Mayıs 2019
Pluto
VKV Koç Özel İlkokulu, Ortaokulu ve Lisesi
Öğrenci Dergisi

PLUTO

Mathematician, physicist and author

Emilie du Chatelet

"Let us choose for ourselves our path in life, and let us try to strew that path with flowers."

Fusion Energy

Life Cycle Of A Star

Neutron Stars And Types

The Brakes Of The Floating Train

Black Holes And Information

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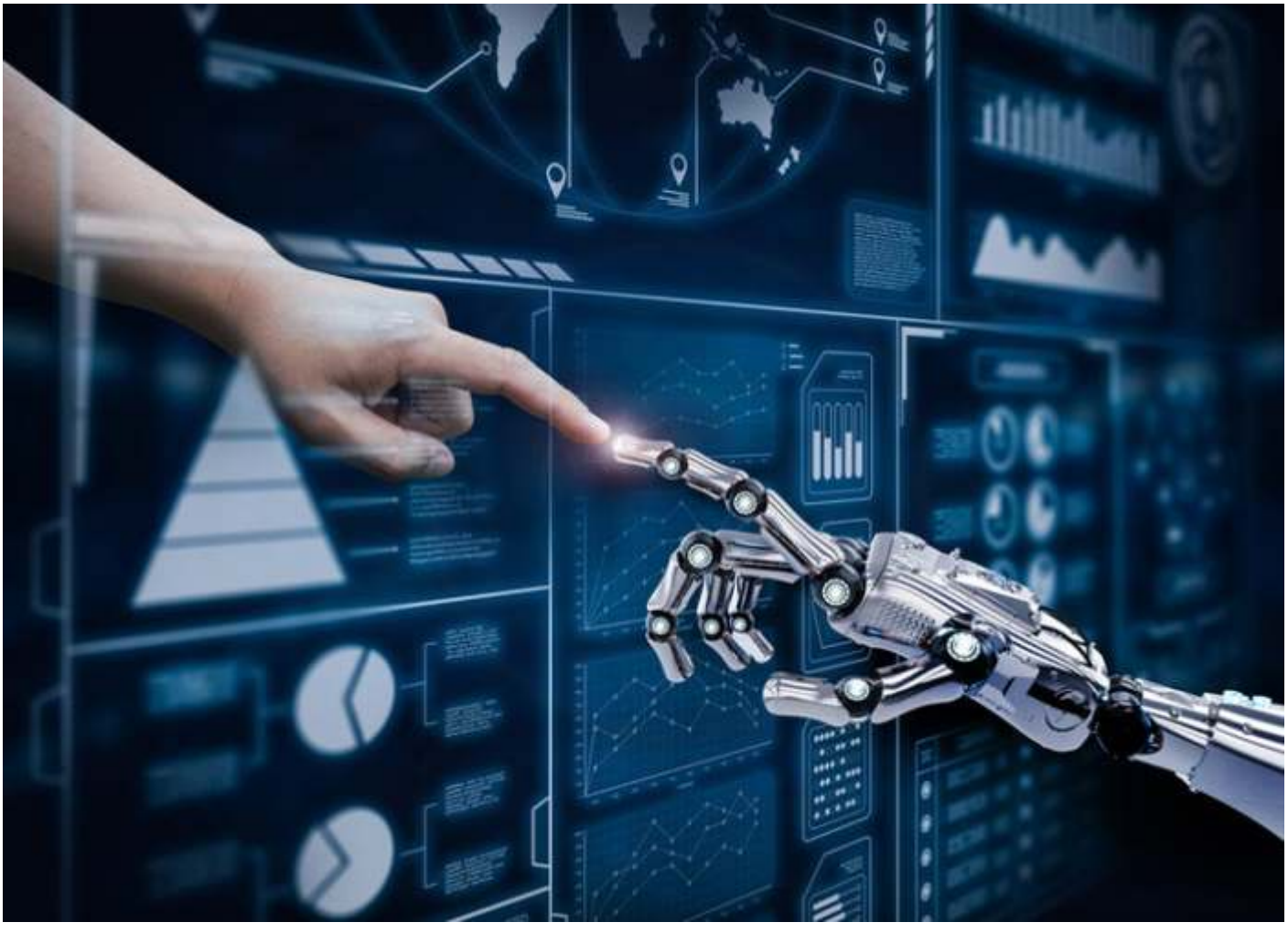
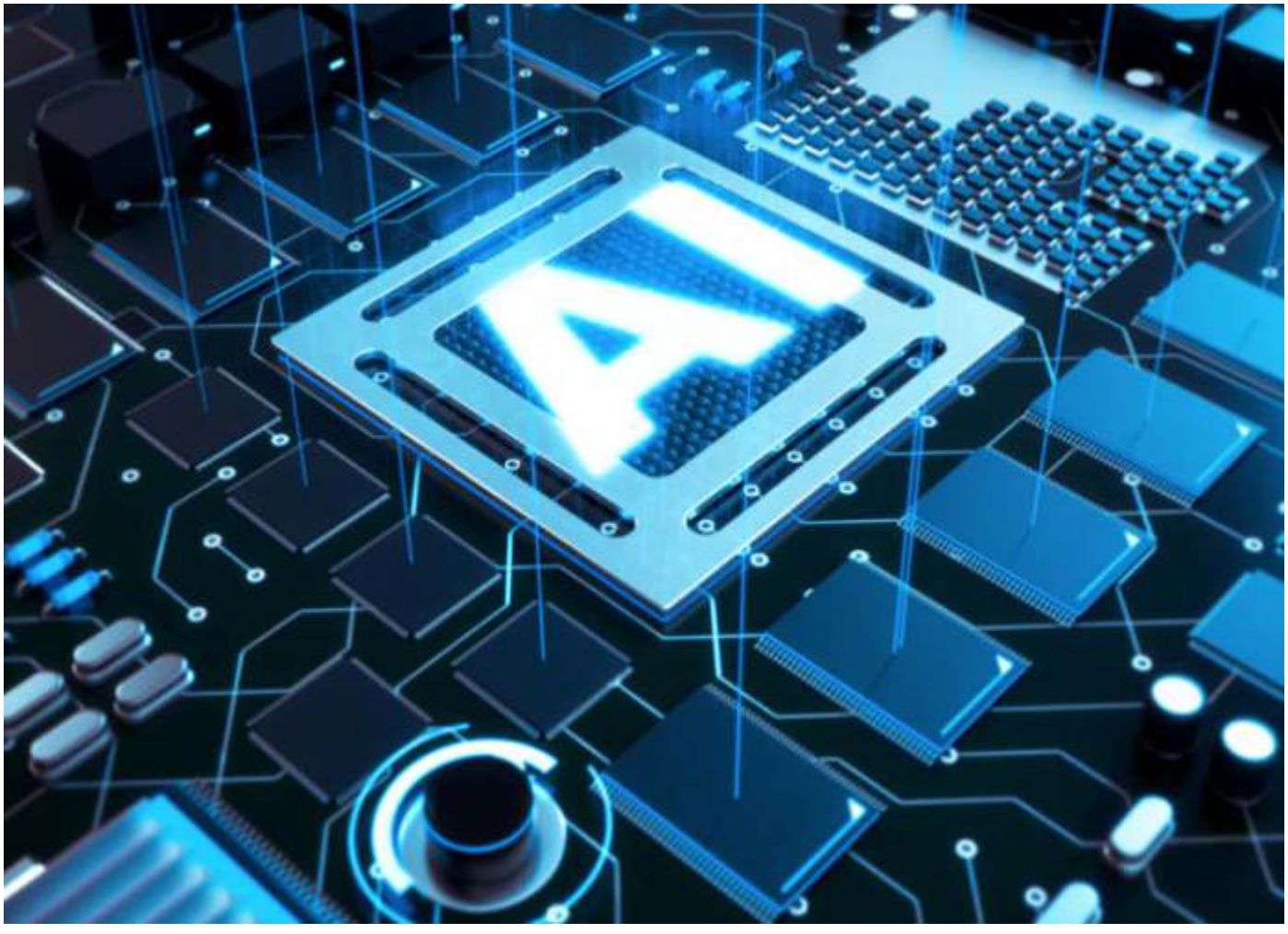
TABLE OF CONTENT

HearingUp



Cavemen would never have expected their descendants to develop technology at a level that allows artificial intelligence to alleviate the burdens carried by humanity. In about fifteen years, this technology will have the potential to eliminate the challenges that are faced by the hearing-impaired with the production of HearingUp. Powered by artificial intelligence, HearingUp will create groundbreaking innovation where knowing sign language will no longer be necessary to communicate with the hard of hearing. Today, many sign languages exist internationally. This diversity can become a negative factor when considering that people may fail to be fluent in different sign languages, and many hearing people would not strive to learn more than one. HearingUp aims to ameliorate this problem by providing glasses with sign language and audio recognition. This glasses will convert audio to written words and project them onto the glasses while converting sign language to audio with the help of artificial intelligence (AI). Designed for the use of hearing-impaired people, HearingUp will provide healthy communication, beget active and social individuals despite its disadvantages that may occur in the first years.

