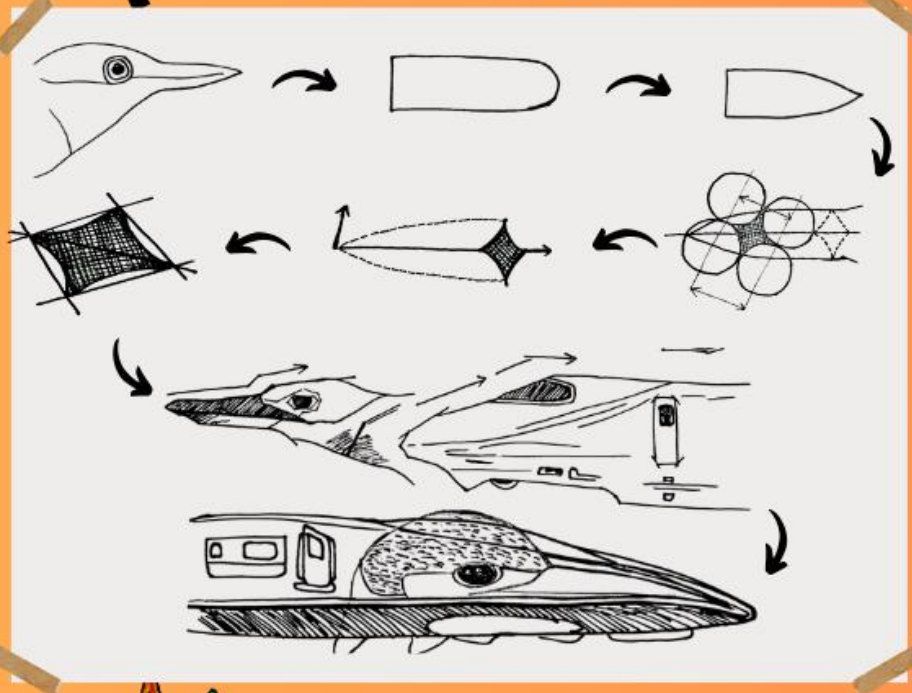
Human beings have challenged me with an intriguing problem. Their high-speed bullet train, designed for rapid travel, has a noisy secret. Whenever it shoots out of a tunnel at top speed, it unleashes a thunderous sonic boom that echoes for miles around. This unexpected occurrence is due to a buildup of air in front of the train inside the tunnel. When it emerges, this air cushion expands with a massive sonic blast, creating quite a disturbance for passengers and the people living nearby. Understandably, they were far from pleased. But fear not, I hold the solution.



The key to overcoming this problem is the unique shape of my beak, which evolved to catch prey. One of my goals when I dive in headfirst and come up quickly is to leave no trace. My long, pointed beak has just the right shape to go into the water quickly and splash-free.

Inspired by the shape of my beak, engineers set out to redesign the front of the bullet train. They imitate my long, pointed beak's sleek, tapered appearance. Conscientious engineers take note of my silent dives and alter the bullet train's front to resemble my long, pointed beak. As a result, the train runs much faster, much quieter, and with less energy use. Yay!! Big boom explosions are no more!

The train's face undergoes a gentle curve. Evolving further, it transforms into a pointed beak. Now, as the precision matters they follow four circles as guides for accurate measurements. Prototyping the Pointed Shape, where the pointed beak takes tangible form. Further, conceptualizing it with a detailed diagram illustrating how the pointed design aids the train in cutting through the air with reduced noise. The streamline shape, comparing the Kingfisher and the train - showcasing nature's impact on modern transportation. Final Output - the train's face seamlessly blending with the Kingfisher's.

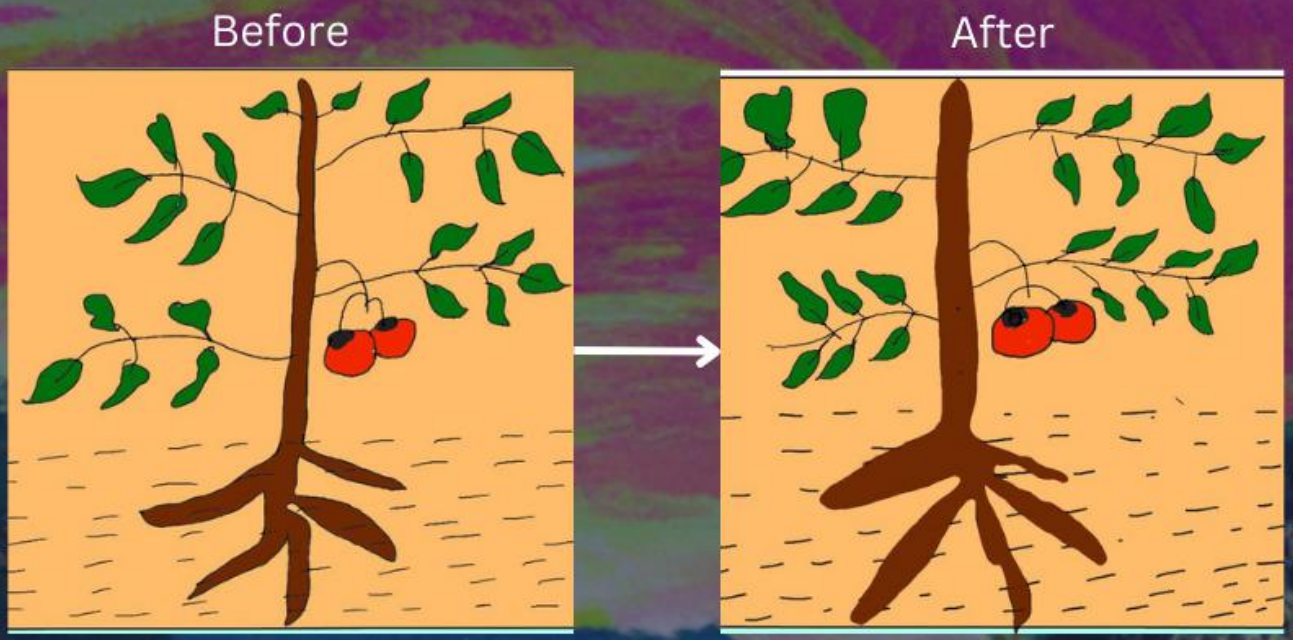


Revolutionizing Agriculture: Harnessing CRISPR for Customized Plant Traits

Illustrated by Raj Patel, Fourth Year, BTech CSE

What is CRISPR?

CRISPR stands for "Clustered Regularly Interspaced Short Palindromic Repeats." It is a revolutionary gene editing technology that allows scientists to precisely modify DNA within living organisms. CRISPR works by using a molecule called RNA, which is capable of targeting specific sequences of DNA. This technology has a wide range of potential applications, from creating genetically modified organisms with specific traits to potentially treating genetic diseases in humans.



Tomato Plant before CRISPR

Less yield
Prone to diseases
Sensitive to envirnomental stresses

Tomato Plant after CRISPR

Increased yield
Disease resistent
Tolerent to envirnomental stress

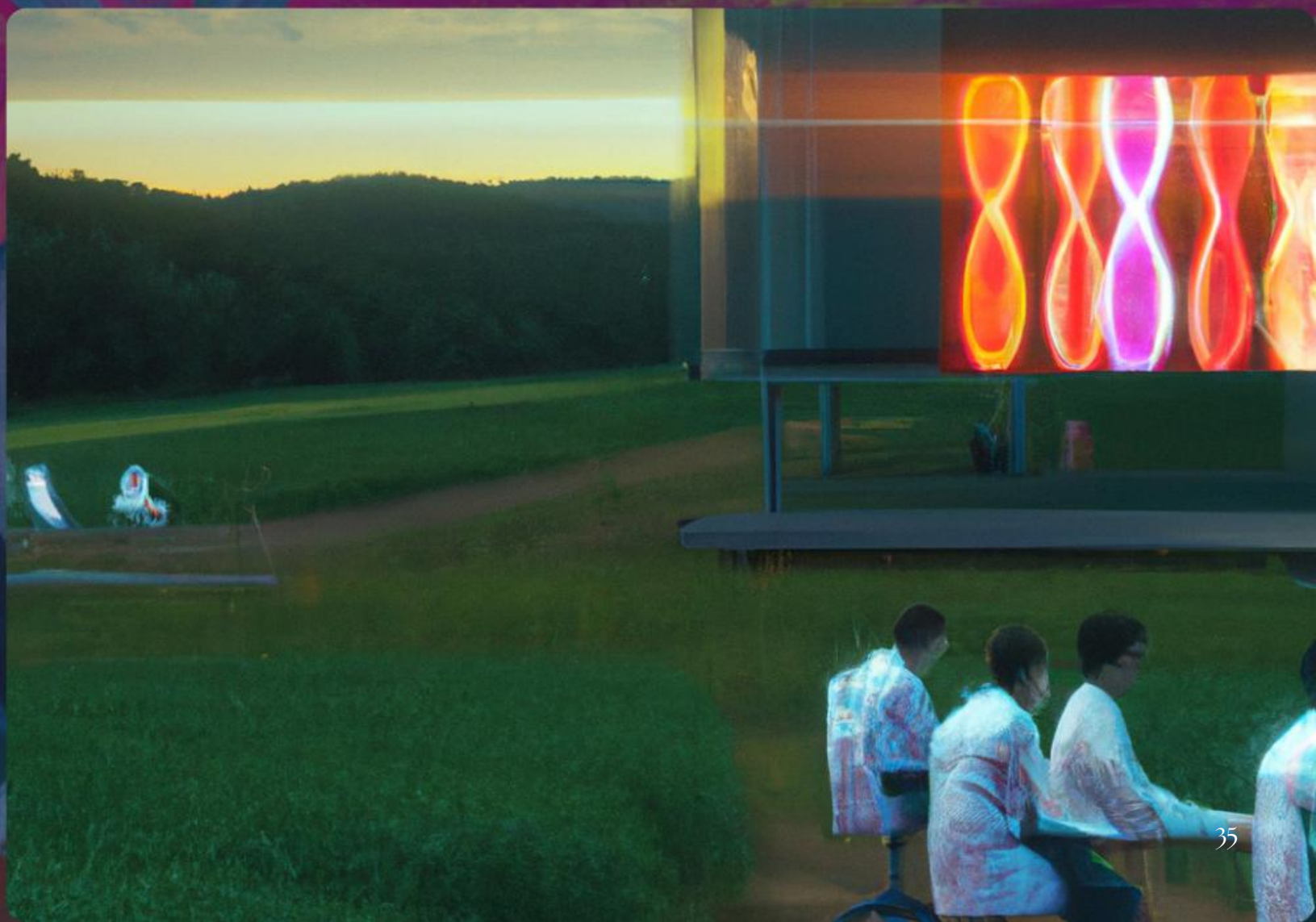
Benefits of CRISPR

CRISPR technology offers significant potential in agriculture by allowing precise genetic modifications in crops and livestock. This can lead to benefits like enhanced traits, reduced need for chemicals, faster breeding, improved nutrition, and adaptation to changing climates. Additionally, it has the potential to reduce food waste and improve livestock traits. However, ethical considerations surrounding genetic modification and biodiversity need to be taken into account. Overall, CRISPR has the power to revolutionize agriculture and address critical challenges in food production and global food security.

How CRISPR gene edition performed in plants?

In a quiet laboratory nestled amidst fields of vibrant crops, a team of dedicated scientists embarked on a mission to revolutionize agriculture. Armed with the transformative power of CRISPR gene editing, they set out to unlock nature's secrets and enhance the very essence of plants.

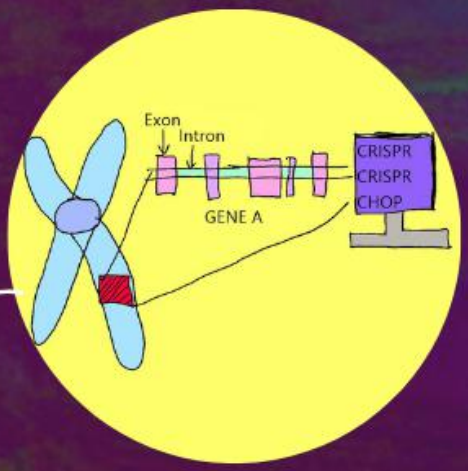
Let's see the process that Scientists follow in order to accomplish the mission



The CRISPR Gene Editing Process

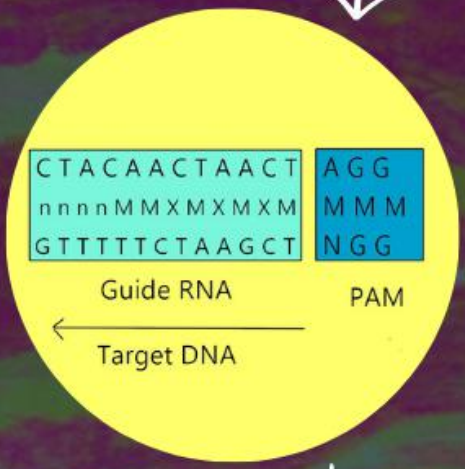
1. Target & gRNA Design

Choose target gene, design complementary guide RNA (gRNA) to guide Cas9 nuclease. The gRNA is a short sequence of RNA that is complementary to the target gene.



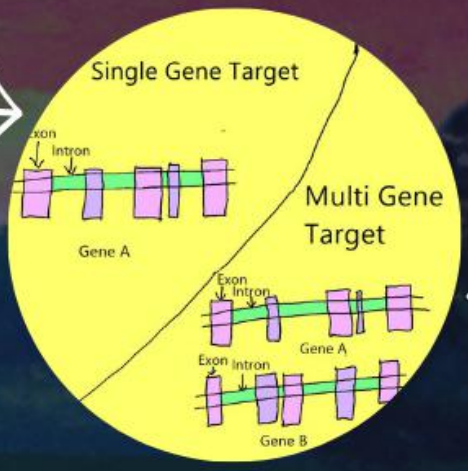
2. Guide RNA Cloning

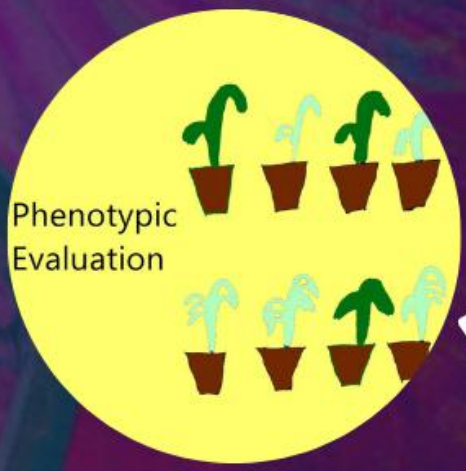
Clone gRNA into plant-compatible binary vector for cell introduction. A binary vector is a type of plasmid that can be used to transfer DNA into plant cells.



3. Vector Introduction

Introduce vector using methods like Agrobacterium, biolistic bombardment, or protoplast transformation into the host species or cell lines.



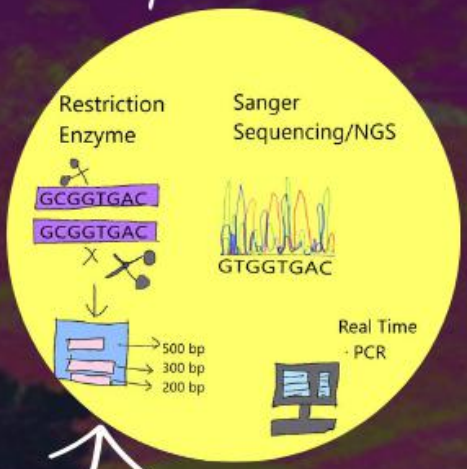


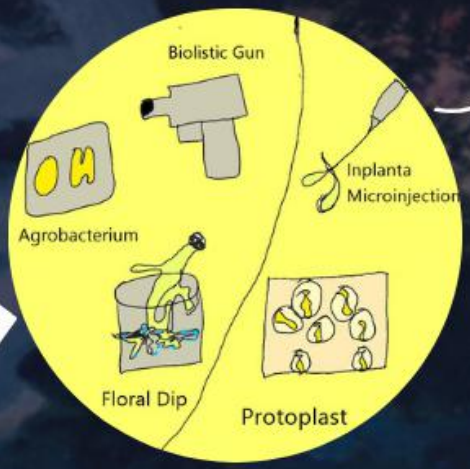
6. DNA Sequencing

After selection, validate edited plants by sequencing their DNA and comparing it to the unedited plants.

5. Screening & Validation

Screen and validate edited lines by applying selective pressure, e.g., herbicide resistance testing.Choose target gene, design complementary guide RNA (gRNA) to guide Cas9 nuclease. The gRNA is a short sequence of RNA that is complementary to the target gene.





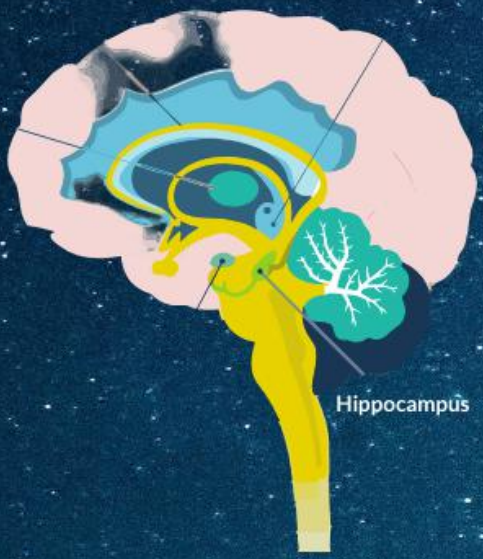
4. Host Transformation

Transform host species or cell lines, allowing gRNA transcription and Cas9 translation.

