SEP 2022

GENESIS

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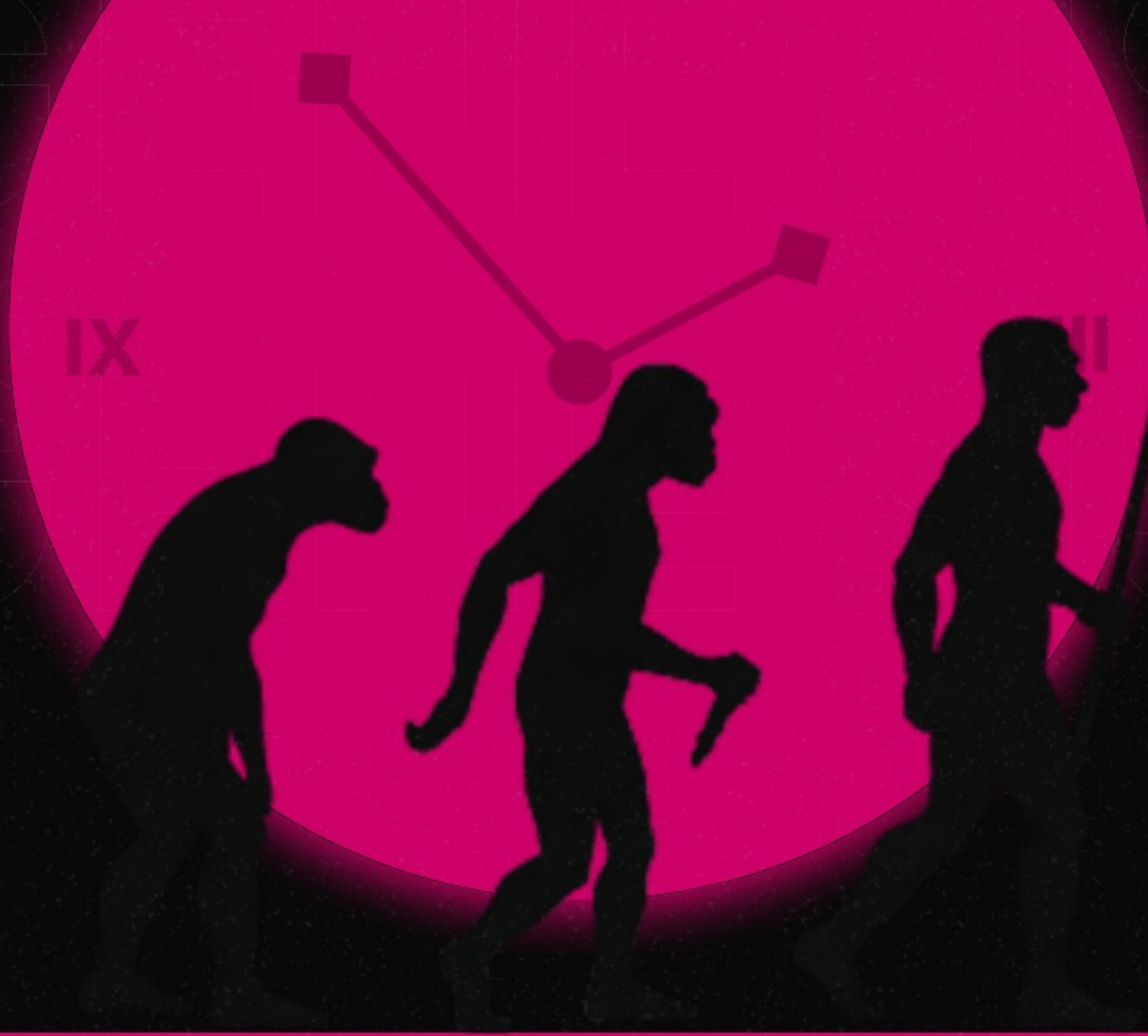

# GENESIS

TIMELAPSE

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"The laws of biology are the fundamental lessons of history"

*~ Ariel Durant*

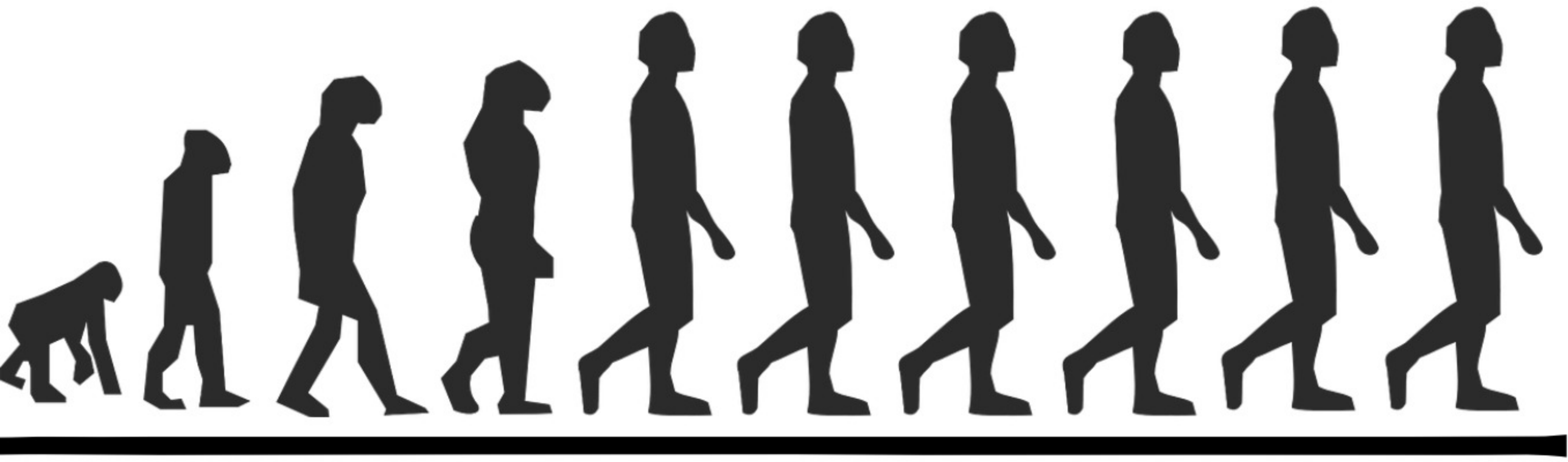
Biology can essentially be defined as the history of earth - its past , present and future. Everything we see around us has been a result of the interactions between life and its surroundings. Exploring this phenomenon is what would make us understand ourselves and our surroundings in a better way. Keeping this in mind , we have various articles that discuss the discovery and evolution of life .

We have a brief update on the research in goings in the Department of Biological Sciences and some interesting write-ups on the trending topics in biosciences. The inquisitive yet simple essence of these articles ensure that you will be able to enjoy the magazine despite your background.

**Yasaswini Sangu**
**Editor-in-Chief**

# ACKNOWLEDGEMENT

This magazine is a result of the work of various minds working towards a singular goal and would not have been possible without the lovers of science throughout the world who support the free and open nature of science . We thank them and hope they continue to inspire more minds with their works !



## INTRODUCTION

Genesis. Creation. Origin.

Humans have always searched for their roots, digging deeper into the unknown in search of our origins. Once upon a time, creation was thought to be a power wielded by higher beings. Wondrous tales of cosmic eggs and dragons spun from the mind's loom in an attempt to determine our place in the universe and our place among ourselves. The creation of creation myths themselves seem to be an attempt to find meaning in the chaos and develop a perfect social hierarchy. But as history and thermodynamics would tell, order seeks chaos.

# DISCOVERY OF LIFE

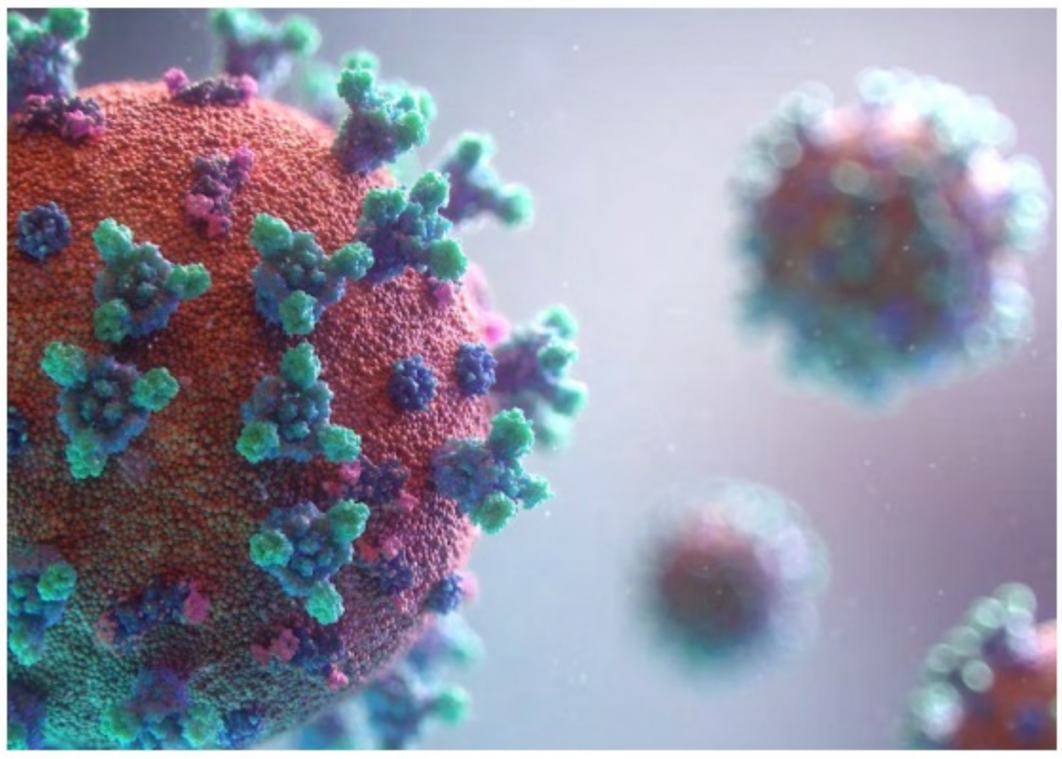
## UNDERSTANDING THE ORIGIN OF LIFE ON EARTH

To understand how life originated, we must first understand what life is. This by itself is a complex task. How can something so intuitive not be boiled down into a clear, single sentence definition? But the more we try to understand life and define its boundaries, the more curveballs nature throws at us. John Casti gave the following definition:

"By more or general consensus nowadays, an entity is considered to be "alive" if it can perform three basic functional activities: metabolism, self-repair, and replication."

But this seemingly satisfactory seemingly-satisfactory definition has its own shortcomings. Viruses, prions, and other quirky protein stuff have been found to float around like specks of dust, devoid of metabolism. The moment they find themselves inside a healthy host, like you and me, they hijack the host cell machinery, to turn it into a mass production unit for others of their kind.

Definitions are still far from reach for us as heated debates spur on, but we may have something that suffices for now. NASA favors the subsequent definition and defines life as "an independent chemical system capable of Darwinian evolution."



Put more simply, life is just matter that is capable of reproducing while also managing to keep up with the constraints that demand survival.

## THE PRIMORDIAL SOUP THEORY

But how did life begin? We know that at some point, time, Earth had no life. Then at some point, it did. The events that happened in that time interval are debated, and uncertain. But here's what most people in the community believe as of now: Life on earth sprung between 4.5 billion years ago (the time earth was formed) and 3.4 billion years ago (the time of the oldest confirmed fossils).

Primitive earth lacked oxygen but consisted of a concoction of simple chemicals that had formed over years of geological activity. These chemicals were eventually self-assembled to form amino acids, on being supplied with enough energy (scientists presume it was lightning). This is the Oparin-Haldane hypothesis, which gained much support in 1953 when graduate student Stanley Miller along with his supervisor, Nobel Laureate Harold Urey, showed that amino acids could be created by passing electric currents through a mixture of water, methane, ammonia, and hydrogen- all found to have been abundant in primitive earth's atmosphere.

## RNA WORLD

Life as we know it has been propagated for millennia by the threefold mechanism of replication, transcription, and translation. DNA has always received the spotlight, so for a while, RNA was thought to be nothing more than a messenger between DNA and proteins. But RNA has been found to do more, way more. Like proteins, it can drive chemical reactions and like DNA, it can carry forth genetic information. RNA's versatile nature and its constant presence on the molecular stage of life led scientists in the '60s to hypothesize that RNA may have been a very important molecule in the transition stage to complex life.

According to them, RNAs emerged from the linking of free nucleotides that were floating around in a primordial soup of molecules. Most of these strands were unstable and degraded on their own, while the stable ones survived. Some of these stable RNAs grabbed onto together to form RNA machines that produced more free nucleotides, aiding the RNA evolution. Recently, biochemists started taking notice of how the RNA world does not account for catalysis- that is, how did enzymes come about? Research by Charles Carter and his team in 2017 has shown that the mystery polymer that was at the interface of life would have had to coordinate chemical reactions that may vary in speed by as much as 20 orders of magnitude.

More importantly, an RNA-only world cannot explain the emergence of the genetic code, which maps all 64 possible three-nucleotide sequences to about 20 amino acids. Evolving a robust set of rules to do that would take too long, according to Peter Wills, Carter's co-author. "The RNA world doesn't tell you anything about genetics," he says.

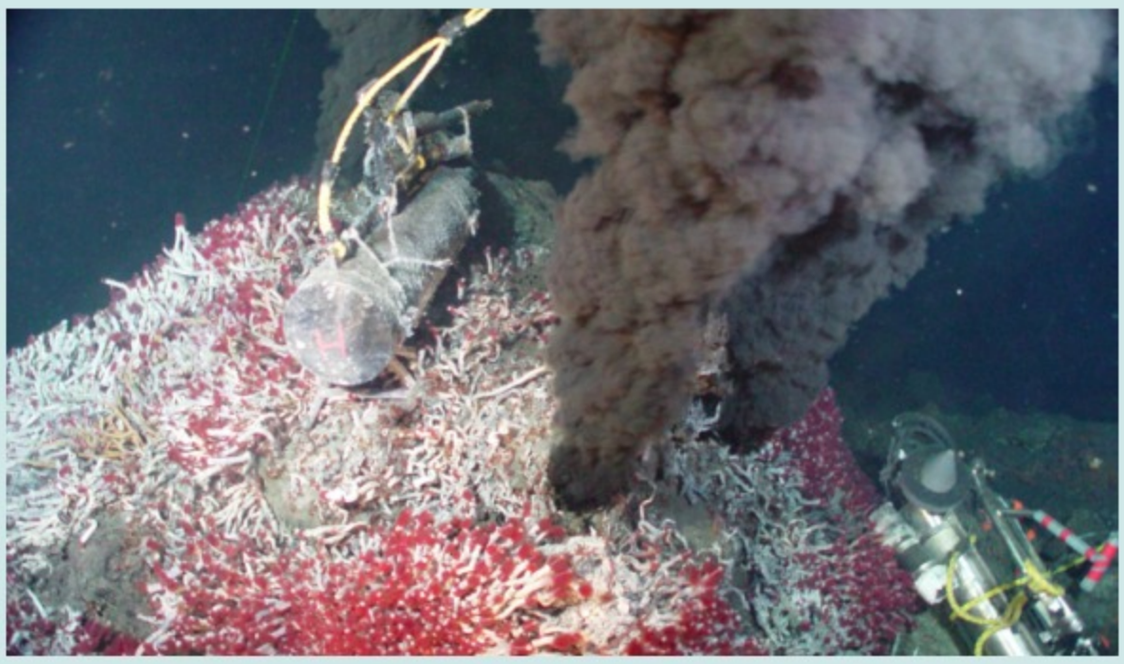
Carter and his teammates propose a more elegant solution: bring peptides into the mix. They suggest that life may have originated from a self-sustaining loop of interactions between RNA and peptides. This would have built a multitude of enzymes by choosing only between 2 types of amino acids. The resulting peptide products seem to enforce the rules that govern the translation process which in turn forms a very tight feedback loop.