Primarily, HearingUp will help the hearing-impaired to have an active role in society without any of the pre-existing obstacles. It translates speech into text for them by using both speech and facial recognition technology with the help of the camera that is placed inside the glasses. First, speech recognition technology analyses the sounds in the user's surroundings with the mini microphone which will be attached to one side of the glasses. Then depending on the algorithms and earlier input, it will make an accurate assumption as to what one is saying. Moreover, the glasses have lip reading technology to increase



the selectivity during one to one dialogues in crowded places. This technology watches the speaker's facial expressions; recognizes speech patterns, gestures, movements and turn these into text with the help of its memory and AI. One of the applications of AI is machine learning, providing computer systems to learn and advance from experience without being specially programmed. HearingUp will convert its user's sign language to voice with the use of machine learning. Although, at first, the conversion process for both sign language and speech will have shortcomings due to the individuality of body language; as HearingUp becomes prevalent, the camera and machine learning technology will enable HearingUp to track the hand movements of the user, then send the visual data to its system and match each visual data (that is unique to its user) with the English meanings of the sign language in its algorithm then spoken with a digital voice.

Aside from machine learning, the product also has a deep learning feature which determines a single output from many inputs. This technology helps the glasses to develop selectivity in crowded places. To conclude, HearingUp will facilitate the communication of hearing-impaired people while overcoming obstacles such as not knowing sign-language.

It is an incontrovertible fact that HearingUp is exorbitantly beneficial for deaf people and provides them with various advantages for their existence in social life. By ensuring mutual communication between deaf and hearing people, this medium of communication is indeed significant considering the fact that approximately 8.3 million people are denominated as 'hard of hearing' and 123,000 people of them are considered as deafened in the U.K [12]. Thus, this product will reintegrate many individuals back into

society. In addition, HearingUp aims to create job opportunities for deaf people due to the reason that they may not have equal chances as hearing people in recruitment. Considering the fact that more than half of deaf Americans being unemployed, creating this product will dispel the distinction between deaf and hearing people when it comes to communication [10]. Subsequently, the recruitment amount of deaf people will increase and eliminate the problem of being unemployed. Finally, these glasses with AI intends to increase the social activities that deaf people can attend. For instance, concerts and theatres are constructed according to hearing people and deaf people cannot benefit from such social scopes. With the use of voice to text attribute of the product, deaf people will be able to attend such social utilities. Consequently, if all the arduousness that deaf people suffer in their life is taken into account, designing such an AI product has a considerable amount of advantages for those people.

On the other hand, even though HearingUp helps its users to have an active role in society, it has some drawbacks since deaf people might have trouble while reading the texts on the glasses according to the studies of ASL (American Sign Language) signers which show that deaf high school seniors read at the level of nine-year-old students on average [9]. The major reason for this setback is that deaf people may not read as fast as hearing people; since when hearing people read a text, they repeat the sounds of the words with their inner voice which is an impossible thing for deaf people to do. Therefore, for deaf people learning how to read is like learning a second language that uses a different alphabet compared to their native language alphabet which is actually the sign language. To sum up, deaf people might have problems when reading and this may slow down the communication process via the glasses, but that doesn't mean that they cannot communicate.

In conclusion, although the prospective initial disadvantages, HearingUp will facilitate the daily life of the hearing-impaired and set a healthy communication medium by enkindling their courage to get active and be productive individuals in society. Translating speech into text for hearing-impaired people by using both speech and facial recognition technology, its

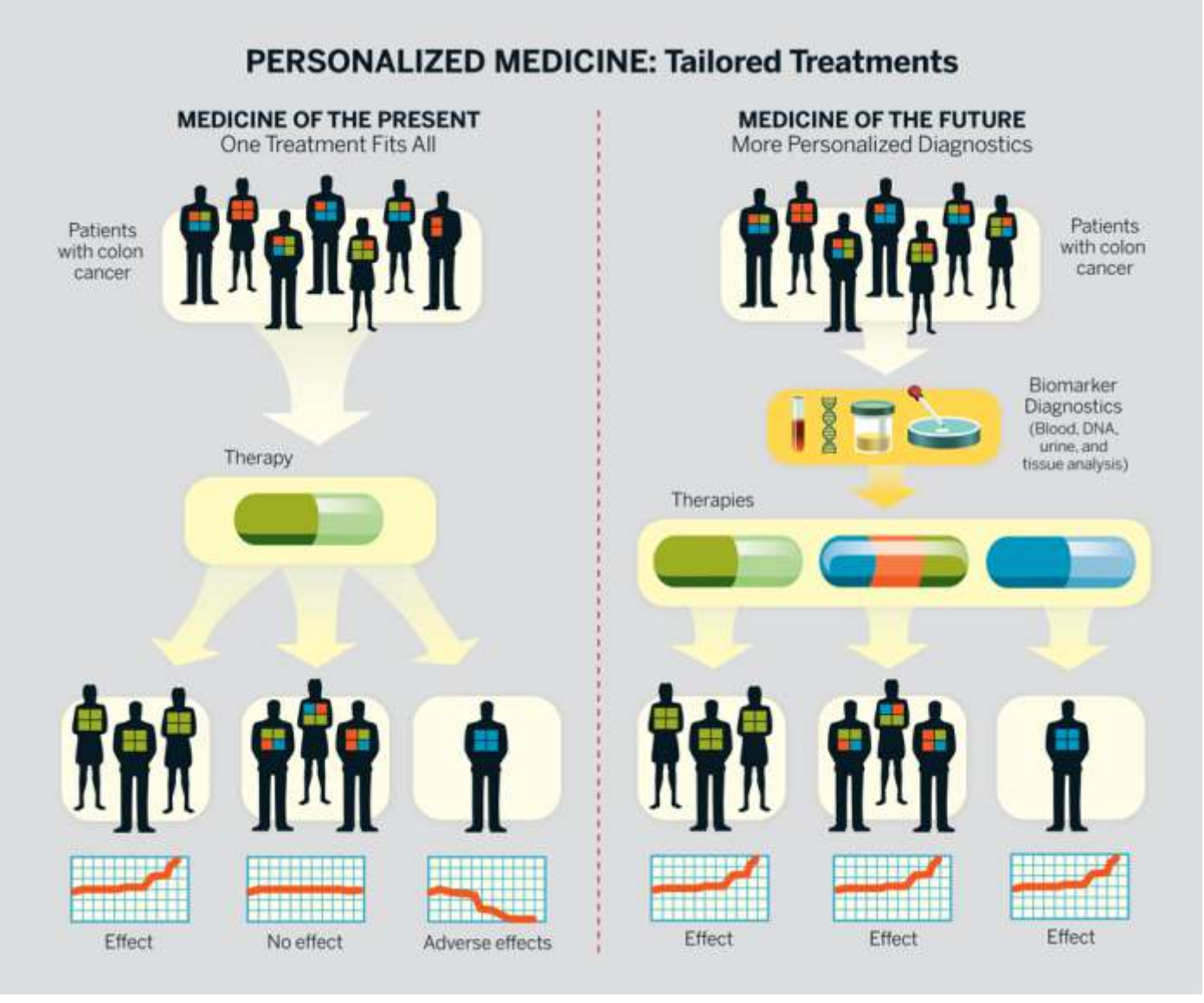
implementation will overcome the communication problem that disables most individuals from becoming a part of their communities. Thus, HearingUp will derive mutual communication between deaf and hearing people, working as a bridge between two sides. While the product is deficient on developing a fully adequate communication environment, the inceptive aim is promising enough to broaden the horizons of many and open to enhancements.

Bora Dağlıoğlugil - Cem Babalık - Cenker Şahin - Ceren Babür - Ege Mert Akın - Eren Berke Sağlam Kaan Doğan Ceyhan - Zeynep Beyen

Stacy Zoern

Stacy Zoern is the founder and CEO of The Kenguru Corporation, a company designing cars suitable for the disabled members of the community, enabling drivers to remain in their wheelchairs while driving. She suffers from muscular atrophy and the hardships she faced during daily life was her inspiration to design Kenguru cars. The cars use electricity as a fuel and reaches 25 miles per hour.

