

HERFED

BY FSA CLUB



SUPERPOWERS AND OUR NATURAL
WORLD

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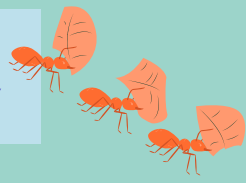
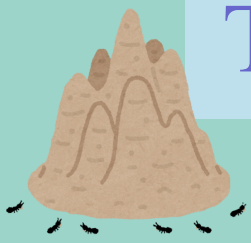
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The Horrifying Slaver Ant

Advik Jha



Slaver ants sound like something out of a horror movie. They sound like some horrible lab mutant out to take over the world. In a way they are mutants, of evolution, out to take over and enslave their world, a few ant colonies. Slaver ants are ants that do not do any work apart from raiding. They don't feed themselves, feed their brood or care for the nest. Like the rich upper classes, they delegate these menial tasks to their servants, or in this case slaves.

Let me give you the basic model. Imagine a regular ant colony doing its own thing that has the bad luck to be situated near a slaver ant colony.



First, the scouts spot it and then release pheromones. Then, the cavalry arrives. The colony that is being attacked is often far larger than the slaver ant colony, but the slavers are relentless.

Polyergus, a famous genus of slaver ant



A victim species of slaver ants.

The brood is kept in the slaver nest and imprinted by the nest's odour and by the slaver ant pheromones. They then form the next generation of slaves.

They release pheromones that confuse and stunt the defensive response. Battles are generally won by the invaders and they carry away the brood.

The slaver ants cannot even feed themselves as they are such specialised slave makers.

All this information is only generic and different species vary. Now comes the interesting part. Some enslaved ants rebel. Although this makes sense from a human point of view for an ant this would not benefit at all.

The rebellion is not a fight to the death but rather the slaves killing the slavers' brood. One hypothesis for why they do this is that they do so to reduce the number of slavers safeguarding nearby colonies. No matter what, the whole slaver-slave relationship is quite interesting, right?



A species of slaver ant called *Polyergus* is especially intriguing. To start a new colony, it invades a host colony, kills the queen and enslaves the workers. It does this during a raid, slipping in, engaging the host colony's queen and killing it with its sharp mandibles

The host colony is not entirely defenceless though. It is in an evolutionary arms race with its enslavers. This is because raids can seriously jeopardise the survival of the host colony while the evolution of the hosts threatens the raiders.



Now, let's go to the different species of the slaver ant. Some parasite- host pairs are:

Rossomyrmex–*Proformica*[15]

Polyergus–*Formica*[15]

Formica–*Formica*[15]

Leptothorax–*Chalepoxenus*[15]

Leptothorax–*Epimyrmica*[15]

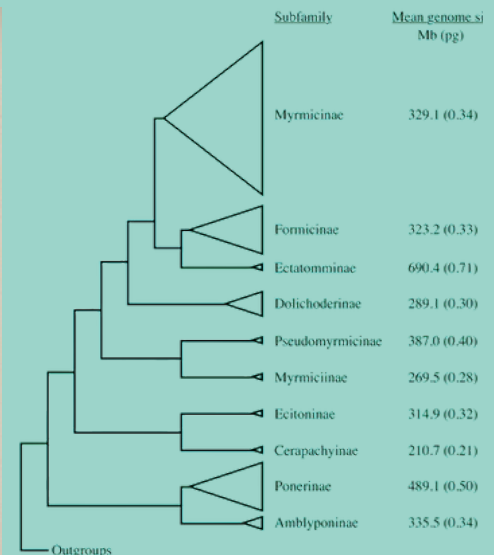
Leptothorax–*Harpagoxenus*[15]

Leptothorax–*Leptothorax*[15]

Leptothorax–*Protomognathus*[15]

Myrmoxenus–*Temnothorax*[16]

Strongylognathus–*Tetramorium*[15]



All in all, slaver ants still sound like something to keep you up at night. For their host species, they are and always will be.