Of course, the Carter-Wills model is a strong contender in the tide of evidence emerging against the long-upheld RNA-only world.

## LUCA

You have parents. They have parents. Their parents have parents. If you could potentially trace back your lineage, then your friends' lineage, and then potentially every species' lineage, you would arrive at an important conclusion: all life on Earth originated from a single common ancestor.

This was the revelation that dawned upon Charles Darwin when he wrote and published On the Origin of Species in 1859. Since then, our abilities to fully sequence genomes and store them in libraries have improved our understanding of phylogenetic relationships between organisms. This primordial common ancestor, popularly known as the Last Unified Common Ancestor (LUCA) is thought to be a small single-celled organism that inhabited iron and sulfur-rich, dark hydrothermal vents in a post-RNA world. .



## INTERVAL

Our journey as a species has been a long and tedious one. And it is far from over. Human curiosity endeavors beyond bounds. In our quest for knowledge, we gaze upon the tiniest elements of life on the ground and then look up to the heavens. The ground and sky may seem to be miles apart, but they intertwine at the horizon. In science, biology and astronomy meet at the horizon of astrobiology.

One of the key aims of astrobiology is to answer our questions about life in space- does alien life exist? And if it does, how can we find it? Over the past 80 years, numerous space missions search for conditions conducive to known life, such as the presence of water and mild temperatures. But so far, all results have either been incomplete or inconclusive.

Perhaps the despairing results can be partially attributed to a fundamental assumption that we are making in our outlook towards extraterrestrial life. The life we know of is carbon-based and hence we assume that alien life would also be carbon-based. It is not an unreasonable assumption to make, since carbon is a versatile chemical partner, forming bonds with remarkable ease with a majority of elements in the periodic table. Other elements fall short of this ability. But considering how vast the universe is and the extreme conditions it imposes on the matter, it is also not unreasonable to assume that there might be certain physical conditions that may enable elements to bond in ways unheard of.

## ALTERNATIVE BIOCHEMISTRIES

While it is difficult to recreate extreme conditions that exist in space back at home, scientists have attempted to mesh out non-carbon-based life forms on the basis of the chemistry they know.

One of their favorites as a replacement for carbon is silicon. Silicon is a close neighbor to carbon, capable of forming of long molecules that can store information. But silicon is not as indiscriminate as carbon when it comes to interacting with other elements. This makes is makes it a somewhat bland option in terrestrial conditions. But under very low temperatures, long- chain compounds of silicon called polysilanols are soluble in liquid nitrogen. This opens up a possibility of life on silicon and nitrogen- rich exoplanets. It may also be interesting to note that microscopic creatures known as diatoms ingest silica and incorporate it into n their its skeletal structure.

Other elements are also considered as a biochemical basis but they suffer from being too chemically rigid and structurally invariable.

Another strong possibility is that exotic life-forms may have evolved and sustained on solvents other than water. Water is very important to native life processes owing to the ability to ability to dissolve most substances, support a diverse set of inorganic and organic solvents, thermodynamic stability and a large temperature range during which it is liquid. A strong competitor to water is ammonia. It can dissolve many organic compounds and elemental metals. Like water, it can accept a H+ ion. It also has numerous chemical analogs in comparison to water, like how the amine -NH2 group is analogous to the hydroxyl (-OH) group.

Ammonia-based life-forms could be found at low temperatures and high pressures, during which it would be in the liquid form. Since chemical reactions generally proceed slowly at lower temperatures, evolution and metabolism can be expected to be slow.

Other interesting hypotheses include dust and plasma-based lifeforms. Charged dust suspended in plasma is known to self-organize into microscopic helical structures. Alternative nucleic acids are also another possibility. Xeno-nucleic acids (XNA) are DNA-like structures with an altered sugar backbone. While they have not been extraterrestrially extra-terrestrially, synthetic biologists have managed to develop at least 6 different kinds of XNA. They have also been of therapeutic interest, since the drugs administered as of now are broken down too quickly by the human body. As XNA is of foreign origin, the human body has not yet developed mechanisms to digest it, allowing it to stay longer in the bloodstream.

# CONCLUSION

To understand our place in the universe, we must understand our origins. But the past is fragmented and its pieces are scattered all over. We find one piece and try to piece it into the story that we have built so far. Sometimes, it adds another paragraph to that story and sometimes it means rewriting a few chapters again. But it is a story like no other, spanning billions of years, the terrain of Earth and perhaps, the vast void of space. Voids are not known to throw back answers, but as JBS Haldane once said, "My suspicion is that the universe is not only queerer than we suppose, but queerer than we can suppose."

# RESEARCH IN PILANI: IN TALKS WITH DR. MEGHANA TARE

**Parkinson's disease(PD) is a progressive neurodegenerative disease. The formation of Lewy bodies in the substantia nigra causes dopamine-producing neurons in the substantia nigra to deteriorate (Lewy bodies are aggregates of misfolded proteins, membranes, etc ).**

Parkinson's disease is now considered a complex multifactorial disease that has genetic as well as environmental influences. The symptoms appear late in the disease's progression and include tremors, slowness in movement, lack of sense of smell, difficulty in maintaining proper postures, etc.

Alzheimer’s is another neurodegenerative disease caused due to neuronal loss. Pathophysiology of these diseases are very similar, in the case of Alzheimer's Amyloid beta-protein which are 40 amine chains long can cross the cell membrane whereas a 42-unit long protein is not able to pass the membrane and forms the aggregate outside the brain cell another protein known as tau protein which helps in maintaining the microtubule structure misfolds causing microtubule dissociation leading to the various problems within the cell and finally leading to cell death.

Similar pathophysiology is observed wherein in Parkinson's disease the Alpha-synuclein protein misfolds and forms the aggregate within the cell and hence triggers cell death.

To study these diseases, Drosophila melanogaster (common fruit flies) serves as a versatile model organism. It is one of the most celebrated models for studying neurodegenerative disease.

Drosophila's genes are very close to human genes; almost 75% of disease-causing genes in humans are also found in drosophila. A short life span (8-14) days allows us to study the pathophysiology of neurodegenerative diseases quickly compared to the human brain, where it takes years to see the symptoms of the disease. Drosophila eye is a cluster of 750 eyes which allows the researcher to test the mutation's effect in multiple tissues at the same time thereby making it easier to derive the results.

**At the fly lab, BITS Pilani, Dr. Meghna Tare, assistant professor, department of biological sciences, wishes to understand the molecular and cellular mechanism of action of various ayurvedic medicines. In the interview conducted by our team, she told us that ayurvedic medicines are underestimated due to a lack of scientific pieces of evidence that support their mode of action.**

She recently submitted a manuscript of her study on how ayurvedic medicine can rescue neurodegeneration. In another study conducted at her lab, she was able to identify that "In the Drosophila eye, a positive feedback loop between the JNK and Hippo signaling pathways promotes A42-mediated neurodegeneration".

She used the GMR-Gal4 fly model, where a gene called the amyloid-beta was misexpressed which resulted in eye cells' death.

Later, misexpression of AB-42 along with the Hpo gene resulted in even stronger apoptosis. To further validate their finding they downregulated the Hpo gene using RNA interference-based technique by miserexpressing the HpoRNAi, they observed a mild rescue of eye imaginary disc.

Coexpression of HpoRNAi+AB42 resulted in the dramatic rescue of the cell from neurodegenerative phenotype (almost equal to wild-type phenotype). These findings validated that the Hpo was acting as a genetic modifier of AB42-mediated neurodegeneration.

They used a similar approach by misexpression, coexpression, and overexpression of various genes like WtsRNAi, Yki, Hpo, and HpoRNAi to validate the positive feedback loop between JNK and Hippo signaling. Cells were mostly apoptotic however necrotic nature wasn't explored but initial speculation suggested that cells were mostly apoptotic.Future research at Fly Lab will be to understand the genetic and molecular mechanisms involved in cell death resulting in neurodegeneration diseases (Parkinson's).

Cell death is largely linked with stress stimuli that affect subcellular organelles like mitochondria and endoplasmic reticulum etc., Dr. Tare's long-term research goal at the fly lab, is to understand the disturbed mitochondrial biology in Parkinson's disease.

She is also interested in developing an understanding of how personalized medicine systems such as Ayurveda can be used to restore the cellular and molecular dynamics of these diseases.

RESEARCH

# Q&A

## Q Do different areas of the tongue taste differently?

We have all learnt in school how our tongue has different 'zones', and each one is responsible for tasing a certain flavour. However, this is a myth that has been prevailing for over a century.

An experiment in 1901 showed that there wasn't a clear delineation of regions in the tongue. German scientist D. P. Hanig recorded that certain areas were slightly more sensitive to flavours than others. This conclusion, though based on statistically incomplete data, has been widely advocated. Perhaps the reason for the inability of this myth to die is the fact that a picture of a tongue with different parts coloured and labelled makes for such an eye-catching image in books, and students of science continue to believe it.
What is humorous about this is the fact that anyone can verify this by placing a pinch of salt on the tip of their tongue, which is believed to only taste 'sweet'.

## Q What is Brain Freeze ?

Ever had a massive headache while devouring any cold food item? Then you've experienced "brain freeze". That pain is the response of your body to think that it's dying.

Even though gulping ice cream too quickly is usually harmless, your body assumes you are in danger due to the cold shock. The trigeminal nerve reports to the brain a sudden temperature change. The brain deciphers the message and dilates the anterior artery in response, a gush of blood flows to your frontal lobe, causing acute pain which lasts for a few seconds or minutes.

To make the ache go away quicker, simply warm the roof of your mouth with your tongue and continue enjoying that delicious treat!

## Q How are fingerprints formed?

Fingerprints are little ridges on the tips of our fingers. Not even Identical twins have the same set of fingerprints. They are influenced by our parent's genes and are formed even before we are born. Several factors influence our fingerprints. These factors include genetic makeup, position in the womb, amniotic fluid flow, and umbilical cord length.

Fingerprints are formed in the innermost layer of the epidermis known as the basal cell layer. Rapid cell growth in the basal cell layer causes this layer to fold and form various patterns. By the time a fetus is 17 weeks old – about halfway through pregnancy – its fingerprints are set. In 2015, a study revealed that fingerprints are stable over a person's lifetime. The pattern of the fingerprints is encoded below the outer surface of the skin. Even if you have a major skin injury, your prints will come back when the outer layer heals – though you might have a scar, too.

## Q How Does Coffee Wake You Up?

It's obviously caffeine. But how?

Well, caffeine is a trickster. To nerve cells, it looks very similar to another chemical, adenosine. Adenosine is a biologically versatile compound, and one of its many functions is to slow down the nervous system. It promotes sleep and suppresses arousal.

Adenosine works by binding to adenosine receptors in the brain. However, caffeine also binds well to them. Eventually, it takes up all the space and prevents the receptors from recognizing adenosine. So, the neurons start firing up, which signals your pituitary to understand that it is an emergency. It guides the adrenal glands to start pumping up adrenaline. Soon enough, you feel awake and alert.

PROSTHETIC LEGS

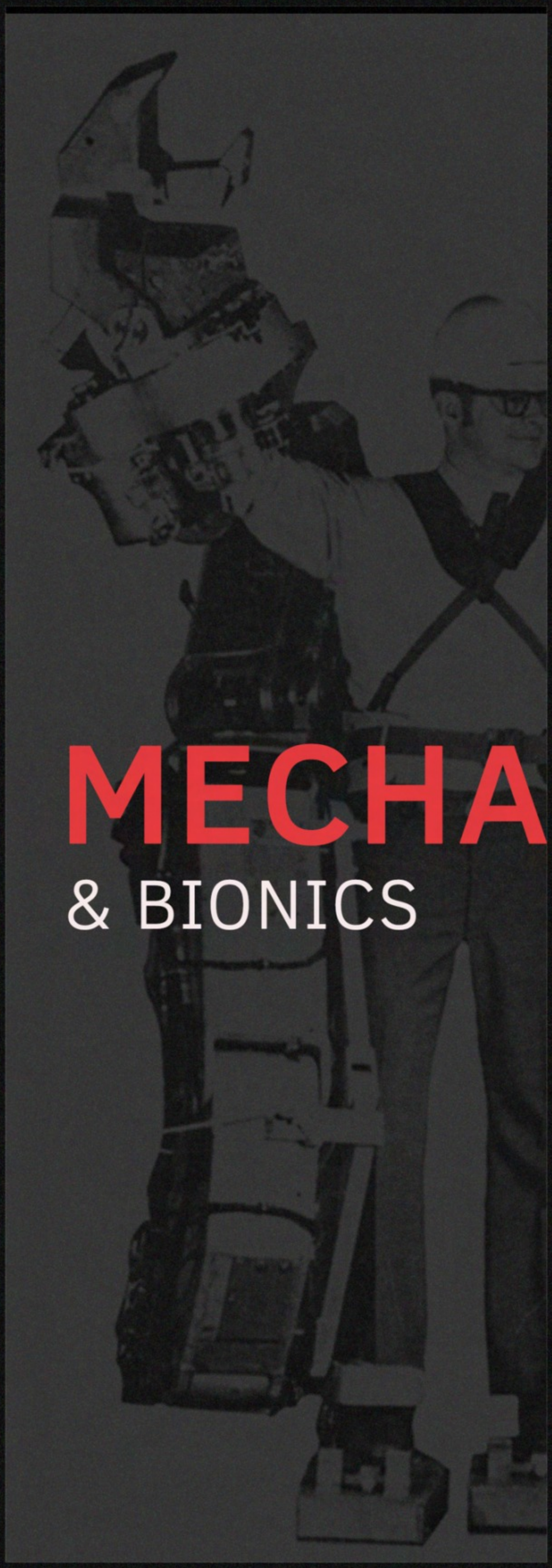
# S-U PER HUM AN

NEUROPROSTHETICS

BIONICS

WRITTEN BY

TANISHQ JAIN
YASASWINI REDDY



# MECHANICS & BIONICS

## EXOSKELETON

Exploring beyond what's humanly possible has been the driving force in biotechnology and sciences for thousands of years. With this vision, it has worked in the direction of increasing human strength, speed and even vision. The earliest military class exoskeleton was used by the Russians in 1890 which increased the wearer's strength. It was operated by compressed gas bags mounted on the back to store energy. After 27 years the United States developed 'Pedomotor', a steam-powered device with artificial ligaments. The first completely mobile exoskeleton was developed in the 1960s, called the Hardiman, was co-developed by General Electric and the US Armed Forces which increased lifting capacity 25 times, so 500kg would feel like just 18kg. But the exoskeleton weighed 680 kilograms itself and was sluggish (moving at a pace under 0.76 m/sec.