Decoding Dreams: Journey into Dreaming and Sleep Phases

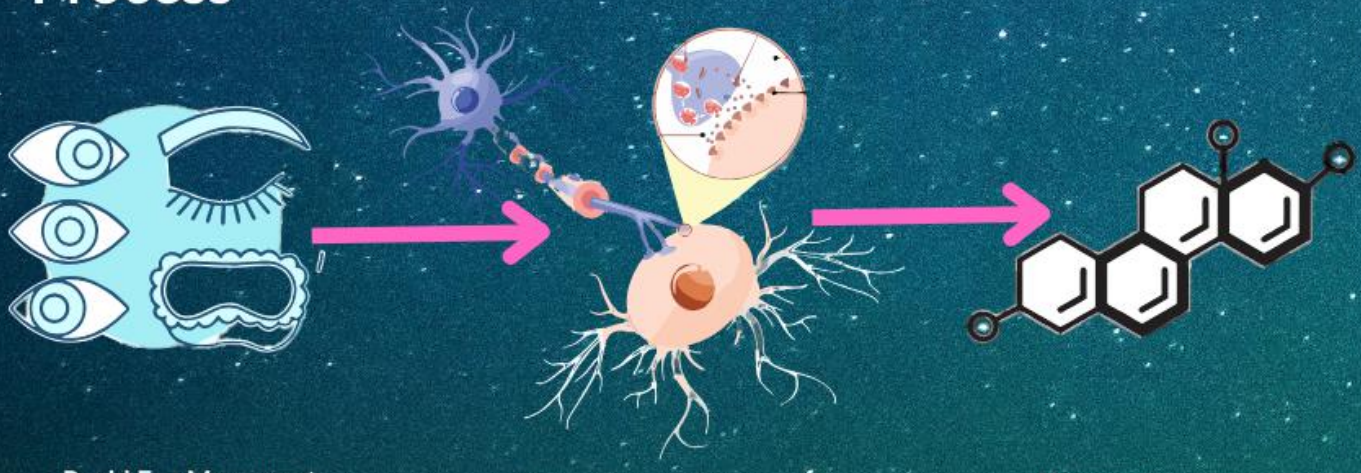
Illustrated by Rishi Agrawal, Third Year, BBA (Hons)

Different functions carried out by brain to dream and various different sleep cycles involved in it. The purpose behind this illustration is an attempt to find out the meaning and reason behind our dreams because well all see dreams every night but what is the reason behind it is unknown.



There 5 different sub-divisions of the brain
The Hippocampus is situated in the temporal lobe which helps us imagine, remember, and dream. It also has a major role in learning and memory. As a major part of dreams is correlated to our memory hippocampus plays a necessary role in dreaming

Process



Rapid Eye Movement (REM) Sleep

Dreams primarily occur during REM sleep. During this astage, the brain is highly active, resembling wakefulness in terms of brain wave patterns. It's believed that the neural activity during REM sleep contributes to dream experiences.

Neurotransmitters

Neurotransmitters, such as acetylcholine and serotonin, play a role in regulating sleep and the transitions between sleep stages, including REM sleep. These neurotransmitters help control the timing and duration of REM sleep, which is when most vivid dreams occur.

Hormones

While hormones are not the primary drivers of dreaming, they do play a role in the sleep-wake cycle and can indirectly affect dreaming. Hormones like melatonin, cortisol, and growth hormone are involved in regulating sleep and wakefulness

Sleep Cycle

1.Non-REM Sleep

This is the transition from wakefulness to sleep, and it's a light sleep stage.
This is a deeper stage of sleep where muscle activity decreases, and brain waves become slower

2. REM Sleep

Brain activity increases, becoming more similar to that of wakefulness. Rapid eye movements occur, giving REM sleep its name. Muscles are temporarily paralyzed to prevent us from physically acting out our dreams. Vivid and emotionally charged dreams commonly occur during this stage.

3. Dream formation

The exact process of dream formation is not entirely understood, but there are some prevailing theories. Some theories propose that dreams serve as a way for the brain to process and consolidate memories, emotions, and experiences from the day. They may help with problem-solving and emotional regulation.

4. REM Rebound

If someone is deprived of REM sleep on one night, they may experience REM rebound on subsequent nights. This means they will spend more time in REM sleep, which can result in more vivid and intense dreaming.

5. Dream Content

Dream content can vary widely from person to person and from one night to the next. Dreams may involve familiar people, places, events, or entirely fantastical elements. They can be pleasant, distressing, or neutral.

This sleep cycle occurs several times during night resulting into different dreams

The Neurobiology of Anxiety

Unveiling the Brain's Role

Illustrated By Khushi Khamar, Fourth Year, BBA (Hons)

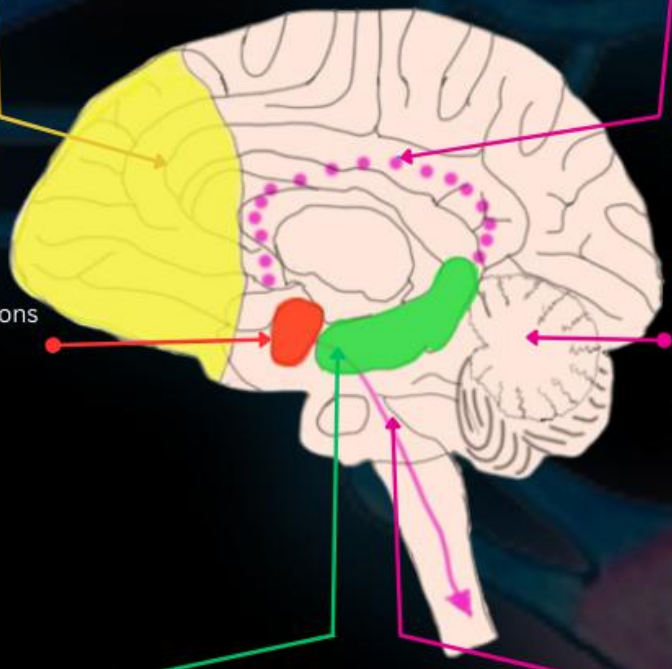
"Anxiety disorders are the world's most common mental disorders, affecting 301 million people"
- World Health Organization

Anxiety: An uncomfortable feeling, nervousness or worry about the present, past and future. To understand this significant condition better, let's look at the science behind it:

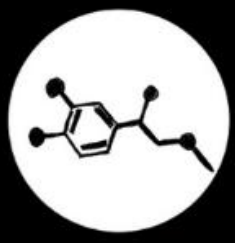
Prefrontal Cortex Regulation: modulates emotional responses from the amygdala, impacting threat evaluation and response regulation, potentially heightened in anxiety disorders.

Neurotransmitter Imbalances: disrupt signal transmission, potentially contributing to anxiety disorders (neurotransmitters like serotonin, GABA, norepinephrine).

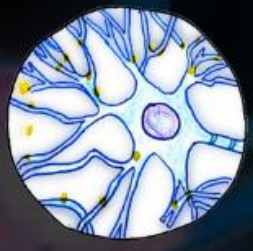
Amygdala Activation: Anxiety-inducing situations trigger sensory inputs, thoughts or memories, activating Amygdala.



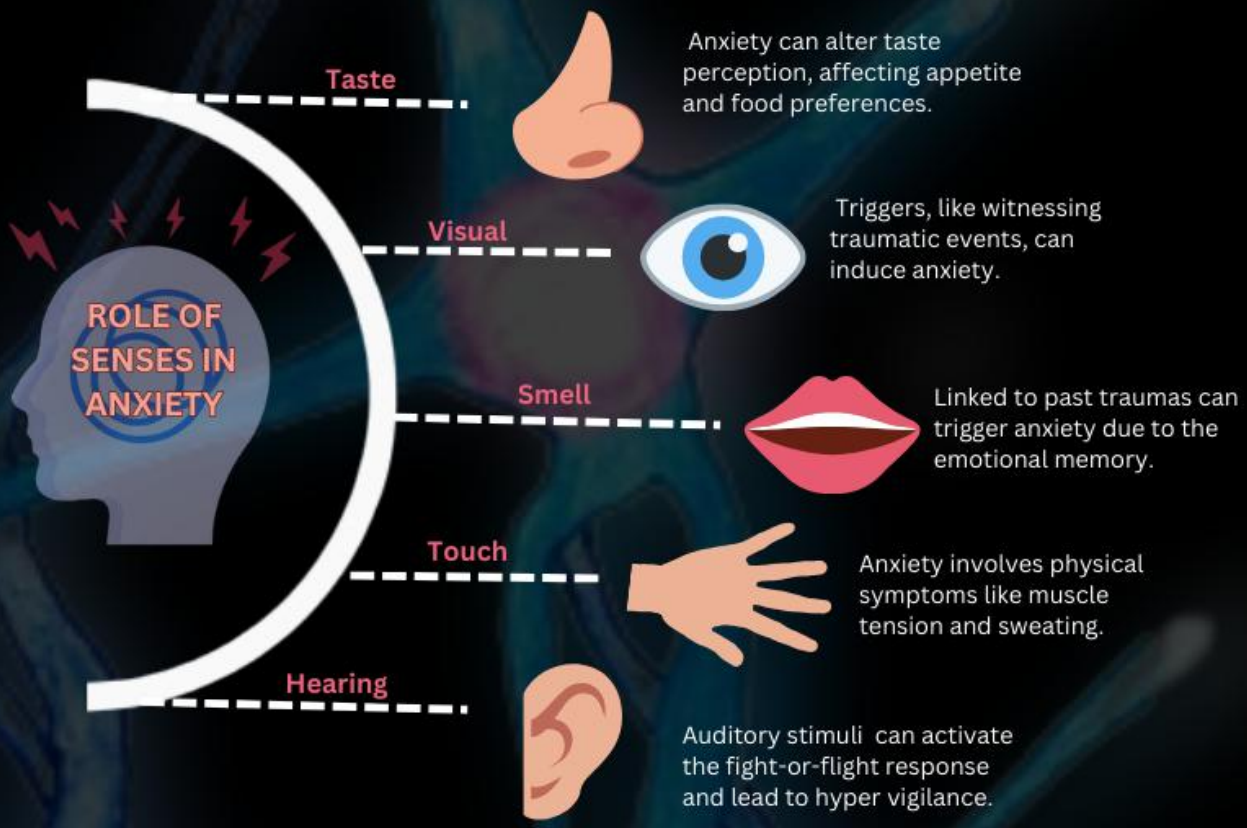
Genetic: variations can influence how the brain processes and responds to stress and anxiety.



Hypothalamus Response: The amygdala-hypothalamus interaction activates the sympathetic nervous system, releasing stress hormones, initiating the "fight or flight" response to address perceived threats.



Neuroplasticity: Neuroplasticity refers to the brain's adaptability, which can be enhanced through repeated anxious thoughts or improved through therapy, which helps rewire these neural pathways.



EFFECTS OF ANXIETY ON THE BODY

Feelings of Impending Doom: Anxiety often leads to a sense of impending doom and difficulty concentrating.

Panic Attacks: Anxiety-induced panic attacks can cause heart palpitations, chest pain and lightheadedness.

Depression: Chronic anxiety increases depression risk, causing social withdrawal and hopelessness.

Breathing Problems: Anxiety can trigger rapid, shallow breathing, particularly during panic attacks.

Heart Palpitations: Both panic attacks and general anxiety can cause heart palpitations, making your heartbeat faster and stronger.

Blood Pressure Spikes: Anxiety can elevate blood pressure levels during episodes of heightened anxiety.

Persistent Fatigue: Anxiety can lead to daytime exhaustion and sleep disturbances.

Muscle Aches and Pains: Anxiety can manifest physically as unexplained aches and pains in the body.

Unheard Impact of Animals in Electricity

Illustrated by Sridharshiny KV, Fourth Year, Integrated MS

Electricity is everywhere, it can be found in the human body too. But how and why do we need electricity in our body? We need electrical impulses to communicate and transport stimulus from other organs to the brain and back. Other animals like eels, black ghost knife fish are more evolved than humans in the use of electricity.

Black ghost knife fish in aquarium

Is it still relevant to study about animal electricity? Animals possessing the ability to generate electric impulses offer promising leads to better understand synaptic transmission (the induction by the nerve impulse of the chemical activity that relays an impulse from one nerve cell to the next and from nerve cell to muscle or gland).

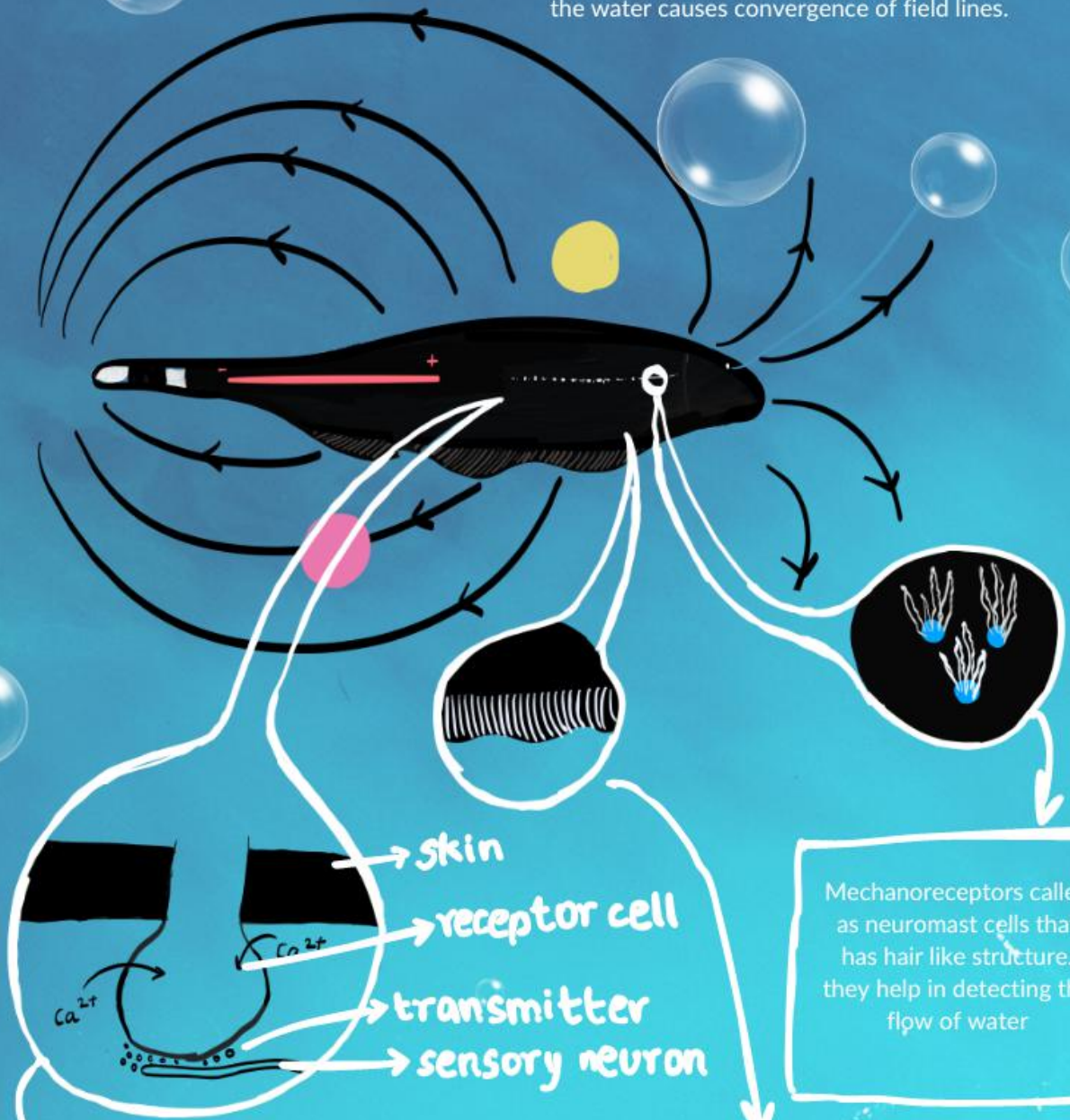
DID YOU KNOW?

During ancient times, in the Roman empire a prescription to cure chronic headaches was by placing a live black torpedo on the area of pain. Similarly for the treatment of gout, a live black torpedo should be placed under the feet when the pain begins.

INTERESTING FACT

The fish produces electric fields by releasing electrical discharges. The electric charges are produced by the electric discharge organ present in the tail of the fish. The electric field generated runs from the head the tail region.

Electric organ discharge (red color) produces electric field around the fish that helps in detection of surrounding. presence of insulator (yellow) in the field causes divergence of electric field. Conductor(pink) in the water causes convergence of field lines.