Personalized Medicine Article



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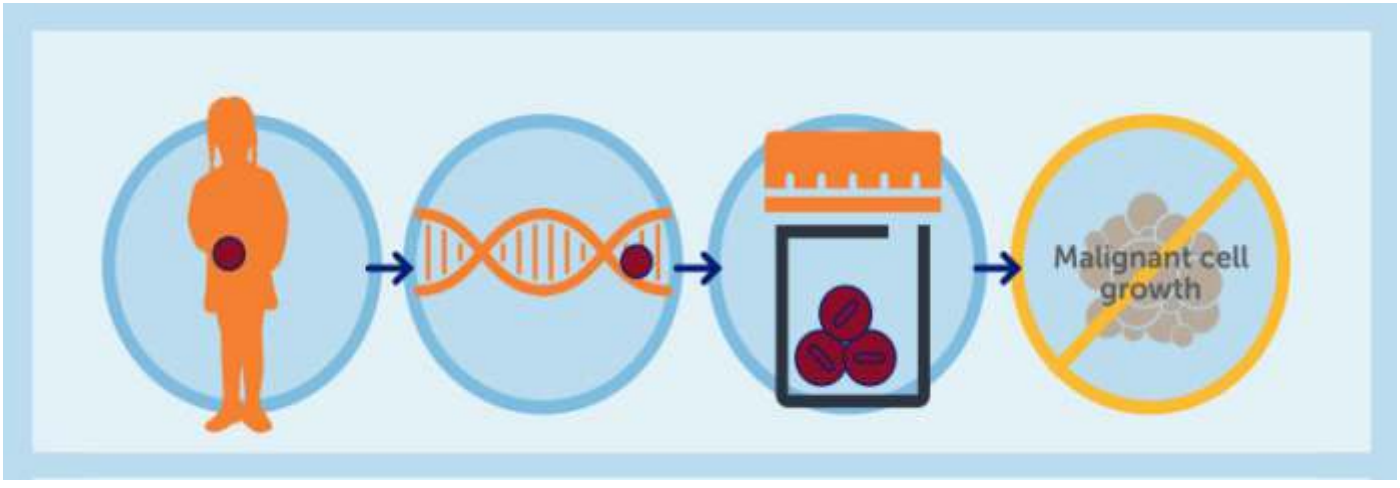
The Future of Medicine: Theranostics

Theranostics, also known as personalized medicine, is a medical model that separates patients into different groups. These groups are treated with specialized medical decisions and special drugs. The development and creation of personalized medicine is supported by biochemistry and medical sciences. By definition, biochemistry is the study of chemical processes within living organisms and medicine is the science of diagnosing and preventing disease in order to maintain health. Biochemistry plays an important role in medicine by identifying diseases and developing drugs to impede disease formation. As a result, both biochemistry and medical sciences have a major impact on maintaining and repairing human health. However, this impact can be improved by using specialized medicine. Vague throughout history, patients have been provided with similar medicine, regardless of their age, gender or genetic background. Certain types of antibodies are designated to specific diseases and all patients are treated with that exact medicine. The medicine certainly contributes to the recovery process but its impact is not optimal since it wasn't specifically developed for the patient. Advancements in the field of personalized medicine are necessary in order to obtain optimal effects.



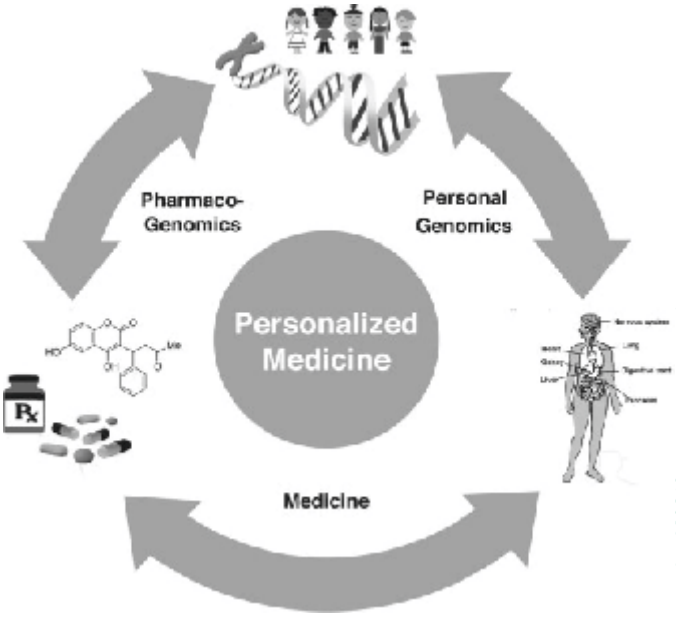
"Genetics Home Reference: What is pharmacogenomics?". National Institutes of Health (NIH).

These advances rely on the technology that uncovers a patient's fundamental biology, DNA, RNA or protein structure. Human Genome and Proteome projects play a significant role in revealing the patients genetic and structural layout. These projects would also relay structural or genetic corruptions, which results in diagnosing diseases and obtaining information related to their severity. Currently, minor diseases such as headaches and throat pains are cured with generalised medicine without the need to use theranostics. However, personalized medicine is rendered necessary when the patient is diagnosed with severe diseases that can't be cured with non-specialized medicine, mainly, cancer.

Cancer is considered to be a leading cause of death, especially in high-income countries. Such countries can treat minor diseases and cancer patients with procedures such as chemotherapy and ease their pain while reducing the tumor growth rate. However, theranostics provide more reliable and definite results when it comes to cancer treatment. Treating and even curing cancer would become much easier and practical with the use of personalized medicine.

The main branch of biochemistry that focuses on identifying and treating cancer patients is called Oncogenomics. By definition, it is a sub-field of genomics that deals with cancer-associated genes. Oncogenomics greatly benefits from personalized medicine since cancer is mainly dependent on genetics and shows unique characteristics at each patients. In current medical technology, personalized medicine cannot provide specialized treatments for each patient; instead, the medical model divides patients' groups depending on their structural or genetic characteristics. For example, female breast cancer patients who express higher levels of the HER-2 enzyme are provided with Herceptin, an antibody that interferes and blocks the HER-2 receptors.

Currently, private companies are aimed at developing personalized medicine. Companies such as 23andMe, Navigenics, and Illumina have created DTC genome sequencing tests which are accessible to the public. Several drug research and pharmaceutical companies such as Alacris Theranostics, Persomics, Flatiron Health, Novartis, OncoDNA and Foundation Medicine are focused on advancing the study of personalized medicine and amplifying genetic research.
Aside from private companies, governmental associations like National Institute of Health (NIH) and Department of Energy's Office of Health and Environmental Research (OHER) develop the



"Personalized Medicine 101: The Promise". Personalized Medicine Coalition. April 26, 2014.

personalized medicine model by contributing to the human genome project.

In brief, personalized medicine separates people into groups regarding their genes and aims to treat them with specialized drugs and medical decisions. Currently, personalized medicine is used for cancer treatment and is mainly under development. Biochemists expect that the popularity and applicability of personalized medicine will improve as the human genome and proteome projects are further developed.

Efe Ertürk

Helen Brooke Taussig

Helen Brooke Taussig found an alternative method to study the heartbeat in children by feeling the beat with her hands. This method leads her to discover "Blue Baby Syndrome", which was termed so due to the cyanotic hue resembling babies who were thought to be ill. Taussig was acknowledged for being one of the first women who received full professorship to Johns Hopkins University. In 1964, Taussig was awarded the medal of freedom from President Lyndon B. Johnson. Finally, in 1965, Taussig was known as the first women of the American Heart Association, for which she is so prominently known for.

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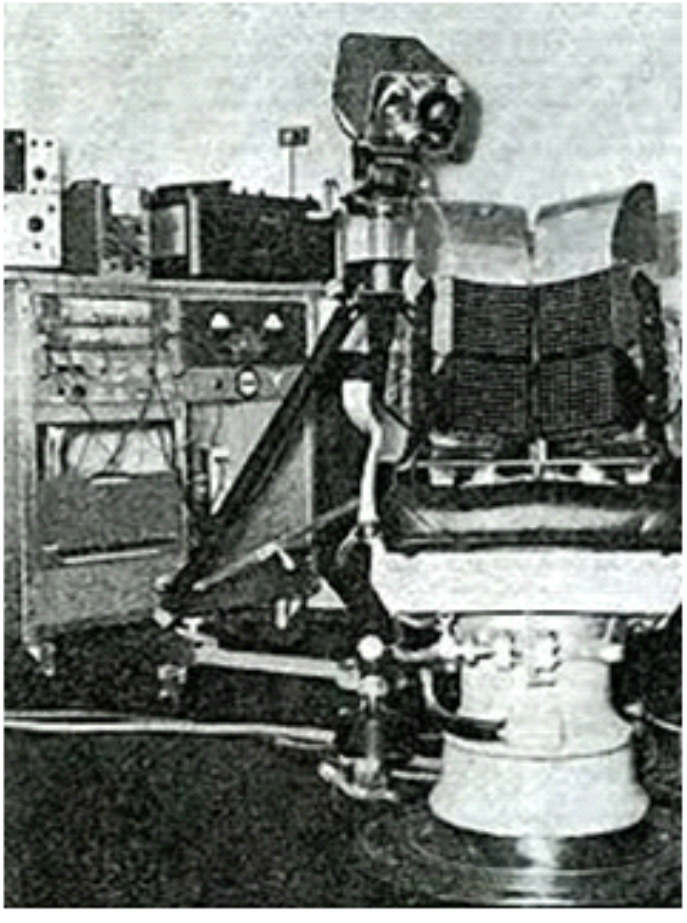
Fluent

Are eyes necessary for vision, or ears for hearing, tongues for tasting, noses for smelling?

