

DECRYPTED



BY FSA CLUB

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Dear Readers,

In this month's issue, we delve into a fascinating array of scientific discoveries and facts. From the mysterious glow of deep-sea bioluminescence to the breathtaking formations of rock and water that shape our planet's surface, we take you on a journey from the ocean's depths to the earth's highest peaks.

Prepare to have your neurons firing as we unravel the intricate connections between science and nature. You'll discover articles on the extraordinary 'super senses' of animals, and the profound impact substance abuse has on the human mind.

This edition is a special one, driven by the passions of our writers. It's a collection of the most intriguing insights into the ever-evolving world of science, sure to leave you captivated and curious.

We hope you enjoy this exciting exploration!

Warm regards,

Adya Joshi

Editor-in-Chief

UNDERSTANDING MAGIC MUSHROOMS

how do they affect our brain ?

Varsha R Reddy 8D

The world of mushrooms is quite interesting, the different types and uses make it quite ironic. They can be lifesaving or fatal, delicious and nauseating. We have been using these mushrooms for medicinal purposes for aeons. I found 'Magic Mushrooms' AKA psilocybin mushrooms AKA psychedelic mushrooms interesting. And apparently, they have been used for a long time.



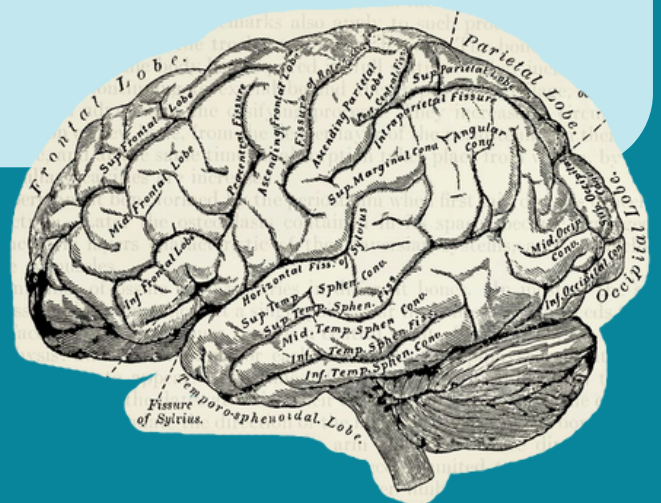
When you eat these magic mushrooms, they kickstart this amazing chain of events within your brain. They activate the default mode network (DMN), which is all about self-reflection and deep thinking. Plus, they mess with serotonin receptors, especially the 5-HT_{2A} type, which amps up connections between different parts of your brain. This whole process leads to some pretty wild changes in how you see things, feel emotions, and experience the world around you.

Magic mushrooms are composed of several complex elements, so they are intricate in their chemical composition. They are mainly composed of psilocybin ($C_{12}H_{17}N_2O_4P$) and psilocin ($C_{12}H_{16}N_2O$) these are the very components that affect our brain.

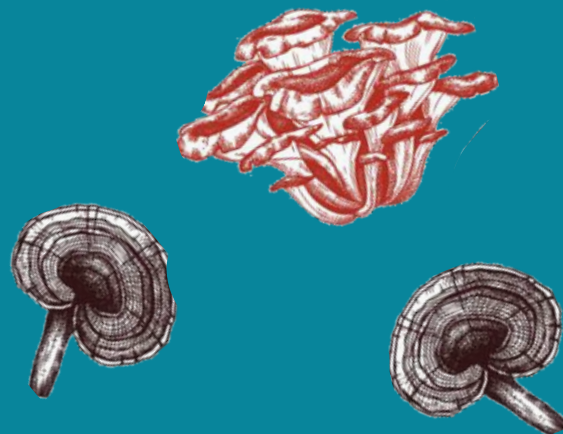
As you can see, the two compounds are made up of the same elements and vary only a little. These compounds belong to the indolealkylamine class, the indolealkylamine class affect serotonin which is basically a hormone that makes us happy, so they are well-known for how they mess with your mind and make you think differently.



Psilocybin mainly affects the cerebrum, the largest part of our brain which is responsible for sensory activities and voluntary movement. It targets areas such as the prefrontal cortex, which influences decision-making and introspection, and the limbic system, which handles emotions and memories (Heads Up: this can take you on an emotional ride). *The visual cortex, at the back of the brain, alters how we see things, often leading to vivid visuals and altered perception of colours and patterns.* It confuses your visual and auditory systems and makes you see sounds, and hear sights. Weird, right? Your pupils dilate, your heart rate spikes and your body temperatures go on a rollercoaster ride. Of course, no rollercoaster ride is complete without nausea, so you will feel very uncomfortable and feel like throwing up. You'll probably feel unusually happy, or connected with your surroundings, but trust me, that isn't going to last.



Do you remember those magic toadstools in the fairytales we used to read? And how the fairies and pixies always had huge eyes and small pupils, and they were always happy and extremely energetic? Does that ring a bell? Well, I think that these stories were written after people observed the people who ate these mushrooms and they developed these characters based on them.



In some places, the mushrooms are illegal, but in others, they're used for medical purposes. There are concerns about their safety, and it's important to have clear rules and regulations. Mushrooms can cause terrifying thoughts, paranoia, panic attacks, death fears, and in rare cases, death. But there is always more room for knowledge, scientists are already on the clock, researching the therapeutic potential of magic mushrooms. Doctors are trying to treat people with various mental health disorders and understand how they work in the body. Who knew that the yummy mushrooms in that pizza had such amazing, cool cousins?



The Formation of a Star

Kaina Tanwani 8D

Looking at the sky, we can see stars that are among the most enchanting and attractive things in our universe. It is complex as well as very interesting to learn about star formation that involves forces of gravity, gases, and high temperatures.

The start of a stellar birth occurs when a cloud of gas and *dust called a nebula collapses due to the pull of gravity*. The hotter it gets, the more the cloud collapses into itself until a protostar forms.

At some point, the **protostar will have contracted enough that nuclear fusion can begin in its core**. Nuclear fusion occurs when hydrogen atoms combine together forming helium thus releasing unimaginable amounts of light and heat. This very hot and bright center is what we call a star seen from afar in our night sky.



As the star continues fusing hydrogen into helium in its core, it finds an equilibrium between inward pressure caused by gravity versus outward pressure from radiation. It's this balance that allows the star to glow consistently for billions of years.

Mass determines size, temperature, and colour of stars with even hotter but dimmer ones being physically bigger than many others like red dwarfs or white dwarf stars being small. Red giant is one example of these types which happens when a smaller star runs out of fuel causing it expands

making it cooler hence red in colour but few such kinds exist because neutron stars and white dwarfs alike come from them.