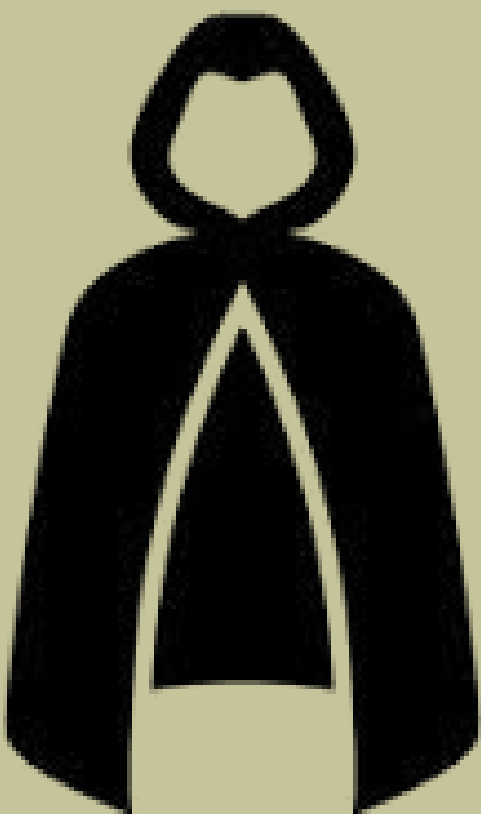
THE PHYSICS BEHIND SUPERPOWERS

ADITYA GUPTA

Superpowers have been a fan favourite in science fiction books and movies for years now.

However until a few years ago the idea of superpowers like invisibility, levitation and super strength in real life seemed impossible. But now however with the help of science superpowers may become a thing of the future.

VISIBILITY INVISIBILITY IN



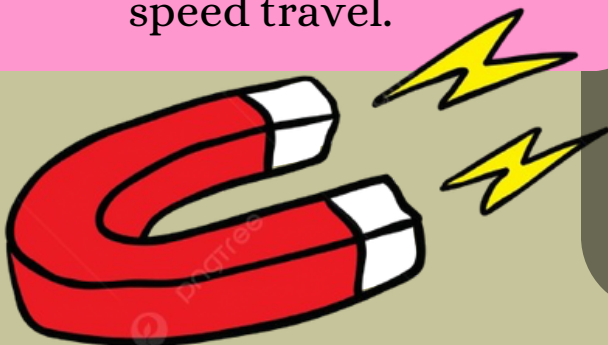
The invisibility cloak in Harry Potter, the invisible plane in Wonder Woman, are some of the most famous instances of invisibility in books and movies. They can be explained through the use of metamaterials. These materials manipulate their refractive index.

The refractive index of an object determines how light travels through a material.

These materials bend light waves allowing them to appear invisible. While current technologies mainly work on certain wavelengths, extending this to a full spectrum remains a challenge due to the complexity of the materials being used. (1)

ES ANTI-GRAVITY DEVICES ANT

Anti-gravity, often used to depict levitation, can be explored through electromagnetic repulsion and superconductors. In order to counteract gravity, electromagnetic repulsion makes use of like-charged magnetic fields which is used to counteract gravity by creating a force stronger than gravity. This phenomenon is seen in maglev trains that float above tracks which reduces friction allowing for high speed travel.



Superconductors exhibit the Meissner effect, where they expel magnetic fields and levitate above a magnetic surface when cooled to extremely low temperatures. This principle has been demonstrated in laboratory settings, though practical applications on a larger scale are still being researched(2).

SUPERHUMAN STRENGTH

Superhuman strength could be achieved by enhancing muscle performance or using exoskeletons. Advances in biotechnology, such as myostatin inhibitors, show promises for increasing muscle mass, allowing for greater strength.



Alternatively, exoskeletons can augment human capabilities externally. These wearable devices, use actuators and sensors to amplify the wearer's movements, enabling them to lift heavy objects with ease.



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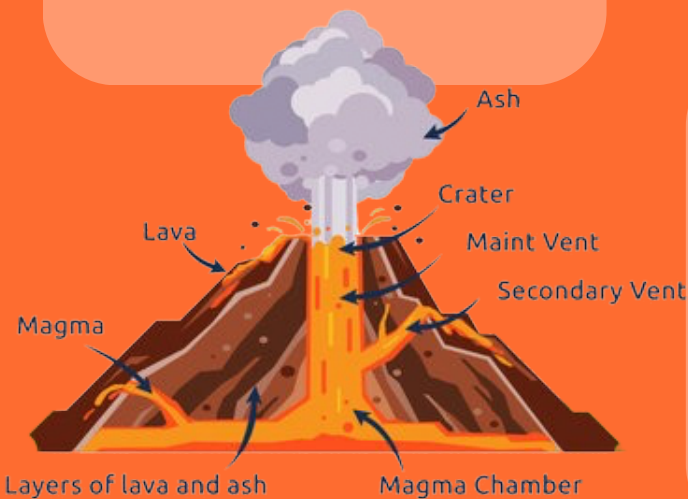
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The Science behind volcanoes

Avishi Dhasmana 8D

A mountain with a crater at the top through which lava and gases escape, volcanoes cover 80%+ of earth's surface above and below sea level.