Mechanoreceptors called as neuromast cells that has hair like structure. they help in detecting the flow of water

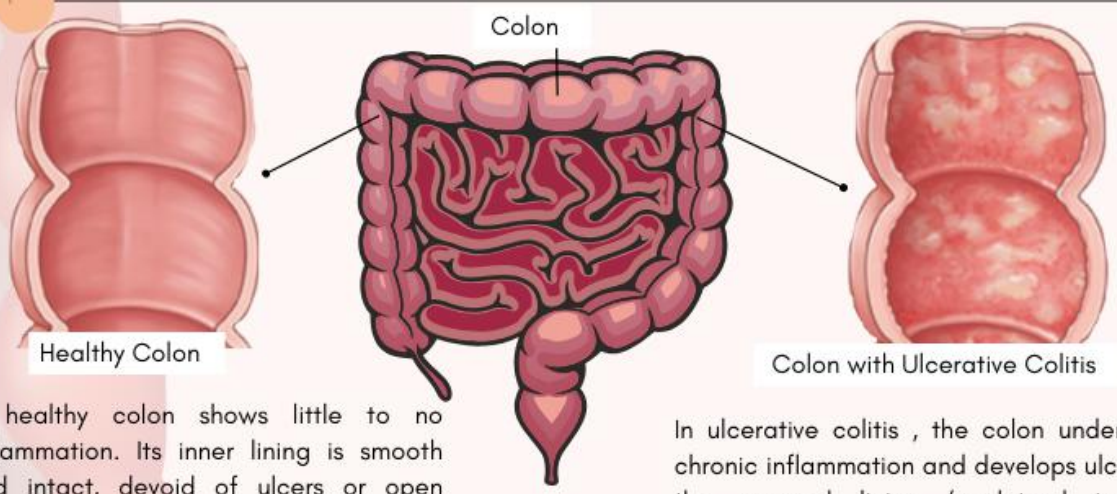
These receptors are present on the skin and help in sensing high frequency electric fields. Influx of calcium ions into the receptor causes the release of neurotransmitter that carries information to the brain.

The presence of anal fins in the fish helps in the forward and backward movement o the fish

Decoding the Gut Puzzle: Unravelling Ulcerative Colitis

Illustrated by Poorva Nahar, Fourth Year, BA (Hons)

Introducing Poorva, a tenacious 21-year-old who uncovered her battle with Ulcerative Colitis (UC) at the tender age of 16. Empowered by her journey, she has chosen to become a vocal advocate, sharing her story to shed light on the silent struggles faced by individuals living with UC. Readers, delve into Poorva's narrative not just as a window into her personal resilience but as an invitation to understand the often-overlooked challenges of those grappling with UC. Through her candid storytelling and digital illustrations, she opens a door to a world that demands awareness and empathy, making her journey not just hers but a collective call for compassion and understanding.

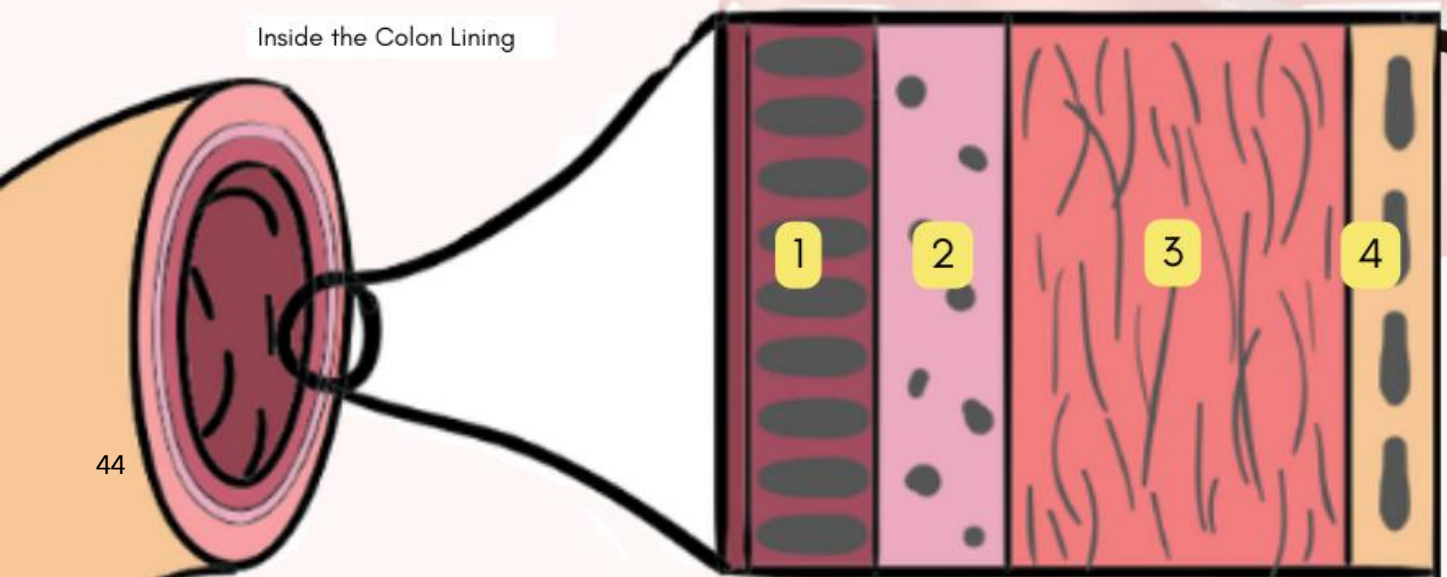


A healthy colon shows little to no inflammation. Its inner lining is smooth and intact, devoid of ulcers or open sores. The colon's primary functions include absorbing water and electrolytes and forming stool.

In ulcerative colitis , the colon undergoes chronic inflammation and develops ulcers in the mucosal lining (explained in the diagram below). This results in diarrhea, abdominal pain, and rectal bleeding.

The gastrointestinal tract comprises of multiple layers:

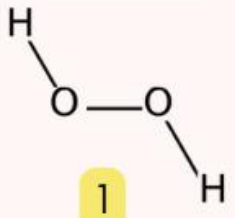
1) **Mucosa**, which lines the innermost portion and plays a role in absorption and protection
2) **Submucosa**, which contains blood vessels and nerves to support digestive functions;
3) **Thick Muscle Laye**r, which controls the movement of the digestive tract.
4) **Serosa** (outermost layer), provides protection and support to the digestive organs.



Now we know what an inflamed colon looks like. It is now time to learn how the inflammation is caused. Here is a step-by-step explanation.

Inside the Submucosa

Hydrogen Peroxide (H_2O_2):



1

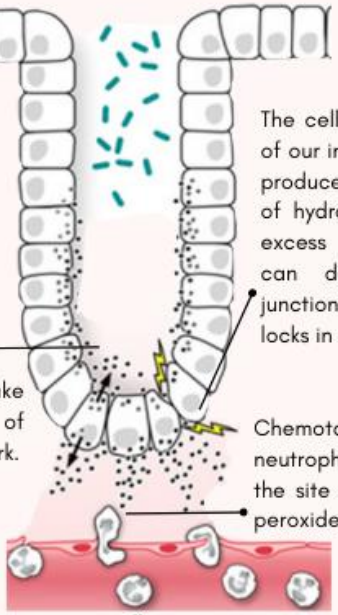
Our Body Produces H_2O_2: All cells in our body make hydrogen peroxide, a kind of chemical, as a part of their work.

2

The cells in our colon (part of our intestines) sometimes produce an excess amount of hydrogen peroxide. This excess hydrogen peroxide can damage the tight junctions, which are like locks in our colon cells.

3

Chemotaxis occurs, where neutrophils are attracted to the site of excess hydrogen peroxide.



A. Pre- Inflammatory Stage

Did you know?

Neutrophil

A type of white blood cell (leukocytes) that act as your immune system's first line of defence.

4

Crypts

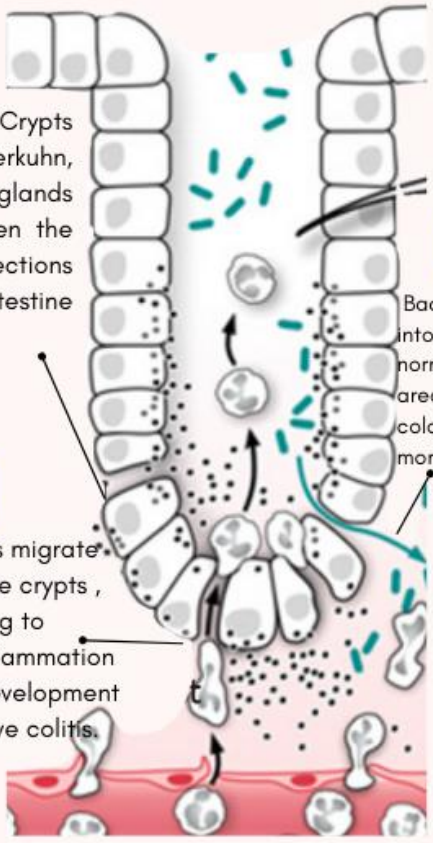
Also known as Crypts of The of Lieberkuhn, are the tubular glands that lie between the finger-like projections of the small intestine called villi.

5

Neutrophils migrate towards the crypts , contributing to colonic inflammation and the development of ulcerative colitis.

6

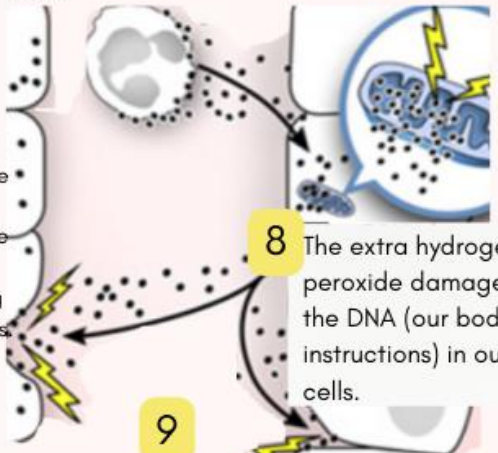
Bacteria move into the normally sterile area of the colon, causing more problems.



B. Active Inflammation Stage

7

Neutrophils Cause More Trouble: The neutrophils, trying to help, produce even more hydrogen peroxide, making things worse.



8

The extra hydrogen peroxide damages the DNA (our body's instructions) in our cells.

9

This damage starts a cycle that keeps getting worse, causing inflammation in the colon, leading to a condition called ***Ulcerative Colitis.***

C. Relapse Stage

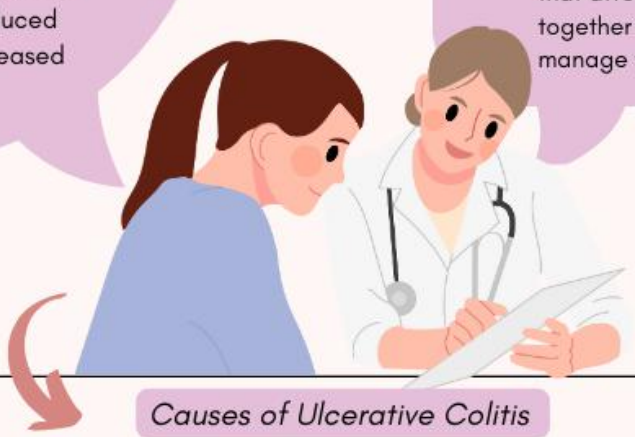
Causes of Ulcerative Colitis

A gastroenterologist's perspective

Gastroenterologists are doctors who specialize in digestive system problems. As a result, Poorva approaches Dr. Medhaa Desia, one of the best known gastroenterologists in Ahmedabad, to get her treatment. This follows their conversation, which will give us an idea of the cause of this illness.

Doctor Desia,
I get recurring stomach cramps, along with the presence of blood in my stool. I have a reduced appetite and increased fatigue.

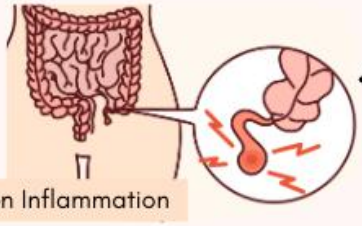
Poorva,
It sounds like you may be dealing with ulcerative colitis, a chronic condition that affects the colon. Let's work together to understand it better and manage your symptoms.



Causes of Ulcerative Colitis

Environmental Factors

Ulcerative colitis may be influenced by environmental factors, with a higher occurrence in urban areas. While researchers have explored factors like air pollution, medications, and diets, no direct links have been established.



Autoimmune Conditions

UC is considered an autoimmune condition, as the immune system can mistakenly attack the colon, causing inflammation. This can happen when the immune system misidentifies beneficial gut bacteria as harmful, resulting in ongoing inflammation.

Genetics

Inheritance of certain genes appears to be a factor in the development of UC, and having a close relative with the condition can increase your risk. The immune system is associated with several genes that have been linked to UC, suggesting a genetic predisposition for immune-related factors in this condition.

Diagnosis of Ulcerative Colitis

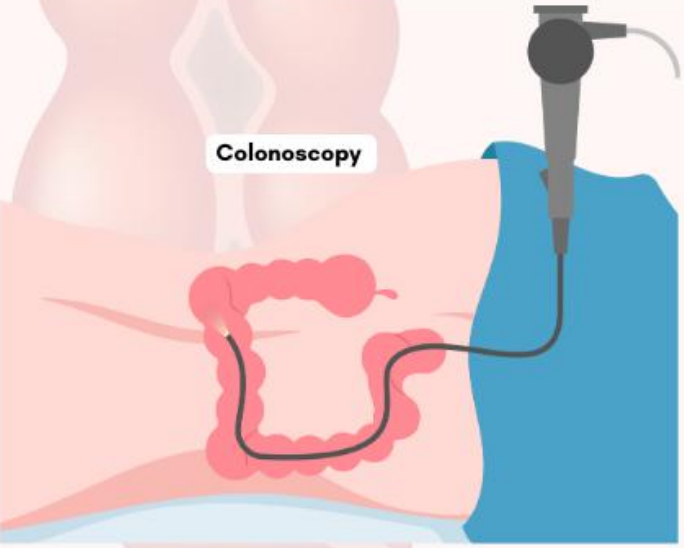
With a focus on Colonoscopy

MRI Scans

Stool Tests

Blood Tests

Poorva was advised by Dr. Desai to undergo medical tests such as colonoscopy, blood tests, and stool tests to confirm the diagnosis and assess its severity. Early detection is encouraged to initiate treatment sooner for better results. Let's explore and understand the details of colonoscopy.



Gastroenterologists use colonoscopy, a 30-minute procedure, to diagnose Crohn's disease or UC. It involves a camera-equipped tool to check for inflammation and ulcers in the colon and rectum, often with biopsies.

To get ready for a colonoscopy, Poorva had to fast for 24 hours, take a laxative, and get sedation. There's also a shorter version called flexible sigmoidoscopy, which checks specific symptoms or how treatment is going, focusing on the lower part of the colon and the rectum.

Categories of Ulcerative Colitis

- MILD UC
- MODERATE UC
- SEVERE UC

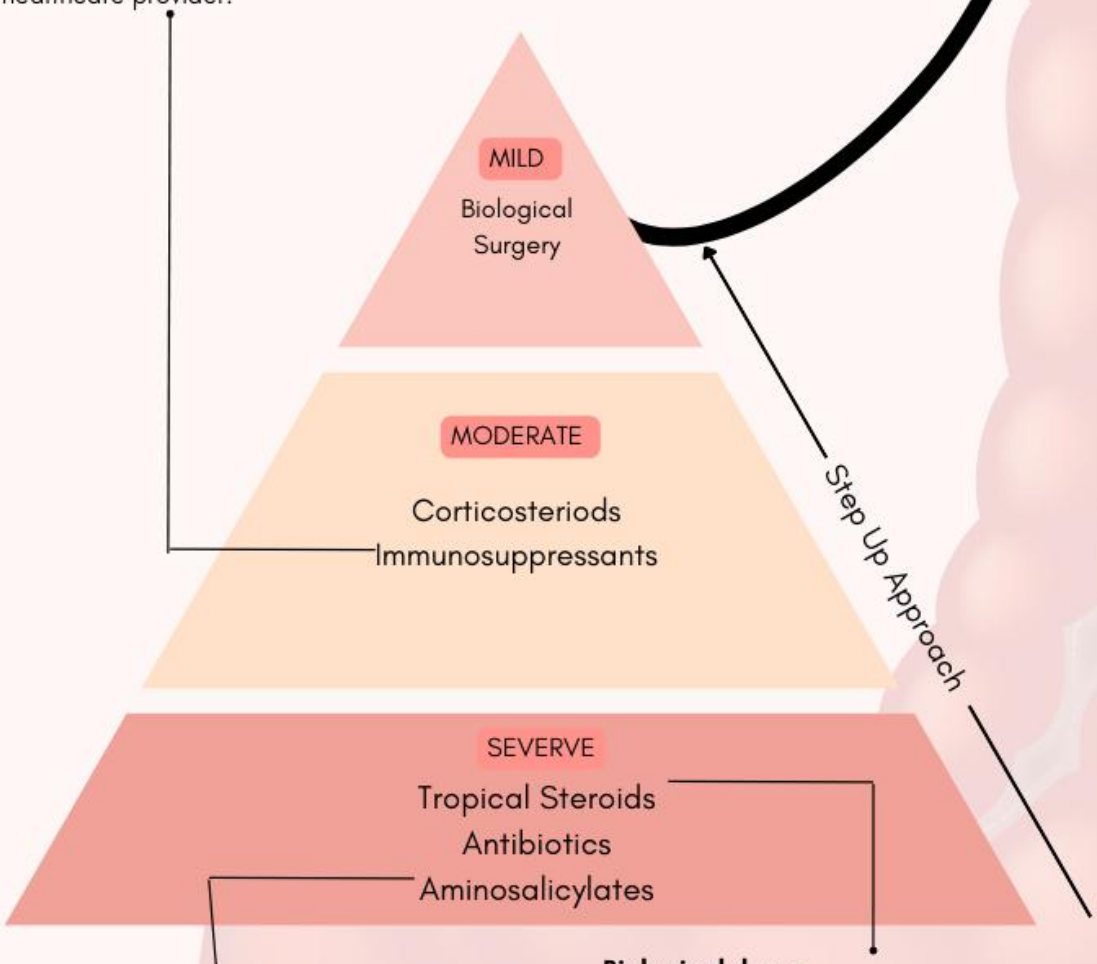
Once the results of these tests are combined and analyzed, the healthcare provider can classify the severity of UC into one of above three categories.