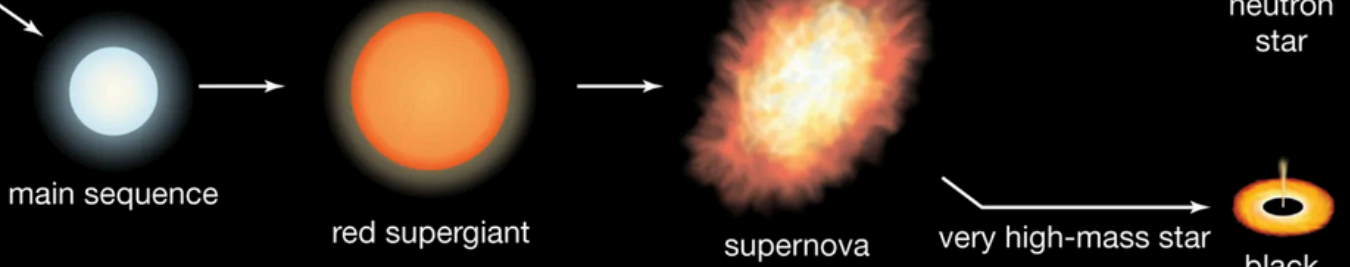
Stellar evolution

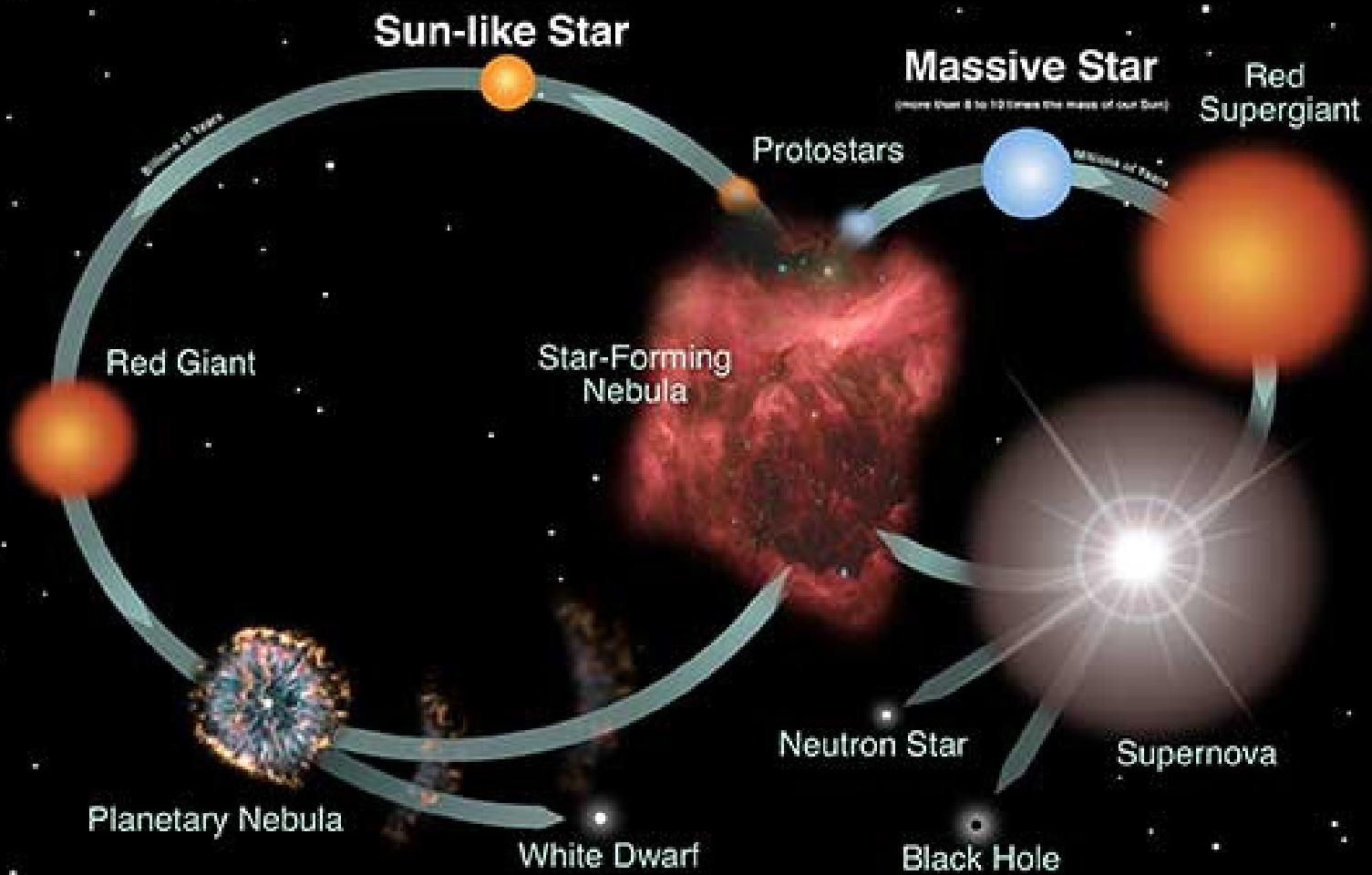
low- and medium-mass stars
(including the Sun)



nebula

high-mass stars





As stars evolve, their fate is largely determined by their initial mass. While some stars end their lives quietly as white dwarfs, others may explode as supernovae, leaving behind neutron stars or black holes. The life cycle of a star is a testament to the intricate balance of forces and the complex processes that govern the universe. From their fiery beginnings to their eventual demise, stars continue to play a pivotal role in shaping the cosmos, offering us a glimpse into the vast and dynamic nature of the universe.