Our intuition tells us that these questions are simple to the point of being silly. Of course, we need them! Can you hear without ears or see without eyes? Yet, these were the questions one of the most brilliant and influential scientists in the field of neuroscience, Paul Bach-y-Rita, spent a career upon. In the end, he concluded that they were not necessary.



In 1969, Bach-y-Rita and his team published an article that had a distinct science fiction tone. The scientists tested on a group of congenitally blind individuals who had lost their vision due to birth defects. The article included a picture of the apparatus the subjects used: a bizarre-looking dentist chair, with a rectangular box of vibrators attached at its back, a bulky camera, and tangles of wires which mark the 1960 selectronics that connect each component to a table-sized computer. This machine, the scientists argued, enabled the subjects to process visual data from their surroundings. They claimed that the machine provided the individuals with the gift of sight.

During the experiment, the scientists performed the following procedure on each subject:

A patient lied on the dentist chair. The small vibrators arranged in tight rows and columns rested on his back. He had control of a large camera and scanned an arbitrary scene in front of him. The visual data was converted to an image by the computer and sent to the vibrators. Each vibrator acted as a pixel, vibrating harder for darker shades and holding still for lighter shades. With practice on the chair, patients learned to view the space in front of them as three-dimensional. They learned to recognize objects like telephones even when they were partially concealed by a vase. They were able to distinguish between objects that were closer or further away. One of the scientists recalls "They started making statements like 'That is Jeff, he is standing next to Jane. She is not wearing her glasses and her mouth is open.' Some of the patients even learned to recognize a picture of the supermodel Twiggy." (Bach-y-Rita, 1969)

How was it possible, the scientists asked, that individuals who were unable to see through their eyes were able to make comments about the picture of a supermodel when the visual information simply entered from the back of their bodies?

Bach-y-Rita eventually decided that how a sensation enters the brain is irrelevant. When we receive the information of one sense from the other (i.e. the visual information through the skin) the cortex in the brain responsible for processing that information (visual cortex) will, with practice, reorganize itself to process the information coming from another sense.

"We see with our brains, not with our eyes." says Bach-y-Rita.

With this insight, Paul has developed many other useful technologies. He worked with engineers to

shrink the hundred-kilo dentist chair in a size that could fit into the frame of glasses and transformed the vibrators into a paper-thin strip of electrodes that can be less invasively slipped onto the tongue. He received NASA funding to develop an electronic touch glove for astronauts to have a "feel" of the outside of their gloves. He even designed a condom that enabled spinal cord injury victims with no sensation in their genitals to have orgasms.

Other uses of his work include the development of super senses, such as infrared or night vision. In fact, he developed a device for Navy SEALs that help them sense how their bodies are oriented underwater. (Doidge, 2003)

Paul Bach-y-Rita is an utterly modest man. He is rarely concerned with his looks and wears Salvation Army clothes whenever his wife lets him get away with it (Doidge, 2003). He has the dark skin of a Mediterranean, along with a curly white hair that gives him an air of sophistication, and he looks a lot younger than his 72 years. He has worked in labs of major scientists and Nobel Prize winners, but he is not interested in the politics that

Barbara McClintock

Many characteristics of organisms are determined by heredity - that is, by their genes - which are stored in the chromosomes inside their cells' nuclei. Barbara McClintock studied corn's hereditary characteristics, for example, the different colors of its kernels. She studied how these characteristics are passed down through generations and linked this to changes in the plants' chromosomes. During the 1940s and 1950s, Barbara McClintock proved that genetic elements can sometimes change position on a chromosome and that this causes nearby genes to become active or inactive.

other scientists have mastered in order to get ahead.

Paul Bach-y-Rita's belief on the potential of the human brain had roots beyond the medicine he studied. It was his father's dramatic recovery, the Catalan poet Pedro Bach-y-Rita who had a paralyzing stroke when he was 65, which changed the way Bach-y-Rita viewed the brain. The stroke had left half of Pedro's body and face paralyzed and had left him unable to speak. He was told that he could not benefit from rehabilitation and that he was too old to recover.

George, Paul's brother, arranged short-term rehabs for Pedro, but to no benefit. He insisted and took care of his own father. George had the idea that his father's condition resembled that of babies. Therefore, he speculated if his father could mimic the activities babies perform as they learn, perhaps Pedro could relearn the functions he had lost. So, they made a plan.

George's exercises included rolling marbles, picking up coins, crawling and essentially many other activities babies would go through as they develop fluency in motion. The regime took many hours a day, every day and George's exercise plan was so rigorous that some of his neighbors accused him of cruel treatment toward his father. However, little by little, Pedro got better. He went from crawling to moving on his knees, to standing and to walking. He struggled with a speech on his own and got better at it. After some more practice, he was active enough to start working on the typewriter.

His recovery lasted a year, at the end of which Pedro was ready to go back to teaching at City College, New York. Having loved being with his students again, he worked until retiring at seventy. Then he got another teaching job in San Francisco and remarried.

On a weekend, 7 years after his stroke, Pedro went to a visit to his friends in Bogota, Colombia. They went hiking high in the mountains. At nine thousand feet, he passed away from a heart attack. He was 72.

Pedro's case was an unusual recovery. Therefore, Bach-y-Rita asked Dr. Mary Jane Aguilar who he believed could make a clearer examination to perform his father's autopsy.

When they examined his brain, they saw that there was a huge amount of unhealed damage in critical portions of his brain. Visible damage showed no signs of healing despite the recovery. A neurosurgeon looking at the brain would have confidently concluded this patient had died in paralysis. Somehow, Pedro's brain had reorganized itself to recover all those functions. It could not have healed, so it worked its way around the problem.

Our brains have a vast potential to change and modern medicine is just beginning to grasp its extent. With enough practice, our brains can see through our backs or recover from a devastating stroke, in a way that can baffle the experts of the field.

The brain is not a computer-like processing machine that is hardwired after a certain age. It is fluent, it is in motion, and it is changing, all the time. This very nature makes endless room for improvement. It is just a matter of practice.

Arda Göreci

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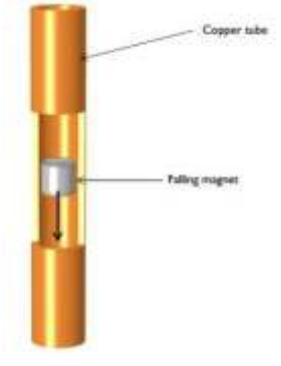
The Brakes of the Floating Train

Shinkansen also known as the bullet train is a high-speed train connecting largest cities of Japan, -Tokyo, Nagoya and Osaka- which began operating in 1st of October, 1964. Despite the frequent natural disasters occurring in Japan, there was not any passenger fatalities since the start, therefore it can be considered as quite safe. Its speed may go up to 320 km/h, however in the test runs it broke a world record reaching up to 603 kilometer per hour.

The reason behind its high speed is the magnetic float, in other words magnetic levitation. There is no friction force except airdrag to slow it down since it is actually floating. For magnetic levitation, there must be a strong magnetic field. There are coil superconductors which are placed at each sides of the carriages in low temperatures to create this strong magnetic field. This can form a magnetic field up to 5 Tesla, maybe even more.



Furthermore, there are normal magnets placed in below the train and on the railway which's north poles opposing each other to make it float.

The real question is what is the brake system to slow down and stop such a fast train which does not even touch the railway? The answer is the eddy current brakes. This brake system creates an electromagnetic force between magnet and the moving object, unlike the normal brakes which utilize the drag force created by friction. The magnetic brakes rely on two laws which are Faraday's law and Lenz's law. Faraday's law states that the changes in the magnetic flux lead to an induction in the voltage and summarizes the ways of the generation of voltage. The voltage will be produced regardless of how the change occurred. When this electromagnetic field is formed due to the change in the magnetic environment, the polarity of the electromagnetic field causes a production of a current which has a magnetic field opposing the change that forms this electromagnetic field as stated in the Lenz's law.

To illustrate, think of a magnet falling inside of a copper tube. While the magnet falls down, the electromagnetic field of the magnet changes and this change generates currents, as stated in the Faraday's law, which is called eddy currents. However, this eddy current also creates an electromagnetic field which's direction opposes the direction of the electromagnetic field of the magnet. This results in the magnet slowing down while falling off.