Volcanic eruption happens due to the movement of heat beneath the earth's surface. The temperature is extremely high within the earth's surface due to which part of the rock melts, known as magma.



Lighter than the solid rocks, the melted magma, gets collected in the magma chambers and rises through the cracks in the earth's surface. The dissolved gases in the magma affect the volcanic eruptions.

Volcanoes are classified as active, dormant, or extinct. Active volcanoes have recently erupted, they are likely to erupt again. Dormant volcanoes are those which have not erupted for a long time but may erupt in the future. Extinct volcanoes are those which are not likely to ever erupt again.



Adapting to Extremes: Science of Surviving Natures Toughest Conditions

By: Ahanah Hirani 8D



While most people can barely survive a mild change in the temperature of our comfort zone, there are many people who battle Mother Nature's wildest conditions daily. The Eskimos, Himba, Sherpas and Huli are only a handful of the many people who endure harsh climates in their everyday lives. Scientists have done extensive research to understand the truth behind human adaptation to extremes however, there is much more to be understood.

A common example of humans adapting to extreme conditions is the Inuits, the indigenous people of North America. The Inuits have adapted physiologically and culturally to the extreme environment they live in. Research shows that over thousands of years, the Inuits have developed smaller hands and feet, rounder faces and they have become stockier as compared to people living in temperate climates. These characteristics help reduce heat loss in the body. They have also adapted culturally: they wear clothes made of animal hide, use snowshoes, dog sleds, kayaks and have created ingenious hunting strategies which are tailor made for Arctic conditions.[1]



Another group of people that live in harsh weather conditions are the Tibetan Sherpas. The Sherpas live at high altitudes. Researchers found the Sherpas' mitochondria were more effective at utilizing oxygen to produce ATP, the energy that fuels our bodies. A regular person's muscles get energy from glucose or by burning fat, which is called fat oxidation. Mostly, our bodies extract energy from fat. Sherpas have lower levels of fat oxidation, showing their efficiency at producing energy from fat. [2] New studies have shown that Tibetans have variants of the *EGLN1* and *EPAS1* genes, main genes in the oxygen homeostasis system at all altitudes. These genes were estimated to have evolved around 3,000 years ago. [3]



The people surviving in intense weather conditions develop a strong sense of survival and become resilient to extreme temperatures. Tourism at these places is also heightened as people across the globe want to discover how some humans live in such harsh conditions. However, adapting to extreme climates can also cause long term health issues. People in extremely cold weather conditions have to deal with the risk of frostbite and hypothermia and in hot weather conditions many face dehydration. They also have increased susceptibility to climate change. Increasing temperatures may lead to more challenges which the people may not have had to face some years ago. [4] It is important to understand how humans have evolved and adapted to extreme climatic conditions over the years so that it can aid researchers in various studies in the future. In a few decades, only some of the extraordinary people living in these conditions will survive, due to climate change. By reflecting on their adaptations, we should get a better understanding on how to create a sustainable future and reverse climate change.



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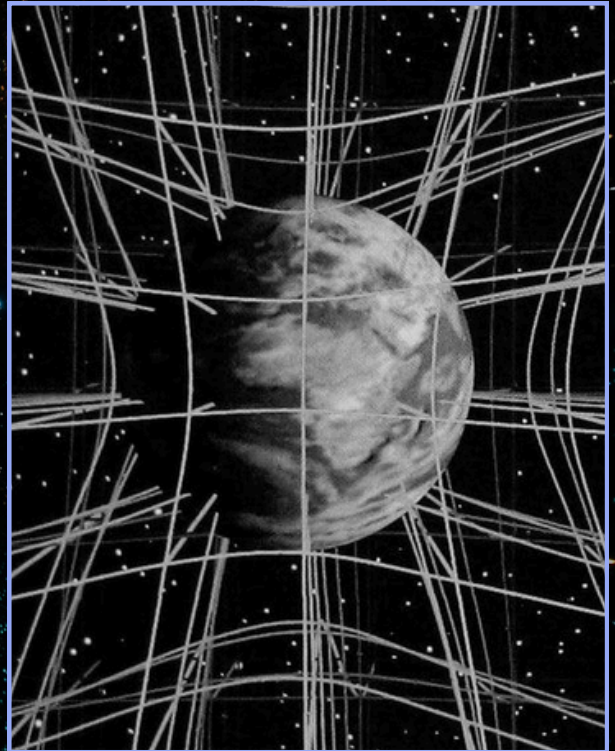
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SPACE AND TIME