Super Senses:

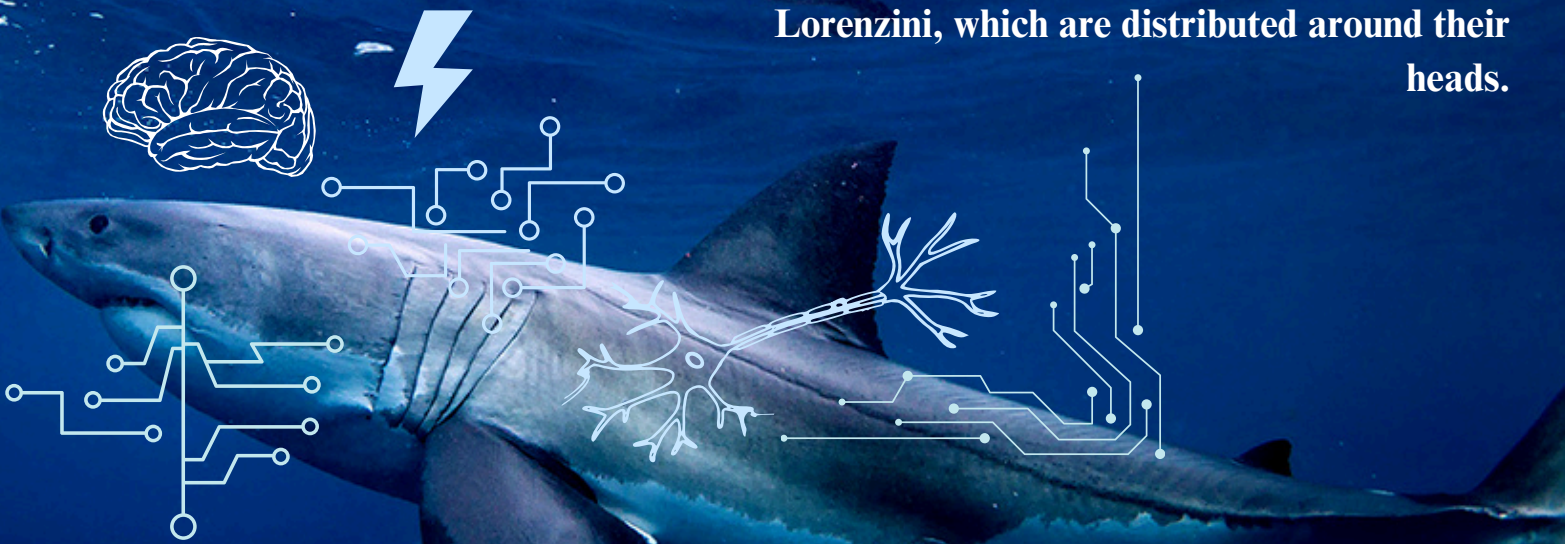
How Animals Perceive the World Beyond Human Capabilities

Indira Mallick 8C

All of us when we were kids hoped for superpowers, something that made us different or unique. Us humans unfortunately can only perceive the world through 5 sense but many animals posses extraordinary capabilities to perceive it in different ways. This article dives into the fascinating world of super senses, exploring the science and wonders behind these enhanced abilities.

One of the most formidable creatures of the ocean possesses a unique ability known as *electroreception*.

This ability allows Sharks to detect the electric fields produced by the muscle movements of their prey. This ability is made possible by a special sensory organs called ampullae of Lorenzini, which are distributed around their heads.



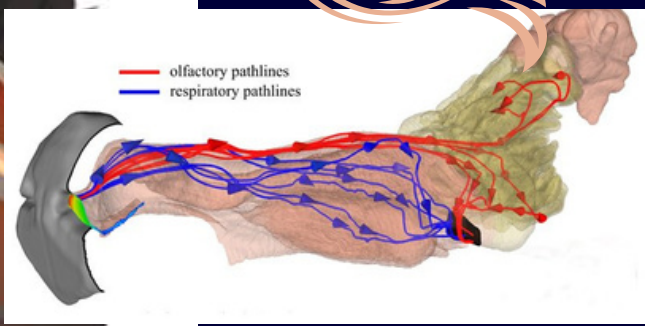
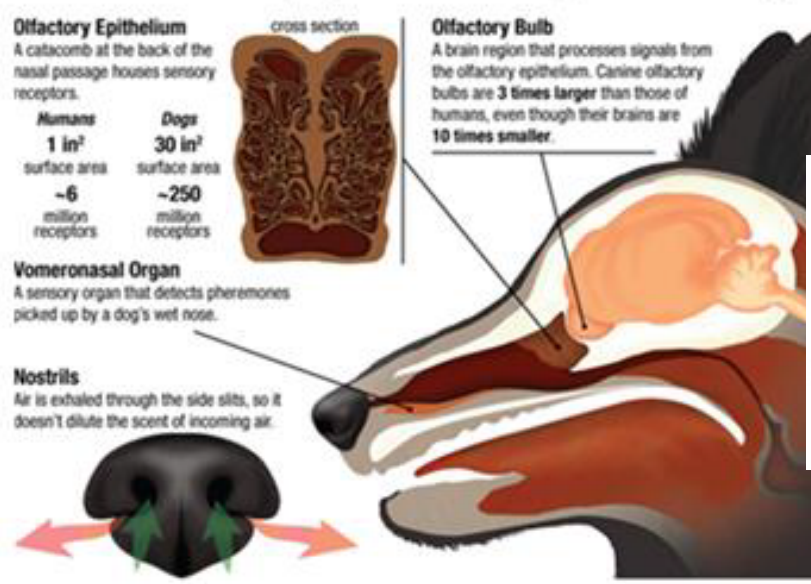
The ampullae of Lorenzini are filled with a conductive gel that can detect even extremely tiny electrical signals in the water. These signals are transmitted to the brain for processing. Sharks have a highly advanced sensory system that enables them to interpret and understand these electrical signals accurately. This allows them to locate hidden and camouflaged prey.



Even the animal who is said to be man's best friend is unique in its own way with this ability. Their keen sense of smell sets them apart from humans, it is said to be 10,000-100,000 times stronger than humans.

Even the animal who is said to be man's best friend is unique in its own way with this ability. Their keen sense of smell sets them apart from humans, it is said to be 10,000-100,000 times stronger than humans. This ability even helps them sniff out things like explosives and diseases. **Dogs have 300 million olfactory receptors in their nose and the part of a dog's brain dedicated to analysing smells is proportionally 40 times larger than that of humans.** The olfactory system in dogs is extremely advanced, quick and efficient, there is direct connection between olfactory receptors and their brain. This allows dogs to process and identify smells rapidly and accurately.

Canine Upper Respiratory Tract

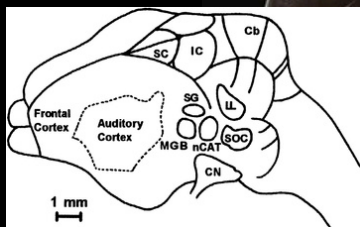


Hover over the image to enlarge it.