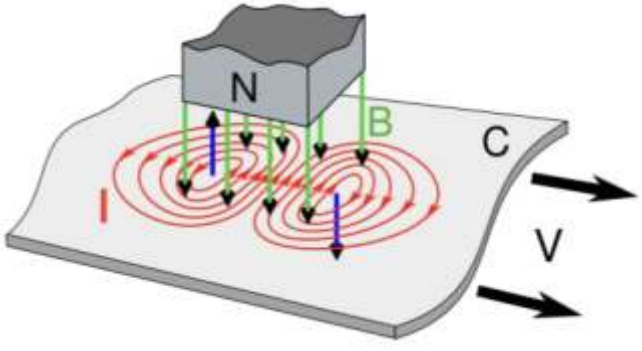
This mechanism is used in the brake system called

Mary Somerville

Mary Somerville is a Scottish science writer whose signature was put first on the massive petition organized for Parliament to give voting rights to women. Even though she is best known for her work on astronomy and she is the first female member of the Royal Astronomical Society at the same time as Caroline Herschel, she is also known for her first paper, "The magnetic properties of the violet rays of the solar spectrum", in which she explored the relationship between magnetism and light.

eddy current brakes. As seen in the diagram on the right side, there is a moving conductive metal sheet (C), which is below a stationary magnet, moving through the electromagnetic field (B) of this magnet. As the metal sheet moves, it creates a change in the electromagnetic field of the magnet which leads to the generation of eddy currents (I). The eddy currents also produce a magnetic field which has a direction opposing the direction of the magnetic field that generated the current in the first place. While entering the magnetic field of the magnet, the eddy currents produces a magnetic field which has upwards direction. While exiting this magnetic field, the eddy currents produce a magnetic field which has downwards direction. The magnetic field at the right and the one at the left of the metal sheet exert opposite force on the metal sheet, slowing it down.

Consequently, the strong brake system to stop such a fast train which can reach up to 320 km per hour is the eddy brake system. The moving metal is not ferromagnetic which has north and south



poles to form a drag force. Instead the change in the magnetic field of the magnet (B) caused by the moving metal sheet (C) generates eddy currents (I), according to Faraday's law. These currents create a magnetic field (blue lines) opposing the direction of the magnetic field which generated the current, as the Lenz's law states. Due to the opposite directions of the magnetic fields created at the different sides of the metal sheet, a drag force is exerted on the metal (opposing the direction of V). Therefore, the train slows down.

Derin Ak

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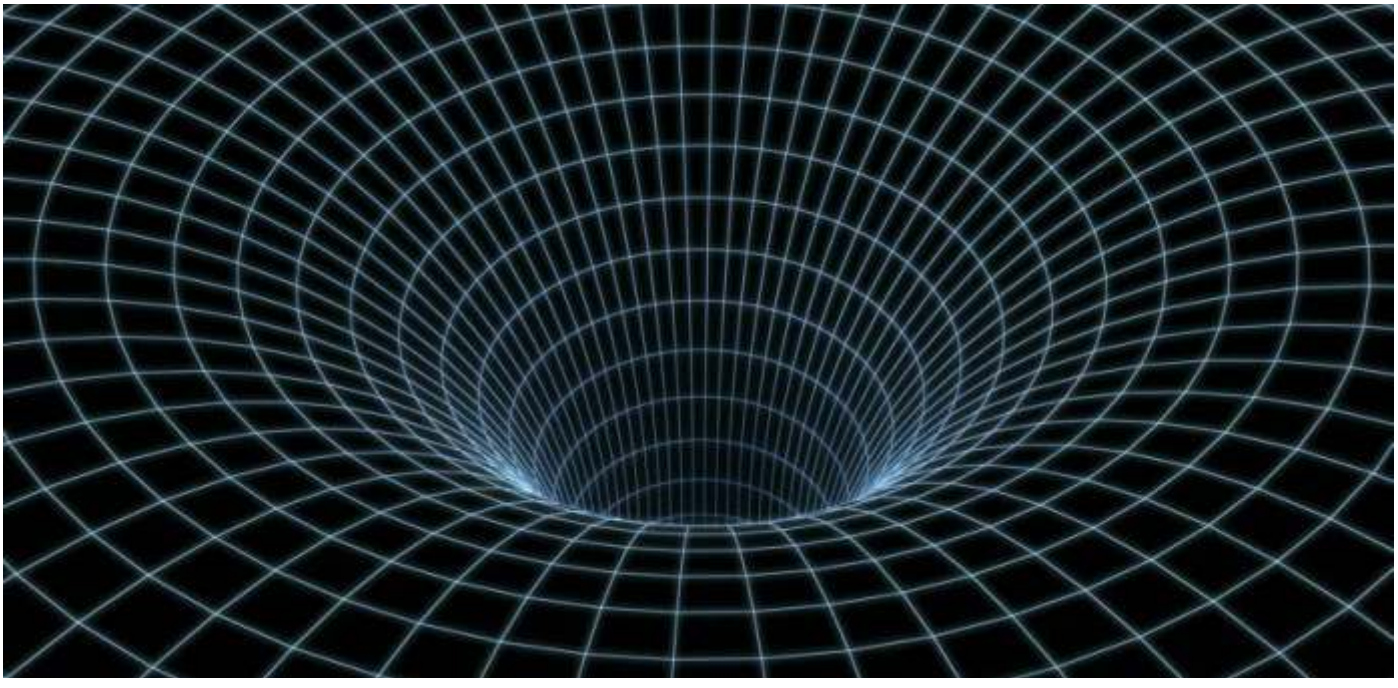
Black Holes and Information Paradox



Pierre: Do you know anything about black holes?
Marie: Not much, I heard they are completely dark and they pull everything into themselves.
Pierre: Actually, it is not 100% true.

Black holes are the most mysterious objects in cosmos without a doubt. However, to be able to understand the black holes, we should first look at Einstein's General Theory of Relativity which elaborates on the existence of black holes.

According to the general theory of relativity, gravity is not explained with forces between masses. But it is the warps and curves in the fabric of space-time. Objects in space warp the space-time and they cause a phenomenon called gravity. These warps in the fabric of space-time get bigger as the mass (energy) increases.

When a giant star (at least 3 times bigger than the sun) dies, it explodes with a supernova and its core starts to collapse on itself. At last, gravity overpowers the strong nuclear force and at the center of a black hole, space-time is warped infinitely and a space-time singularity occurs.

Marie: You still did not explain why I am wrong.
Pierre: Be patient, we are coming to that.
Because of this singularity, black holes are accepted as if they have no volume. These mysterious objects are able to pull nearly everything into them, including light. There is a region around black holes called the event horizon. This zone determines the area from which nothing can escape. Objects (also energy) are able to escape from the gravitational field of black holes if they are out of this region.

Until the 20th century, scientists thought that the information an object contains was not destroyed, opposingly stored in an unknown area when the object is pulled into a black hole. However, in 1974, Stephen Hawking stated that because of Hawking radiation, black holes slowly evaporate and simply disappear. Therefore, the information also disappears This theory of wasn't in correspondence with the general theory of relativity which stated that the information cannot be lost. So, many scientists tried to find a way to explain how the information would not be lost. This situation became the sparkle that started the black hole wars. Many famous scientists like Hawking, Leonard Susskind, Joseph Polchinski, and Gavin Wince participated in this intellectual race. The structure of Hawking radiation was one of the most debated issues of this conflict.

Think about outer space, Marie. People generally think that most of the space is empty. Actually, space is full of particle pairs (one of them is matter, the other one is anti-matter, example: electron-positron) that annihilate themselves as they occur.

When these particle pairs occur at the event horizon, one of these two particles is pulled by black hole before they annihilate each other and the other particle goes to space by escaping from the black hole. According to the first law of Thermodynamics, the fugitive particle must carry positive energy; therefore, the particle pulled by the black hole carries negative energy and negative mass (anti-matter) decreases the mass of black hole. As a result, its mass is evaporated. This situation is called Hawking Radiation.

Imagine two different objects with the same masses. When these are pulled by a black hole, the same radiation will be emitted because they have the same masses. Since the radiations are the same, their pieces of information will lose their uniqueness, becoming unrecognizable, and will eventually be lost.

Additionally, Polchinski presented a new idea: an invisible firewall (not the same with Hawking radiation) surrounding the black holes. His idea stated that this firewall destroys the information at the edge of the black hole.

On the other hand, since this situation is against the concept of relativity, some scientists believe that information cannot be lost. One of the first theory on this idea belongs to Leonard Susskind. His proposition was that the information will not be lost at the edge of the black hole.

Then, Leonard Susskind proposed a model which states that quantum entanglement happens via microscopic wormholes and it protects the information at the event horizon of black holes.

There are various theories about this topic; one is that both of the particle pairs at event horizon fall into black holes and black holes will never completely disappear. The information will stay at the center of black hole forever or photons around the event horizon will protect the information. But remember this; if the information is destroyed, we need new laws of physics to describe the universe.

Marie: Which theory do you believe in?
Pierre: It doesn't matter.
Marie: I think Susskind's theory makes more sense.
Pierre: It may be true but don't forget, none of these theories are proven.
Marie: By the way, you still did not answer my question.
Pierre: Oh, yes. Since the black holes emit some particles, they cannot be all dark.
Marie: Thank you, I learned my lesson today.
Pierre: What is it?
Marie: Black holes are complicated.
Pierre: They certainly are.

İnal Kağan Seki

Katie Bouman

American computer scientist Katie Bouman is a member of the Event Horizon Telescope team which developed the algorithm to capture the first image of a black hole. She was awarded the Ernst Guillemin Reward for the best Master's Thesis at MIT. She is expected to join the faculty of the California Institute of Technology as an assistant professor of computing and mathematical sciences.