## SUIT

Monty Reed, a US Army Ranger who had a broken back by a parachute accident in 1986 built Lifesuit, an exoskeleton to support only him, but while recovering he was inspired by the fiction novel Starship Troopers (1959), written by Robert Heinlein and also read Heinlein's description of mobile infantry power suits. Then in 2001 started designing and in 2005 he wore his 12th prototype in Saint Patrick's Day Dash, a foot race in which he reached a speed of 4 km/hr and that suit could also lift 92kg.

Exoskeletons are used for clinical, military, research, industrial and commercial purposes. Present military-focused, compact and mobile exoskeleton was first introduced in 2010, HULC (Human Universal Load Carrier) by Ekso Bionics and Lockheed Martin and XOS and XOS2 by Sarcos.

As seen from the image beside they were full body suits but were still quite heavy and high energy demanding machines. Currently, they have been improved and made more and more agile.The latest and most advanced version of the skeleton for military purposes is named Onyx, AI-equipped and weighing just 9 kilograms is made from carbon fibre, aluminium, plastic, fabric and even titanium. Its AI can predict what task the user is going to perform and provide the necessary torque and strength. Assistance is provided to the wearer's lower body in climbing, repetitive kneeling and squatting and carrying heavy loads for a prolonged period.The predictive AI system has a reaction time of 150 milliseconds which is the same as muscles responding to brain signals. The next step in innovation would be to cut the reaction time to half, which means not only it would react to brain signals but also command the motors to perform the next possible movements.

## GLOSSARY

**Infantry:** Soldiers trained, armed, and equipped to fight on foot

**Denervated:** Deprived of a nerve supply

**Reinnervated:** Restoration of function to a denervated body part and especially a muscle by supplying it with nerves through regrowth or grafting reinnervation of the biceps

**Afferent fibres:** Axons (nerve fibers) carried by a sensory nerve that relay information from sensory receptors to regions of the brain.

ER

"Our need will be the real creator"

*-Aristocles*

With the perpetual innovations and development, biotechnology is incrementally getting further robust and compact. The image on the side is a potential future full body, AI acquired military and commercial grade exoskeleton, currently under development of Ekso Bionics, a leading firm in the wearable powered exoskeleton and bionics devices is US-based.

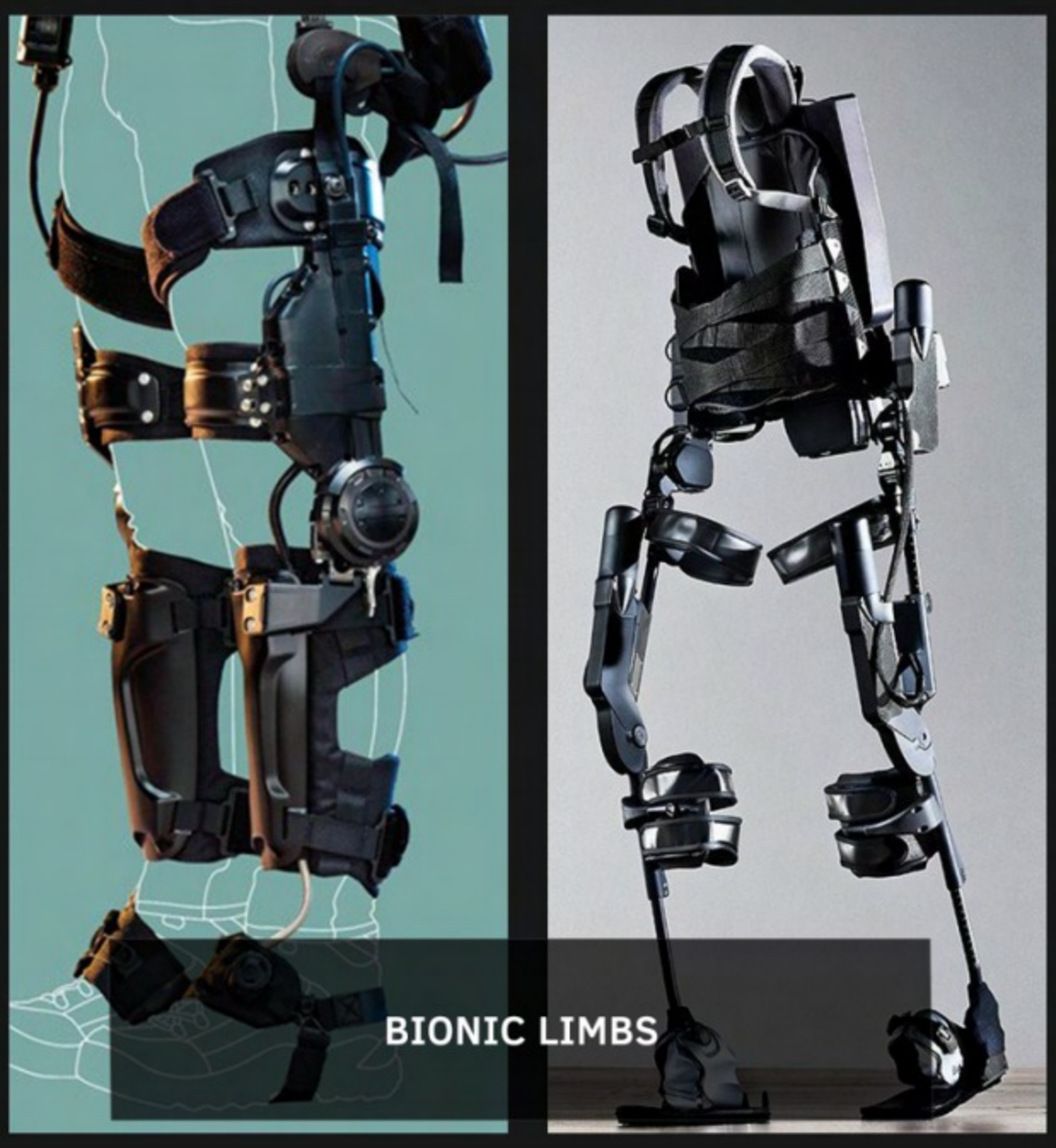
Japan and China lead the Asian exoskeleton research and development. DRDO has been doing R&D in this field for years in its DEBEL (Defence Bioengineering and Electromedical) lab. Their primary focus is specific military logistic applications involving bending, lifting payload and endurance enhancement among soldiers.

"ONYX" Exoskeleton

FROM DARPA'S REVOLUTIONIZING PROSTHETICS PROGRAM

Bionic limbs and exoskeleton in the clinical field to provide necessary support or power are used, which may be in a form of neuroprosthetics, where electrical impulses are created to mimic the brain signals to trick the brain to perceive it as an actual hand or legs. Modern-day neuroprosthetics has also been able to introduce the sense of TOUCH! Which has been feasible because of targeted sensory reinnervation, surgery in which skin near or over the targeted muscle is denervated, then reinnervated with afferent fibres of the remaining hand nerves

For commercial purposes, to increase speed and ease down running for long distances, Nike-backed researchers invented an ankle exoskeleton which makes running 14% easier. For helping manual labourers in commercial purposes Chinese company, ULS Robotics developed an exoskeleton to lift weights for delivery and movement. To reduce injury and fatigue during construction, a UK-based company built a bionic vest to assist in weight lifting which gives up to 7kg lifting power.



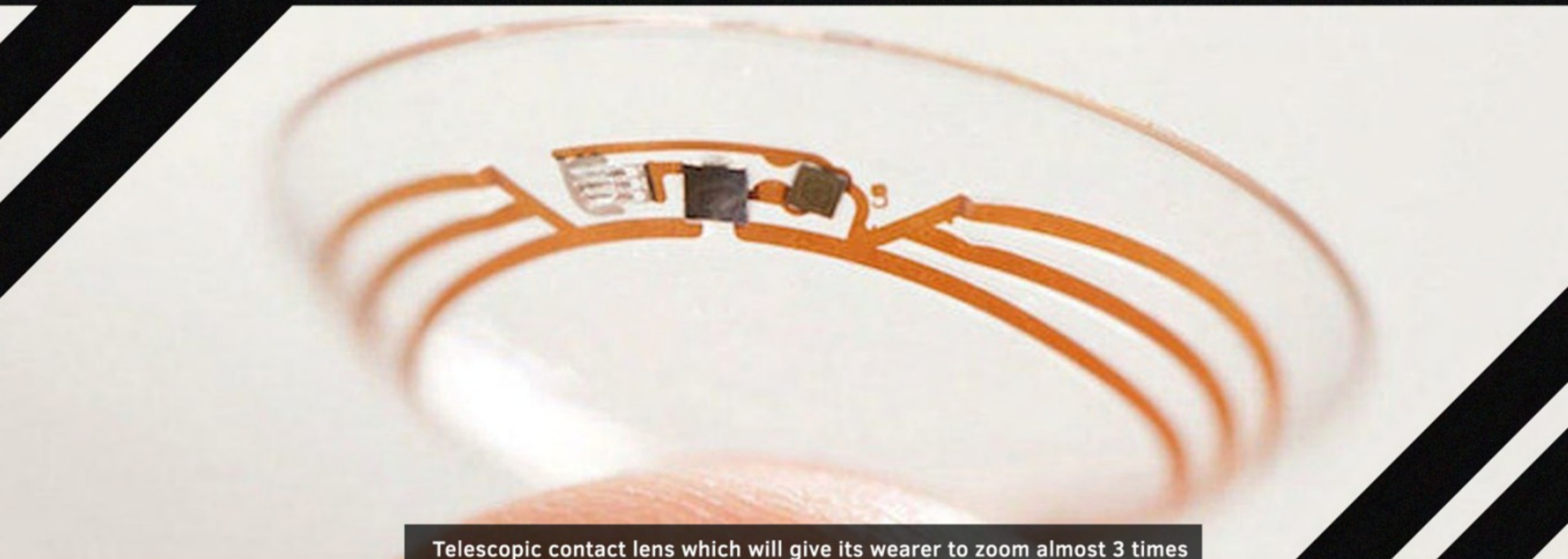
BIONIC LIMBS

## ZOOMING INTO THE FUTURE

Glimpse on to the million colours around us and feel how blessed we are. Human eye has a resolution of 576 megapixels! Which is humongous compared to 108MP in the latest Samsung smartphone (Galaxy S20 Ultra).

Evolution accomplished its task of the development of eyes and now it's the time where technology steps in. With the recent advancement in nanotechnology, new dimensions are discovered. Soon it will be possible to have a camera like zoom in and out integrated within a contact lens. An international team of researchers has created the first such telescopic contact lens which will give its wearer to zoom almost 3 times.

From the image below, two distinct regions can be observed. The centre of the lens allows light to pass straight to provide normal vision while the edge outside acts like a telescope and has the potential to magnify our sight by 2.8x, which will enable us to see a clear sight to a glass kept at 90 to 100 meters away from us. Some bionic lenses also have the capability of facial recognition, which can be utilized in spy and undercover operations. Recording what we see in real-time through such a bionic lens is just next door to become a reality.



Telescopic contact lens which will give its wearer to zoom almost 3 times

## "Nitro" to your body

In just minutes, Steve Rogers transformed from a skinny and weak guy to a strong, bulky person, which also increased his endurance and speed exponentially in the renowned movie, 'Captain America: The First Avenger. This fictional concept of super soldiers is not too far from reality. It is possible by using PED (Performance enhancing drugs) like anabolic steroids, HGH (Human growth drug) or EPOs (Erythropoietin), which temporarily increase stamina and speed.

EPO (Erythropoietin) is a natural peptide hormone produced in controlled amounts in kidneys to promote red blood cell production in the bone marrow. It has been used for medical purposes in the treatment of some forms of Anaemia, with its first use back in 1987. Noticing its outright promising effects on speed and endurance it was used illegally.


Bryn Lennon/Pool File Photo via AP

Multiple cases have been found where prominent athletes were allegedly accused of illegal blood doping and EPO drug abuse to enhance their performance. Essentially it provides 'nitro' to the muscles by increasing oxygen supply substantially which is a result of the rise of red blood cells, a by-product of EPOs

Side effects of unrestricted usage include thickening of blood leading to stroke, pulmonary embolism and heart failure and other cardiovascular diseases. To administer the side effects and unfair advantages to some athletes, numerous restriction and blood doping tests have been implemented thereafter.

## GLOSSARY

**Peptide hormone:** Hormones made up of peptides molecules.

**Bone marrow:** A spongy substance found in the center of the bones, which manufactures bone marrow stem cells and other substances, which in turn produce blood cells.

**Anaemia:** A condition in which there is a lack of healthy red blood cells to carry adequate oxygen to your body's tissues.

**Pulmonary embolism:** Blockage in one of the pulmonary arteries in your lungs

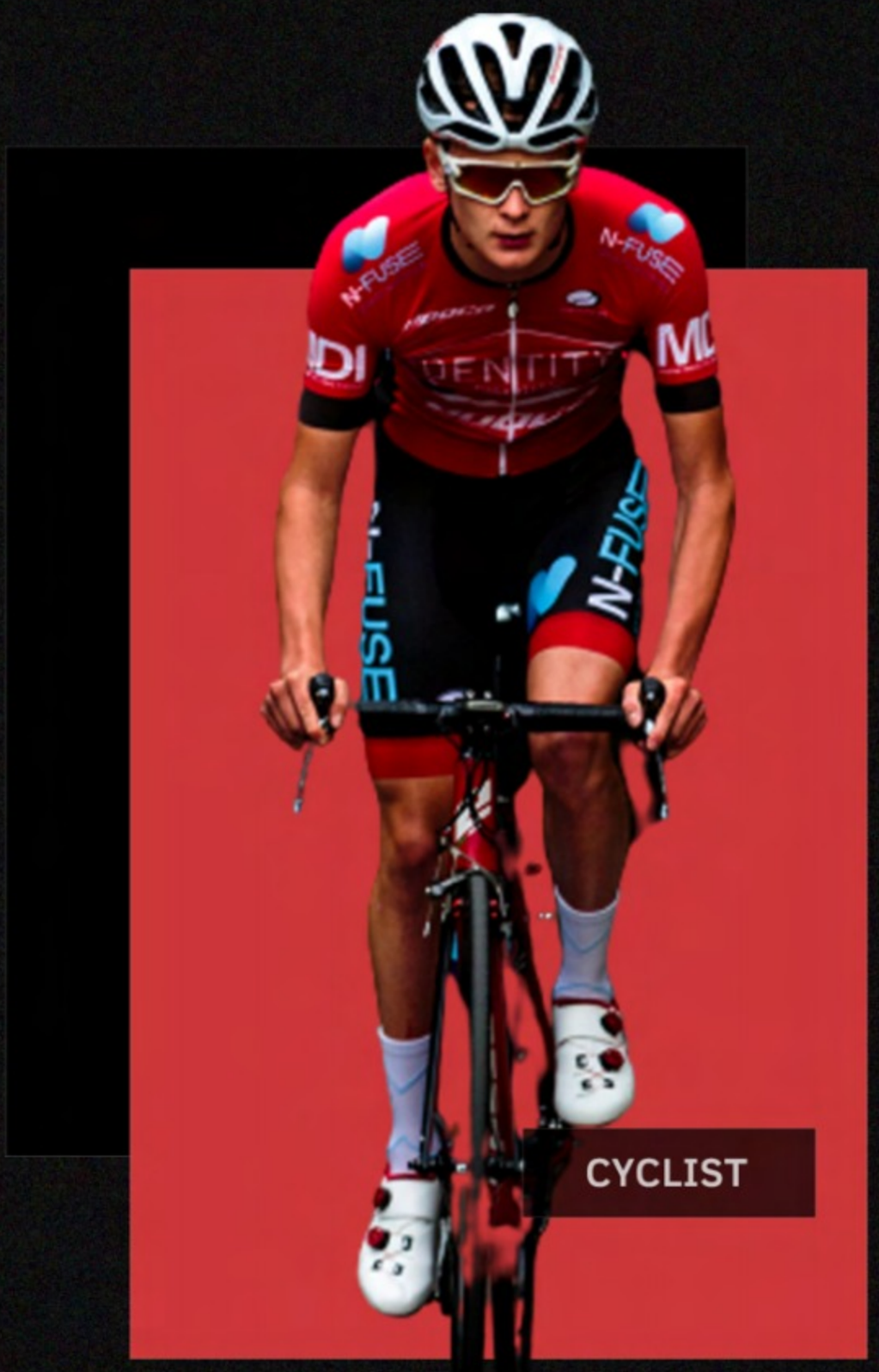
# PERFORMANCE ENHANCING DRUGS

In 2012 ,an investigation conducted by the United States Anti-Doping Agency(USADA) found renowned cyclist Lance Armstrong guilty of using Performance Enhancing Drugs (PED) over the course of his career . Henceforth, he was stripped off of all the titles won by him. This news shocked the entire world and brought more attention towards the use of steroids by athletes to enhance their performance. So ,what are Performance Enhancing Drugs and why are they so controversial ?