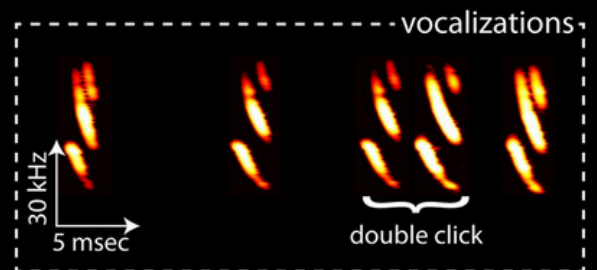
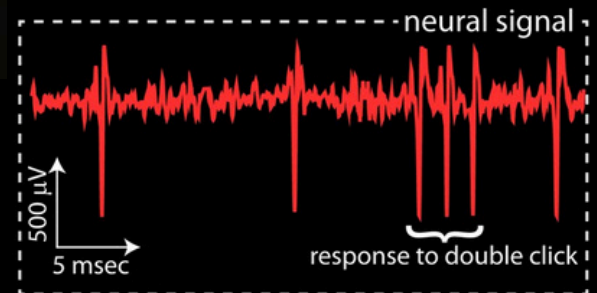


Bats are nocturnal, therefore they need help in catching and hunting prey in the dark. Luckily they have an ability known echolocation. They emit high frequency waves that bounce off objects and produce echoes.

These echoes are then analysed by their highly advanced auditory system. Echolocation allows bats to locate prey and objects in their way and their size with extreme precision. Bats have adapted larynxes which permits them to produce such high frequency sounds, their ears have also have been fine tuned to detect such frequencies.



Their ear structure helps them capture the echo efficiently. **The auditory cortex of bats is highly developed, allowing them to process the returning echoes rapidly and accurately.** This part of their brain is capable of interpreting complex auditory information, effectively creating a mental map of their surrounding.



These extraordinary sensory capabilities possessed by animals provides valuable insights into the world of nature. They possesses capabilities that help them perceive the world kn a way humans can only imagine. By continuing research and exploration of super senses in animals we can unlock new possibilities in science and technology, improving our ability to interact with and understand our environment.

Astrophysical Marvels

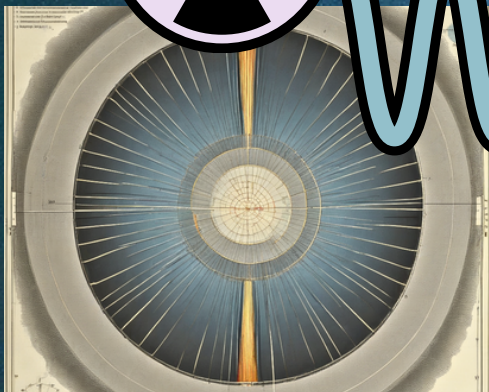
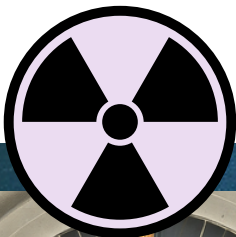
Urvi Shah 8C

Astrophysics is the study of the physical and chemical structure of the stars, planets, and other natural objects in space.

Astrophysicists seek to understand the universe and our place in it.

When we study astrophysics, you apply the concepts and theories of physics to astronomic observations. Astrophysicist came first, from the Greek aster, or "star," and ta physika, "the natural things," or "natural science

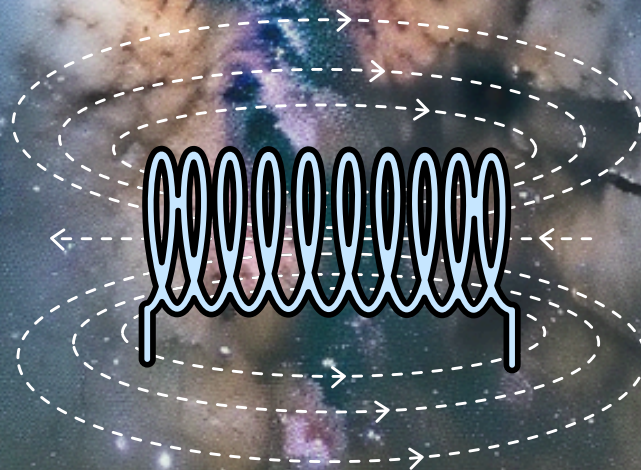
Astrophysical processes involve the scatter and the optics of neutrons, X-rays, gamma rays, and charged and neutral particle beams, which interact in mediums of varying density, composition, and shape, with imposed electromagnetic and gravitational fields.



Angelo Secchi is regarded as the father of astrophysics.

His birthplace was Reggio Emilia in Italy and he died in 1878, on 26th February while in Rome.

Also, Angelo was a renowned mathematician and physicist who had a great passion for astronomic studies.



There are two types of astrophysics:

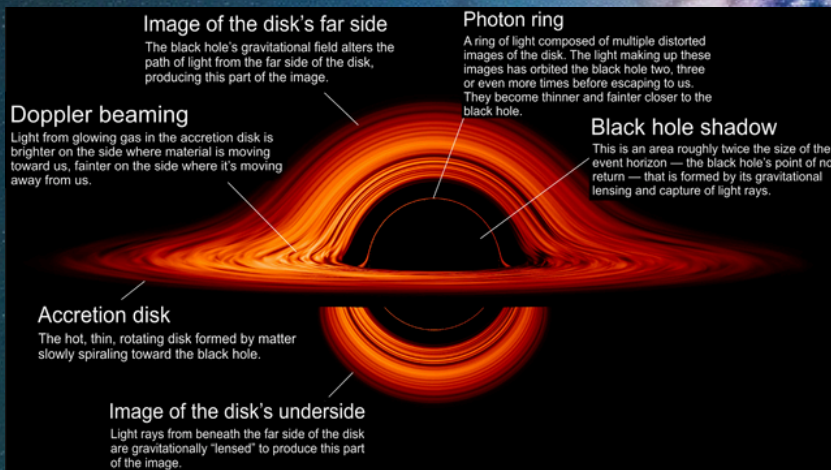
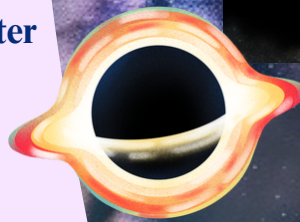
- . observational
- . theoretical.

Observational astrophysics is about recording data. Most data is recorded using the electromagnetic spectrum.

Theoretical astrophysics includes mathematical models for astronomical systems, along with templates to fit to new results when they arise.

BLACK HOLES:

A black hole itself is invisible. But astronomers can still observe black holes indirectly by the way their gravity affects stars and pulls matter into orbit. As gas flows around a black hole, it heats up, anomaly making these invisible objects into some of the brightest things in the entire universe.