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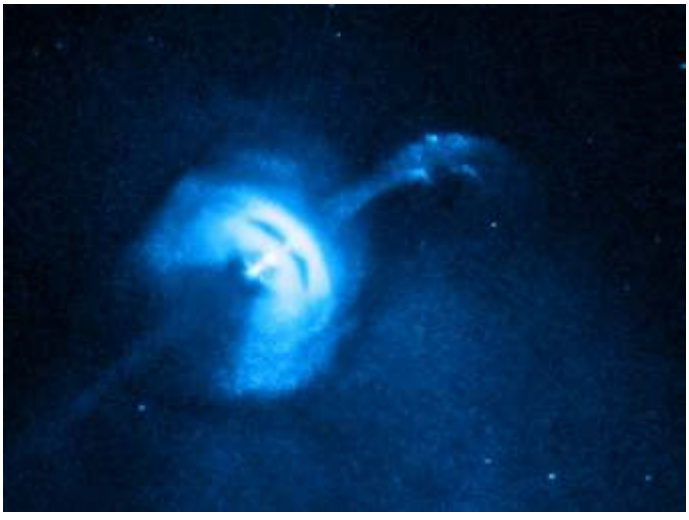
Neutron Stars and Types

Neutron Stars
Neutron Stars are celestial objects formed after a supernova explosion. They have a small diameter of 30 kilometers relative to other stars but have an enormous mass. If we took a teaspoon of a neutron star it would weigh 107 tons. Neutron stars (as predicted from its name) are highly composed of neutrons but still contain densely packed iron atoms in the outer shell.

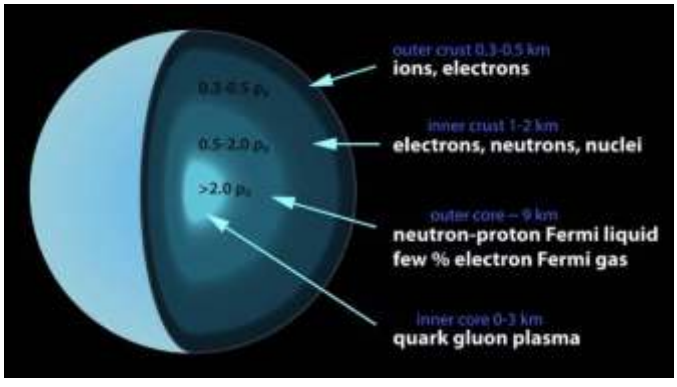
Formation
There are two main forces that balance the stars: Gravitational forces and the radiation pressure produced by the fusion of hydrogen atoms into helium atoms. As stars get older, the hydrogen inside the core is depleted. In order to balance the gravitational forces; the helium fuses into carbon then neon then oxygen then silicon and finally iron. However, after silicon fuses into iron, iron cannot fuse into another element which leads to an enormous drop in the radiation pressure. As the radiation pressure drops, the gravitational forces become dominant and if the mass of the core increases, reaching the Chandrasekhar limit (1.4 solar masses); the core collapses. Even the fundamental forces inside the atom cannot withstand the gravitational forces electrons get close to the core of the atom and fuse with protons to produce neutrons and neutrinos. After the collapse, the outer layers of the star explode with a supernova and the core gets even denser until there is no space between neutrons.



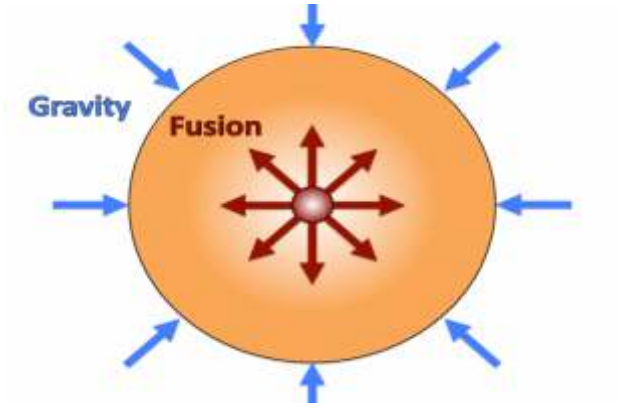
Properties
The resulting core is a neutron star; the densest object in the observable universe which has a diameter of approximately 20 km but a mass of one to three times the sun. The neutron star has five main parts: atmosphere, outer crust, inner crust, outer core and inner core. The atmosphere of a neutron star is composed of plasma and the surface temperature of newborn neutron stars can go up to 1012 Kelvin however, as the huge amounts of neutrinos (which are emitted by the neutron star) leave and take energy from the neutron star, the temperature falls to 106 Kelvin within few years. The outer crust is made of densely packed iron atoms which electrons travel through. The inner crust is mainly composed of

Dame Susan Jocelyn Bell Burnell

Dame Susan Jocelyn Bell Burnell is an astrophysicist from Northern Ireland who co-discovered the first radio pulsars. Her discovery was distinguished by 1974 Nobel Prize in Physics but she was not one of the prize's recipients despite becoming the first to observe the pulsars. She served as the president of the Royal Astronomical Society. She donated the £2.3 million Special Breakthrough Prize in Fundamental Physics to help female, minority, and refugee students become physics researchers



Source: https://en.0wikipedia.org/wiki/Pulsar



Source: https://en.0wikipedia.org/wiki/Neutron_star

superfluid neutrons and electron gas. As we approach the outer core of the neutron star, we see fewer electrons and more neutrons and the outer core is just composed of tightly compressed neutrons. The inner core of the neutron star is very mysterious. We are not sure what it is made of, but scientists guess it is made of quark-gluon plasma.

Pulsar

After the supernova explosion in order to conserve the angular momentum, the neutron stars' rotation rate increases. Newborn neutron stars spin up to several hundred times per second, but they slow down as time passes. Neutron stars that spin and emit radio waves are called pulsars (pulsating radio stars). When there is a white dwarf, star or a planet in the range of the pulsar; the pulsar absorbs the energy of that celestial object. Because of the massive energy gained from that object, it rotates even faster. The fastest spinning pulsar (PSR J1748-2446ad) rotates at a rate of 716 spins per second which is equivalent to 24% of the speed of light. The shapes of the pulsars are elliptic due to the high velocities.

Magnetars

The magnetic field strength of neutron stars is approximately a trillion times the magnetic field strength of the Earth (1011 tesla). Although neutron stars have extreme magnetic field strength, a specific kind of neutron star called "Magnetars" has over 1000 times the magnetic field strength of neutron stars. Like every neutron star, the crust of the neutron star is strongly connected to each other with a magnetic field and each small movement or damage in the crust can cause in massive explosions. In magnetars, because the magnetic field is strong, even small movements can cause the magnetar to release massive amounts of electromagnetic radiation. A magnetar called SGR 1806-20 had an explosive burst where in one-tenth of a second it released more energy than the sun has emitted in the last 100,000 years!

Conclusion

Neutron stars, Pulsars and Magnetars are incrediably mysterious objects. However, there are objects much more mysterious than them that we haven't discovered yet, for sure. Around 100 years ago, we didn't even know about neutrons nor we haven't observed the first radio waves. The universe is a massive field containing billions of stars and planets. Even the objects and discoveries done in our universe are enough to impress many of us. Although we may think that we know much about astronomy and space, with technology improving at an accelerating rate; there surely are new objects and planets to discover. Maybe in just 100 years, we will discover alien life. Maybe one day, humanity will cross into another universe. The only thing we must do is to dream and experiment.

Mehmet Efe Çığ

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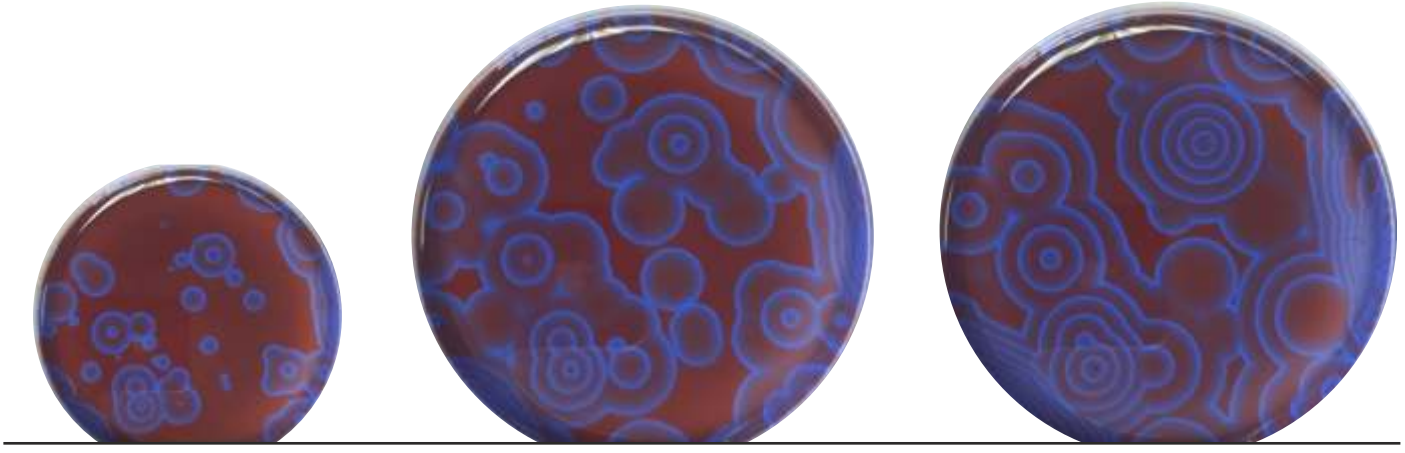
Belousov-Zhabotinsky Process



"The expression or application of human creative skill and imagination, typically in a visual form such as painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power."