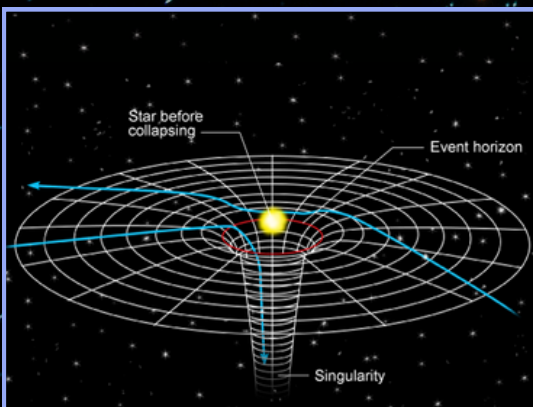
Aryansh Agarwal

Isaac Newton said that every object has mass. He stated that the greater the mass of an object the more the gravitational force. It means that a heavier object will pull a lighter object in space towards it. The physics seemed to fit in and everyone agreed. Some years later, Albert Einstein stated that space was an elastic fabric that when a heavy body was placed on it, the closer body would be drawn to it.

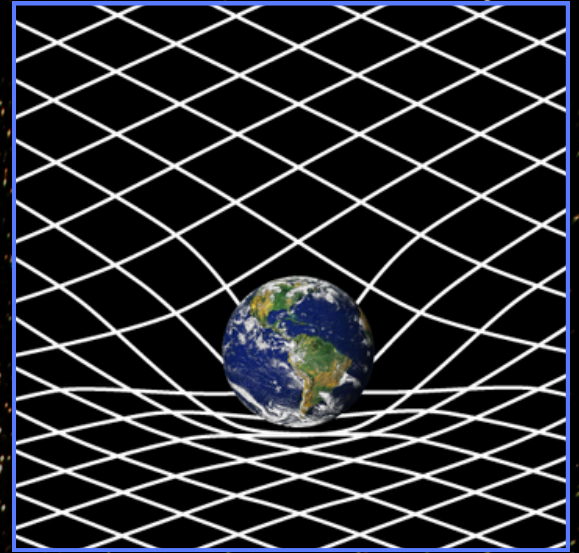
The general theory of relativity states that space has 4 dimensions namely length, breadth, height and time. It is believed to be a 'continuum' because so far as we know, there are no missing points in space or instants in time, and both can be subdivided without any apparent limit in size or duration. But what is the General Theory of Relativity? It is physicist Albert Einstein's understanding of how gravity affects the fabric of space-time.



The general theory of relativity, which published in 1915, expanded the theory of special relativity that he had published 10 years earlier. Special relativity argued that space and time are inextricably connected, but that theory didn't acknowledge the existence of gravity.

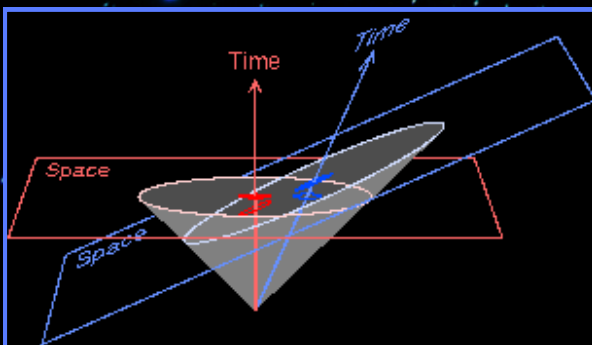
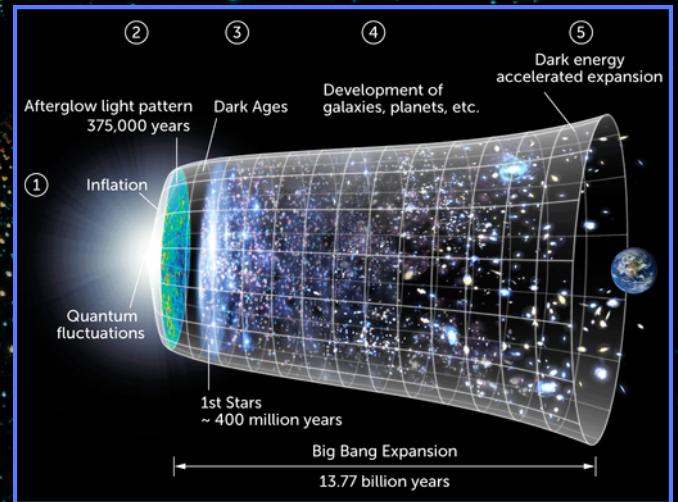


Einstein spent the decade between the two publications determining that particularly massive objects warp the fabric of space and time. According to Einstein, space was a fabric which would bend when a heavy object was placed on it such as a planet.