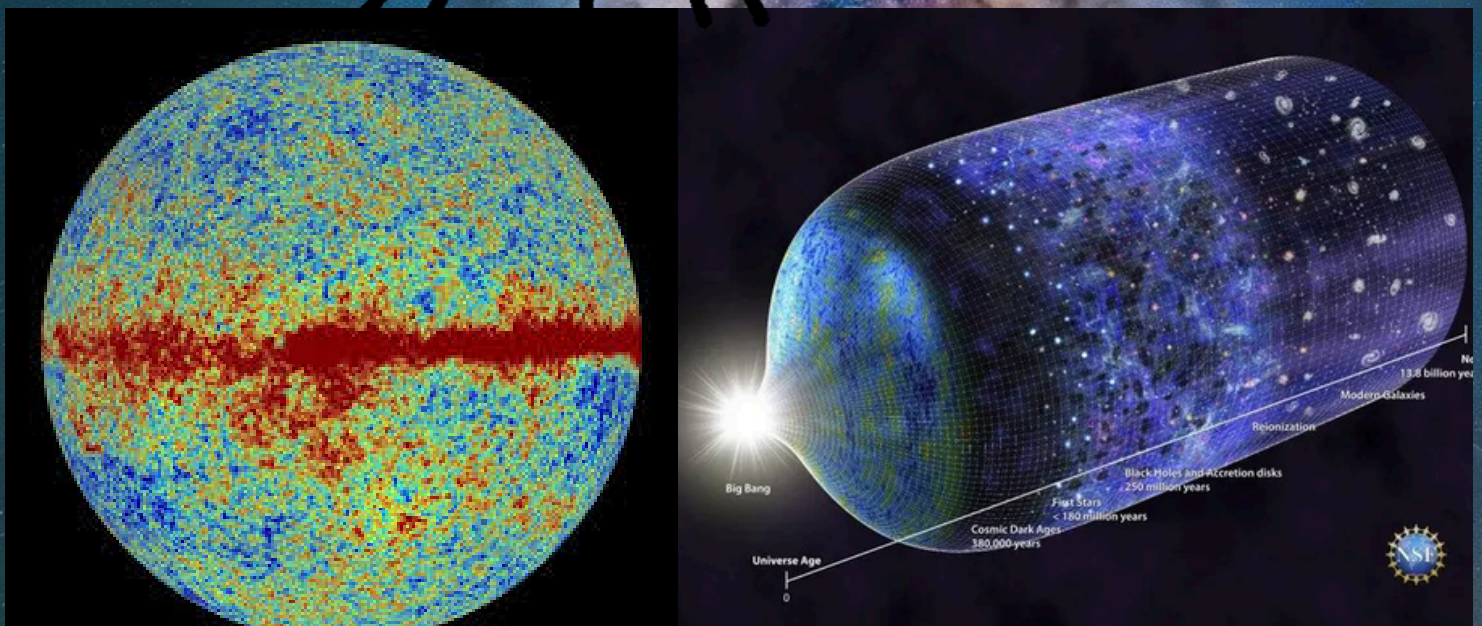
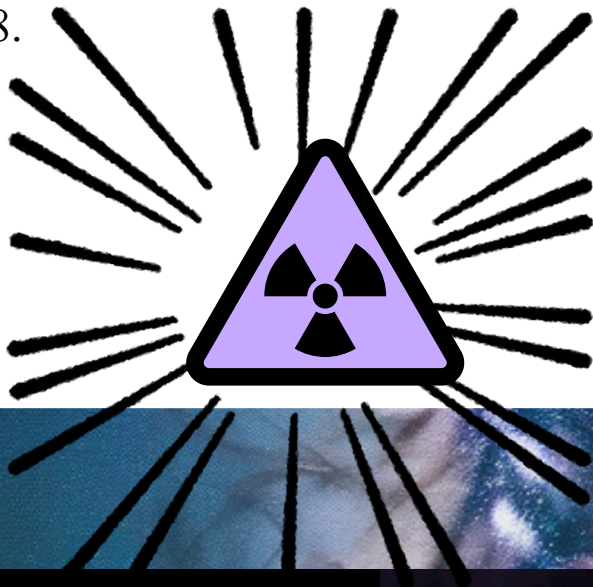
SUPERNOVAE:

The hot material given off by the supernova, the radioactive isotopes, and the free electrons moving in the strong magnetic field of the neutron star, all these things produce X-rays and gamma rays. These high-energy photons are used by astrophysicists to study the phenomena of neutron stars and supernovae.

COSMIC MICROWAVE BACKGROUND RADIATION (CMB) : The Cosmic Microwave Background is the remnant of the first light that could ever travel freely throughout the universe. This ‘fossil’ radiation, the furthest that any telescope can see, was released soon after the ‘Big Bang’

DARK MATTER AND DARK ENERGY:

Dark matter pull galaxies together, while dark energy pushes them apart . Astronomers measure the expansion of the universe using the explosives of white dwarfs , called type Ia supernovas , which led to the discovery of dark energy in 1998.



The Enigma of Bioluminescence

Nature's Radiance

Sarah Shahpurwala 8C

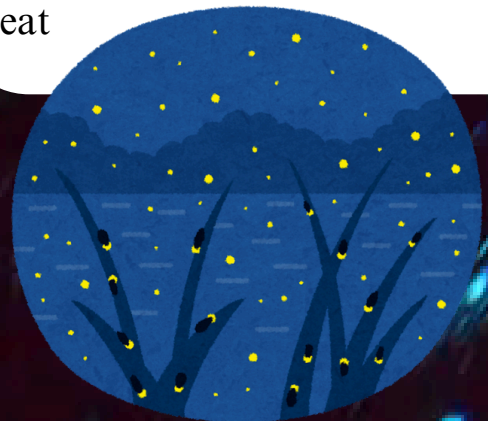
Bioluminescence is the ability of certain organisms to produce their own light, and is one of nature's most enchanting phenomena. Bioluminescence occurs widely in marine vertebrates and invertebrates, as well as in some fungi, microorganisms including some bioluminescent bacteria, and terrestrial arthropods such as fireflies. Other than being nature's spectacular visual marvel, **this glowing ability is vital for the survival of the organism.** These organisms use their light for many purposes. They can use their abilities for repelling predators, attracting mates, and camouflaging.

the principal chemical reaction in bioluminescence involves a light-emitting molecule and an enzyme, generally called *luciferin and luciferase*