Performance Enhancing Drugs are substances that are used to improve any form of activity in human beings . The most common example involves anabolic steroid usage in sports by athletes and bodybuilders but there are other kinds of PED's like androstenedione , growth hormone, diuretics,creatine ,erythropoietin and stimulants.

Even though these steroids heighten the athletic ability of the consumer for a certain period of time , they also result in severe side-effects that might even cause life-long damage. One can indisputably say that the cons outweigh the pros.

Use of PEDs goes further back in history than one might think , they were in fact even considered legal up until the 20th century. During the original Olympic Games in 776 BC , Greek athletes drank “potions” made of hallucinogens like mushrooms and opium juice (“doop” in Greek , hence the word doping) . They even consumed raw animal hearts and testciles for the extra strength . Even Roman gladiators engaged in extra supplementation while they fought for their lives in the Colosseum , circa 100 AD .

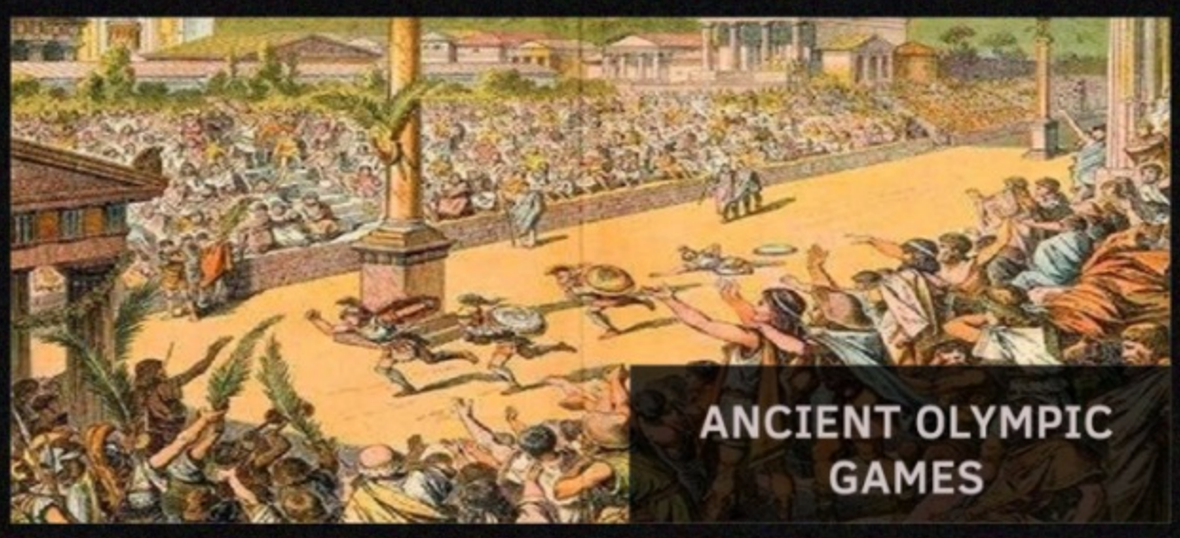


CYCLIST

Their diets included stimulants such as strychnine to deal with trauma and to improve the intensity of fighting. Modern usage of PEDs mostly involve consumption of anabolic steroids and growth hormone.

In 1991 , two years after the fall of the Berlin Wall and the integration of East Germany into West Germany , declassification of certain records revealed a sophisticated and decades long program of administering performance enhancing drugs to the East German athletes by the German Democratic Republic party.

While doping resulted in impressive results in the Olympics , it had disastrous effects on the physical and psychological state of many athletes. The numerous side effects include increased risk of cardio-vascular diseases, liver problems , violent mood-swings , cancer and appearance of male traits in female athletes.


ANCIENT OLYMPIC GAMES

## ANABOLIC STEROIDS

Anabolic steroids are steroidal androgens that include natural androgens as well as synthetic androgens that are structurally related and have similar effects as testosterone. They target the androgen receptor , the natural receptor of testosterone and its metabolite dihydrotestosterone which results in simulation of androgen receptor that causes cell growth.Testosterone is a hormone responsible for the development of male traits such as facial hair and deeper voice .It also has anabolic effects like muscle building by increasing muscle mass and strength.

Testosterone was chemically synthesized independently by Aldolf Butenandt and Leopold Ruzicka in Germany in 1935. It was initially used to treat depression and was misused by athletes for the first time during the 1954 OLympics when Russian weightlifters were administered testosterone as revealed by a Soviet team doctor. Since then using anabolic steroids has become common not just by athletes but by the general populace as well.

## STIMULANTS

Stimulants are substances that work on the Central Nervous System to increase alertness , reduce fatigue , increase competitiveness and aggressiveness. Most stimulants result in the increase of brain chemicals dopamine and norepinephrine .The most common stimulants are amphetamines, cocaine, ecstasy and methylphenidate (Ritalin).They are more effective when they are snorted or injected than when they are taken as a pill.

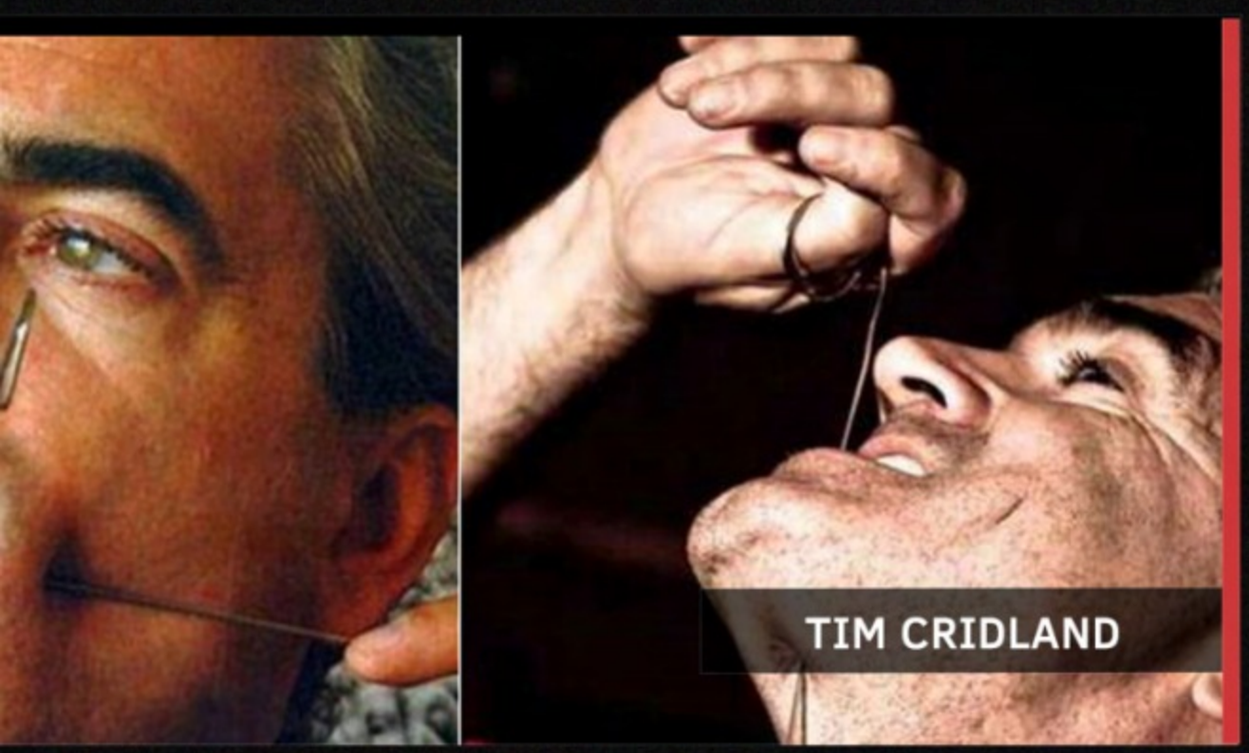
Even though stimulants provide a short-term high , they have long-lasting physical effects like high blood pressure , extreme weight loss , breathing problems, muscle deterioration , increased risk of stroke and psychological effects like paranoia , depression , hallucinations , delusions. Many athletes were found guilty of stimulant consumption including former world champion sprinter Tyson Gay , Jamaican ex-100m world record holder Asafa Powell

## WHAT'S THE FUTURE ?

As we learn more about our bodies and with the various advancements in science and technology , drugs can be made to be more specific and with less harmful side effects. Right now, next-generation PEDs include SARM (selective androgen receptor modulators) , designer steroids - both of which are anabolic steroids with less severe side effects , peptides , testosterone replacement therapy and eventually modifying our genes to maximize performance .

## SUPERHUMANS AROUND YOU !

Meet the person who can run a staggering 560km in 80 hours 44 minutes, without stopping for SLEEP! which is the same distance as running from Jaipur to Amritsar nonstop. Dean Karnazes of San Francisco (US) has a rare genetic condition that accelerates his clearing of lactic acid, a chemical responsible for muscle fatigue during exercise. He can ignore extreme fatigue, he even ran 50 marathons in 50 days in all the 50 states of America.


Tim Cridland aka 'Tortue King' holds the Guinness World Record for penetrating 106 pins in his body at once. His famous stunts include sword swallowing, fire walking, sleeping on beds of nails, body skewering and electrocuting himself. He was born with a mutation that disabled him from feeling pain the way normal people do, during his stunts even though he feels everything that touches him, the malfunctioning receptors in his nerve cells don't even register pain.

Isao Machii also known as 'Super Ninja' , from Japan has superhuman reflexes and can process his surroundings in a different way to the average man. He holds several Guinness World Records for his katana skills to slice twin bullets at a speed of 320 km/hr!

# DIET CULTURE

## East and Southeast Asia

China dominates the culture with a wide spectrum of food coverage from Shanghainese chili red meat to Mandarin's noodles. Japan centres most of its dishes on rice and seafood. Sushi, tofu and a variety of noodles sprinkled with wasabi, and garlic being the popular choice here. Korea's cuisine is a blend of Chinese and Japanese, with 'fire beef' as the National dish and 'kimchi' as the mainstay; seafood remains the major staple. Vietnamese cuisine includes rice with vegetables and eggs and pho as staple. Fish sauce is the main flavouring in most dishes. Malaysia and Singapore having Indian, Chinese mix serves spicy kebabs with peanut sauce, fiercy curries. Chinese noodles, meat and seafood simmered in milk are popular cuisines. Popular desserts include cendol and kacang.

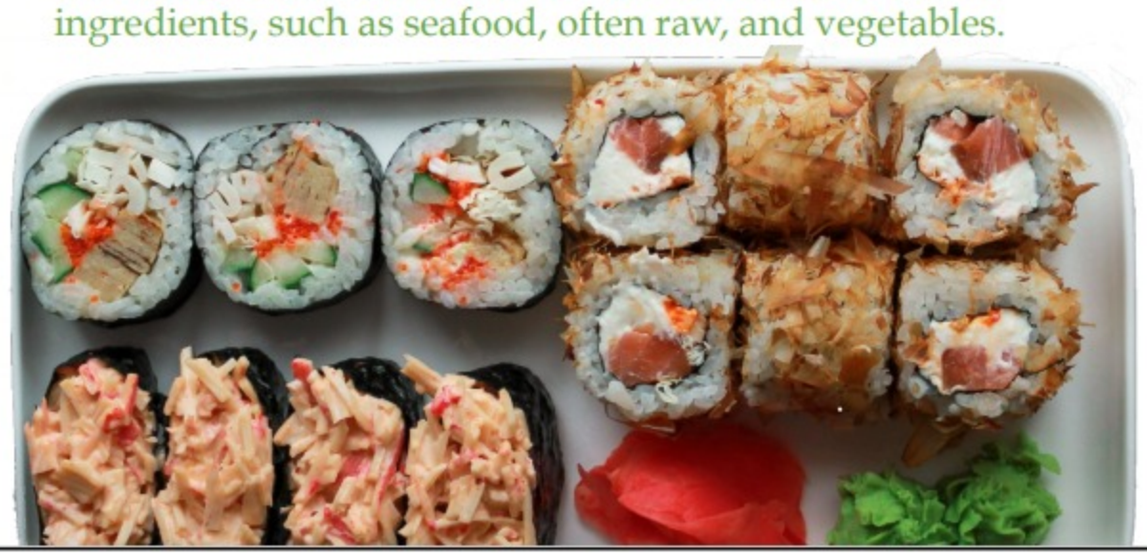
## South Asian

India dominates the flavours here, with a mix of various spices and seasonings and nuts, the food here has innumerable textures and tastes in a single meal. North has a dominance of meat based food while South meals focuses on rice and vegetables. Dairy products are integral part of the diet extensively used in various desserts. Tea is the most popular drink here.

ASIA

Chinese Noodles

Sushi : A Japanese dish of prepared vinegared rice, usually with some sugar and salt, accompanied by a variety of ingredients, such as seafood, often raw, and vegetables.



Jalebi

# EUROPE

## Northern Cuisine

The Northern cuisine focuses a lot on fish. The traditional food is seasonal due to the climate—mushrooms and berries in the fall and meat for the winter. In the north, more wild meat is eaten than in the southern parts, where you eat more beef and pork instead. Chicken is also popular.

## Western Cuisine

Belgian cuisine is an aggregate of Dutch and French cuisine. The dishes usually have mild, spicy, and soft flavors. Commonly used spices are chervil, nutmeg, tarragon, parsley, bay leaf, and chives., fish and meat are usually used in the base food. In the UK, some everyday dishes are Yorkshire pudding, bacon, and eggs, etc. The lunch, usually tea and a sandwich or similar.