He postulated that time was like a flowing river depending on the effects of gravity and space time. In the 17th century, Isaac Newton saw time as an arrow fired from a bow, traveling in a direct, straight line and never deviating from its path.

To Newton, one second on Earth was the same length of time as that same second on Mars or Jupiter or in deep space. He believed that absolute motion could not be detected, which meant that nothing in the universe had a constant speed, even light. By applying this theory, he was able to assume that if the speed of light could vary, then time must be constant.



Space time is a discovery that has changed the way we think about the universe. There are many concepts of space time, all of which are magnificent.

BLACK HOLES

Advitya Kothari

What are black holes?

A black hole is a place in space where gravity is immensely strong, even to the point where light cannot escape. Black holes occur in a process called the supernova when the centre of a star of more than 20 solar masses (1 solar mass is 2×10^{30} kg), uses up all the nuclear fuel in its core and collapses.



Myths Surrounding Black Holes

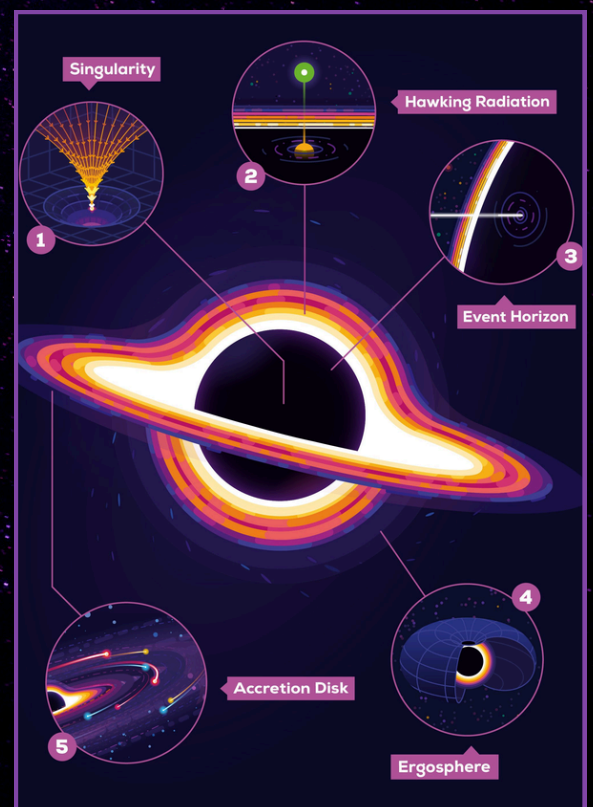
Contrary to popular belief, black holes are not these vacuum cleaners of space, since anything that has mass exhibits gravitational forces just as the sun's gravitational force pulls the 8 planets of our solar system and keeps it into orbit, the supernovas of the large stars form black holes exhibit extremely powerful gravitational forces, to the point where literal light cannot escape, causing an inaccurate representation.



Fun Facts!

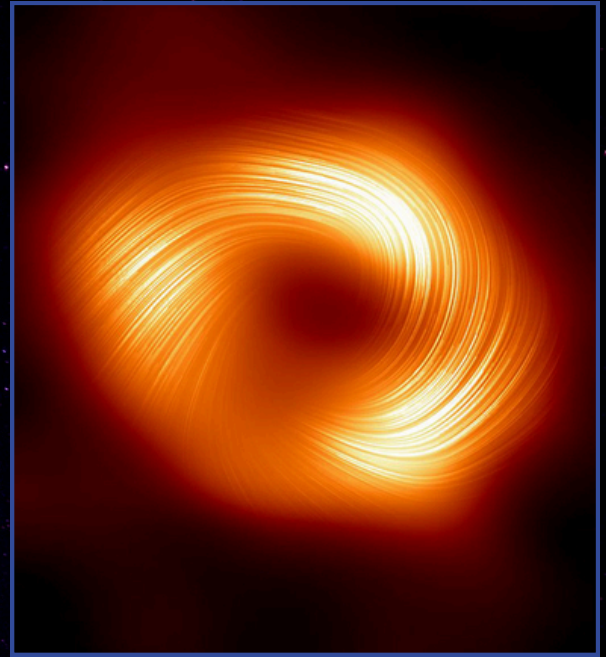
Black holes themselves are fundamentally invisible, they can only be seen by specialised telescopes noticing how stars around a black hole behave differently as compared to normal stars. Since we cannot bring light past beyond the event horizon, and is irrecoverably lost to the gravity, the only real way to confirm its existence is to see its effect of light on other objects,

We know that they exist due to the groundwork laid by Einsteins theory of relativity when a large star collapses to a small volume causing a gaping dent in space-time. The lifespan of an average star is around 10^{10} years, after which it dies, due to a theory called hawking radiation, and turns into a black hole.