Treatment of Ulcerative Colitis

Poorva was informed about the various treatments, and it was suggested in the end that, in her case, medicines should be opted for instead of surgery. The treatments aimed at promoting and maintaining remission from ulcerative colitis may not be effective for everyone, and serious side effects can be caused by some.

Immunosuppressants (Azathioprine)

They reduce the overactive immune response in ulcerative colitis, helping to manage symptoms and induce remission in some cases. They may increase the risk of infections and other side effects, so their benefits and drawbacks should be carefully considered in consultation with a healthcare provider.



Aminosalicylates (Such as Mesalazine)

They reduce gut inflammation, providing relief for mild to moderate cases in roughly 60-70% of instances. This data highlights their significance, aiding patients and doctors in making informed choices.

Biological drugs

They impact UC by inhibiting the effects of inflammatory signals. These medications can be highly effective in reducing symptoms and promoting remission. Yet, it's important to note that the benefits may wane in some cases, and not all patients may respond. Personalized approaches to UC management are essential for the best outcomes.

Surgeries

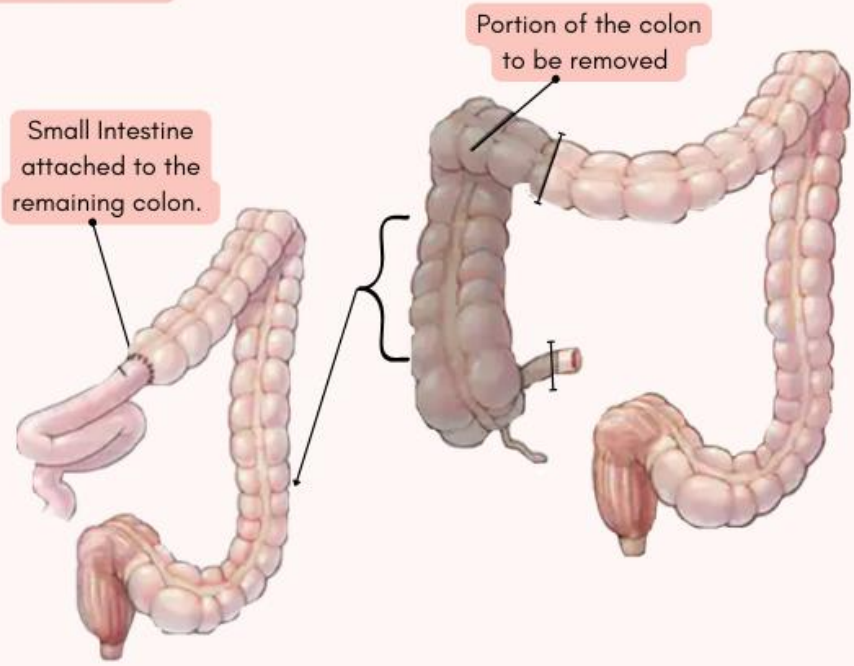
Biological Surgeries to Treat UC

Bowel Resection

- Surgically removing a section of the small or large intestine and may be performed as a treatment for UC when medications are ineffective.
- Bowel resection is a surgical procedure aimed at treating conditions like ulcerative colitis by removing the diseased portion of the intestine.

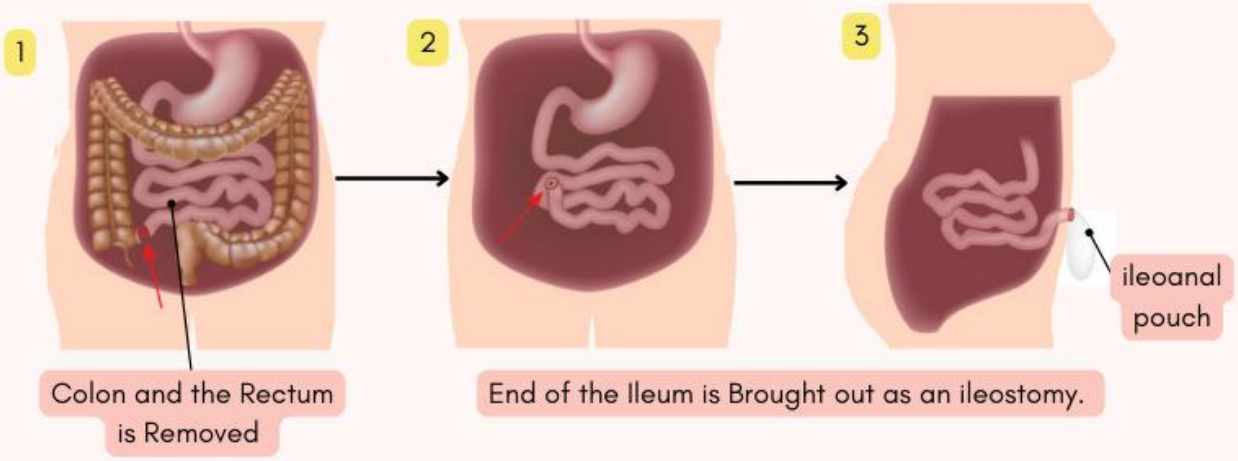
Colectomy

- Surgical procedure that involves the complete removal of the colon, which is the large intestine.
- Performed for various medical conditions, including UC , severe diverticulitis, and colon cancer, among others.
- It may be done to relieve symptoms.



Proctocolectomy

- Surgical procedure involving the complete removal of both the colon and the rectum.
- Typically performed to treat conditions like UC , which pose a high risk of colon cancer.
- Eliminates the risk of cancer development in the colon and can significantly improve a patient's quality of life, albeit requiring ostomy or ileoanal pouch surgery for waste elimination.



Living with Ulcerative Colitis

As Poorva nears the end of her journey, she's shown how resilience can bring victory. By making simple changes in her diet, sleep, and exercise, she's on the verge of remission, proving that determination and self-care can conquer adversity.

Reduce foods high in fibre

7-8 hours of sleep

Exercises that help in relieving stress, such as, yoga and meditation.

Staying Hydrated through out the day.

Taking the prescribed medicines during flare up.

Poorva envisions a life filled with resilience and a desire to raise awareness about ulcerative colitis as she looks forward to living with ulcerative colitis. By inspiring others, she hopes to foster a community of support and understanding for people living with Ulcerative Colitis.

References

Materials for more information on Ulcerative Colitis

Page 1:

- https://www.mayoclinic.org/diseases-conditions/ulcerative-colitis/symptoms-causes/syc-20353326#:~:text=Ulcerative%20colitis%20is%20an%20inflammatory,intestine%2C%20also%20called%20the%20colon
- Seril, DN, Liao J, Yang GY and Yang CS. Oxidative stress and ulcerativecolitis-associated carcinogenesis: studies in humans and animal models. Carcinogenesis. 24(2003):353-62.

Page 2:

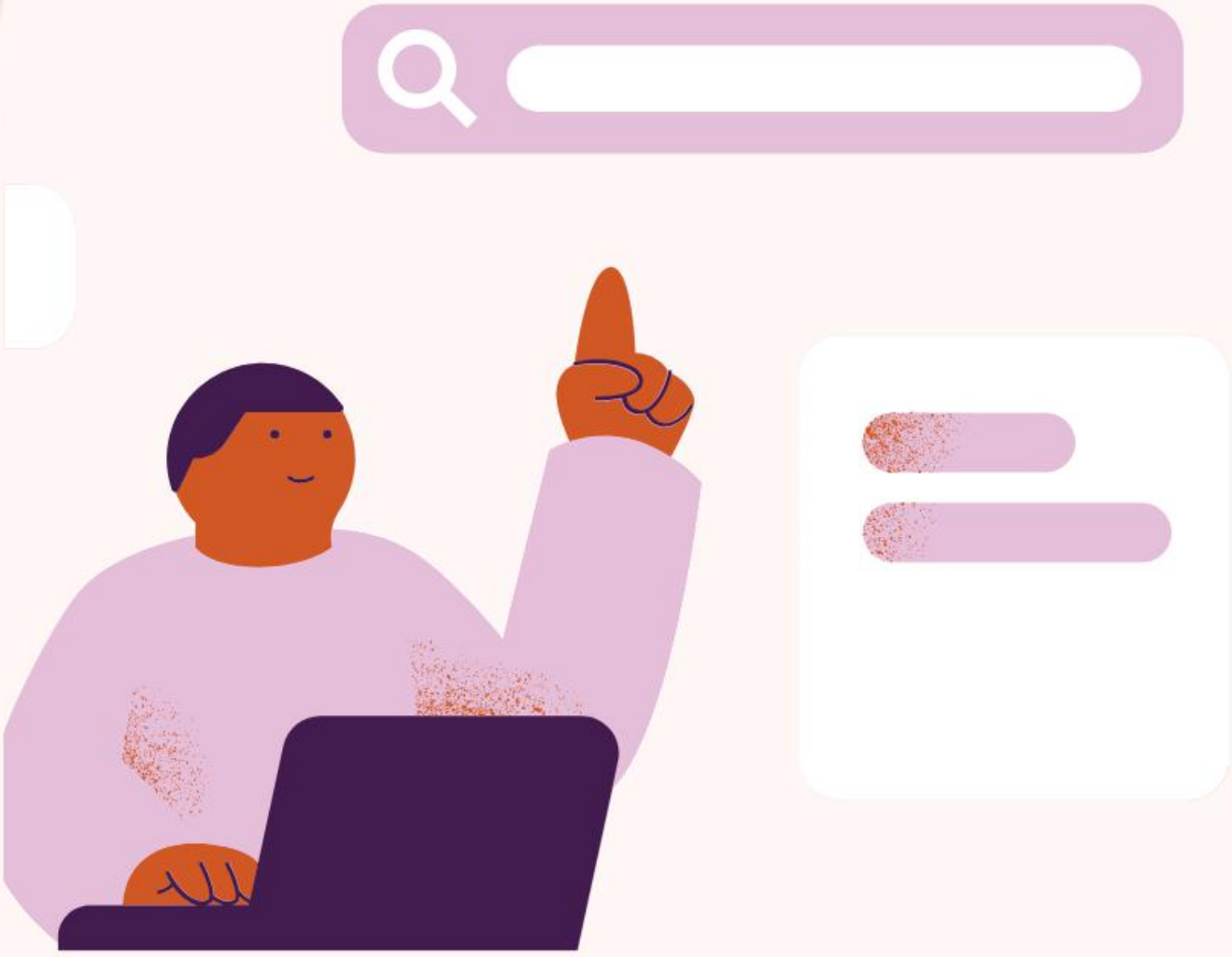
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6044200/
- https://www.nhs.uk/conditions/ulcerative-colitis/

Page 3:

- https://www.niddk.nih.gov/health-information/digestive-diseases/ulcerative-colitis/treatment
- https://www.crohnscolitisfoundation.org/what-is-ulcerative-colitis/treatment-options

Page 4:

- https://www.mayoclinic.org/diseases-conditions/ulcerative-colitis/in-depth/ulcerative-colitis-flare-up/art-20120410#:~:text=Say%20no%20to%20fiber%20if%20it's%20a%20problem%20food.&text=However%2C%20if%20you%20have%20ulcerative,on%20this%20food%20group%20entirely.



Honeybees
A Vital Part of Our Ecosystem

Illustrated by Ananya Aggarwala, Third Year, BBA (Hons)

"These creatures are vital to what we eat and what our countryside looks like," says Gill Perkins, chief executive of the Bumblebee Conservation Trust. "They provide a whole ecosystem service."

We often take them for granted, but honeybees play an essential role in our lives and our planet's well-being. A world without bees would look very different and change our lives enormously. They are often associated with their sweet and delicious honey, but their actual value lies in their role as essential pollinators. These tiny insects play a critical role in producing many of the fruits, vegetables, and nuts we rely on for food. In fact, it is estimated that these tiny insects are responsible for pollinating about one-third of the world's food crops. With honeybees, our diets would be much more diverse and nutritious.

In addition to providing us with food, honeybees also help to pollinate wildflowers and other plants, which are essential for the survival of many wildlife species. They also produce honey, beeswax, and propolis, which have many valuable medicinal and commercial uses.

A 2015 study by Canadian researchers estimated that 24 billion bees and wasps are killed by vehicles on roads across North America every year.

Bees are the world's most important pollinators, fertilising a third of the food we eat and 80% of flowering plants. Bees and other pollinating insects have a global economic value of around £120bn ($150bn) and contribute around £690m ($850m) to the UK economy every year, according to a study by the University of Reading.

In the US, bees pollinate an estimated $15bn (£12.3bn) of crops every year, including almonds, courgettes and melons, according to the US Department of Agriculture.

Despite their importance, honeybee populations are declining worldwide due to various factors, including habitat loss, pesticides, and diseases. These threats have led to a decline in honeybee populations worldwide, raising concerns about the future of our food supply. We must do everything possible to protect honeybees and ensure their survival.

Studying reproduction in honey bees can help humans save their population in several ways. To effectively protect honey bee populations, we need to understand their reproductive cycle; this way, we can better manage their population and identify potential threats to their survival. We can also use this knowledge to develop new methods of beekeeping and pollination.

Society in Comb: Life of a Honeybee

Honey bees are eusocial insects, meaning that they live in colonies with a distinct social hierarchy. Their colonies are highly organized and complex societies of bees that work together to ensure the survival and reproduction of the colony. A hive's inhabitants are commonly divided into three types which are queen bees, worker bees, and drone bees.

The Worker bees are the smallest in the colony and comprise most of the population. As their name suggests, they forage for food, nurse the brood, build and defend the hive, clean, circulate air by beating their wings, and perform many other societal functions.

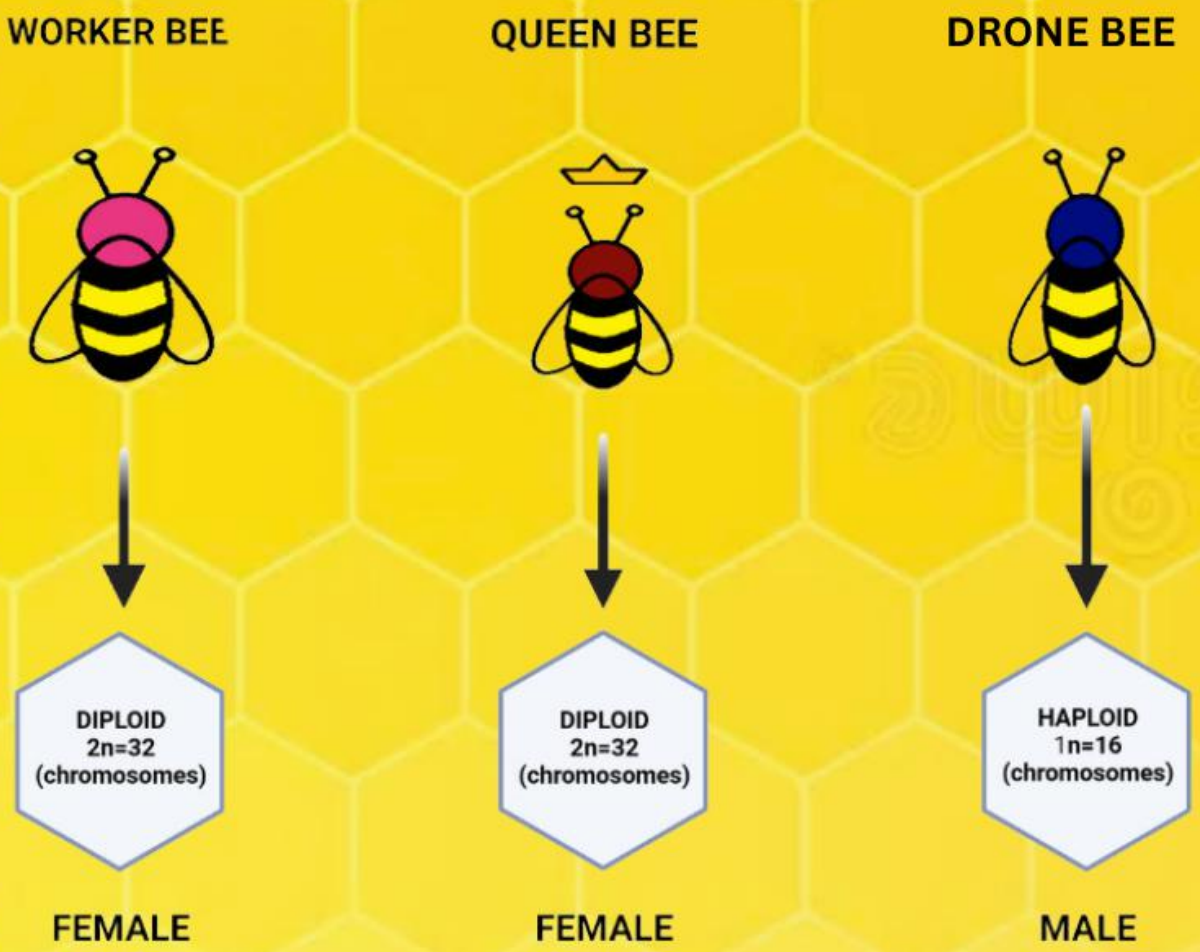
The Queen Bee is the largest bee in the colony and is responsible for keeping the hive alive, i.e., laying eggs.

Male bees are called drones, which is the third class of honeybee. They exist as minorities in the colony. Their primary purpose is to mate with virgin queens from other colonies to produce more worker and drone bees.

Did You Know!!