## Southern Cuisine



Mediterranean cuisine uses a lot of fresh ingredients such as fruits, vegetables, sheep, etc. Some dishes typical of Mediterranean cuisine are moussaka, serrano ham, pesto, tzatziki, etc. Greek cuisine has olive oil, herbs, and beans as primary ingredients. In Greece, not much meat is eaten, seafood is more popular here. Olive oil is an essential ingredient in the whole Mediterranean cuisine.

## Eastern Cuisine

Eastern European cuisine corresponds to many different food cultures. Ukrainian cuisine is well known for its variety of bread recipes. Some Ukrainian dishes are brisket, dumplings, etc. Eastern European shares pork and vegetables in common. Meat pies are also typical here.

# AUSTRALIA

Unlike other societies with a dominant agrarian history, Australia has not inherited a cuisine in the traditional sense.The proliferation of foods and techniques is so widespread that there might not even be a single distinctively 'Australian' cuisine, especially in a country where the climate ranges from cool maritime to tropical.

Some touchstones in the evolution of Australian Cuisine are:

Introduction of the Meat and three vegetable dinner regime, hearty puddings and love for tea and beer.

The gold rush brought larger numbers of Asian migrants, and by now Chinese and Thai restaurants are ubiquitous.

Highly nutritious, it included many native foods like bush tomato, yams, quandong, wattleseed, lemon myrtle and lilly pilly which have since gone global-appearing on restaurant menus around the world.

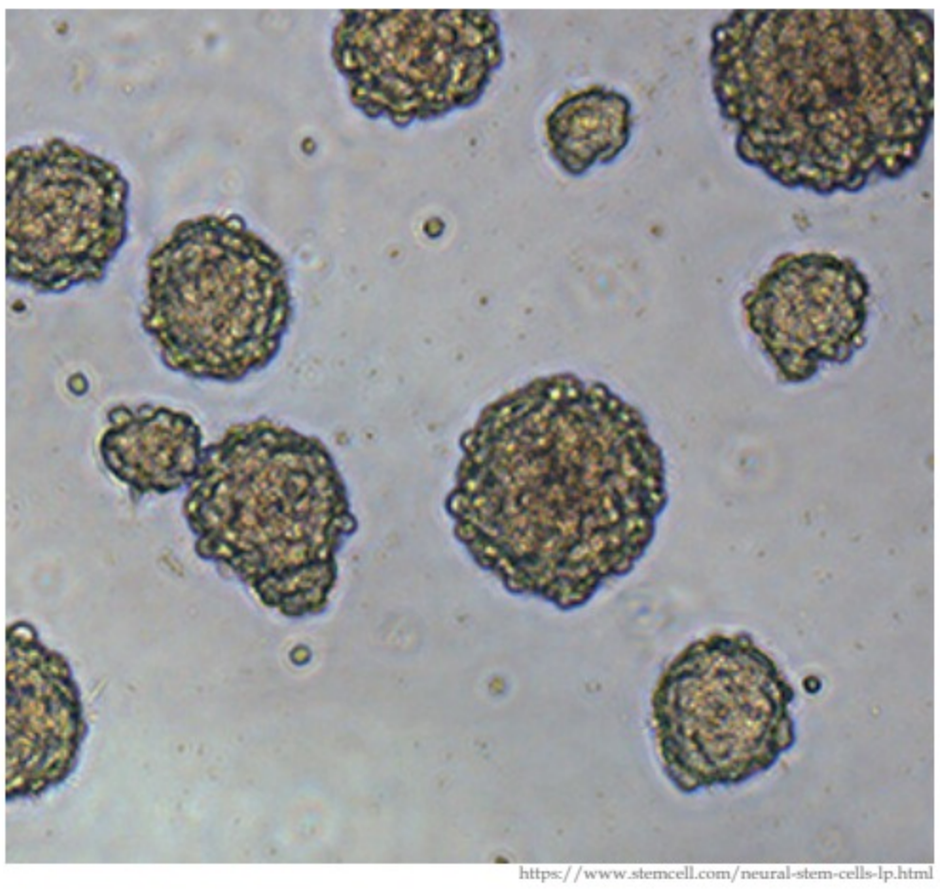
Earlier, Australia's staple hot beverage was tea but post World War II, Australia opened the gates to European migration and settlers introduced coffee . Since then coffee consumption has exploded.

American food has been inspired by indigenous American Indians, African Americans, Asians, Pacific Islanders, and many other cultures and ethnicities, reflecting the country's rich history. North American cuisine is among the world's most delectable, unique, intriguing, and tasty. Some of the famous dishes from north America includes steak grilled shrimp burritos etc.

# AMERICA

# RESEARCH IN FOCUS

## ADULT NEURAL STEMS



https://www.stemcell.com/neural-stem-cells-lp.html

It has been earlier shown that neuroinflammation has a negative effect on adult neurogenesis. The cause of inflammation was believed to be not present in the neurogenic niche ( a complex microenvironment that supports Neural progenitor cells) but external influences. Neural cell proliferation is regulated by the peripheral immune system and doesn't require immune cells in the brain parenchyma, but in contrast, studies have shown the presence of an enriched immune gene signature in neural progenitor cells, which might upregulate the inflammatory response in adult neurogenesis. Tcf-4 is highly expressed in the brain parenchyma and has a huge role in early brain development. However, its role in adult neural stem cells remains undiscovered.

A study conducted by Shariq et al. reveals the previously unknown fact that adult hippocampal neural stem cells are characterized by a potential inflammatory response that is suppressed by a transcription factor, Tcf-4. This suppression of immune response helps adult neural stem cells in adult neurogenesis. In the study, they knocked out the Tcf-4 expressing gene and further studied neurogenesis, and found that deletion of Tcf-4 significantly reduced the number of newborn neurons, indicating impaired adult hippocampal neurogenesis. To further study the role of Tcf-4 in adult neural progenitor cells, they isolated the NPC and induced the Tcf-4 deletion, and performed RNA sequencing. It was found that cells lost their self-renewable property as neurospheres were very small and transcriptome data analysis showed tcf-4 deletion upregulated myeloid inflammatory gene signature, suggesting tcf-4's role in controlling their expression.
The revelation of latent inflammatory potential may have broader implications in fields like neurodegeneration and neuroinflammation. In neurodegenerative diseases, reduction of adult neurogenesis is observed, so the tcf-4 expression can further be explored in adult neural cells of patients.

DOI: 10.1126/sciadv.abf5606

# Timeline of Mass Extinctions

A mass extinction event is when species vanish much faster than they are replaced. This is usually defined as about 75% of the world's species being lost in a 'short' amount of geological time - less than 2.8 million years.
So far we have had five such events and the sixth one is currently going on!

500

450

400

350

300

250

## ORDOVICIAN-SILURIAN EXTINCTION 440 MILLION YEARS AGO (MA)

**Scientists theorize that there for two main phases to this extinction: a glaciation event and a heating effect. Abundant plant life removed carbon dioxide (CO2) from the air, causing global cooling and glacier formation. This led to a drop in sea levels reducing habitat. Later came global warming and sea level rising again. Creatures that had adapted to the cooler are climate were unable to survive the increased temperature. Since most fauna was marine at the time, 86% of the life was lost.**

Species Lost : 86%

## LATE DEVIONIAN EXTINCTION – 365 MA

**About 75% of life died off during this period. One theory suggests that land plants developed deep roots, releasing an abundance of nutrients into the ocean that fed algae. Because of this algae blooms consumed vast amounts of oxygen (O2) in the oceans suffocating many species. Another theory suggests that another global cooling took place. Resulting in glaciation and a fall in sea level leading to habitat loss.**

Species Lost : 75%

## PERMIAN-TRIASSIC EXTINCTIONS – 252 MA

**The Permian-Triassic was the deadliest extraction in history: 96% of all life perished. Scientists believe that volcanic activity in Siberia put massive amounts of carbon dioxide, a greenhouse gas, into the atmosphere. Bacteria that thrive on CO2 began producing methane, and other greenhouse gas. Large quantities of both gases warmed the planet and combined with earth's water making the ocean and rain acidic, creating a highly toxic environment for life.**

Species Lost : 96%

200

## TRIASSIC – JURASSIC EXTINCTION – 201.3 MA

**Some scientists theorize that volcanic eruptions spewed tons of CO2 into the atmosphere which trapped heat and acidifies the oceans causing this mass extinction. Other scientists contend that an asteroid or comet impact triggered the extinction. About 80% of life was lost in this extinction, including most of the mammals. Making way for the dinosaurs' ancestors.**

Species Lost : 80%

150

## CRETACEOUS-PALEO-GENE EXTINCTION – 66 MA

**The Cretaceous- Paleogene extinction wiped out the dinosaurs along with 60-76% of all life on earth. A widely accepted theory is that an asteroid landed in the Yucatán Peninsula in Mexico and killed the dinosaurs. The impact would have ejected enormous amounts of debris into the atmosphere, causing global temperatures to drop. The impact may have also caused local fires, earthquakes, tsunamis, and acid rain.**

Species Lost : 60-76%

100

50

0
(Present)

## HOLOCENE EXTINCTION 11,700 YEARS AGO TO PRESENT

**The next mass extinction may already be happening. The current extension rate is at least 1000 times greater than the "normal" extinction rate. A "normal" or background extinction rate is the average rate of extinction based on the longevity of species through time with human influence determined by the fossil record. Scientists believe that human impact on the environment is the leading cause of extinctions today.**

# Research In Pilani : In Talks with Dr. Prabhat Nath Jha

Enterobacter cloacae is known to be opportunistic nosocomial pathogen and which was found while working on plant associated microorganisms for biofertilizers, they characterized and isolated this microbe, but they reasoned to not utilize any potential harmful pathogens, for this notion to be true it had to be tested and was initially tested on mice and was found out that it had indeed such potential and so they became further interested in its pathogenic properties including it mode of pathogenicity and how it attacked the host.

Now, to study its pathogenicity they first thought of mice as a possible host as earlier but it has a complicated genetic structure and physiology, furthermore there were ethical issues and emotional concerns for some researchers as well. So a model host was needed which is simpler to study and its genetics are well known, for which C. elegans were an adequate choice.

Escaping the pharyngeal grinding of C. Elegans which is its, the E. Cloacae bacteria colonize the entire gut in mere 48 hours. E. Cloacae SBP-8 have been reported to have different virulence factors like toxins and secretion system, and that could possibly influence its pathogenesis and manner of development of the disease.

**What are opportunistic nosocomial pathogens?**

These are microorganisms which are carried from hospital- borne conditions or associated infections. In hospitals there are many kinds of microbes which can affect patients with minor cases, the equipment present there or even visitors. The 'opportunistic' here means that the organisms that can cause severe diseases if they breach the first barrier of the body defense system, our skin, which might be exposed due to injuries. Researchers previously used antibiotics to study the pathogenesis but currently numerous microbes show antibiotic resistance which showed another level of complications.

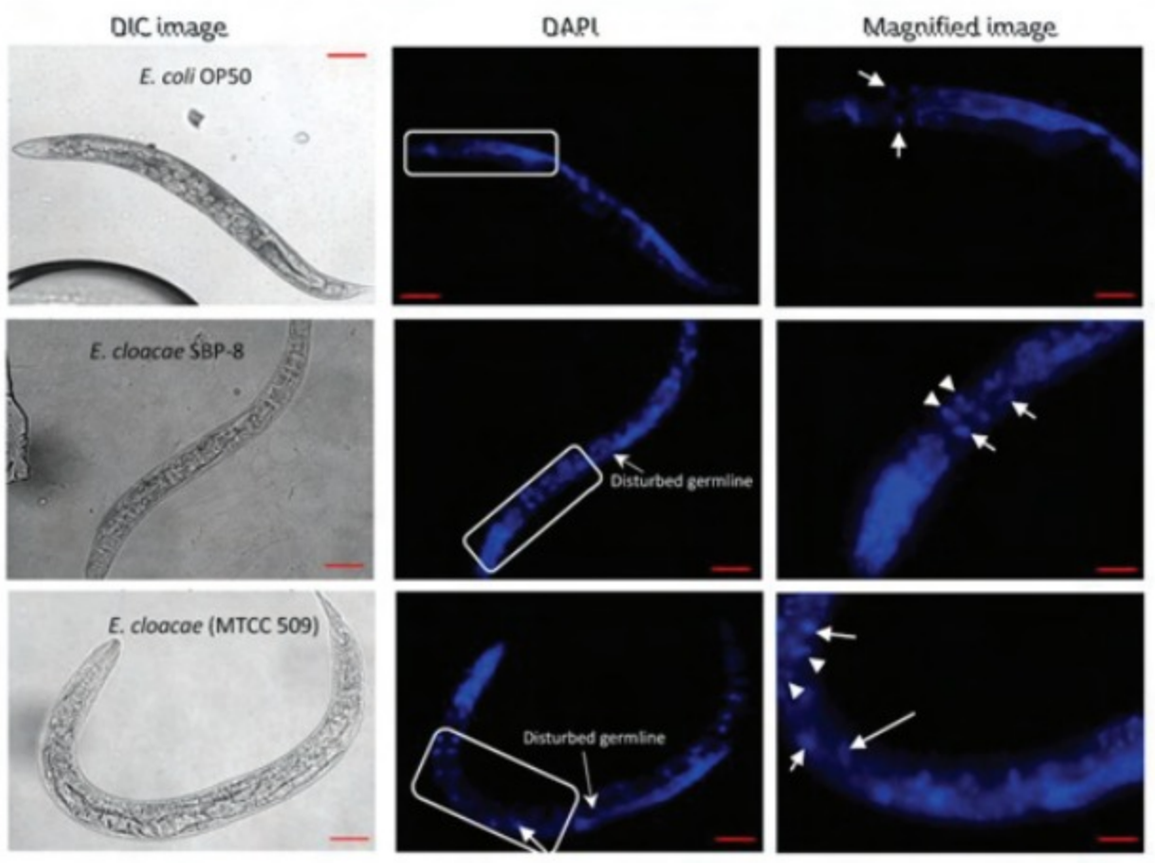
In humans, E. cloacae infection occurs due to side effect of antibiotic therapy or compromised immune system, which accounts for numerous nosocomial complications which includes 5% sepsis, 4% urinary tract infections, 5% pneumonia, and 10% postsurgical peritonitis cases and neonatal outbreaks. Principal aim of the research paper is to demonstrate the pathogenic potential of E. Cloacae SBP-8 and it's the first study indicating that E. Cloacae infections could potentially originate from an exogenic source. E. cloacae strain SBP-8, which is a genetic variant with genes that encodes virulence factors like toxins, chemicals and colonization factors.

**Why C. Elegans?**

Caenorhabditis elegans (C. elegans) were chosen as a suitable host to study the pathogenesis of E. cloacae because of its shorter regeneration time, relatively simple anatomy, and similarity with the mammalian innate immune system, innate immunity is the one which we are born with, and produces certain chemicals and cells to defend itself against pathogens, other type of immunity is called adaptive immunity. Other possible host options include mice and Drosophila melanogaster (fruit fly) which is commonly used to study host-pathogen interactions. The general trend is to study those microbes which have been dreadful in the past or are known to have severe effects, but those microbes are ignored which have the potential to create havoc and create grave conditions.