Pros of Black Holes

- Supermassive blackholes release vast amounts of energy that power quasars, which are galactic nucleus, which boost the growth of new stars and are hence, essentially creating galaxies
- During their collisions, they spread heavier particles such as gold and platinum, which make up everything on Earth, including us.
- Studying black holes helps confirm Einstein's theory of relativity, and helps scientist understand the cosmos and how mass, space, and time are related.



Polarised Emissions
Black Hole : Sagittarius A

Cons of Black Holes



Supermassive Black Hole Energy Jet

- Since black holes release vast amounts of energy, they can shower millions and perhaps billions of radiation and particles, hence keeping a large amounts of its surroundings extremely hot, thus posing threats to nearby celestial bodies.
- They emit large amounts of gravitational forces. They can potentially grow in size and engulf various cosmic bodies, blasting radiation in its way.
- We have very little knowledge on them, and if they ever posed a threat to vaporise earth, there is nothing we can do to stop them.

In my opinion, the dangers of blackholes, although terrifying, are extremely rare, and there are no immediate dangers since there is no black hole close enough to pose a threat to our earth. In fact, the sun has a higher chance of destroying earth through solar storms. Whilst the sun provides us life and energy through sunlight, it can also eradicate us. Similarly, black holes, although low, have a chance of destroying us. At the same time, they are also responsible for life on earth, and birth of new stars. The study of black holes can also help us understand the beginning of the universe, and how it works.

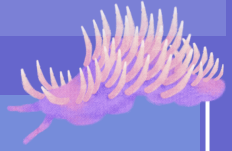
Superpowers in Nature

Regeneration



Regeneration is the ability of creatures or organisms to regrow damaged or broken parts of their body. Several organisms are blessed with this ability and can survive an event which would be harmful or lethal to an average animal or creature.

Axolotl

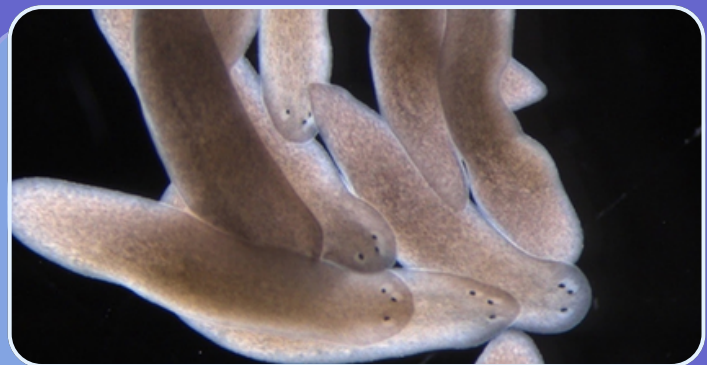


An axolotl is found in Mexico and is one of the creatures capable of regenerating their body. It is said that this creature never ages and can revive its dead body parts. It does not only cure a few cells but also limbs and other organs of the body.



Planarians

Planarians, also known as immortal flatworms, are worms that take regeneration to the next level. They can grow back limbs and organs.



Furthermore, when you cut a planarian in half, not one but both pieces will survive as two different worms. This happens because they can regenerate their cells very quickly and convert them into different types of cells.



Super Strength

Super strength is the ability to push, pull or carry objects that are beyond that organism's capability on basis of size.

Dung Beetle



A dung beetle is no larger than a human thumb but it can lift up to thousand times its own weight. It rolls balls of dung over massive areas.

For comparison if a human had the power of a dung beetle, then an average human would be able to carry at least 60 tons of weight.



Leafcutter Ant

Leafcutter ants are creatures that have great strength and team work. They lift up to 50 times their body weight.



They have strong mandibles. Their strength allows them to survive by harvesting leaves and eating fungi.

Flight



Flight is the ability of an organism to adapt specially to fly in the sky. Several birds have wings that allow them to fly away from predators and other dangers such as harsh climate, etc.