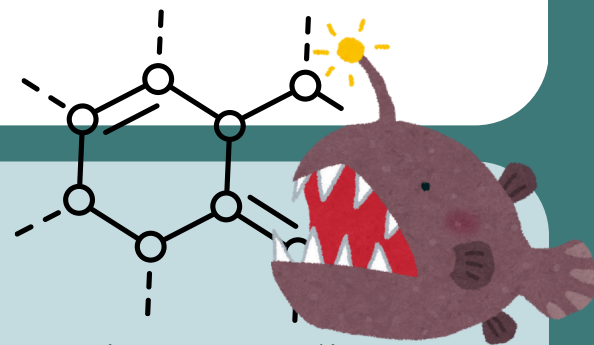
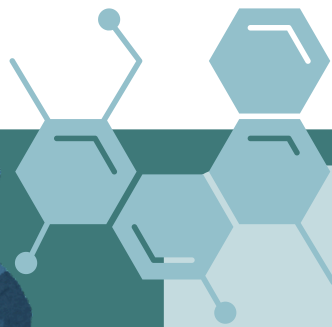


Luciferin when interacted and combined with **oxygen and ATP**, produces light with impressive **efficiency**. Almost all this energy is converted into light, using minimal heat

Bioluminescence is a "cold light." Cold light means *less than 20% of the light generates thermal radiation, or heat*. Conventional artificial lights are inferior to "Cold light", as artificial lights waste most of their energy as heat.



Bioluminescent markers are used to track gene expression and monitor cellular processes, in the medical field. It is useful to scientists who monitor the spread of infections and observe the behaviour of cancer cells in real time and molecular biology to study gene expression and protein interactions. These markers help in imaging and tracking disease progression in medical diagnostics. This innovative approach has significantly advanced our understanding of the biological systems and led to the development of much more effective treatments for cancer. Scientists have harnessed the power of bioluminescence, and have developed groundbreaking treatments for diseases.



Though this study has great potential, bioluminescence is an enigma, containing many unanswered questions. Researchers and scientists are still unravelling the mysteries of this ability as well as exploring its occurrence in various species, and investigating way to apply them in emerging technologies.

Certain organisms can adjust their luminescence in as a response to pollutants, which serve as sentinels for water quality. This innovative and *natural approach provides a cost-effective solution to detecting contamination, assessing aquatic health, and ensuring the sustainability of marine life.*

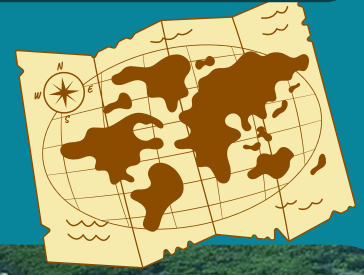


In conclusion, bioluminescence shows off its gorgeous displays in nature and also emerges as a helpful tool for environmental monitoring and scientific inquiry. As we continue to explore this remarkable phenomenon, we discover new ways to apply its power, creating a brighter future for our planet.

Strange and Magnificent Natural

Formations

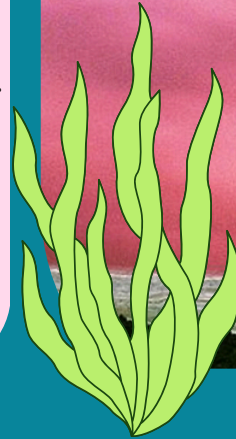
by Vihaan Arya



LAKE HILLIER - AUSTRALIA

Lake Hillier is an extremely salty saline lake off the coast of Australia, well known for its bubblegum pink colour, supposedly due to the presence of *Dunaliella Salina*, a **green algae found in waters with a high concentration of salt**. It causes the salt to create a red dye, giving it its pink shade. Halophilic bacteria present also contribute to the creation of the red dye.

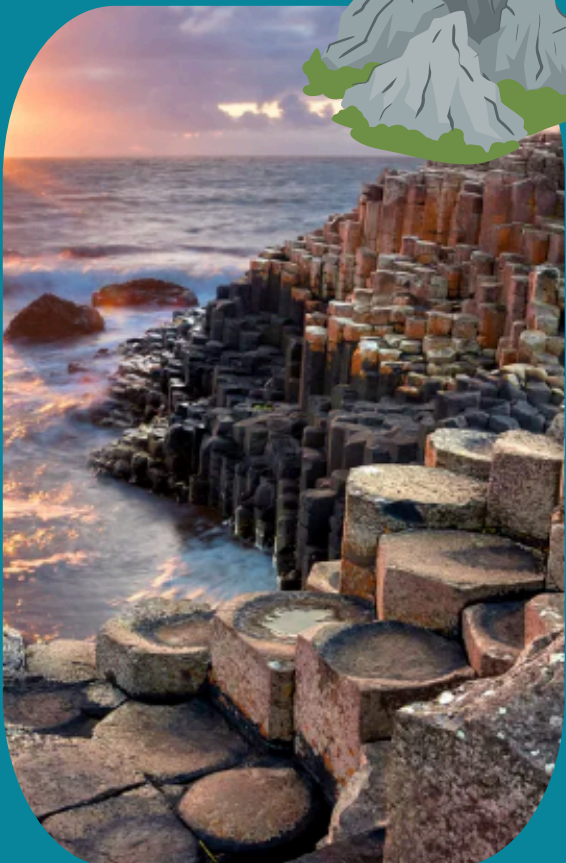
While this theory has been contested by others, it is the most accurate of the theories regarding the colour of the lake. This can be proved because while other pink lakes change colour occasionally, this lake stays pink perennially.



GIANT'S CAUSEWAY - IRELAND

Legend has it that two giants, Irish and Scottish, despised each other. After a heated exchange of words, the Irish giant built a path to Scotland to do battle with his foe, but the Scottish big destroyed the causeway, giving us the 40,000 peculiar basalt columns we see today at the northernmost tip of Northern Ireland.

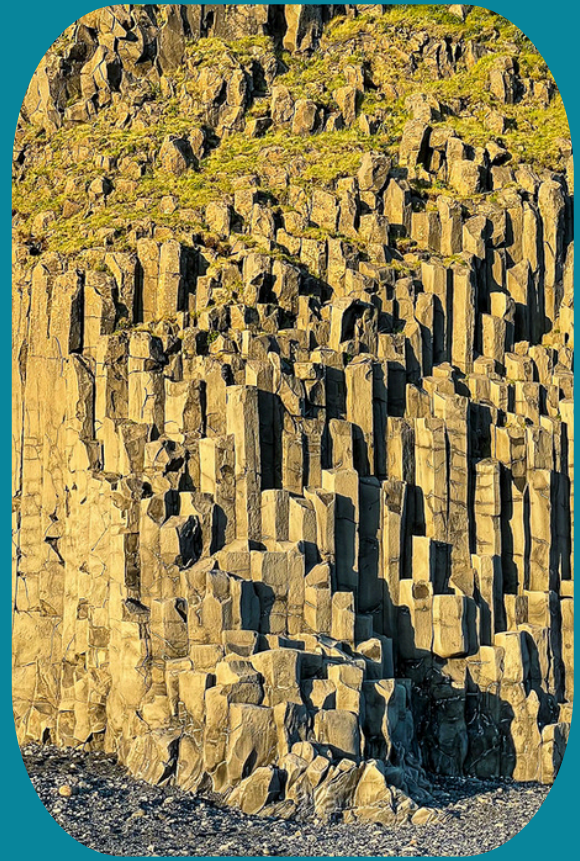
However, living in a world of science and technology, not magic and monsters, we have discovered that 60 million years ago, during the Paleogene Age, flows of lava moving towards the shore cooled. This process is called columnar jointing. The molten lava solidified and shrunk as it cooled, leading to a network of shrinkage cracks, forming the hexagonal pillars.