For the research three strains of E. Cloacae were used one is the; SBP-8 as discussed earlier, which was obtained from our lab itself, the MTCC 509 strain which is a clinical isolate and was obtained from Indian microbial Technology, Chandigarh, India and E. Coli OP50 and one clinical isolate of P. aeruginosa PAO1. To observe the fragmented and condensed DNA, hallmark for programmed cell death, C. Elegan worms were exposed to E. cloacae SBP-8, E. cloacae (MTCC 509) and E. coli OP50 for 48 h. After washing with M9 buffer, paraformaldehyde and DAPI (4',6-diamidino-2-phenylindole), worms were mounted on agarose pad and imaged using UV filters. By CFU (colony forming units) and fluorescence microscopy followed by DNA fingerprinting the correlation between intestinal colonization and the reduction in lifespan of E. cloacae SBP-8 fed worms was observed. We deduce that E. cloacae SBP-8 avoids pharyngeal grinding and gradually colonizes the entire gut. The bacteria colonized the pharynx region by 6 h and then colonized the entire gut by 48 hours and also increased internal hatching of eggs by 70%. So the results are that E. cloacae SBP-8 infection decreases the lifespan of C. elegans through intestinal colonization, and induction of reactive oxygen species, internal egg hatching and cell death. We investigated the pathogenic potential of E. cloacae SBP-8 by analyzing the host (C. elegans) response at the molecular and physiological levels. Through this study, we prove that against the established nosocomial origin of E. cloacae infections, the infections could also arise from environmental isolates.

In future we are working on a specific protein secretion system known as secretion system 6, where a complex of many proteins form a needle like structure which penetrates and injects the harmful toxins into the host and damages it. So we removed the gene responsible for this protein formation and tried to observe its effects. Further we will look into the effect on gut microflora and its impact on the gut itself. In order to avoid any major virus outbreaks in the future we need to understand the virus first to defeat it by utilizing vaccines or other medical practices. Bacteria are quite adaptive microorganisms, they find their way around vaccines and antibiotics by certain gene modifications.



# CHEMOTHERAPY

**Dosis facit venenum. - Paracelsus**
**"The dose makes the poison."**

According to the World Health Organization, cancer is one of the leading causes of death worldwide. Today, the most common treatments for cancers include chemotherapy, radiotherapy, and surgery. These treatments are also used in tandem to improve recoverability.

## Chemotherapy: Origins

When we hear the word chemotherapy, our minds connect it with cancer. However, the term 'chemotherapy' originally described the method of treating disease through chemical means. Paul Ehrlich, a Nobel Laureate, coined the term while studying immune responses and the action of dyes on microbial particles. He theorized that cells have side chains that stick to particular toxins, neutralizing them. He further elaborated this theory by saying that when under attack, a cell produces an excess of these side chains and releases them as antibodies in the bloodstream. His studies moved to observe the action of methylene blue on malarial parasites which gave him the idea to modify the dye to treat the infection.
The idea of synthesizing new drugs to treat diseases eventually led to cancer chemotherapy. Cancer chemotherapy uses chemicals to inhibit the division of cancer cells and therefore reducing their growth and spread. As mentioned earlier, chemical-based (herbal) therapies for cancer have been used since thetimes of the Ancient Greeks. Modern cancer chemotherapy, however, emerged during World War II. In 1942, researchers at Yale School of Medicine harnessed nitrogen mustards (initially used in chemical warfare) to treat lymphoma. After World War II, the work of Sidney Farber showed definite proof that cancer could be treated pharmacologically. He discovered that folic acid had a major role in the proliferation of metastatic cells. He designed a drug that inhibited the action of folic acid by competing as a substrate. This drug called aminopterin helped reduce the severity of leukemia in children temporarily but showed definite results that drugs could be used to treat cancer.
** Paul Erhling won the Nobel Prize in Physiology and Medicine in 1908 for the treatment of diseases using blood serum rich in antibodies.

**Paul Erhling won the Nobel Prize in Physiology and Medicine in 1908 for the treatment of diseases using blood serum rich in antibodies.**

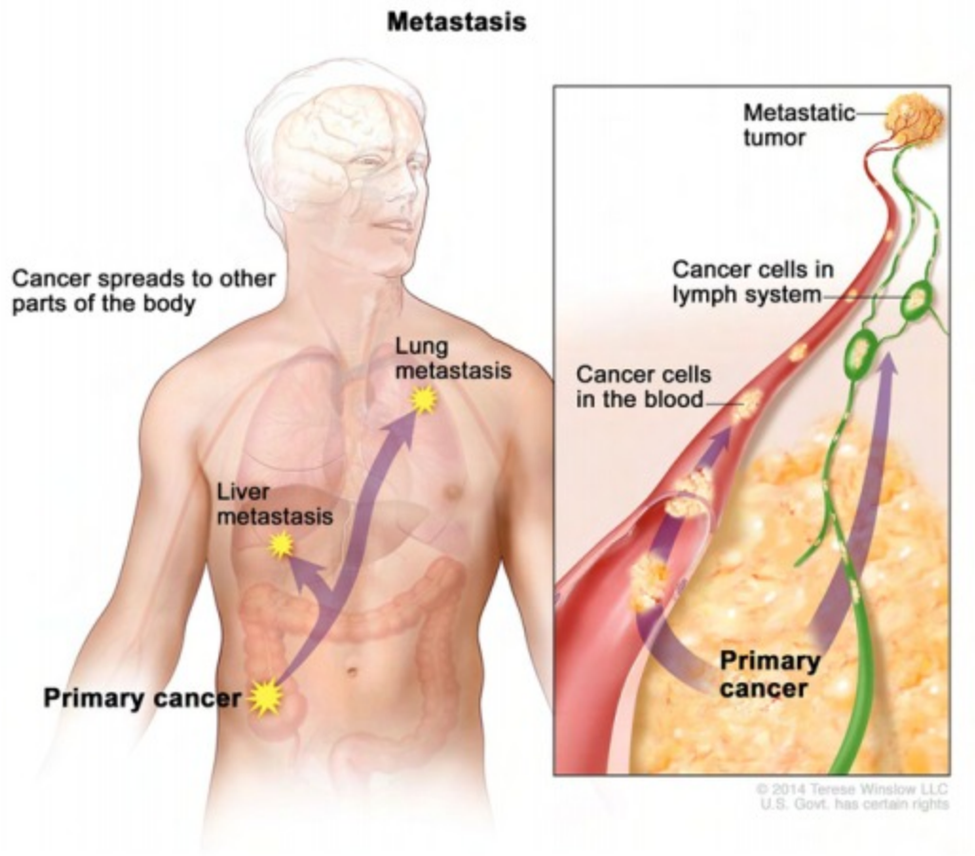
# Mechanism

Since then, various other kinds of chemotherapies have been developed. The following table classifies the types of chemotherapy drugs on the basis of mode of action.

| No. | Chemotherapy Drug /Technique | Mechanism of Action | Example |
|---|---|---|---|
| 1 | Alkylating Agents** | They damage the DNA of the target cell by forming cross-links. This is done by the addition of an alkyl group. | Nitrogen mustards |
| 2 | Antimetabolites | They resemble and substitute the original components of DNA/RNA which consequently interferes with cell metabolism and protein synthesis | Aminopterin (antifolates) |
| 3 | Anti-tumor antibiotics | These bind to DNA to prevent its replication | Anthracyclines |
| 4 | Topoisomerase inhibitors | As the name implies, they disrupt the function of topoisomerase. | Camptothecins |
| 5 | Mitotic Inhibitors | They prevent enzymes from creating proteins essential for mitosis | Taxanes |

** most alkylating agents are unable to enter the brain. Nitrosoureas are an exception making them helpful in treating brain tumors (bubble fact)

# Treatment using chemotherapy




Treatment done using chemotherapy is not an easy task. There are various factors to account for when treating a cancer patient. These include the type of cancer, dosage, and side effects. Patients are prescribed chemotherapeutic drugs only after evaluation of the amount of drug(s) they can handle**. Similar to the concept of antibacterial resistance in bacteria, cancer cells also can develop immunity against the chemicals that attack them. Instead, multiple drugs can be administered at once to increase the efficacy of the treatment (known as combination chemotherapy). After all, two is better than one! It is also important to understand that chemotherapy is not necessarily used to cure cancer but rather to relieve the symptoms for a while. This is known as palliative chemotherapy.

Chemotherapy is used in combination with surgery and radiotherapy to treat cancers as efficiently as possible. This is known as combined modality chemotherapy. In some cases, chemotherapy is used post-surgery/radiotherapy to kill any stray cancer cells that remain. This is known as adjuvant chemotherapy.

| Cancer | Leukemia | Hodgekin's Lymphoma |
|---|---|---|
| Drugs | Vincristine, Amethopterin, Mercaptopurine, Prednisone | Methotrexate, Oncovin, Nitrogen Mustard, Prednisone |
| Treatment Symptoms | Fast-dividing cells (body and cancer) killed. Patient is extremely ill | Fast-dividing cells (body and cancer) killed. Patient is extremely ill |
| Notable Side effects | WBC count reduced significantly. Increased risk of infection | Harsh gastrointestinal discomfort, nausea, sterility, |
| Results of Successful Treatment | Strong remission. Neurological damage due to drugs being blocked from entering the brain | Strong remission. Chance of developing a drug-resistant leukemia after a decade |
| Supporting Data | 5 and 10 year survival rate over 99% and 95% respectivelt | 35/43 people in the initial test achieved complete remission |

**The drugs used in chemotherapy are toxic to the body beyond a specific concentration, so the dosage is crucial. Different people have different tolerances to drugs as well.

## TERMS EXPLAINED

***Radiotherapy*** **- Treatment of cancer using radiation**

***Cytotoxic*** **- Toxic to cells**

***Lymphoma*** **- Cancer of the lymphatic system.**

***Proliferation*** **- Growth by rapid production**

***Metastatic*** **- Property of cancers to spread to other parts of the body.**

***Topoisomerase*** **- An enzyme that makes cuts in DNA to ease its unwinding during replication**

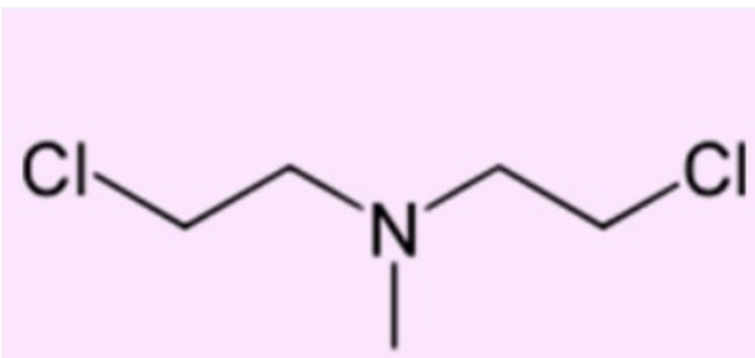
***Oncologist*** **- An individual trained to diagnose and treat cancer**

***Methylene blue*** **- A common stain used in labs to dye DNA/ RNA-rich areas of cells )**

# Side Effects

It is evident that chemotherapeutic drugs used are toxic to the human body over long periods. Common side effects of chemotherapy arise because the drugs use target fast-dividing cells. Hair loss, immunodepression, gastrointestinal discomfort all occur because the hair follicles, bone marrow, and lining of the digestive system are damaged. Organ damage is not uncommon and is often a consequence of the other side effects. The liver, heart, and kidneys are the most susceptible to damage through chemotherapy.

Certain drugs can cause nerve damage as well. The symptoms of this are chills and numbness. Nerve damage is often progressive for the duration of the treatment, which means it gets worse the longer the drug is administered. Various other side effects can afflict the patient depending on the kind of drug used. It is, therefore, crucial to design a treatment to reduce the side effects as much as possible.




The First Chemotherapeutic drug - Mustine


Source: cancer.gov

# The Bleak Future of Chemotherapy

The future of chemotherapy is not very bright in the age of modern medicine. The risk chemo poses by targeting healthy cells and cancer cells has slowly been eliminated by introducing newer and more specific therapies. Researchers look for essential proteins that are expressed more in cancer cells than in normal cells. They then design drugs to block said protein's function and thus prevent cell proliferation**. These drugs are small molecules so that they can pass through the cell membrane easily.

Targeted therapies, unfortunately, do not replace chemotherapy entirely. The side effects of targeted therapy are similar to that of chemotherapy. They also can be resisted by cancer cells (similar to antibiotic resistance). The edge they have over chemotherapy is that they do not kill cells but rather disrupt their function.

For now, targeted therapies and chemotherapy are both tools that can be used in the fight against cancer. There are cases where chemotherapy is more effective and cases where both can be used. SO, chemo is not off the books just yet but the age of chemotherapy has paved the road to understanding and modeling various kinds of cancers.

Human epidermal growth factor receptor 2 (HER-2) is an example of a targeted protein. A mutated version of a regular protein can also be targeted.

# A BRIEF REPORT ON SYMPOSIUM: INFORMATICS-DRIVEN ADVANCES IN BIOLOGICAL SCIENCES

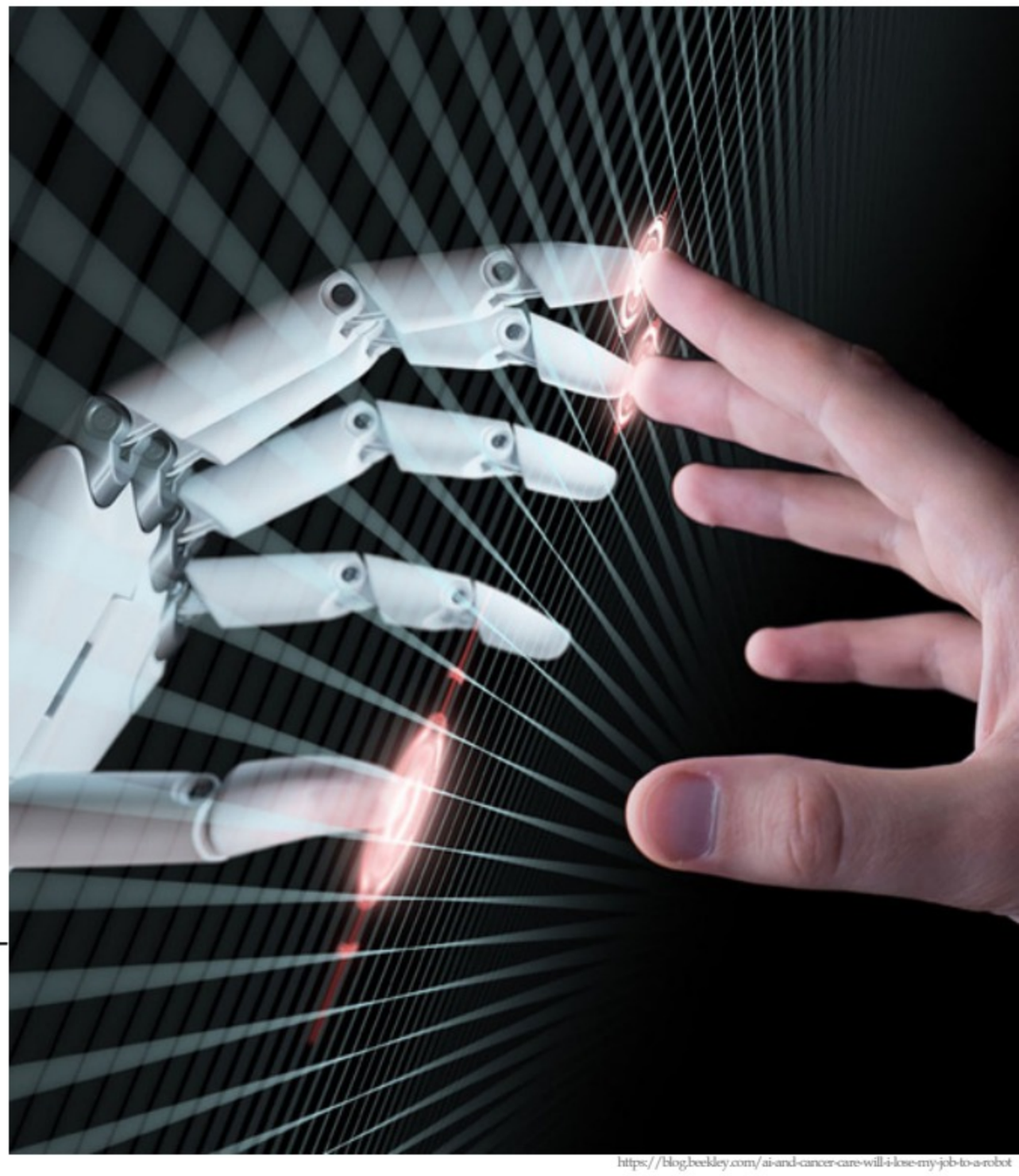
The Department of Biological Sciences at BITS Pilani, Pilani Campus in association with the Asia Pacific Bioinformatics Interaction and Networking Society (APBians) organised a one-day online symposium on 2nd March 2022 with an aim to highlight the "Informatics-driven Advances in Biological Sciences".