Peregrine Falcom

The peregrine falcon that can dive at a speed of 240 miles an hour is the fastest animal on the planet. The adaptations the falcon has are a streamlined body, strong muscles and sharp wings.

It is like a rocket.



Albatross



The albatross is a bird that has the longest wingspan of nearly 12 feet. They fly vast distances for hours. They do this by continuous motion of their wings and by soaring for hours with the help of wind currents near oceans.



These awe-inspiring creatures have led humans to push their limits and make technological advancements to access these abilities such as machines for super strength, flights, planes, helicopters for flight and several medical advancements for regeneration.



There are several more such creatures and there is something to learn from each one of them. Therefore it is incredibly important that humans keep pushing their limits.



Brain Power- Extraordinary Minds

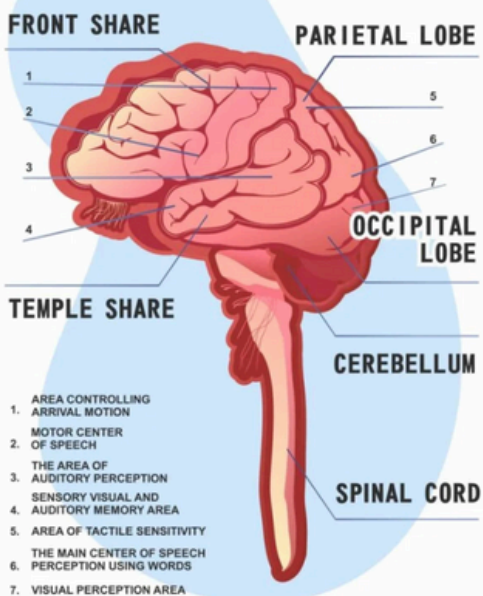
by *Vir Bhansali*

Brain power is your cleverness or capability to think. Our brain constantly receives signals, whether from the outside environment in terms of perceptions or memories from our past. It then activates different patterns via waves in the brain through billions of synapses. The brain automatically casts aside everyday occurrences but holds onto the unusual ones. Our brains are so developed that common events rarely influence us because we can predict them.



The brain consists of the cerebellum, cerebrum, and medulla oblongata.

PARTS OF THE BRAIN



The cerebellum: The nervous system consists of specialized cells called neurons. Despite the cerebellum being only 10 percent of our brain and incredibly compact, it contains about half of all the neurons in our entire body.

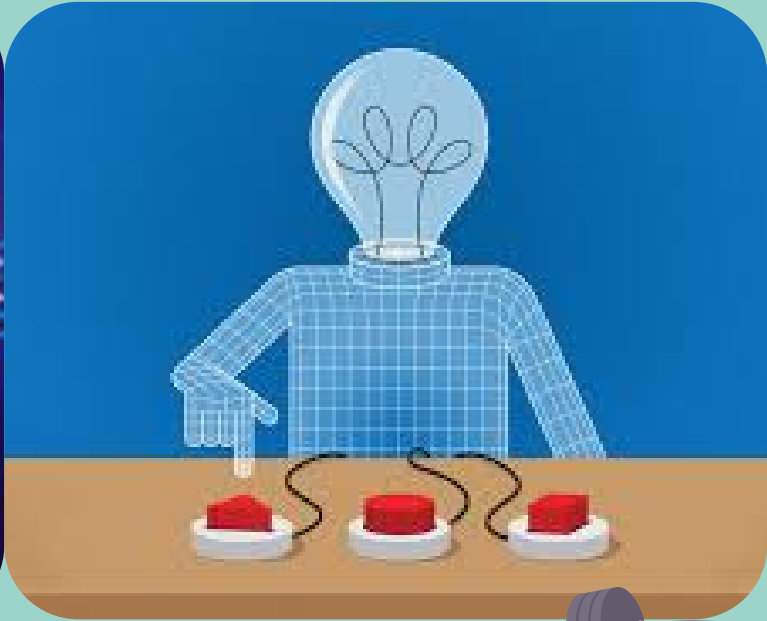
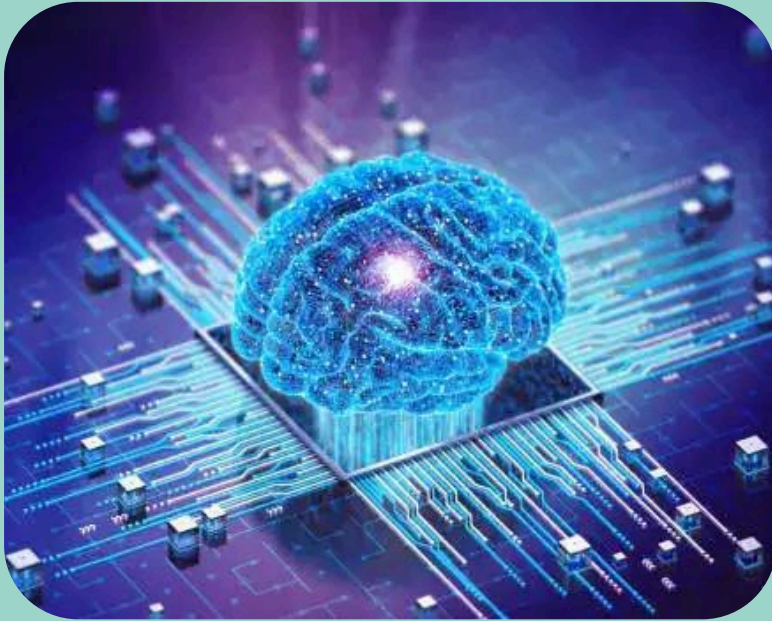
The cerebrum: It is the largest part of the brain, weighing 85 percent of the organ.. The cerebrum makes the human brain and in turn people so formidable.