REYNISFJARA - IRELAND

Reynisfjara is a beautiful black sand beach in Vik, Iceland. Its sand was **originally volcanic ash that settled on the beach after the many eruptions of Katla, one of Iceland's largest and most famous volcanoes, and its smooth pebbles and stones that the remnants of basalt lava.**

The beach stretches for about 3 kilometres, but the most magnificent part of the beach lies in one corner of it. Basalt sea stacks formed due to ***columnar jointing*** just like the Giant's Causeway. Additionally, they also have a mythological tale behind them. It is believed that two trolls, this time companions, tried to pull a ship onto the beach. The two trolls were caught by the sunlight and petrified, turning into the pillars.



MARBLE CAVES - CHILE

Arguably the most breathtaking of all natural spectacles, the Marble Caves are found in the centre of Carrera Lake, Chile. For around 6000 years, the water of the lake has mixed with calcium carbonate, slowly creating the spectacular pure marble on the roof and columns of these marble caves. **The azure waters are reflected on the arches, giving them a rich blue hue, and parts of the marble can also be pink or green.** I can picture what a truly thrilling experience it would be to experience the magical sights of these caverns.



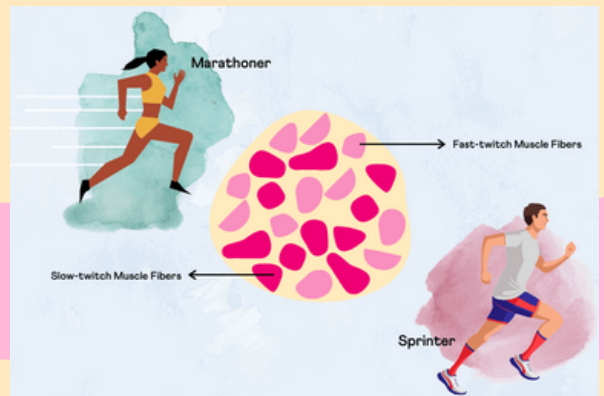
However, an increased amount of tourism to these formations can be highly detrimental to their fragile environment and this has also been expressed by many biologists. Lake Hillier is starting to lose its pink shade and Reynisfjara pillars are collapsing at an alarmingly high rate. Serious action must be taken to prevent the destruction of these dazzling wonders.

Playing with DNA: Genetic Superpowers

by Shreyasi Daga 8D

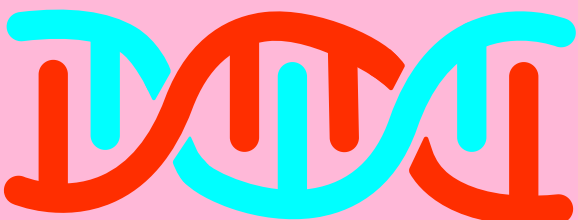
While genetic transformations into amazing superpowers are frequently depicted in comic novels and motion pictures, the truth is that some genetic variances can undoubtedly provide improved skills. Researchers are only now beginning to understand the genetic underpinnings of what are aptly termed "superpowers."

A well-known example of a "superhuman" genetic feature is the ACTN3 gene, also referred to as the "speed gene." The protein required for the fast-twitch muscle fibres that propel sprinting is encoded by this gene.



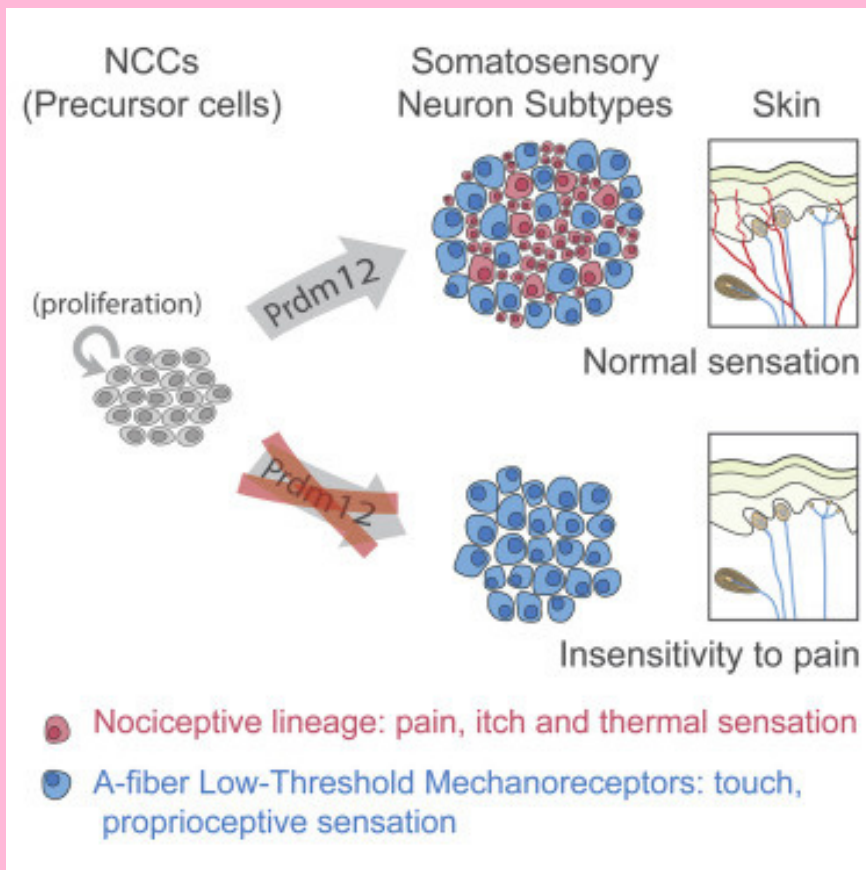
Because they typically have a higher percentage of fast-twitch muscle fibres, those with the RR genotype of ACTN3 are naturally superior sprinters[1]. Sprinters who are elite in Jamaica and Africa are more likely to carry the RR genotype.[1]

Insensitivity to pain is another inherited "superpower". alterations in genes such as Pain perception can be reduced or eliminated by SCN9A and PRDM12[4]. Though it might sound like a superpower, those who have these alterations are more likely to hurt themselves without feeling pain, which makes it potentially dangerous.