A total of eight eminent scientists from within and outside the country shared their work and expertise during the symposium. The symposium began with the welcome address by Prof. Rita Sharma, BITS Pilani followed by brief introduction of the ongoing research activities at Department of Biological Sciences by Head of the Department, Biological Sciences, Prof. P.R. Deepa. The President of APBians, Prof. Shandar Ahmad also briefed about the inception and ongoing activities of the society.

The scientific session consisted of a broad range of topics demonstrating increasing relevance of bioinformatics approaches in solving biological problems with talks by several eminent personalities in the field of bioscience . The first talk of the symposium was delivered by Dr. Santosh Mishra from North Carolina State Veterinary Medicine, North Carolina, USA who elaborated on the molecular pathways of Itch and Ouch sensations. Dr. Niharika Sharma from Orange Agricultural Institute, New Wales, Australia; Dr. Paritosh Kumar, Centre for Genetic Manipulation of Crop Plants, New Delhi and Dr. Kashmir Singh, Panjab University, Chandigarh elaborated on applications of diverse high-throughput omics approaches in elucidating the genetic pathways regulating plant development and stress response, and their implications on crop improvement. Adding the flavour of structural bioinformatics, Dr. Arjun Ray from IIIT Delhi and Dr. Shibasish Chowdhury from BITS Pilani talked about the recent advances in analysis of protein cavities and biomolecular interactions, respectively, using structural bioinformatics approaches. Another eminent computational Biologist, Dr. V Umashankar, ICMR, Chennai provided a comprehensive overview of bioinformatics approaches in microbial genomics and drug discovery. Finally, Prof. Shandar Ahmad, Jawaharlal Nehru University, New Delhi discussed the role of genome level cooperativity and target topology in protein-DNA interactions elucidated in his lab using machine learning approaches.The symposium was concluded by Dr. Mukul Joshi, BITS Pilani followed by vote of thanks by Prof. Shandar Ahmad and Prof. PR Deepa.

The symposium was attended by 343 participants out of which , about 32% were postgraduate students, 25% were Ph.D. students and research scholars, 20% were faculty members/scientists, about 18% were undergraduate students and the rest were postdoctoral fellows from central and state universities, and research institutes across the country. Overall, the symposium provided a platform for students, researchers and faculty members from diverse backgrounds to acknowledge the increasing role of informatics in solving biological problems, and foster collaborations between bioinformaticians and biologists.

# Cancer treatment using AI robotics



https://blog.beekley.com/ai-and-cancer-care-will-i-lose-my-job-to-a-robot

Have you seen people after getting cancer treatment treatment for cancer? Either they bear some loss (such as hair loss) or suffer through some disease (Anemia). The main reason for side effects is in the therapeutics. Chemotherapy or Radiation therapy of cancer is a generalized approach and the drug is not targeted towards the tumor cells. Targeted drug delivery not only enhances the effectiveness of the drug but also saves the individual from the harmful effects of the drug on other good cells.

Now this challenge can be overcomed by using biomicrobots with nanotechnology to create assisted microbots which can travel through our body fluids and pass through physiological barriers to reach the target site. Bioactive microbots could serve the purpose of a smart drug delivery system and move to the target region based on chemical and magnetic stimulus signals.

Biohybrid microbot composed of motile Magnetococcus marinus strain magnetospirillum magneticum(AMB-1) and light-triggered indocyanine green nanoparticles (INPs) that exhibit sequential magneto/ optics-conducted capability. The AI microbot with nanomedicine would enter the body and with the help of thefrom body's response to foreign pathogens.Meanwhile, fluorescence and magnetic dual mode imaging can be used to monitor the distribution of the AI microrobots in the body in real time. Thus, delivering the drug exactly at the target site and reduce the risk of side effect of microbes. The INPs with the help of NIR Laser could ablate cancer tumors by photothermal therapy. Therefore, nanoengineered bio-microrobotics can be accurately manipulated to treat hard to-access diseases in the body. It opened opportunities for the synthesis of new targeted therapeutic, imaging, and diagnostic vectors to enhance the delivery and efficacy of various nanocarriers or drugs.

# MARINE LIFE IN EACH OCEAN

INDIAN OCEAN

## Synanceia verrucosa

The fish with lachrymal sabre, switchblade like structure embedded on the face of the fish, one beneath each eye. They deploy this defence mechanism by squeezing their cheeks. Also known as "Stone fish" are found in tropical regions of Indian and Pacific oceans from the Red Sea to the Great Barrier Reef (Australia) are also the most venomous fish and has phenomenal camouflage capabilities. Its venom can kill an adult person in less than an hour.

NORTH PACIFIC OCEAN

## Exocoetidae

Spotted over 4 feet ABOVE the ocean surface, these species of fishes are also known as 'Flying fish'. They propel themselves out of the water at more than 56km/hr and spread their 'wings' to glide up to 200 meters. Found in tropical and temperate climate in Pacific coasts of the United States and Atlantic Ocean are of 40 different species.

SOUTH ATLANTIC OCEAN

## Toxotes

Aim, shoot and KILL! Archer fish shoots water through their mouth and aims perfectly at an insect sitting on a leaf or branch up to 5 feet above the water surface, while shooting their eyes face forward for the shot. They live in brackish water and coastal mangrove forests. They are widespread geographically, ranging from East Africa, through the coastal waters surrounding Asia, all the way to Australia.

NORTH ATLANTIC OCEAN

## Alpheidae

AKA the “Pistol shrimp” can make a cavitation bubble which reaches speeds up to 100 km/hr and then collapses with a loud pop (218 decibels, louder than a gunshot) and capable of breaking glass jars. They can be recognised by their large snapping claw, which moves backward like a hammer in pistol, claws once lost can also be regenerated. They are found in western Atlantic Ocean and the Gulf of Mexico.

ARCTIC OCEAN

## Synanceia verrucosa

Known as “Box jellyfish” for its body shape, is the most venomous living organism on the Earth. They have nematocysts, tiny darts filled with poison which are set in their tentacles which acts as a biological booby trap for preys. Poison once injected can cause paralysis, cardiac arrest and even death. They have clusters of eyes on each side of box which have lens and a cornea, making them highly sophisticated.

ANTARCTIC OCEAN

## Grimpoteuthis

Deepest living genus of octopuses, also known as Dumbo Octopus, getting its name from a Disney character for its large lateral fins or ‘ears’. They have bell shaped eyes (1/3rd the width of their head) still they can hardly see instead they sense the water current using strand like structure around its suckers called cirri. They are found in the deepest parts of the ocean at 9,800 to 23,000 feet.

SOUTH PACIFIC OCEAN

## Eurypharynx Pelecanoides

Also known as the Pelican Eel can open its mouth so large that they completely swallow preys larger than the eel itself, and their stomach also expands to digest that. They live at 500 to 6,000 feet in deep sea and are rarely seen by humans. They also have bioluminescence which they use to attract mate.

# BioTube

Search Internet or scan the QR

Try searching for

- How do nerves control every organ and function in the body?
- Why are human brains the biggest?
- Do blind people dream in visual images?
- Why do camera flashes make your eyes turn red?

## The Insane Biology

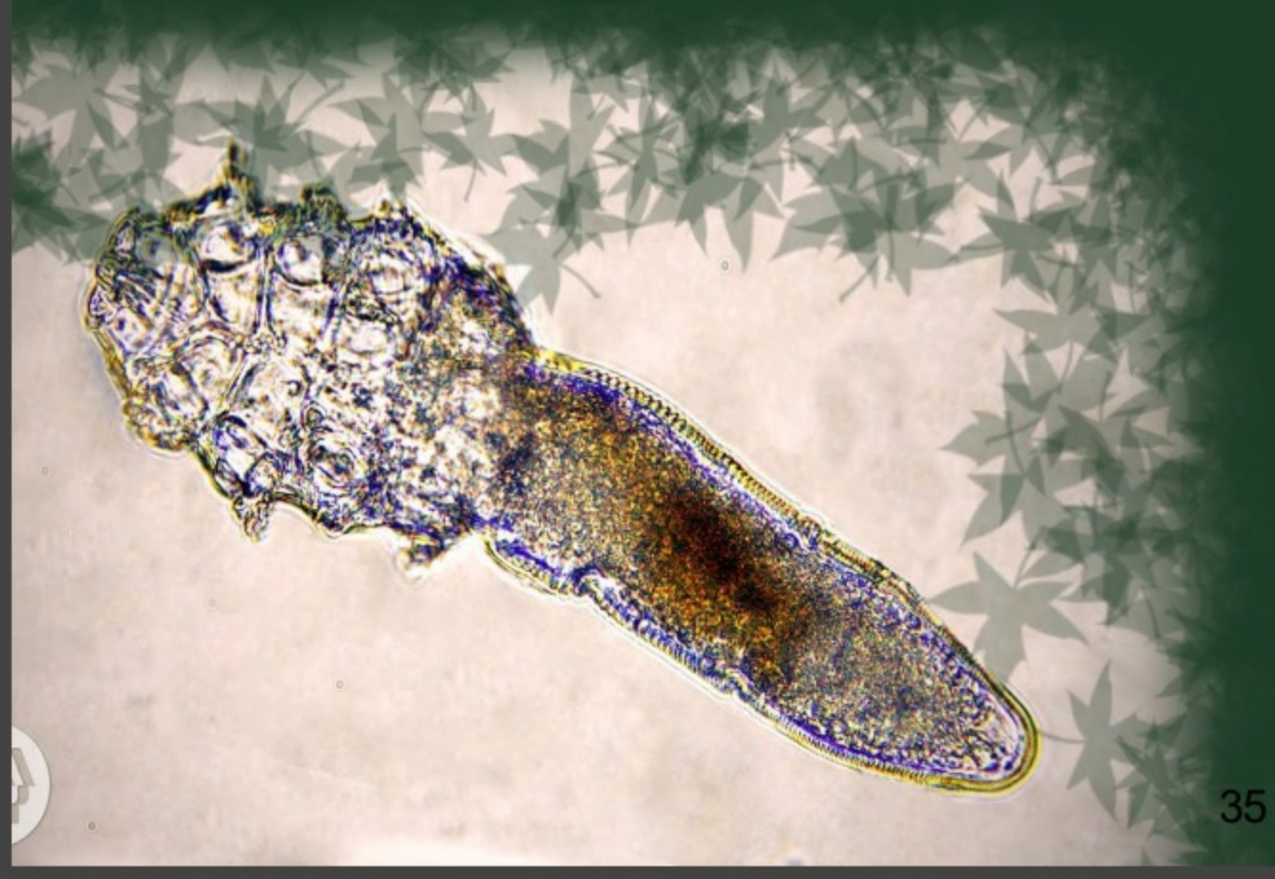
21:27

Have you ever had a sudden urge to watch a random documentary about an octopus? Well, this video explains what we know about the octopus to date in a cinematic fashion. It is easy to follow. If instead, you have an urge to learn about some other wacky animal, then the "Insane Biology of: " series on this channel will suit your needs.


## These Face Mites Really Grow on You

3:27

Imagine someone living in your face...now believe it! Demodex folliculorum, the face mites which spend their life span inside your hair follicle, only coming out to mate. Passed down from parents to babies they feed on the sebum produced by our skin. Our immune system keeps their population in check but in rare cases, an increase in their number can cause red rashes on the skin but they are harmless.



## Hydra: Stretchy, Speedy, & Probably Immortal

8:24

Nature has found a way to incorporate Greek mythology into microcosmic reality in the form of hydras- a nearly immortal polyp that lures and captures its prey using its stinging cell-laden tentacles. On being chopped up into pieces and shredded into individual cells, it still renews into a full-fledged hydra- a breathtaking example of regeneration in the living world. Join Hank Green on his channel Journey into The Microcosmos to find out more!


## The Magical Leaf: The Quantum Mechanics of Photosynthesis

4:01

Photosynthesis has an efficiency of almost 100% which is practically impossible to achieve yet.Do plants use quantum mechanics to achieve such high efficiency or are plants performing quantum computing to achieve high yield despite being at a temperature of 300 K. To find the answers to these questions check out the video.

## Why can parrots talk?

5:03

"Hello hello," it said with its squeaky voice, it was not a human speaking, it was a PARROT! You might have heard them talking live at a friend's house or in some videos. Check out this video to find out the fascinating reason they can repeat several words though they do not have any lips to shape the air.

## Why Life Seems to Speed Up as We Age?

7:40

Most adults feel that time elapsed a lot more slowly when they were young and has now dramatically sped up as they got older. There are a lot of factors contributing to this phenomenon which is explained beautifully via this video. There is no single internal clock like we have external clocks--our internal clocks are actually a bunch of clocks with our brain integrating, coordinating and synchronizing the output from multiple sensory modalities like the sleep cycle, audio-visual cues etc. into a cohesive final product.

## The Deadliest Being on Earth–The Bacteriophage

7:08


The amazingly animated video tells us how bacteriophages work and survive and increase their population. And also puts some light on how humans and bacteriophages team up to kill the deadly bacterias which have now evolved to become superbugs.

## Do Doorways Actually Make Us Forget Things?

4:05

The Doorway effect' Have you also forgotten why you entered a room at times? It might be the fault of the doorway you just crossed! Our brain breaks the information that we receive into small chunks. According to event segmentation theory, the brain creates event models to predict what might succeed the current event. Passing through a doorway, getting in a new room indicates a new event model, which often leads to a memory refresh.