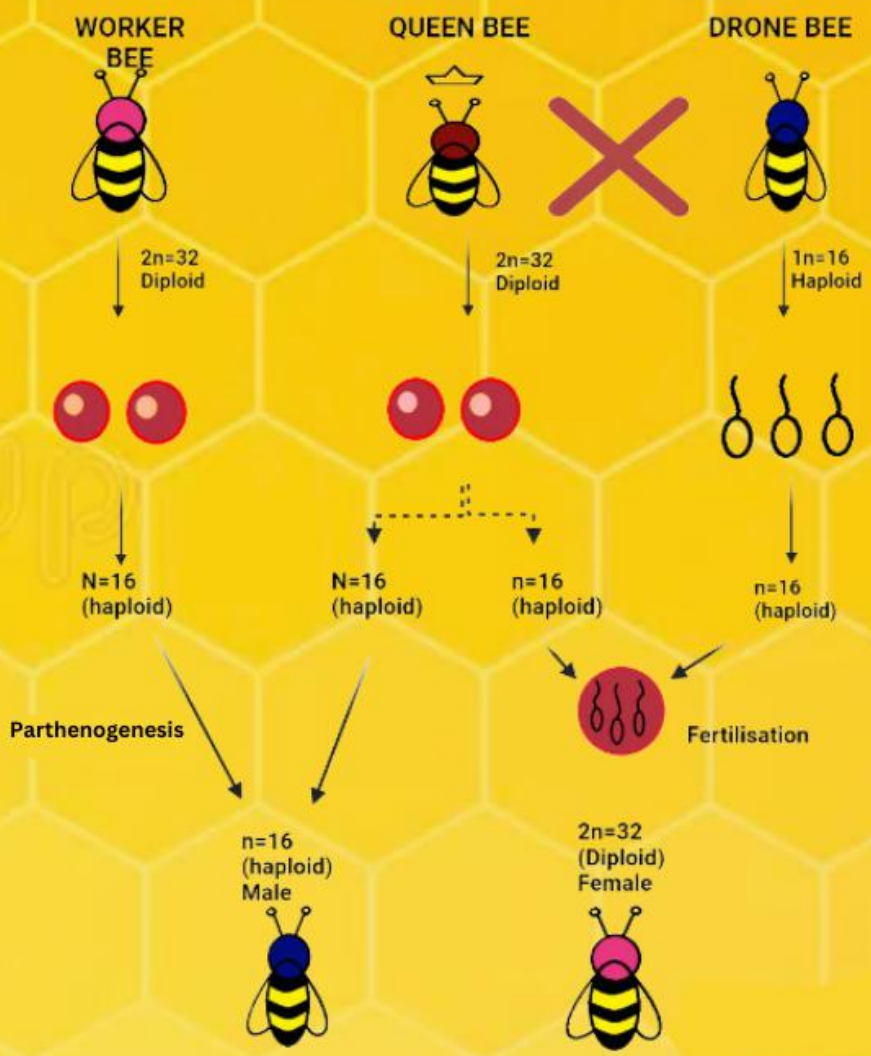
In the spring season, we hear a lot of buzzing. Because the hive has grown large enough, swarms of bees with the old queen split off to look for a new nest. The swarming process begins when the queen lays eggs into queen cups and raises the new queens. This phenomenon is essential to the bees' survival; if the settlement becomes overcrowded, it will lead to a scarcity of resources, and the colony's health will begin to decline. The old queen and a portion of the worker bees leave the colony in a swarm to establish a new hive and the scout bees then usually spend a few days hanging from a tree in a beard-like cluster till they find the perfect home. The remaining bees stay in the original colony with the newly crowned queen. Thus, the original single colony reproduces two or more colonies.

Haplodiploidy in Honeybees



Haplodiploidy is a sex-determination system in which males (drone bees) are haploid (they carry only one set of chromosomes) and females (worker bees and queen bees) are diploid (they carry two sets of chromosomes).

Sex Determination in HoneyBees



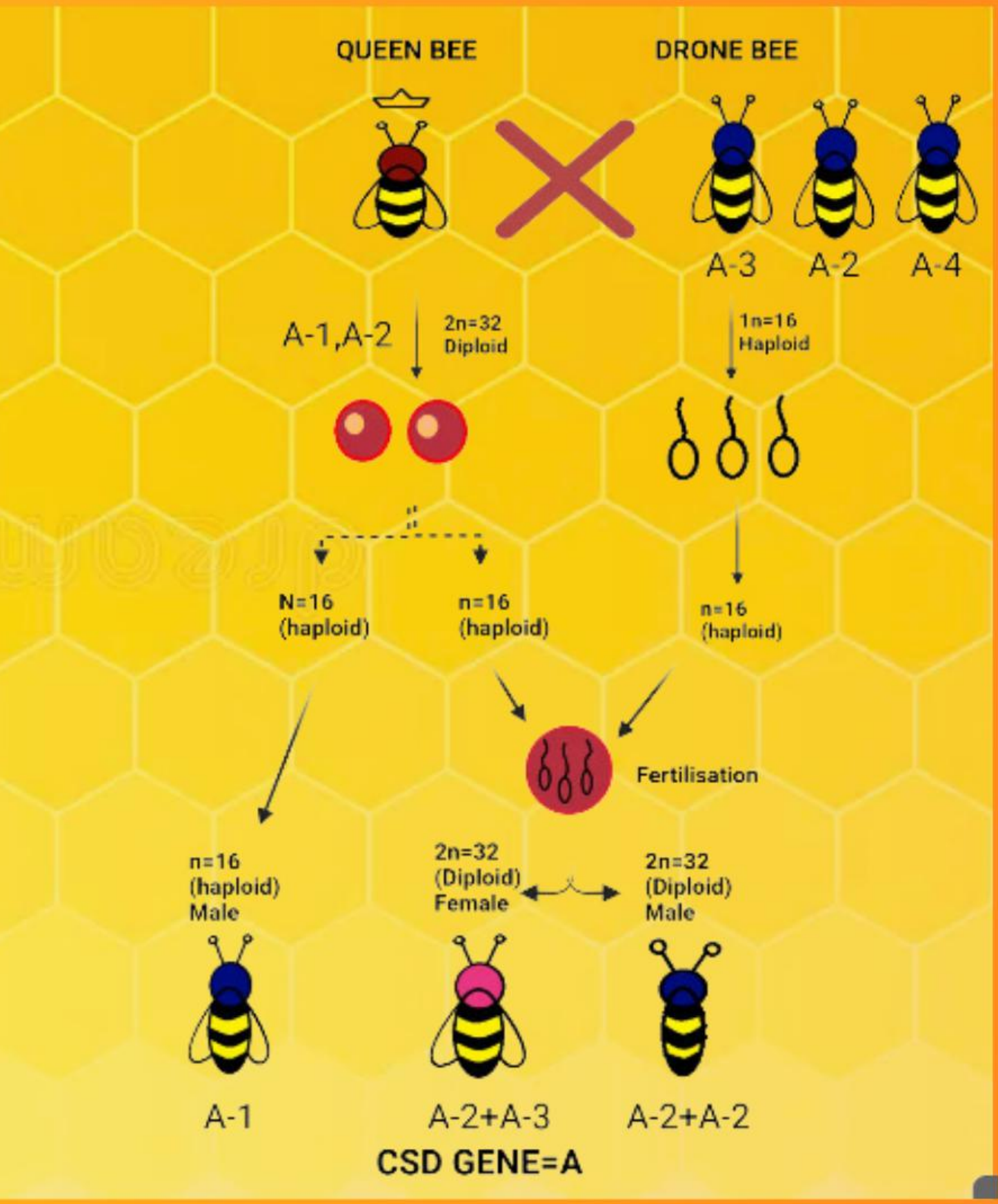
Fertilization in honeybees occurs when a queen bee mates with a drone bee, producing diploid female bees that can become either worker bees or queens. Non-fertilization or Parthenogenesis (is a natural form of asexual reproduction in which the growth and development of embryos occur in a gamete (egg or sperm) without combining with another gamete (e.g., egg and sperm fusing) occurs when the queen or the work bees lay an egg without fertilizing the egg with a drone bee's sperm, producing haploid male bees called drones.

Complementary Sex Determination

After further research, it was found that there are male diploids, too. This was because, in honeybees, sex determination is controlled by a single gene called the complementary sex determiner (csd) gene. This gene is present in both the queen bee and the drone bee. The queen bee has two copies of the alleles: csd gene (A-1) and csd gene (A-2). The drone bees only have one copy of the allele (A-3 or A-2). Bees with two different copies of the csd allele (A-2+A-3) will develop into diploid females. This phenomenon is called heterozygosity, where an individual possesses two different alleles of a particular gene or genes. Diploid females can become either worker bees or queens, depending on how much royal jelly they receive as larvae.

In honeybees, diploid males are a rare occurrence, resulting from an unusual combination of genetic factors. These males inherit two copies of the same csd allele, either csd (A-2+A-2). This homozygous (where an individual possesses the identical alleles of a particular gene or genes from each biological parent) condition disrupts the normal balance of gene expression, leading to the development of male bees despite having two sets of chromosomes. Diploid males are typically sterile and do not play a significant role in reproduction, but their existence highlights the complexity and flexibility of honeybee sex determination. Because of their complex nature, they are born abnormal and are killed by worker bees as soon as they are hatched.

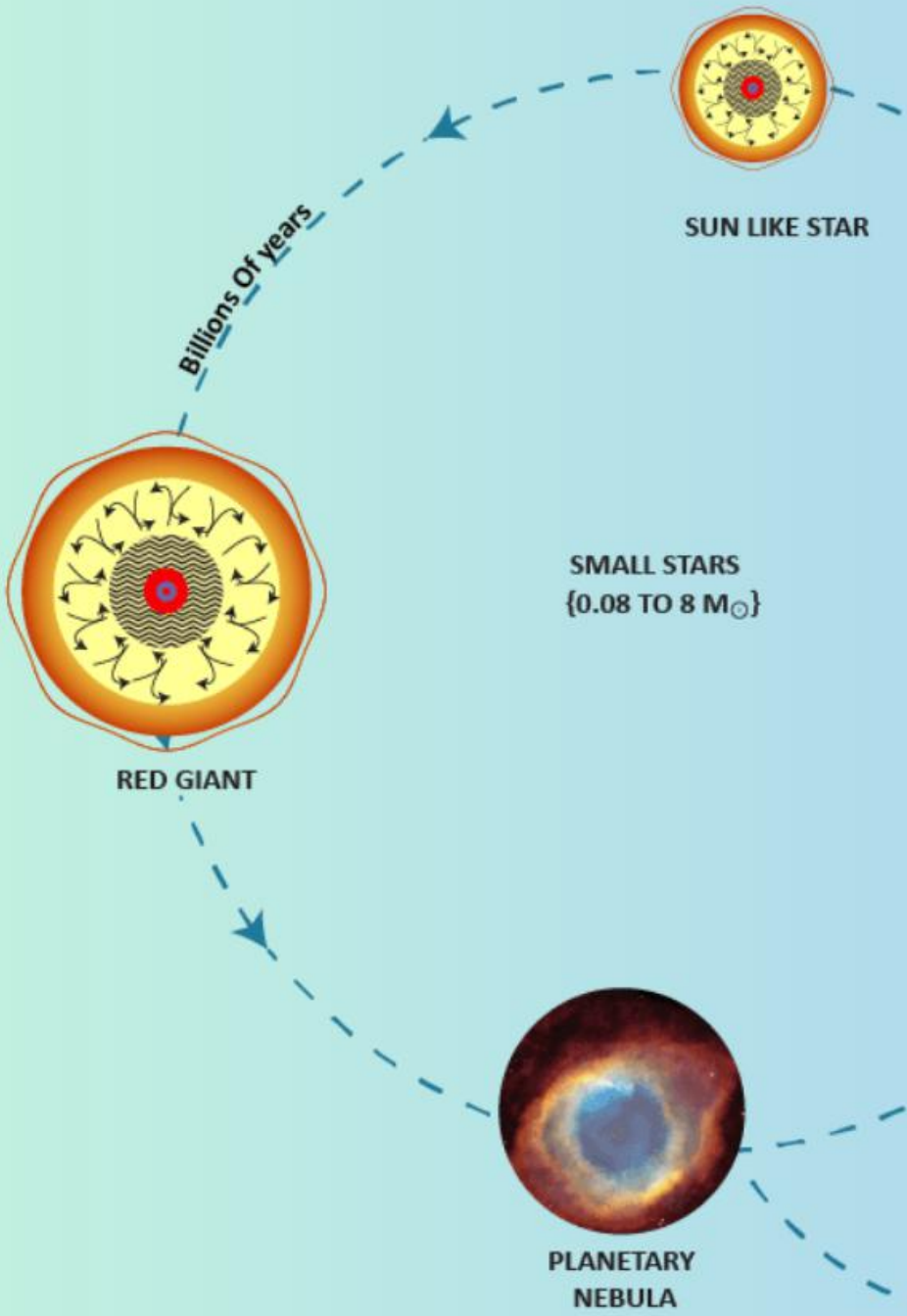
In honeybees, hemizygosity refers to the presence of only one copy of a particular gene (A-1) on a specific chromosome. This occurs because honeybees have an odd number of chromosomes (16), resulting in unpaired chromosomes in haploid males. Haplodiploidy, the sex determination system in honeybees, leads to male bees inheriting only one set of chromosomes, creating hemizygosity for all genes located on unpaired chromosomes. This genetic condition has implications for gene expression and may contribute to the distinct characteristics of male honeybees.

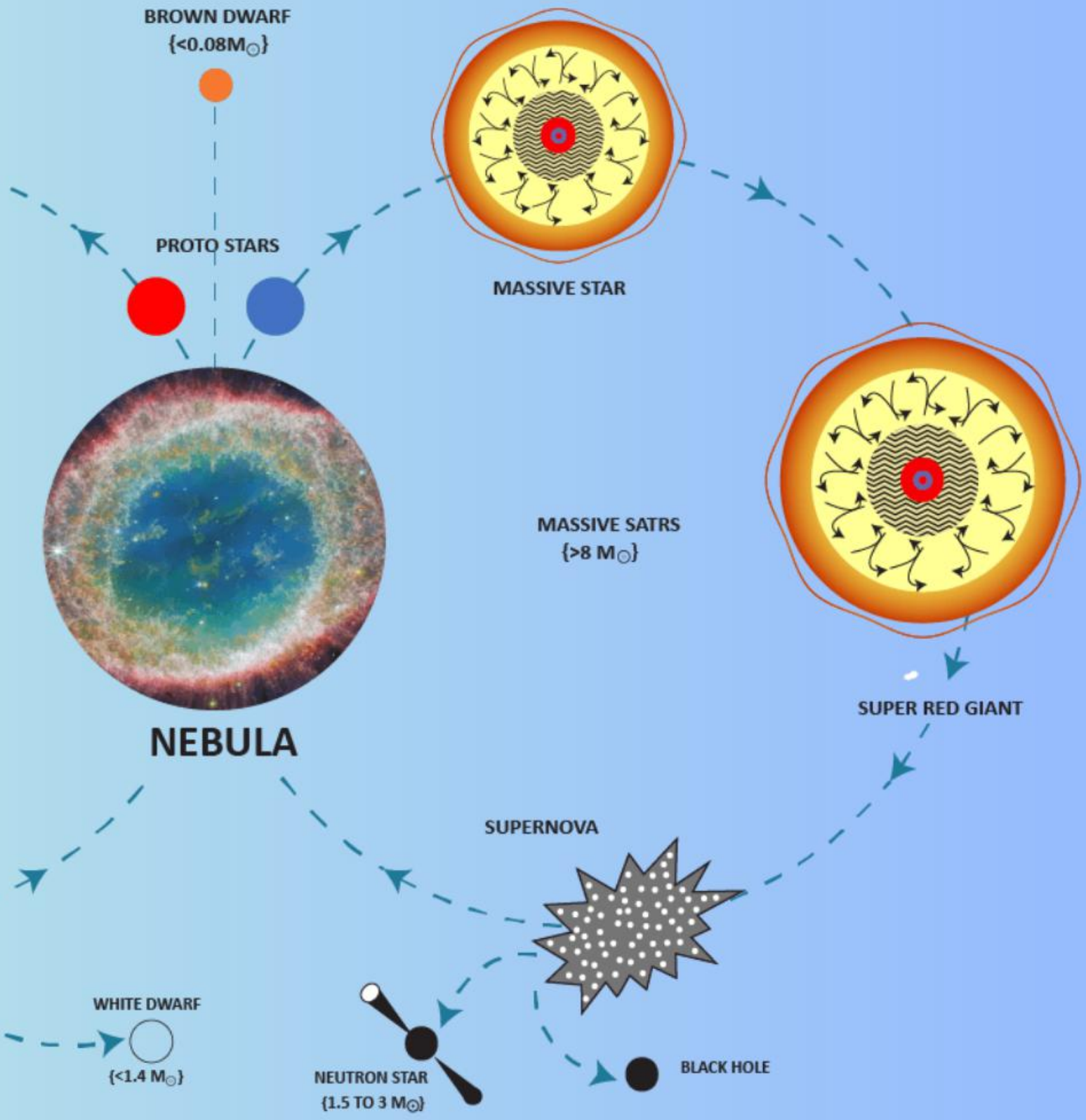

QUEEN BEE
DRONE BEE
A-3
A-2
A-4
A-1,A-2
2n=32
Diploid
1n=16
Haploid
N=16
(haploid)
n=16
(haploid)
n=16
(haploid)
Fertilisation
n=16
(haploid)
Male
2n=32
(Diploid)
Female
2n=32
(Diploid)
Male
A-1
A-2+A-3
A-2+A-2
CSD GENE=A

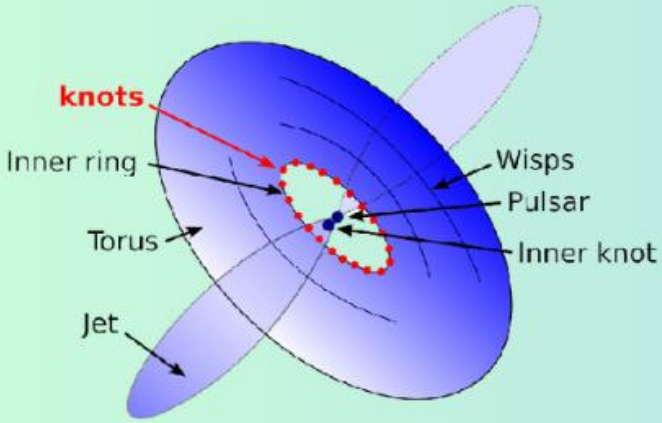
Journey Of The Star

Illustrated by Krishna Shah, Fourth Year, BBA (Hons)

The life-giving carbon on Earth originated in the hearts of ancient stars. It began when a massive cloud collapsed under gravity, heating its core into a fusion crucible. Hydrogen fused into helium and heavier elements, radiating energy. Over eons, the aging star cooled as helium fusion took over. Smaller stars faded into white dwarfs. But massive stars ended dramatically in supernovae, unleashing huge energy and forging heavy elements. Their remnants became neutron stars or black holes. This cosmic life cycle forged the carbon in our bodies and iron in our blood. It is a grand celestial dance of creation and destruction, painting our majestic cosmic canvas. Our human bodies contain carbon created inside long-dead stars. Under extreme temperatures and pressures, nuclear fusion transmuted hydrogen into carbon within that ancient stellar core
As the star aged over cosmic timescales, carbon essential for organic life was forged. Supernovae explosions scattered heavier elements like iron formed in its final throes. Billions of years later, some of that stardust formed our solar system. On Earth, the carbon, iron and other elements combined into complex life chemistry. The star-forged heavy elements made consciousness possible. So the carbon and iron in our bodies came from stardust, created in cosmic events spanning eons. We owe our existence to the spectacular celestial forces that shaped matter across the vastness of space and time.