The medulla oblongata: The medulla controls essential involuntary functions like heart rate and breathing while also managing nerve connections



OUR BRAIN IS FASTER THAN A SUPERCOMPUTER!

Accessing the signals coming from your eyes, your brain quickly calculates when, where, and at what speed something will have to be done at. Our brain can process, download and react to information coming from our organs considerably faster than a computer can.



3 WAYS TO IMPROVE BRAIN POWER

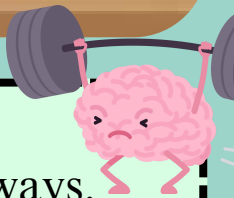
Meditation: Meditation regularly adjusts the brain in several ways.

It alters brain waves and improves connectivity within the brain.

Brain Exercise: Brain exercises should target some of the areas measured by IQ tests, such as working memory, executive function, and spatial reasoning.

Critical thinking: Question assumptions, reason through logic, and diversify your thoughts and perspectives.

The brain is an outlier among other mammalian bodies brains, defying evolutionary rules that apply to other species, with a uniqueness seeming necessary to justify the superior cognitive abilities of humans over mammals with even larger brains.



The bizarre world of defence systems of animals

By Adnan Shikari

Animals. Probably the most interesting, enrapturing, and even sometimes explicitly weird, subject to study, at least in my perspective. I am an avid enthusiast on all topics of zoology. In this article I will mostly be covering the interesting, captivating part of animals, with a healthy dose of weird, disgusting and bizarre, which I am guessing all you fellow teens will happily devour.



The Iberian ribbed newt has an incredible—though unsettling—method of avoiding predators. It creates spiky body armour by pushing its ribs forward through its stretched skin when it feels threatened. Oh, and there's poison in the spikes. They release a milky liquid that can cause the predator great agony or even death as it seeps through the newt's skin. The gory tactic has no appreciable negative effects on the newt itself, and it can be used again with no issues to cure itself each time.

So, when you think about animal defences, you think about shells, or maybe scales. But, here, now, I will introduce you to one of my favourite reptiles – the Texas Horned Lizard, along with all the other horned lizards. This lizard, when approached by predators such as hawks and snakes, squirts blood at them from the corners of its eyes. Texas horned lizards have muscles that line the veins surrounding their eyes. When contracted, these muscles cut off blood flow to the heart and flood the ocular sinuses. The lizards can contract the muscles further and make the blood shoot four feet from their eyes. In biology, it's called autohaemorrhaging or "reflex bleeding."



Ants. Pretty cool right? Living in huge colonies, and each ant having a different role to play is a really cool concept to study. Now we come to the 'exploding ants', around 15 different species of ants found in Southeast Asia. Worker ants from these species have large, poison-filled glands that run through their whole bodies. When under threat, they will violently contract their abdominal muscles to blow themselves up and spray a sticky poison. It's this corrosive chemical irritant, rather than the explosion itself, that immobilizes or kills the attacker. Unfortunately, it also kills the ant.



There are many, many more examples I can give of the unnerving world of animal defences, but unfortunately, I must stick to a word limit that has been deigned appropriate by the wonderful editing team, so that other people can also write articles. I really hope that this article has given people insights into the wonderful world of animals, and that at least a handful of people might do some more research into the topic