# TECHNIQUE OF DISEASE DETECTION

## A Brief History of diagnostic methods

Have you ever had to go to a doctor for a blood test or an X-ray? We often forget to realise how far we have come in the field of diagnosing diseases. We went from smelling and tasting pee to now identifying and treating possible disorders in the womb of a mother itself.

Being in the middle of a Pandemic, humanity understood the importance of developing tests for quickly and accurately identifying diseases. But, even with the technologies available to us in 2021, medical science still needs to advance in this area. Before we map out our future, let's understand appreciate how we got here.

In the ancient era, Egyptian medicine documents the earliest diagnosis of diseases.It wasn't until 300 B.C. that Hippocrates, widely regarded as the "Father of Medicine.", made a significant impact on Greek and Roman medicine by introducing his humoural theory of the nature of diseases. In ancient Greece, specific bodily fluids were called humours: blood, phlegm, yellow bile, and black bile. According to his theory, all illnesses occurred due to humoural disbalances.The doctors would listen to the patient's lungs, observe their appearance, taste their pee, and understand their personality to achieve an accurate result.

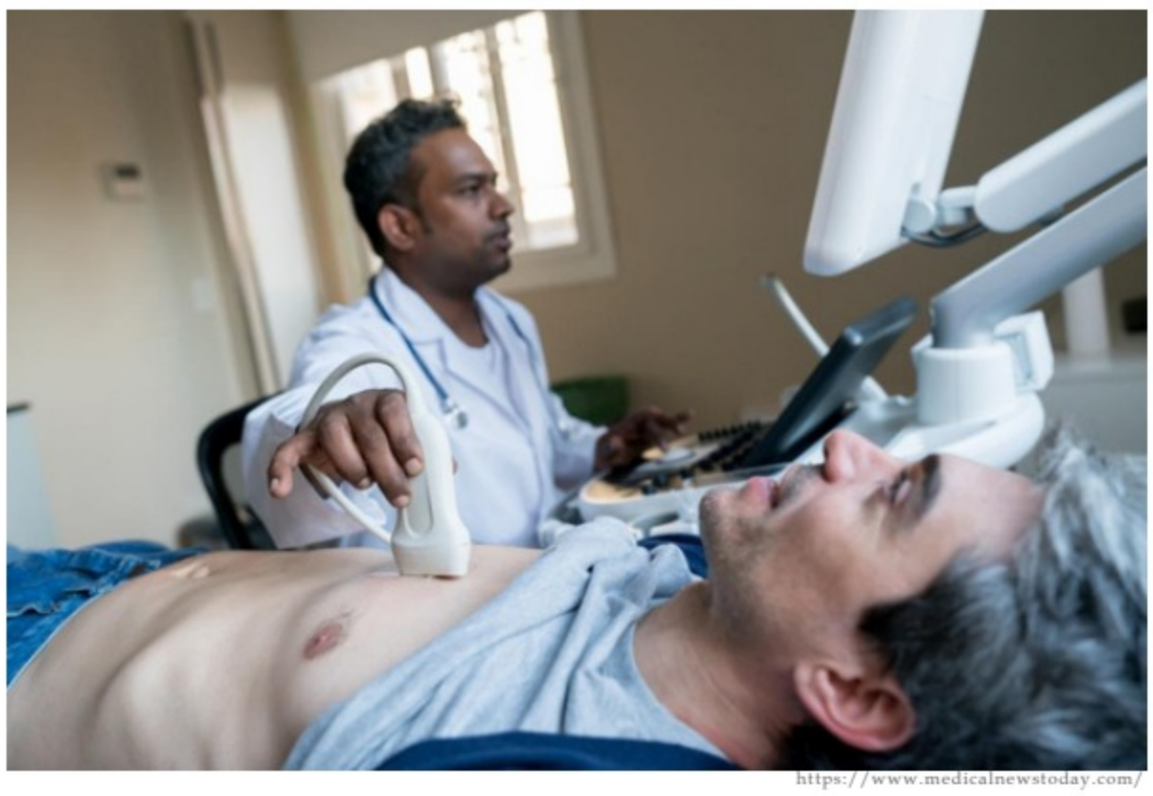
HTTPS://XRANM.COM/SERVICES/DIAGNOSTIC-RADIOLOGY/X-RAYS/

The early physicians used only their senses to identify a patient's illness as those were the only available tools; in fact, even this was considered a luxury. If you were a middle or lower class person, your fate was in the hand of God. An animal, such as a sheep, was sacrificed in your name and presented to the Gods. The condition of the inside of the sheep was later used to determine your illness. These not-so-accurate methods of understanding disorders prevailed all around the world during that time.

These diagnoses required all senses of the physician. During this time, the appearance of blood, pus or bubbles was attributed to different ailments. Even with significant flaws in this theory, works from his time give precise descriptions of pathological features such as wound inflammation, tumours, haemorrhoids, malaria and tuberculosis, even with only animal dissection at their disposal.

HTTPS://WWW.EGYPTTOURSPORTAL.COM/

The second-century presented us with the ideas of Galen, one of the most significant medical figures of all time. He improved upon the Hippocratic theory by travelling and educating himself about other medical practices, and combining his findings. His ideas were so widespread and uncontested that they brought European medicine innovation to a halt till the middle ages, which happened nearly 14 centuries later.



https://www.medicalnewstoday.com/

During the middle ages, diagnoses were superfluous. Diagnosis by inspecting excretions was commonplace. Around 900 AD, under the Jerusalem Code of 1090, failure to examine a patient's urine even exposed a physician to public beatings. Markets sold decorative flasks for patients to take to the physician. They also found the interpretation of dreams to be a diagnostic tool. Dreams of floods or flights were seen as your body signalling an influx or efflux of humours.

During the 17th century, we finally start to see glimpses of the medical science we know now. With the invention of the microscope, a german scientist named Athanasius Kircher was the first to use the device to study the causes of diseases. Using a microscope, he studied the blood of plague victims. Upon observing "little worms" there, he concluded that microorganisms caused the disorders. Even though his conclusion was correct, it is possible that he was observing RBCs and WBCs. His experiments also showed how maggots and other living creatures developed in decaying matter. He proposed hygienic prevention of diseases such as isolation, quarantine, burning of clothes of an infected person and wearing a facemask.

Even though uroscopy was still prevalent, the number of illnesses diagnosed via this method reduced significantly during this era. This century also accomplished intravenous injection of drugs, blood transfusion and checking pulse and heart rates for wellbeing.

# PRESENT METHODS OF DIAGNOSIS

Fast forward to the present, and the whole avenue of detecting diseases has changed drastically. From external scans, MRI to Internal blood microbiology to rapid testing techniques, this division of medical practice has come a long way. Techniques and methods for detecting diseases in plants and veterinary medicine have also started to emerge with the growth of their importance in our society. With the development of medical sciences, our understanding of various diseases and their symptoms increased.

Symptoms play a significant role in the detection of a particular disease. They narrow down the possibilities of diseases from over a thousand to a few. This, in turn, increases the speed of detection, which is of prime importance given that just a decade ago, around 10,000 people used to die every year in the UK due to late detection of cancer. According to WHO, people die of Cardio-vascular diseases in their productive years due to late or no detection of these diseases. Besides these, identifying symptoms also improves the accuracy of diagnosing diseases and reduces the risk of medical error in the crucial treatment process.

Besides the evolution of traditional techniques, newer techniques are being employed for this purpose as well.

Some of which include electron microscopy, immunohistochemistry and rapid diagnostic methods. Immunohistochemistry is used for testing particular diseases by making use of the concept of selective identification of antigens related to the antibodies of that specific disease. This technique is advantageous if the patient's sample takes time to be tested since this technique can make use of both frozen and fresh tissue samples. Besides, since it does not involve any living matter other than the tissue itself, it is a safe method too

Rapid diagnostic methods boast quick sample collection and diagnostic results as compared to other detection techniques. This novel method is based on the principle of nucleic methods (real-time, multiplex and simple polymerase chain reaction), bio-sensor methods and immunological based methods. All of these techniques, irrespective of the steps followed, make use of DNA and its structure to identify the diseases. Despite its quick, easy logistics and results, the major drawback of this technique lies in the percentage of false-positive and false-negative results. This is reflected in the data of COVID-19 RT-PCR tests, which reported about 28% false positives according to a conducted review.

# CHALLENGES FACED BY THE INDUSTRY

Despite the significant strides in this field, there are still several challenges that need to be tackled. The primary ones include diagnostic errors and late results. Early and accurate diagnosis is necessary since diagnosis is the first step of treatment or the therapeutic phase, which can worsen the patient's health if done erroneously. Further, this is even more vital in the case of communicable diseases. Hence this avenue is critical, so much so that there is a diagnostic challenge conducted by WSU in which multiple students solve such case-based problems

The way forward in dealing with such problems include:

Making use of mechanisms and techniques to minimise errors. These involve many vital steps such as test selection, sample collection and preparation and result processing and interpretation.

The instruments used in these tests, sample collection and analysis, need to be checked periodically, and faulty ones need to be replaced.All of these above steps include both technical and doctoral intervention, so both the parties have to be at near perfection for ensuring smooth and accurate diagnosis.

The other part of the problem involves doctors, technicians and other human errors. Symptoms, clinical history and physical exam all are open to medical mistakes, most of which can be avoided. According to a study conducted by John Hopkins University in the USA involving 3.5 lakh patients, it was found that diagnostic errors caused death or disability twice more than any other cause in consideration. The way to reduce these would be for doctors and medical personnel to exercise caution and diligence during physical examinations and while understanding a patient's history.


https://www.medicalnewstoday.com/

Currently, there are no stringent laws in India for defective medical devices, other than a draft bill that penalises the manufacturer and/or the hospital, clinic housing for the device. Passing such a bill might help reduce the risk of incorrect diagnosis. Further, there have been many fraudulent methods and claims of equipment and treatment that give false results, which can be dealt with by utilising such laws. For example, the infamous case of Elizabeth Holmes blood testing techniques that promised the best results with minimal blood samples.

The patient can also take a second or even a third opinion in case of a difficult diagnosis. Besides these, the stress on the doctors due to long overworking hours might also lead to such misinterpretations. Considering the medical practitioners to patient ratio in many countries, including India, is still below the WHO recommended mark of 1:1,000, the pressure and the stress on the medical industry are reflected in such errors.

Therefore, increasing this ratio by the respective governments will help in improving the current statistics on such errors.

# LOOKING FORWARD

The future of medical science focuses on convenience and efficiency. To achieve this, we have been aiming to implement artificial intelligence to aid the process. So, let's take a look at what our future looks like.

From the patient's perspective, they need not travel 4 hours to a clinic to do a 10 min blood test. They would be required to take a home diagnosing kit, and the AI will bring it back to the lab for analysis. All X-rays, MRI scans and PET scans are also likely to be completely automated.

The doctors also benefit from this revolution. As medical science progresses, digital pathology and histopathology will help scientists in taking a second opinion. The AI would also aid them by analysing scans of the patient and making a prediction based on the patient's history. Robotics will also help us access remote consultations and even surgeries! The integration of AI in the hospital system would be very cost-effective.

For diagnosis, scientists have realised that molecular diagnostics is the future. Studying and attacking a gene (for example, RNA of a virus) provides a solution at the core of the problem itself. One such technology being developed is the SHERLOCK based on the CRISPR Cas13 protein.

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SHERLOCK stands for Specific High-sensitivity Enzymatic Reporter unLOCKing. This technology uses CRISPR to detect biological materials. For the test, a small amount of DNA or RNA of the patient is amplified in a large number of RNA molecules. These molecules are mixed with reporters sensitive to the Cas13 protein. Finally, an engineered Cas13 protein is added to the mixture.

HTTPS://M.ECONOMICTIMES.COM/

The Cas13 protein is equipped with a guide RNA designed only to get attached to the viral RNA. When the viral RNA combines with the protein, Cas13 gets activated. Due to its nonspecific nature, Cas13 cuts most RNA around it, including the reporters, upon activation. The reporters contain signatures on each end which are then separated by the Cas13 protein. This causes a unique signal within the sample. The sample is then transferred to a flow detection system. The reporters are collected at different lines depending on whether they are intact or not, signifying negative or positive results, respectively.

Even though not fully functional yet, CRISPR technology will shape the next generation's medicinal knowledge by creating precise, cost-effective, and convenient methods of detection and rectification.

However, our predictions are based only on our current knowledge. Who knows what science might reveal in the coming decades and centuries. All we can do is marvel at how far we've come and imagine and work towards improving diagnostic sciences for the betterment of society.

# POISONOUS Plants

## AMERICA

Deadly nightshade is one of the most toxic plants found in western hemisphere. Tropane alkaloids are found in all parts of the plant, making it one of the most deadly plants. The most dangerous component of the plant is usually the root, however this varies from specimen to specimen.

An adult can die from ingesting just one leaf of the plant. Skin pustules might result from casual touch with the leaves. Children are more at risk from the berries, which are visually appealing and have a mildly sweet flavor. Children's ingestion of two to five berries and adults' consumption of ten to twenty berries can be fatal.

Wikimedia Commons

## AUSTRALIA

Plants develop toxicity as a defence mechanism since they cannot run away from their predators. The level of toxicity can vary with the age of the plant, its genes, soil type and even the season( more poisonous in the summer and during droughts). 2 fascinating but deadly plants found in Australia are:

**1. Deadly nightshade (Atropa belladonna)**

AKA ‘devil’s berries’ or ‘death cherries’, ingestion of a single leaf or about 20 berries will kill an adult. Its dull green leaves and shiny black berries about the size of cherries contain atropine and scopolamine which paralyses the involuntary muscles of the body( including the heart).Even just physical contact with the leaves may cause skin irritation. In Shakespeare’s story “Macbeth”, Macbeth’s soldiers used wine made from these sweet berries to poison the invading Danes.

2. Strychnine tree (Strychnos nux-vomica)AKA nux vomica, poison nut, semen strychnos and quaker buttons, the tree which is native to SouthEast Asia and Australia bears small, orange-coloured fruits with highly neurotoxic seeds. They damage the body's nervous system, causing convulsions, paralysis and even death. Even the tree's blossoms and bark can be poisonous, containing the alkaloids strychnine and brucine. At low levels, this tree is used in homeopathic and herbal medicines to promote appetite and aid digestion. Strychnine has a long and fascinating history as one of the world's most common, but least subtle, poisons which is why it tends to be the focal point of mysteries in which a victim has obviously and spectacularly been poisoned and the only question is which of the suspects did it.It's continued popularity is probably mainly due to its availability.

## EUROPE

**Datura** is a flowering plant, commonly known as thornapples, also known as devil's trumpets. It is poisonous and potentially psychoactive, especially its seeds and flowers, which can cause many severe diseases and even death if taken internally. Due to their effects and symptoms, various groups have used them as poisons and as hallucinogens throughout history. It is also used as a traditional medicine due to the presence of alkaloids.

**Euonymus europaeus, the European spindle**, is a flowering plant native to Europe. The fruit of the plant is poisonous, contains alkaloids, theobromine, caffeine, and terpene. Poisonings are very common in young children, who are attracted by brightly colored fruits. Ingestion of the fruit can lead to liver and kidney damage and even death. The plant is used as an ornamental plant in gardens; its wood makes spindles and holds medicinal properties.

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