BROWN DWARF
{<0.08M⊙}
PROTO STARS
MASSIVE STAR
MASSIVE SATRS
{>8 M⊙}
SUPER RED GIANT
NEBULA
SUPERNOVA
WHITE DWARF
{<1.4 M⊙}
NEUTRON STAR
{1.5 TO 3 M⊙}
BLACK HOLE



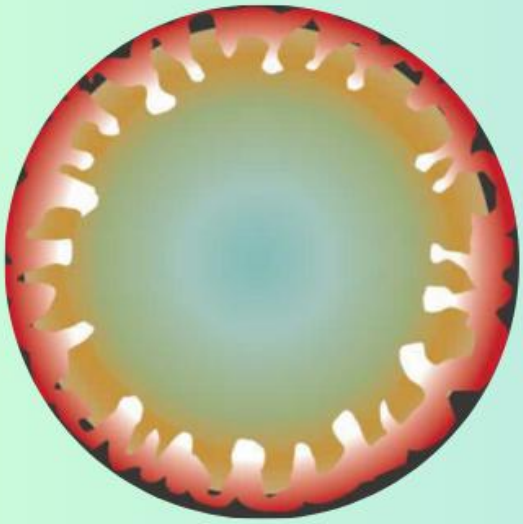
Nebula Star

Nebulae, often called stellar nurseries, are expansive regions in space comprising gas and dust. Within these cosmic clouds, the intricate dance of gravity orchestrates the condensation of materials, giving rise to the birth of new stars. As gravity tightens its grip, a luminous core emerges, heralding the creation of stellar entities. Nebulae are pivotal to the cosmic ballet of star formation, showcasing nature's grandeur. These celestial landscapes captivate observers with their breathtaking displays, reminding us of the awe-inspiring beauty embedded in the vastness of the cosmos.

Massive Star

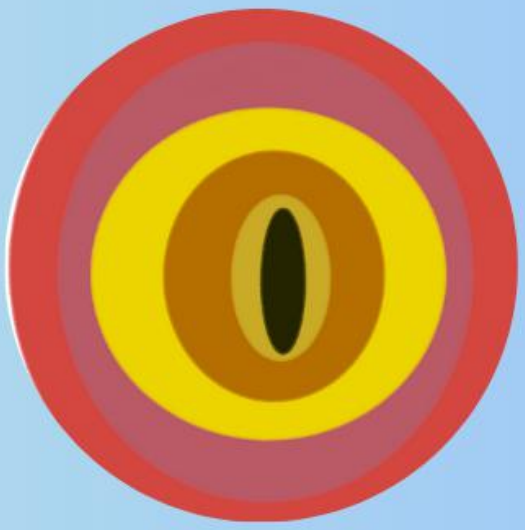
Massive stars, towering celestial behemoths, boast masses surpassing the Sun's. Their defining feature is the vigorous nuclear fusion transpiring within their cores, generating soaring temperatures and luminosities. Despite their brilliance, the lifespans of these giants are comparatively brief, marked by spectacular metamorphoses. As these stellar juggernauts exhaust their nuclear fuel, they culminate in explosive supernova events. Such cataclysms give birth to enigmatic entities like black holes or neutron stars, illustrating the dynamic and transformative nature of these colossal cosmic actors in the vast cosmic theater.

Supernova Star



Supernova

A supernova, a celestial spectacle of cataclysmic proportions, marks the culmination of a star's life as it explosively sheds most of its mass into the cosmos. This dazzling event, a fleeting burst of brilliance, can momentarily outshine entire galaxies, giving rise to neutron stars or black holes in its aftermath. Beyond their visual splendor, supernovae significantly shape cosmic evolution by dispersing essential heavy elements into space. These elements, crucial for planetary and biological formation, contribute to the cosmic symphony orchestrating the diverse tapestry of the universe.

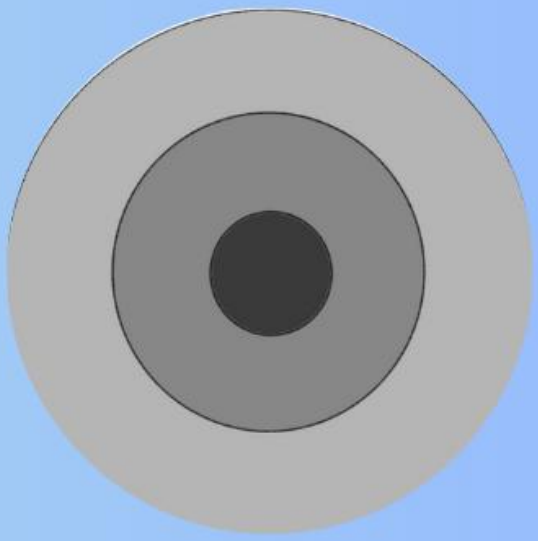


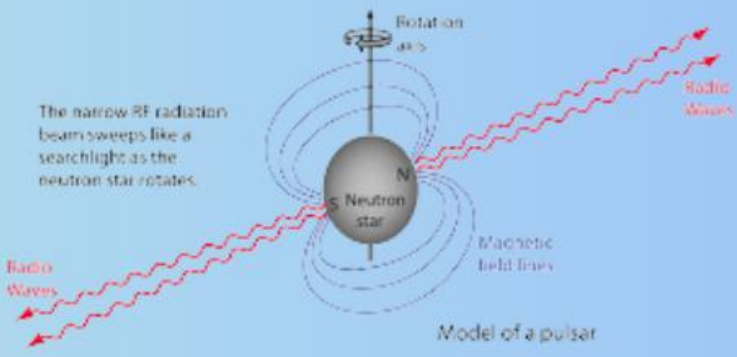
Red Super Giant Star

Red supergiant stars, colossal cosmic entities in the twilight of their existence, embody the later stages of stellar life cycles. These titans, dwarfing the Sun by hundreds to thousands of times in size, exhibit a distinctive crimson tint owing to their cooler surface temperatures. Often situated at the conclusion of the main sequence phase, red supergiants are marked by inherent instability. This instability serves as a harbinger of spectacular celestial events, with potential outcomes including explosive supernovae or gravitational collapse into neutron stars or enigmatic black holes, highlighting the dynamic and transformative nature of the cosmic stage.

Black Hole

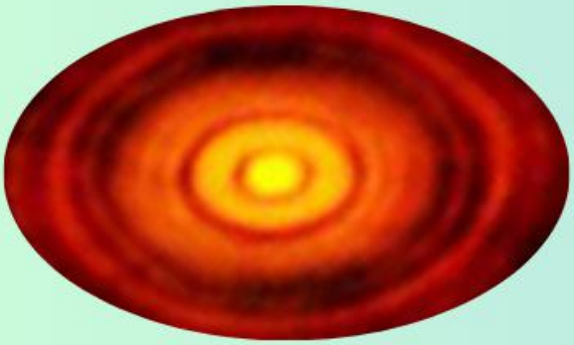
A black hole, an enigmatic cosmic phenomenon, manifests as an intensely gravitational region, born from the colossal concentration of mass compressed into a minuscule space. The gravitational force is so formidable that even light succumbs, rendering the black hole's appearance inky and impenetrable. These cosmic voids emerge when massive stars undergo a dramatic collapse, concluding their life cycles in a gravitational ballet. The elusiveness of black holes renders them among the most captivating mysteries in the universe, pushing the boundaries of our comprehension of fundamental physical laws.





Neutron Star

A neutron star is a remarkable celestial object formed from the collapsed core of a massive star during a supernova explosion. It's incredibly dense, packing a mass greater than the Sun into a city-sized space, resulting in extreme gravitational forces. Neutron stars are known for their astonishing magnetic fields and often appear as pulsars, rapidly rotating and emitting beams of radiation. Their intense conditions yield unique insights into fundamental physics and astrophysical phenomena, making them a focal point of scientific study.

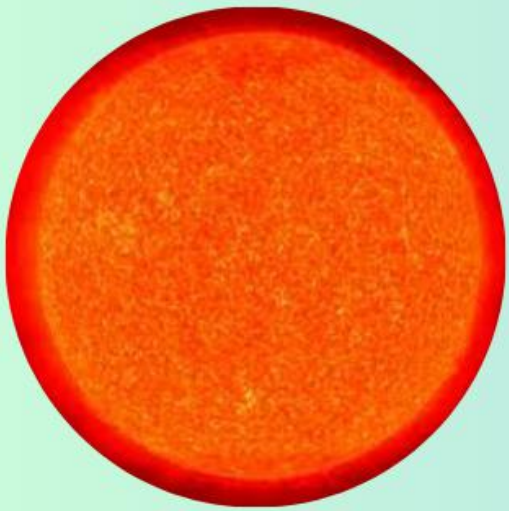


Protostar

Protostar: Protostars represent the earliest stages in a star's evolution before the nuclear fusion of hydrogen begins. They form from gravitational contraction of dense regions inside giant molecular clouds of gas and dust. As the protostellar cloud collapses under its own gravity, conservation of angular momentum causes it to spin faster, flattening it into a disk-like structure with a hot dense protostar at the center. The protostar continues accumulating infalling material while contracting and heating up. When the core temperature exceeds 10 million K, deuterium fusion begins and the protostar becomes a true star on the main sequence.

Sun-Like Star

Sun-like stars, as the name suggests, share broadly similar characteristics with our Sun. They belong to the main sequence category, fusing hydrogen into helium in their cores and converting mass into energy. Sun-like stars maintain stable luminosities and surface temperatures in the range of 4,000–6,000 K for billions of years, enabling life to evolve on orbiting terrestrial planets. They have similar masses ranging from 0.7 to 1.5 times that of the Sun. Sun-like stars are composed mostly of hydrogen and helium with traces of heavier elements. They rotate at moderate speeds and often host exoplanets.



Red Giant Star

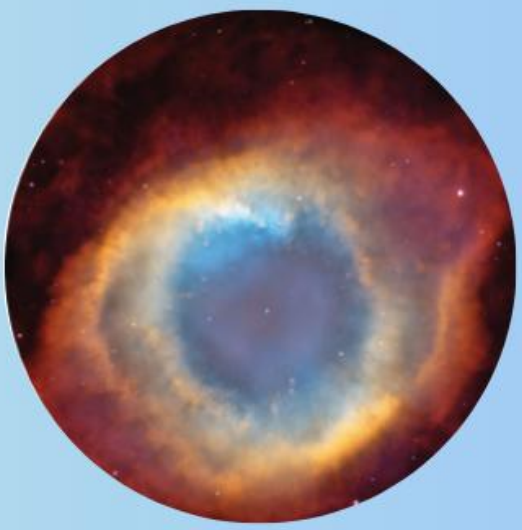
A red giant is an evolved star that has exhausted the hydrogen fuel in its core needed for nuclear fusion. As fusion stops, the core contracts and heats up while the outer layers hugely expand and cool to about 5,000 K, causing the reddish color. Low to medium mass stars transition to red giants in the later stages, increasing greatly in size to over 100 times the radius of the Sun. The expanding outer layers eject mass into space forming beautiful planetary nebulae. The core eventually becomes a dense hot white dwarf.

Brown Dwarf Star

Brown dwarfs are substellar objects that have masses between the heaviest gas giant planets and the lightest stars, occupying the mass range of around 13 to 80 Jupiter masses. They are not massive enough to sustain steady hydrogen fusion in their cores, the process that powers stars. Lacking the internal heat source of hydrogen fusion, brown dwarfs radiate away the stored heat from their formation, causing them to cool and dim over time. Brown dwarfs glow dimly from the heat left over from their collapse from interstellar gas clouds. Their faint infrared light distinguishes them from brighter stellar objects.

White Dwarf Star

White dwarfs are the final evolutionary stage of low to medium mass stars after they have exhausted their nuclear fuel. No longer powered by fusion, white dwarfs are supported against gravitational collapse by electron degeneracy pressure. They are extremely dense and compact, with a mass comparable to the Sun packed into a volume similar to Earth. White dwarfs lack internal energy production so they simply radiate away their stored thermal energy and cool over billions of years, eventually becoming black dwarfs.



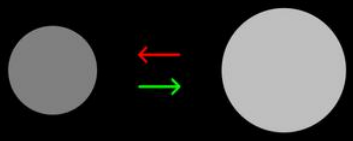
Planetary Nebula Star

A planetary nebula is a glowing shell of gas and plasma ejected from aging low mass stars late in their evolution. As a star transitions to become a white dwarf, its outer layers expand and are expelled, forming a surrounding nebulous cloud. These nebulae are named 'planetary' since early astronomers thought they resembled giant planets through telescopes. But they actually have nothing to do with planets. Energized by the heat of the central white dwarf star, planetary nebulae glow brightly with emission lines from ionized gases. Their vivid colors and swirling shapes make planetary nebulae some of the most beautiful astronomical objects. Though short-lived, they illuminate a crucial transitional phase as low mass stars march toward the final white dwarf stage.

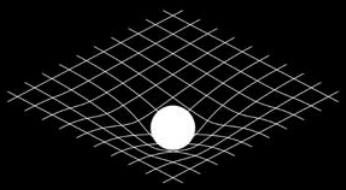
LIGO: Discovering Gravitational Waves

Illustrated by Lalit Chowdhary, Fourth Year, BS (Hons)

Gravity is the invisible force that makes things with mass (like planets, stars, and everyday objects) pull towards each other. It's what keeps us on the ground and the planets in orbit around the sun.The more massive an object is, the stronger its gravitational pull.



Imagine a large rubber sheet on which a marble is kept. The marble deforms the sheet. Gravity is similar—it results from space-time fabric, where objects with mass curve it.



Gravitational waves, on the other hand, are ripples or disturbances in the fabric of space-time itself that propagate through the universe. They are produced by the acceleration or motion of massive objects, such as two orbiting black holes or colliding neutron stars.

1915

The concept of gravitational waves emerged as a consequence of Einstein's theory of general relativity. He proposed that massive objects, like planets and stars, warp the fabric of space-time around them, resulting in what we perceive as gravity.

1972

When two massive objects such as black holes or neutron stars accelerate, they emit ripples in space-time, also called gravitational waves. Rainer Weiss proposed initial designs for a gravitational wave detector.

1989

Rainer Weiss and Kip Thorne submitted a proposal for Laser Interferometer Gravitational-wave Observatory to the National Science Foundation.