Certain genetic variants result in enhanced ability in particular domains. For instance, changes in the LRP5 gene may result in higher bone density, which would strengthen and be impervious to breaking bones[4]. On the other hand, fragility and abnormally low bone density can result from additional LRP5 transformations[4]

Although humans lack the capacity for flight or laser vision, genetic research has identified real-world examples of hereditary "superpowers." Scientists are hoping to learn more about these genetic variants and develop new treatments for osteoporosis and chronic pain as a result[4]. Thus, even though we might not be X-Men, there is some unexpected "superhuman" potential in the human genome.



Time Travel ~ *The Theory*

Jiyaan Gandhi 9C

Time travel is the hypothetical activity of traveling into the past or future.

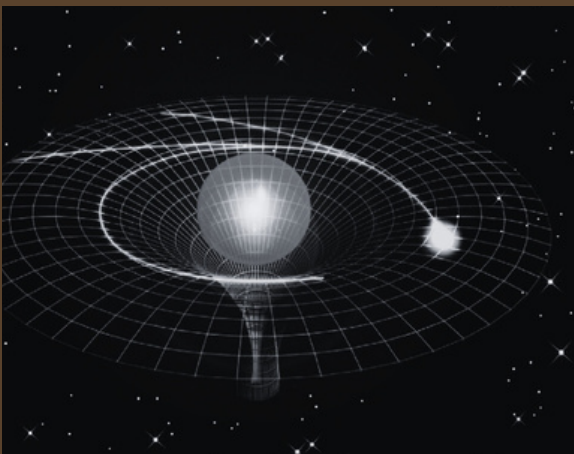
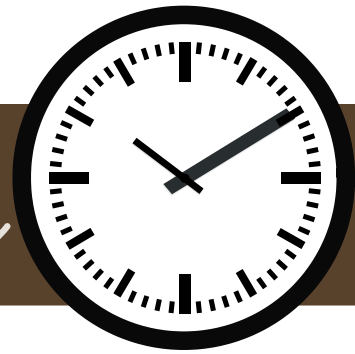
It is uncertain whether time travel to the past would be physically possible. Such travel, if at all feasible, may give rise to questions of causality. Forward time travel, outside the usual sense of the perception of time, is an extensively observed phenomenon and is well understood within the **framework of special relativity and general relativity.**



However, making one body advance or delay more than a few milliseconds compared to another body is not feasible with current technology. As for backward time travel, it is possible to find solutions in general relativity that allow for it, such as a rotating black hole.

Traveling to an arbitrary point in spacetime has very limited support in theoretical physics, and is usually connected only with quantum mechanics or wormholes.

Some theories, most notably special and general relativity, suggest that suitable geometries of spacetime or specific types of motion in space might allow time travel into the past and future if these geometries or motions were possible. In technical papers, physicists discuss the **possibility of closed timelike curves, which are world lines that form closed loops in spacetime, allowing objects to return to their own past.** There are known to be solutions to the equations of general relativity that describe spacetimes which contain closed timelike curves, such as Gödel spacetime, but the physical plausibility of these solutions is uncertain.



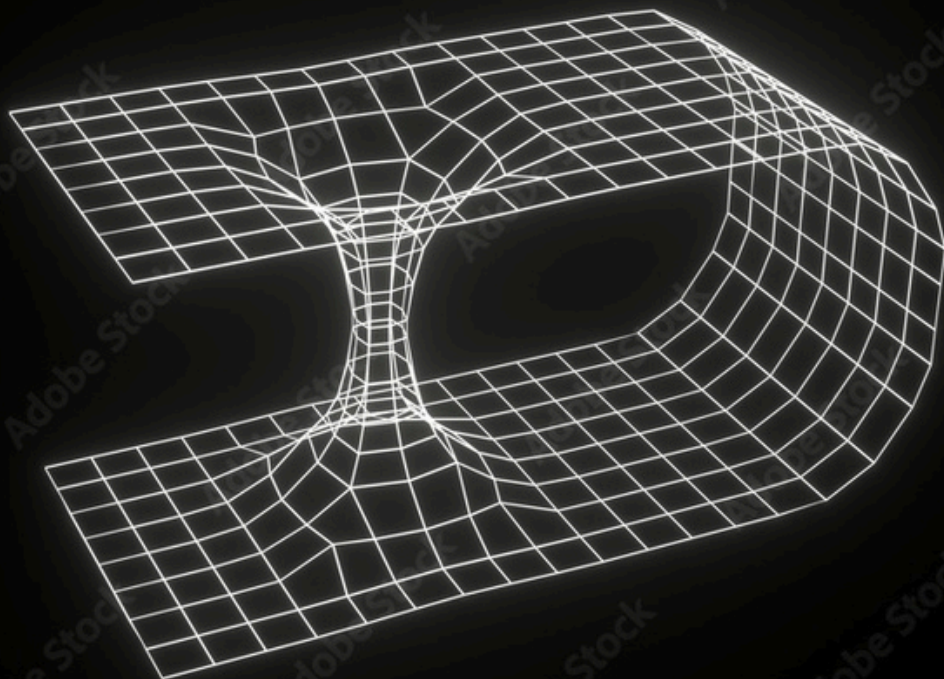
Many in the scientific community believe that backward time travel is highly unlikely to be possible. Any theory that would allow time travel would introduce potential problems of causality. The classic example of a problem involving causality is the **"grandfather paradox,"** which **postulates travelling to the past and intervening in the conception of one's ancestors** (causing the death of an ancestor before conception being frequently cited).

Some physicists, such as Novikov and Deutsch, suggested that these sorts of temporal paradoxes can be avoided through the Novikov self-

consistency principle or a variation of the many-worlds interpretation with interacting worlds

.However, the potential for time travel raises ethical questions, such as the potential disruption of historical events or the consequences of interacting with past or future versions of oneself.

Thus, time travel can be a double edged sword with both good and bad side effects.



geographical formations

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DNA

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[2]

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[3] https://powerlisting.fandom.com/wiki/DNA_Manipulation

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