This is the definition of art given by the Oxford English Dictionary. I would like to disagree; I think 'The expression or application of creative skill and imagination, typically in a visual form such as painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power.' is a much more suitable definition. After all, nature has always been the primary inspiration for art. From the 20000 years old Lascaux to French Impressionism and modern romantic novels, nature has always been appreciated by humanity. There is a reason why most romantic comedies include scenes of sunset; because nature is inherently beautiful. Now, I cannot -in good conscience- say that I understand much about art, I would even say that I am as far away as a human can be from classical forms of art. However, I appreciate a good painting or scenery and I would like to share one of the most mesmerizing things in nature with you: Belousov-Zhabotinsky Process.

Belousov-Zhabotinsky (BZ) Process is an oscillating chemical procedure; one of the few that we know of. An oscillating chemical procedure is a set of chain reactions that trigger each other and produce each other's reactants. An example would be:

Here, the first reaction produces the reactants of the second reaction and the second reaction produces the reactants of the third reaction. These reactions are generally started due to physical differences in the mixture that contains the starting reactants. As they are not stirred after mixing, some part of the mixture may be more acidic or hot or dense or the concentration of the reactants may be higher. These physical difference push

$$A + B \rightarrow C + D + e$$

$$C + D \rightarrow A + B + f$$

equilibrium to the mixture; it is the first rule of nature, everything wants to be in balance.

BZ Process consists of 5 substances that are put into a beher-glass. These substances are:

- Concentrated Hydrochloric Acid
- KBrO3
- NaBr
- Feroin
- Malonic Acid

The physical imbalance that causes the BZ process is that in some parts of the mixture there are more Br_ ions. So, the chain reaction starts with the propagation of these ions to a less concentrated place through diffusion.

Uma Chowdhry

Retired senior vice president and chief science and technology officer of DuPont

Uma Chowdhry is an American chemist who made specific contributions in polymer science and technology and is specialized in the science of ceramic materials, including catalysts, proton conductors, superconductors and ceramic packaging for microelectronics. In 2006 she became DuPont's chief science and technology officer. She was also selected to the National Academy of Engineering in 1996 and the American Academy of Arts and Sciences in 2003.

The whole process of BZ mainly consists of three steps. The first one is the reduction of Bromide salts and the reaction between Malonic acid and the Bromide ions. This step continues until there are no free Bromide ions left in the beaker. Then the second step begins which is the oxidation of ferroin gives iron ions into the beaker. After this step, the third and final step begins in which iron ions react with the Malonic Acid+Bromide compounds to release the malonic acid and bromide ions to restart the reaction. However, after each step some of the Malonic acid stays unreacted- it either is left bonded to the iron from the third step it is decomposed as Carbon dioxide. This causes the malonic acid to be the limiting reagent that determines how long the process lasts.

It is this balance between the propagation of Bromide ions and the reactions that create the beautiful chemical dance.

Ataberk Ayata

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Are We Living in a Simulation?

In these days, a tricky and sometimes frightening question causes everybody to wonder until their minds are about to burst: Are we living in a computer simulation? With the unexpected improvement of computing and virtual reality technologies, some of the world's most renowned scientists have given rise to the simulation argument and started a formidable debate. In order to understand the simulation argument completely with all its concepts, first, it is necessary to concretize the definition of simulation and reality.

The word simulation means a model of a set of problems or events that can be used to teach someone how to do something or the process of making such a model. In other words, it basically refers to the act of creating a false reality to discover various results of an event or problem.

The definition of the word reality is the state of things as they actually exist which can be simply shortened to the phrase "the true world we live in with all its facts". But then, there is this little but troubling question: Do we actually live in the only true reality or only we are thinking like this?

Simulation Hypothesis

The simulation hypothesis proposes that all of reality including our world and the whole universe and all of the living things within these huge systems are in fact just an artificial simulation, most likely a computer simulation. The idea of artificial reality and we are being deceived by an illusion has a long philosophical and scientific history that goes back to even the Indian philosophy of Maya. You can think that such a simulation must require enormous computing power and colossal facilities in order to work successfully and overcome all kinds of conflicts that may occur within the system which makes it nearly impossible for a simulation realistic enough to make all its habitants not realize the simulation. According to the advocates of the simulation hypothesis, all the tiny particles within a matter don't have to exist at the same time but only when someone looks at them. For instance, when you look at a piece of timber with unaided eye you can only see the outlines of it (the visible parts in the macro universe) not the particles and all the atoms forming the object and according to the simulation hypothesis until you want to examine the timber in the micro-universe, the system doesn't design it with all of its particles but when you look at the timber under a microscope the system forms the particles for you to examine and believe that you are not a part of the simulation. Thus, computing power can meet all the necessary power to operate the simulation perfectly. This system is very similar to the design of the rendering algorithms of video games. For instance, sometimes the whole map and patterns of the video games don't appear clearly until you get close enough.

Is Reality Real?

Considering the possibility and theory mentioned above it is highly possible that we are living in a computer simulation and our reality is just a stack of hardware and software because probably after the creation of the first simulation by the real living things, every simulation thrived in time and created their own simulations and the circulation keeps repeating itself. Hence, the possibility that we are in one of the simulations rather than the real world is very high. On the contrary, assuming that we are in the real world is no different from looking for a needle in a haystack. Thinking on all these probabilities and supposing that they are true leads to a significant

question: Who are those that created the very first simulation and started this circle?

Posthuman Civilizations

Most of the leading corporations and executives of today's world predict that we will have an advanced level of computing power in the future and be able to design incredible patterns on our own. When these ideas are taken into consideration, it is palpable that there has to be a posthuman civilization or maybe more with the computing power in our dreams to design such simulations that can contain the whole universe. However, we have no evidence to prove this idea and even if the posthuman civilizations are real, why did they feel it is necessary to create such simulations?

Reasons for Simulations

Mostly it is considered that posthuman civilizations created these simulations due to two main concepts: ancestor simulations, and video games

Ancestor Simulations

The most reasonable reason for posthuman civilizations to design a simulation is their curiosity. According to this hypothesis, posthuman civilizations designed a simulation, starting the whole circle in search of the ways their ancestor one used to live accordingly. Now, they are observing our lives and trying to understand their past.

Video Games

We have games like Sims that basically simulate real life and entertain us. Since the creation of Sims, there have been many more and developed attempts to simulate the real life and the video game sector kept improving itself, designing better games after every step. According to this proposition, we are just games designed to entertain posthumans like the games we create for ourselves.

Ideas of Stephen Hawking, Neil DeGrasse Tyson, Elon Musk

Until a few months, the world wasn't talking about simulations or fake realities, although the idea was always a part of our lives, with the influential speeches of today's most prominent geniuses like Stephen Hawking, Neil DeGrasse Tyson, and Elon Musk, the idea of artificial reality has gained a popularity among everyone. Even though all say there is a high possibility for simulation hypothesis

Caroline Lair

Caroline Lair is the co-founder of Women in AI, a non profit working towards gender-inclusive AI. She's also part of the business team at Snips, building the next generation of private by design AI Voice Assistant.

to be true, there is dissent between scientists whether the improvement of simulation technologies and artificial intelligence related to it will be beneficial for us or on the contrary detrimental.

Possibilities that We May live in

To sum up, there are endless possibilities that we may live in and it is hard to say which one we are living in. The concept of simulated reality is likely to stay a mystery for a long time and it will always preoccupy the people. Can a simulated being realize that he or she is a part of a simulation or can we prove that we are not simulated? Since we cannot completely answer these questions, we may never be able to determine the truth.

Cenker Şahin

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Fusion Energy

Almost everyone reading this article must have heard about some aspects of fission energy -what most of us know as nuclear energy is actually called fission energy-. However, this article will not be about fission energy but instead about, its twin, fusion energy which will most likely replace the former one in about 30 years. Before I go any further, I want to make a further clarification by saying that both fusion and fission are called nuclear reactions and they both occur in the nucleus.

So, what exactly is fusion energy?

After realizing that atoms have a nucleus, humans being humans, wondered if they could crack open the nucleus, and they got their answer. In 1942, the first nuclear chain reaction was successfully observed in a stable environment. As we all know, these reactions released an immense amount of energy. The energy which holds the nucleus together is called the strong nuclear force, the only downside is that its effective range is really low. This strong nuclear force is exactly where we get our energy from. By bombarding the nucleus with countless neutrons, we have a really high chance of hitting it and splitting the nucleus. After we are done with splitting, nuclei the force I mentioned earlier is unleashed; however, we are not done there. The nuclei we just split will actually form new elements which we can hit and split again creating a chain reaction which results in even larger amounts of energy that we can use to power our cities, phones, computers, and houses.