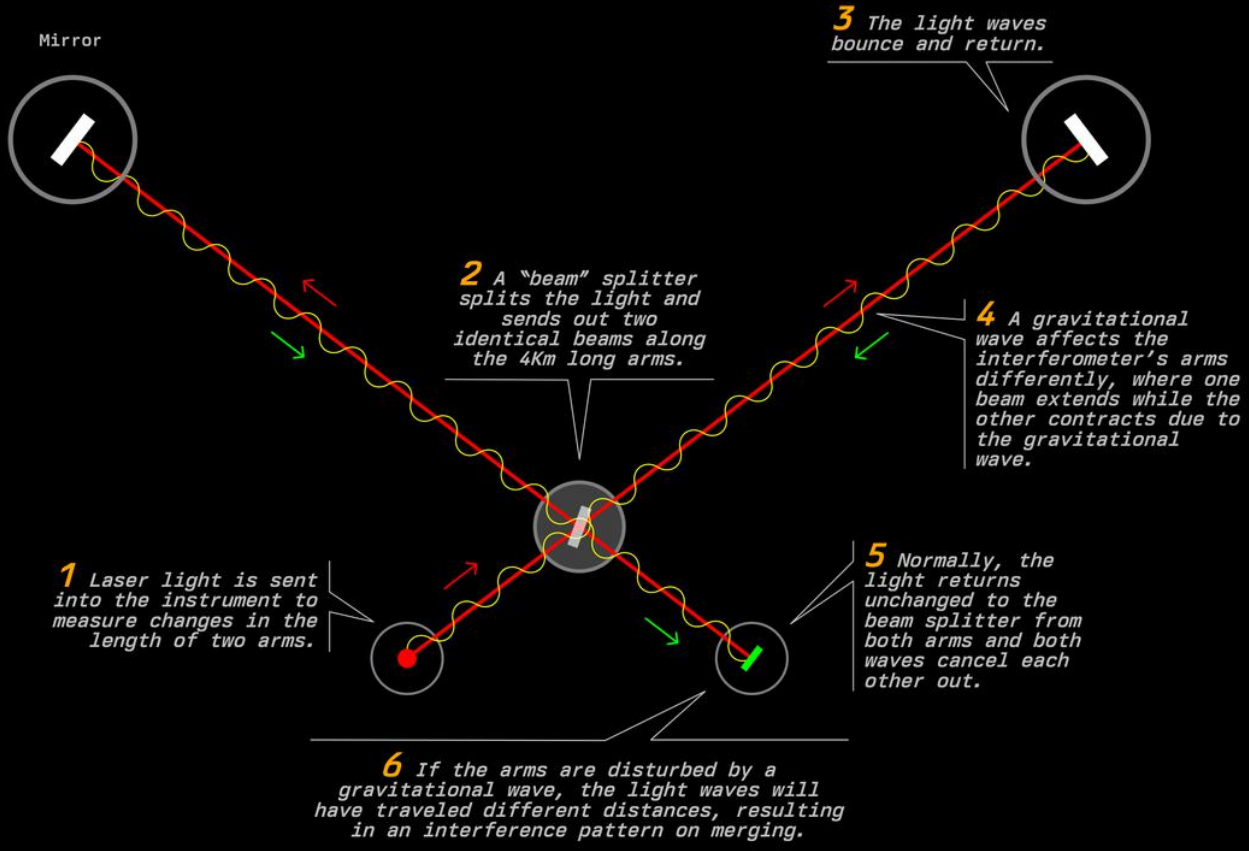
1994

Construction began on the twin LIGO detectors in Hanford and Livingston.

2015

On September 14, 2015, LIGO detected the web-like flutters of space-time created by the merging of two massive black holes some 1.3 billion light years away. Nearly half-a-century after its conception,

Two black holes spiraling each other, creating gravitational waves



Neuromarketing
Science of Consumer decisions

Illustrated by Sparsh Tiwari, Second Year BBA (Hons)

Who uses neuromarketing? The New Coke Story

In 1985, facing declining sales, Coca-Cola introduced New Coke, a product preferred by 200,000 consumers in taste tests. Despite high expectations, the public response was unexpectedly negative. Dissatisfied customers flooded the company with complaints, leaving Coca-Cola perplexed. The issue wasn't the taste; it was the emotional connection. Coca-Cola, known as a classic brand with a strong emotional bond, had inadvertently disrupted this connection with the launch of New Coke.

The company had focused on taste improvement rather than reinforcing the emotional link with consumers. This event highlighted the growing realization among companies that subtle emotions play a crucial role in shaping consumer experiences with a product.

Process

So what did the company actually do?

Step 1. Studying the brain
Analyzed the brain and how it reacted to certain tastes ,through studying the limbic system, of the consumer participated in the taste test .

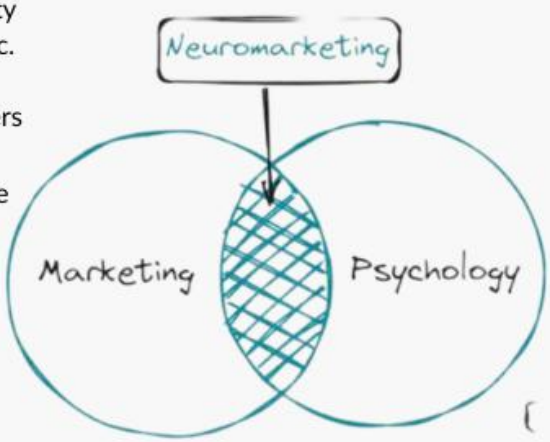
Step 2. Making changes
Improved the taste with the help of the data collected

Step3. Rectify & changed the method marketing -
But eventually realized the problem was the emotion attached to the brand not the new taste.

Neuromarketing in actual and it process

What is Neuromarketing?

Neuromarketing is a field of marketing that employs Neuroscience into marketing. This involves tracking the brain's behavior and activity with a multitude of technologies such as fMRI, EEG, eye-trackers, etc. in revealing the consumer buying-decisions.
While traditional marketing answers questions like "What consumers buy?", neuromarketing aims to answer the question "Why do consumers buy what they buy?".Neuromarketing can be very subtle yet powerful.



Process & implementation: steps involved

Step 1 : Understanding the brain-
In order to understand the consumer thoughts, the marketers first start with the study of the limbic system of the brain.

Function of the limbic system and its parts

It processes and regulates emotion and memory while also dealing with sexual stimulation and learning. Behavior, motivation, long-term memory, and our sense of smell also relate to the limbic system and its sphere of influence.

The Limbic System

1.Helps in cognition and episodic memory recall

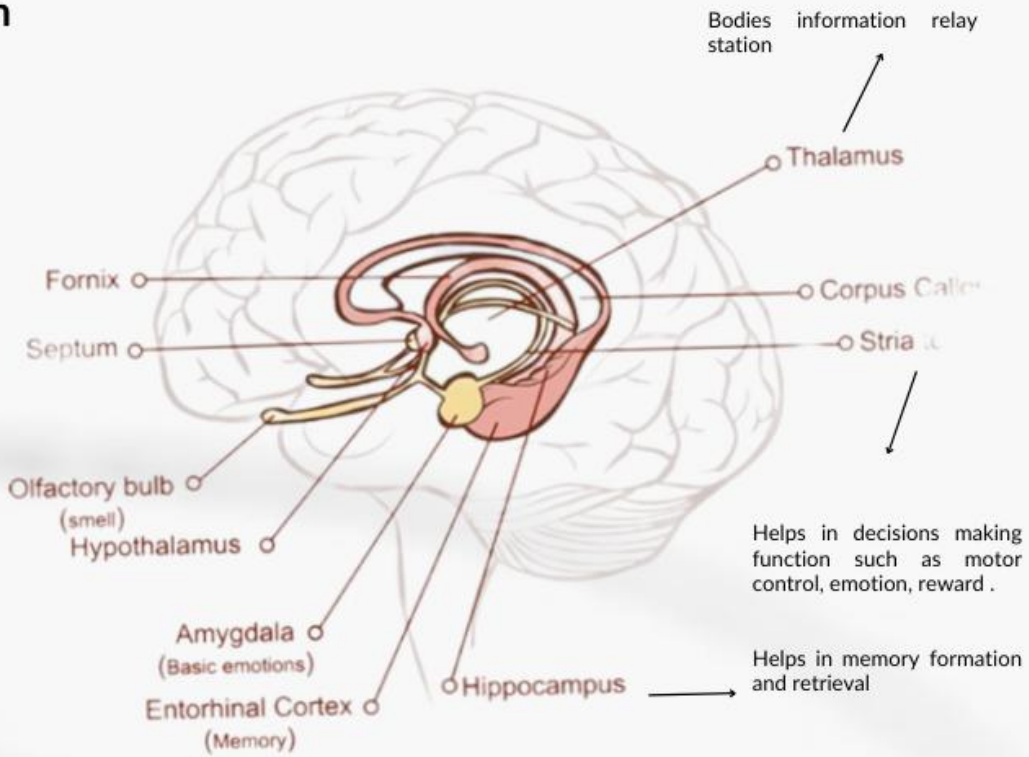
2.Supports physiological functions

3.Receiver for neural input of ours detected by cell

4.Manages hunger, thirst , body temperature, moods

5.Helps in perception of emotions (anger, fear, sad)

6.Works as a network hub for memory, navigation



Techniques of Neuromarketing

Step 2 : Choosing the right technique to understand behaviors

After the study of the brain , the second step is to choose the most efficient technique/method from the outside/inside reflex in order to collect the consumer behavior information with respect to the task in hand . Like taste test was the technique used in the case of coca -cola

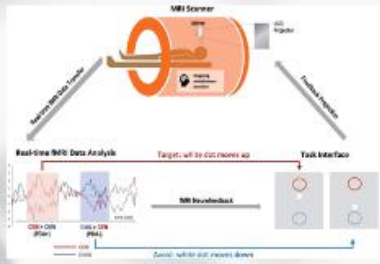
Outside /inside reflex

On the basis of the information needed the market choose between the two reflexes the outside /inside reflex. On the basis of which several techniques are divided-

Outside reflex & inside reflex techniques

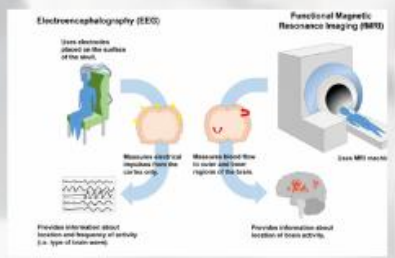
Empathic Design	EEG
Eye tracking	FMRI
Facial coding	MEG
Body language	PET

Inside reflex techniques



1. Functional magnetic resonance

FMRI is the best neuromarketing technique for predicting consumer behaviour, such as buying behaviour and sales (hard KPIs)

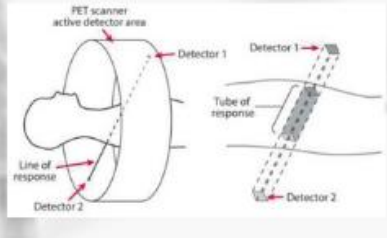


2. Electroencephalography EEG

Allows you to measure the initial impression and quick brain responses to marketing messages. EEG is good for measuring the brain's cognitive processes, such as calculations. This allows us to predict your customers' thinking and discover optimal price for product/services.

3. Positron Emission Tomography

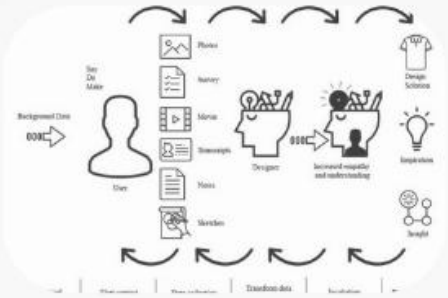
Technique has similar efficiency and spatial resolution like fMRI. The technique requires mild exposure to radioactive particles (positrons) for obtaining results.



Outside reflex techniques

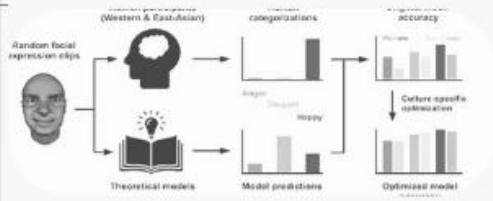
Body Language

Body language offers a window to detect brain emotions similarly to a fMRI scanner. Body language expression iincludes non - verbal emotions and communicational cues expressed by contraction and relaxation of muscles.



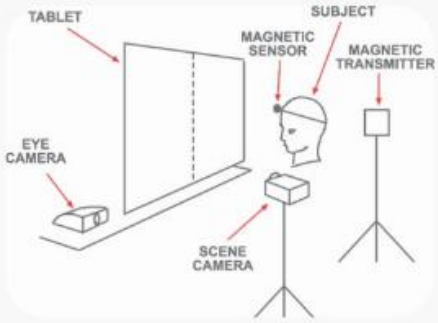
Facial coding

Facial coding is a method of measuring different human emotions through analysis of facial expressions while being exposed to certain stimulus.



Eye tracking

to understand consumer behavior, enhancing marketing strategies and product design. Eye tracking inneuro-marketing helps businesses gain insights into consumer decision-making, allowing for more effective marketing campaigns.



Body language

Body language offers a window to detect brain emotions similarly to a fMRI scanner. Body language expression includes non-verbal emotions and communicational cues expressed by contraction and relaxation of muscles. Hence when you meet and greet customers, ones body language send that have big impact .

Step3: Implementation of the results

Last step involves the implementation of the data collected from using the desired techniques, to get the desired result. As coca-cola did when they understood that emotions attached to the brand where a problem for dropping sales. Hence made changes in advertising.

The Future

Scope of neuromarketing

1. Accessibility

Neuromarketing is steadily becoming the gold standard in market research in developed markets, specifically in Europe and the US. According to experts, neuromarketing will become more widespread across the developing world as local companies begin to realize the potential of this growing field and begin demanding this level of research and consumer insight within their home markets.

2. Scalability

Consumer Neuroscience technologies will become more affordable and widespread, integrated into everyday life through convergence with existing technologies. For instance, Apple's acquisition of Emotient suggests potential integration of Facial Coding into all Apple products. This trend will grant marketers real-time access to biometric data for more informed decision-making, enabling personalized recommendations based on users' emotional states

3. Automation

Artificial Intelligence, Machine Learning, and Big Data will have an enormous impact on the field of Neuromarketing in the years to come. We're already seeing the rise of predictive techniques that reduce the need for larger sample sizes, some of which don't even require human respondents. This increase in automation will increase both the speed and accuracy of Neuromarketing insights going forward.

Conclusion -

With the means of neuromarketing, we can find out how the consumers behave and make decisions while accessing the unconscious emotions, thoughts, feelings, and desires which trigger us the purchase decision. Neuromarketing can help us understand how unconscious mind processing influences the decision to purchase, providing a better understanding of the consumers' emotions, thoughts, feelings, needs, and motivation in relation to the marketing products.

Reference

For the source of information collected-

1.https://bhcg.medium.com/neuromarketing-20d97d6aa1cf

2. https://hbr.org/2019/01/neuromarketing-what-you-need-to-know

3.https://www.researchgate.net/publication/330422858_Neuromarketing

Science of Addiction

Illustrated by Stuti Doshi, BA (Hons)

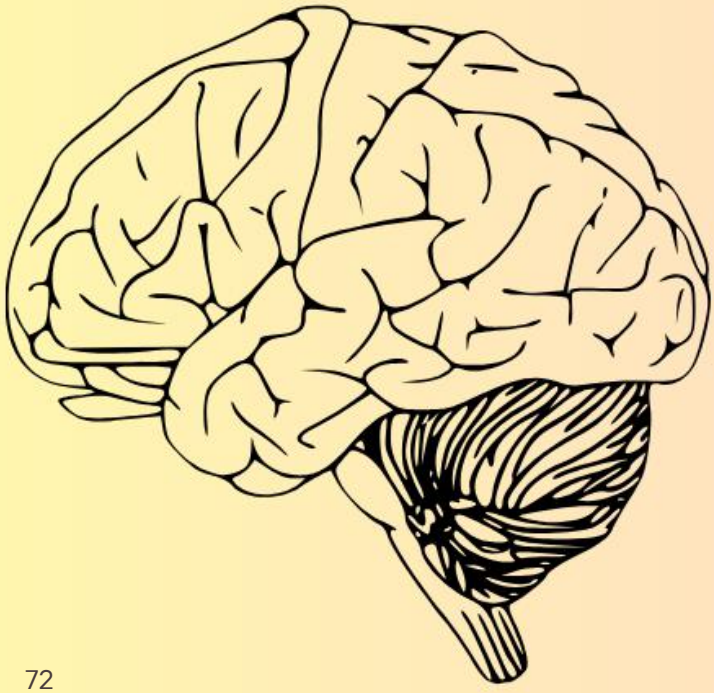
WHAT is addiction?

Addiction is defined as a chronic, relapsing disorder characterized by compulsive drug seeking and use despite adverse consequences.It is considered a brain disorder, because it involves functional changes to brain circuits involved in reward, stress, and self-control.

WHY do people seek drugs?

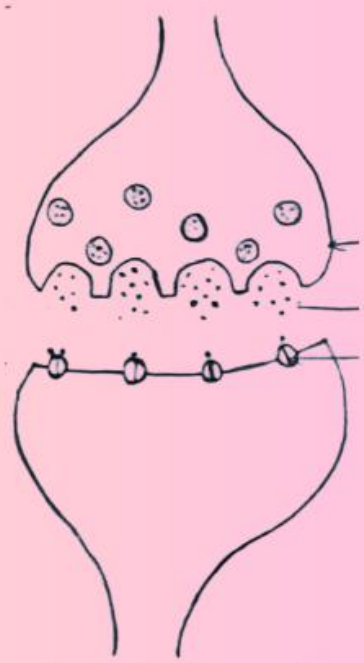
The most common reason people (especially teenagers) indulge in drugs is trying out of curiosity or peer pressure. People take drugs "to feel good" since they produce a feeling of euphoria (intense pleasure), to feel relaxed or to get relief from stress, anxiety and other negative symptoms and it's also taken to increase/enhance one's performance since it boosts confidence and gives a sense of heightened energy.

The prefrontal cortex:
is responsible for thinking, organising, problem-solving, decision-making, and exercising self-control over urges. A person with a substance use disorder will persistently pursue the drug because of a shifted balance between this circuit and the circuits of the basal ganglia and expanded amygdala.



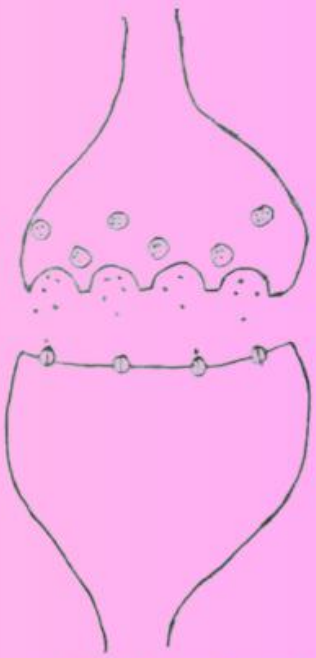
The basal ganglia:
which is involved in habit formation and positive kinds of motivation such as the pleasures of healthy activities like eating, socialising, and sex, are among the brain regions that are impacted by drug use. These regions serve as a crucial node in what is occasionally referred to as the brain's "reward circuit." The euphoria of the drug high is produced when this circuit is overactivated by drugs. However, after repeated exposure, the circuit becomes less sensitive to the drug's presence and finds it more difficult to experience pleasure from sources other than the drug.

Enlarged amygdala:
Stressful emotions like worry, anger, and uneasiness, which characterise withdrawal when the drug high fades and encourage the person to seek the drug again, are influenced by the enlarged amygdala. As drug usage increases, this circuit becomes more sensitive. Over time, a person with an addiction uses drugs to temporarily relieve this discomfort as opposed to becoming euphoric.



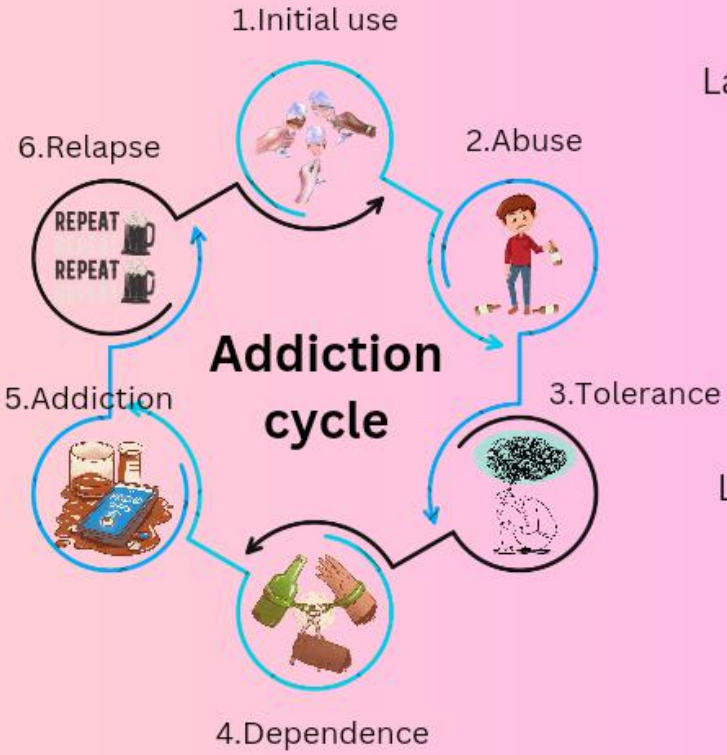
Natural release of dopamine (While eating, drinking water or having sex)

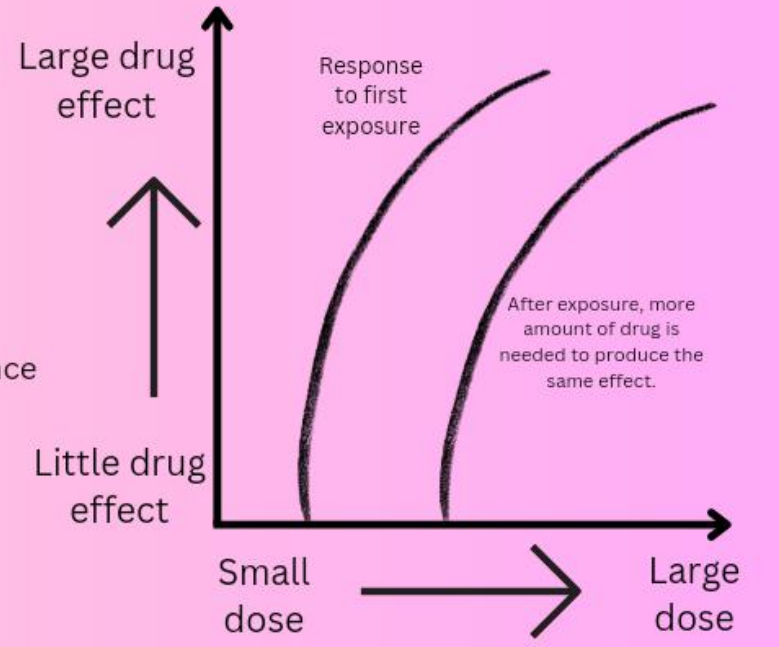
Excess release of dopamine (After intoxication of substance)



Lower than normal release of dopamine (Due to development of tolerance)

Comparision of neurotransmitter release





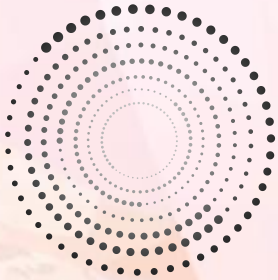
Drug dose vs drug effect graph

Contributors

Aarohi Desai
Fourth Year, Integrated MS
Throughout my academic journey in university as well as high school, I have come across several inaccessible (and slightly ugly) scientific schematics which completely miss the mark. Personally, this scientific illustration was my first shot to switch things up for my audience, including students. Science, especially science at the molecular level, not seen by the human eye is best understood by creative visual representation. With my keen interest in illustration, I attempted to make an illustration explaining the wonders of aquatic bioluminescence without oversimplifying it for the reader. Here's hoping my illustration sparks more ‘ohh!’s than 'huh?'s :)

Ananya Aggarwala
BBA (Hons)
I am passionate about animals and love volunteering at my local animal shelter. I wanted to write about honey bees because of my passion and interest in animals and biology. Honey has always been a part of our daily diet; most days, our days start with a honey meal, used in green teas, pancakes, waffles, ice cream, etc. We have never dwelled in their hives and tried to understand how they work or how different they are from us. In my illustration, you can see a small but essential part of their life.

Ayush Chaurasia
BS (Hons)
I chose to illustrate black holes and general relativity because I am fascinated by the mystery of them. How can something be so powerful that it can trap even light? What happens to matter and energy that falls into a black hole? They resonate, “What happens in a black hole stays in a black hole.” I wanted my illustration to capture the beauty and mystery of black holes. I hope that my illustration will help people to learn more about black holes and to appreciate the mystery and wonder of the universe.



Chaitri Sengar
BA (Hons)
I am a visual artist and digital illustrator raised in Delhi majoring in Social and Political Sciences. My illustration is centered around experimental studies that locate communication and network patterns in fungi and mold activities. Many researchers have dedicated their efforts to tracing the complex and surprisingly comprehensive networking chains that slime molds branch into. This project enabled me to write freely and exercise diverse stylistic choices to generate a series of illustrations that inform the larger theme of fungal communication and networking.

Dhruvi Mewada
Integrated MS
I am thrilled to share my illustration on "Stem Cells: A New Frontier in Heart Disease Treatment." Delve into the intricate world of regenerative medicine where I unravel the incredible potential of stem cells in reshaping heart disease treatment. and show how these tiny cells could transform heart disease treatment. Dive into my illustration to discover the hope and breakthroughs that stem cell research brings to the table.

Khushi Khamar
BBA (Hons)
In management studies, where my science always stumbled, I discovered that science thrives in creativity. My weapon of choice: illustrations. My canvas? The complex realm of anxiety. Beyond the WHO-labeled 'most common' disorder lies a mysterious impact on our bodies. Through artistry, my illustration unravels the enigma, peeling back the layers to reveal the intricate Neurobiology of Anxiety. Join me on this visual journey through the science of the mind.

Kirti Pishe
BA (Hons)
I am an environmental enthusiast who believes it is crucial to let people know that climate change is real and affects us all in some way or another. We need to understand how we can play a part in mitigating it. The coral reefs being impacted means we also get affected. At the rate it is going, we don't have a choice but to care and believe we have a fighting chance. Through this illustration, I hope to showcase the importance and getting more people involved in this growing concern.

Krishna Shah
BBA (Hons)
My reason for illustrating the "Journey of a Star" is to blend artistic expression with educational outreach. Creating a visual narrative of a star's life cycle engages viewers in the awe-inspiring cosmic ballet, fostering scientific curiosity and understanding. Such an illustration serves as an accessible tool for science communication, breaking down complex astrophysical concepts into digestible visuals. Beyond personal artistic fulfillment, my work could inspire students, enthusiasts, and the public to appreciate the celestial journey of stars, bridging the gap between art and science to cultivate a broader understanding of the wonders of the universe.

Lalit Chowdhary
BS (Hons)
I am majoring in Computer Science and interested in Systems Programming and Astrophysics. In the vast expanse of space, where galaxies co-exist, a hidden symphony, not of sound but of gravitational waves – ripples the fabric of spacetime itself. Unlocking the secrets of these elusive waves has been an ever-longing quest for astrophysicists. My Illustration talks about Laser Interferometer Gravitational-Wave Observatory, or LIGO, stands as the instrument through which humanity has begun to decode this mystery.

Malay Mehta
BBA (Hons)
I have made a digital illustration of Mantis Shrimps, which explores how these crustaceans attack their prey. This topic came to my mind when Professor Rama Ratnam delivered a guest lecture on how an owl catches its prey. Similarly, I thought of other creatures living in the ecosystem with a unique attack mechanism which is unknown to us. My illustration explores the attack mechanism and supporting features it has.

Mitul Gohel
BBA (Hons)
I have always been fascinated by space, with movies serving as a significant source of inspiration. However, I'm not content with just the cinematic portrayal; I actively follow the latest developments in the field. This curiosity has led me to explore and compare two widely used spacecraft propulsion systems, analyzing how they've contributed to cost-effective space travel. My illustration bridges my passion for space with my academic pursuits, merging my interest in finance and accounting with space exploration.

Poorva Nahar
BA (Hons)
I am majoring in Economics. Despite my academic focus, my fervor for fine arts has remained constant. At the age of 16, I faced an unexpected diagnosis of Ulcerative Colitis, an experience that fueled my determination to raise awareness. Turning to digital illustration as a means of expression, I endeavor to communicate the nuances of living with Ulcerative Colitis. I would like to thank the Professors for allowing me to share a glimpse of my academic and artistic journey.

Raj Patel
BTech (CSE)
Come with me and advocate for sustainable agriculture. As someone who travels between the worlds of science and storytelling, I want to show you how CRISPR could help solve the global food crisis. With CRISPR, we can create plants with custom traits, like drought resistance or higher nutrient content. This could help us reduce our reliance on chemicals and create a more sustainable food system. Join me on this journey as we explore the balance between innovation and responsibility, and cultivate a hopeful narrative for the future of our fields.

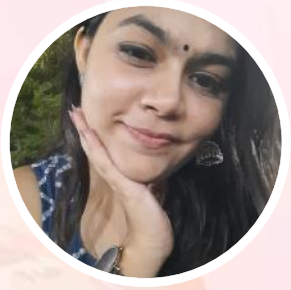
Rishi Agrawal
BBA (Hons)
I am majoring in Accounting and Finance. The thing that motivated me to choose this topic was my curiosity about dreams. I often see dreams and was curious about how these dreams occur and how the brain functions. As this course required a science communication topic I decided to work on my curiosity and it turned out to be quite fun. This course helps us to think beyond our ability by bringing the scientific perspective

Sanjana Kataria
BA (Hons)
I am majoring in Economics. My project is all about "Unlocking Genetic Power with CRISPR." I chose this topic because I'm excited about how CRISPR could completely change genetics and make a big difference in people's health. It's a really cool technology that could help cure diseases and maybe even make new kinds of living things.

Shraddha Chaplot
BBA (Hons)
Hola, readers! I am an avid explorer of the creative cosmos. Driven by an unwavering passion for creativity and insatiable curiosity, I have embarked on a captivating journey into the world of biomimicry for my scientific illustration. Picture this – nature is akin to a 'choose your adventure' book, and the page I couldn't resist turning to was Biomimicry. I've embarked on a mission to unveil the fascinating story of the Kingfisher's beak and its intriguing connection with the Bullet Train. So, buckle up as we journey to the crossroads of art, science, and imagination.

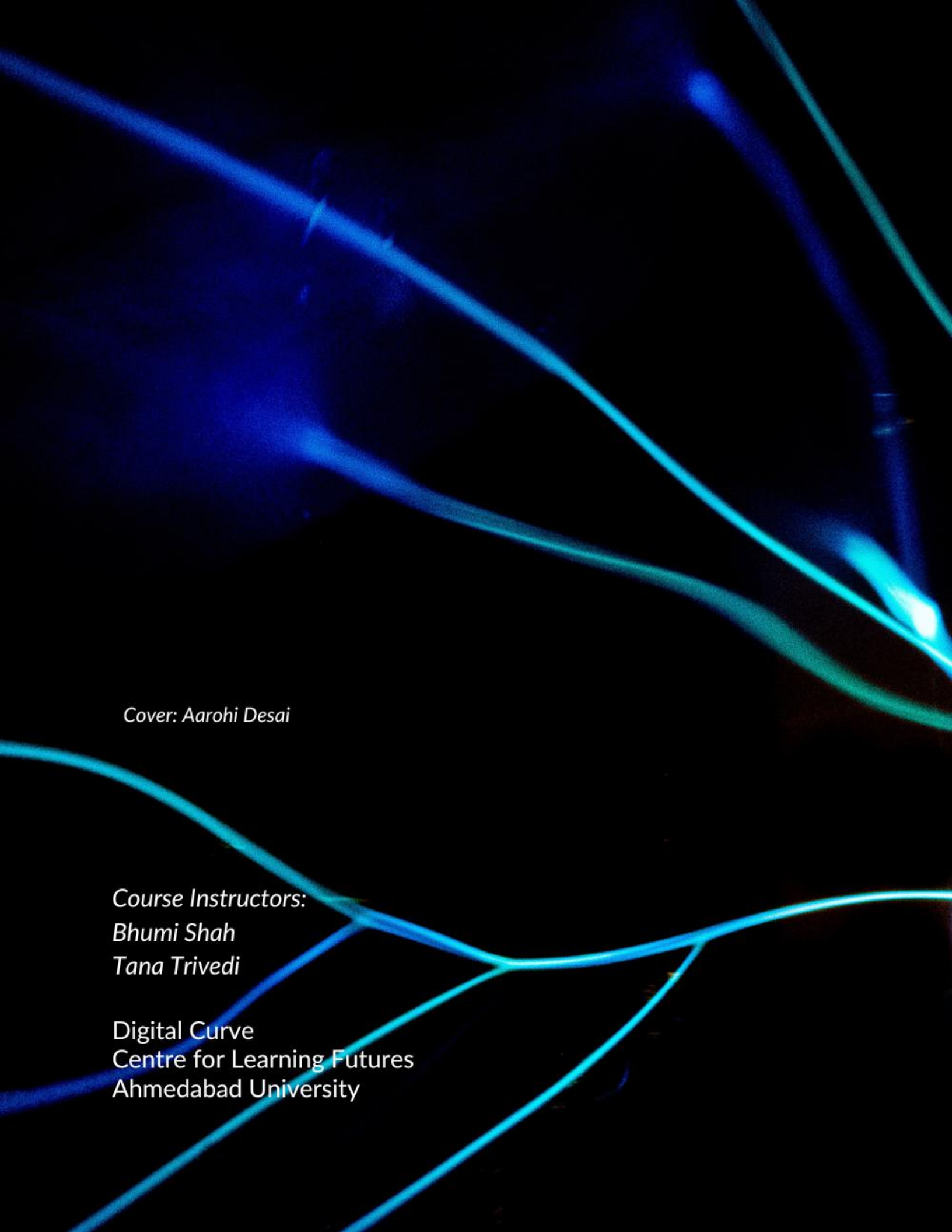
Sparsh Tiwari
BBA (Hons)
I have a passion for exploring the intersection of Business and Neuroscience. In my illustration, I delve into the fascinating realm of neuromarketing, where the mind meets marketing strategy. Through vibrant visuals, I aim to capture the intricacies of consumer behavior influenced by subconscious cues. As a student fascinated by the dynamic landscape of business psychology, my artwork reflects the allure of decoding the human brain in the context of marketing, merging analytical thinking with creative expression. Join me on this cerebral journey through the lens of neuromarketing in my illustration for a visual exploration of the mind's influence on consumer choices.

Sridharshiny KV
Integrated MS
My illustration is about black ghost knife fishes that I am currently working with. These enigmatic creatures have been the subject of various studies to understand their electrical properties. An interesting fact, all the initial works in the field of electricity started from electric fishes. Through this illustration, I am trying to share information about these fishes that fascinated me the most!



Stuti Doshi
BA (Hons)
I recently completed an internship in a de-addiction hospital here in Ahmedabad and it helped me understand the science behind addiction. Addiction is a prevalent issue in the current youth but not many know the cycle of addiction and how it affects the human body negatively. This was an opportunity to reach a larger audience and share some basic information about addiction.

Tanvi Mehta
BBA (Hons)
I like to dwell myself in the world of technology and literature. With a passion for learning, I chose this topic ‘Seeing the spectrum : A canine’s View of World’ as it offers insights into their sensory perception, color vision limitations, and night vision capabilities, providing a unique perspective on how they experience the world and how different fur balls are from us!



Cover: Aarohi Desai

Course Instructors:
Bhumi Shah
Tana Trivedi

Digital Curve
Centre for Learning Futures
Ahmedabad University