Fusion is almost the opposite of fission: instead of splitting the nucleus of an element, we are combining two elements to create a heavier element. For example, if we combine two hydrogen elements (specifically their isotopes deuterium and tritium) we will successfully create a helium element. Since helium atoms are noble gases, they have a lower energy state than hydrogen elements which are not at rest because they have only one electron in their outermost shell. So, what really happened when we turned elements with higher energy states into an element with a low energy state such as helium? Of course, energy got released from that transformation. And that is exactly the logic behind fusion energy.

But we have a really big problem. It is not that easy to bring together two hydrogen atoms and mash them into each other; if it were that easy, there would be fusion reactions happening all around us. The first problem we encounter is to actually make the two elements meet each other in a universe that is mostly made out of empty space and many other elements that we may not want our hydrogens to fuse with. So, let's say we have a vacuumed environment where we give our hydrogen elements enough energy so that they actually meet; that's great… but not enough. We are faced with a problem here: It's the "Coulomb barrier". Imagine if you were trying to make two magnets with the same poles touch each other. Most of us probably tried doing this and also probably saw that it was rather hard to accomplish. Well, the same thing occurs for our protons in the hydrogen elements and it's even more challenging.

As seen at the picture on previous page hydrogen atoms will repulse each other if we try to bring them together.

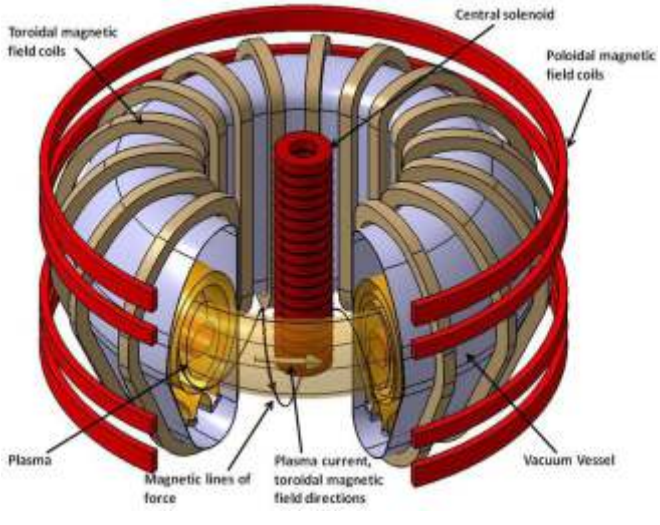
But of course, there's a way to bring these hydrogen atoms together. If we increase their velocities by giving them enough energy, we can get our hydrogen atoms really close (10^{-15} m). When we do that, the strong nuclear force starts working its magic. After the atoms are close enough, the strong nuclear force will have enough energy to overcome the coulomb barrier and smash the nuclei of our atoms for us. After all this hard work, we are finally able to create a helium nucleus and therefore lots of energy. (Our aim here is to of course acquire energy much larger than the energy we just used to create this reaction)

Fun fact: Our sun is actually a huge fusion reactor. Atoms merge into each other millions of times as we speak, so when scientists are talking about making fusion reactors on the Earth, they are actually talking about creating mini suns of our own.

Even though it was just on paper, we were able to create a fusion reaction. However, in real life, we have to consider many advantages and disadvantages we will eventually face.

Here are some of them:
Pros of nuclear fusion
• Clean energy
• Almost unlimited and cheap fuel (we can distil hydrogen from water).
• Easier to control and stabilize than fission reactions
• No serious nuclear waste

Cons of nuclear fusion
• The construction of fusion plants are too expensive and still a little unknown
• Requires a lot of energy to operate
• We could've invested in renewable energy instead of fusion.
Where are humans in nuclear fusion?
Humans will eventually have to switch to fusion energy. Despite all the setbacks it has, it is more science than fiction. We have the technology to heat up atoms so much that they fuse into each other. We can partially do this today, but our current understanding of fusion is not enough to profit from this technology. The energy required to start up a fusion reaction is much more than the energy we get, which is where ITER (International Thermonuclear Experimental Reactor) comes on stage.



https://www.newscientist.com/article/dn17950-iter-how-it-works/

ITER is a project that is being conducted by the collaboration of many countries worldwide and it is aiming high: when it boots up in 2025 it is predicted that instead of a total loss in energy, ITER will produce 10 times the energy required to start the fusion reaction inside, but how does ITER do it? The answer is by using Tokamak.

The simplest explanation of what a Tokamak does is that with strong magnetic fields, it keeps the plasma inside which helps the whole energy stay in one place as well as maintaining extreme amounts of heat.

However, ITER is just an experiment. Yes, millions of dollars thrown into ITER will not be used to create energy; however, they will not go to waste as well. If ITER succeeds, a real fusion power plant called DEMO will be constructed, so that humanity will enter another age: the fusion age.

Eli Morhayim

Melanie Windridge

Melanie Windridge is a British plasma physicist who is best known for her work on fusion energy. One year after she received her Ph.D. in Plasma Physics, she launched a new career in science communicating during which she visited schools to give lectures and published one of her two books: Star Chambers: the Race for Fusion Power. Her other book Aurora: In Search of the Northern Lights explores the beauty of the Northern Lights and Windridge received various awards for this book.

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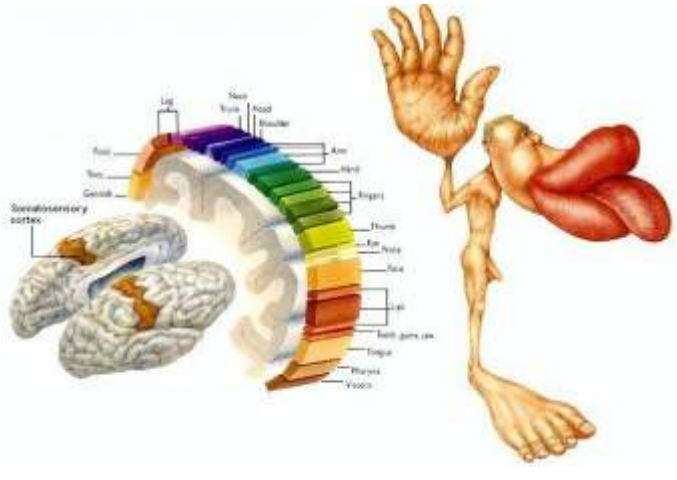
Phantom Limb Syndrome

Our brains are continuously shifting. Brain plasticity is the brain's ability to change in the means of development. The process of learning literally alters our brain. By building certain synapses (and revising them), the knowledge evolves your brain as it takes place in your system. The genetic and experiential factors shape the brain through the renewal of neural connections and pathways. This is what happened as you grew up from an embryo to an infant to the state you are in right now. This is what has been happening through all these years of education, the cramming at the night before the exam and through all relationships: all that you have been experiencing.

The brain is the tool which stores experiences and creates a mapping accordingly, which is a sort of a guideline for us. But it does more than that. It interprets the stimuli and creates an outcome by it; it molds the sensory experiences and reflects it to us like a mirror.

We have a "map" of our body in our brain. The somatosensory cortex has a neural "map" of our body parts. The sensitivity of the area is further shown on the model on the right, "Homunculus", which has been drawn in proportion to the sensitivity of the body parts to represent our sensory input mechanisms. This strip-like representation distributes the sensory body parts as they have distinct positions but the size may grow or shrink according to the sensory input from the body part. When your wrist is injured, the area is grown and as a result, the sensations of/from the area are greater.



Hegarty, Stephanie. "What Phantom Limbs and Mirrors Teach Us about the Brain. " BBC News, BBC, 5 Dec. 2011, www.bbc.com/news/magazine-15938103.

Phantom Limb Syndrome is thought to correspond directly to these mentioned changes in the somatosensory cortex. PLS is the condition of having sensations, mostly painful, in the limbs that do not exist. The non-painful sensations are mostly external while the painful sensations are mostly described as burning and the feeling of tingling of pins and needles in the area. While this syndrome is mostly occurring in amputees, the sensations may be observed by people who have lost function of body parts, survived strokes, had injuries of the spinal cord or PNS (Peripheral nervous system) or even the people that were born without the limb. This case can be recognized as a spectrum since it can be experienced in various ways which are discrete. Some may have long-lasting, unbearably painful experiences while some have short and tolerable sensations.

"The Maladaptation"

PLS used to be perceived as a psychological case until the physical treatments showed a positive response. To this day, the main and the common reason for these cases is debatable but the most deducible reason for the recurrence of PLS in up to 90% of amputees is the reorganization of neural connections. And the faulty adaptation of these pathways are simply called as "maladaptation". When a limb is amputated, the limb may be lost but the neural pathways are left behind. The loss does change the inner processing of the brain. When a part of the brain has no neural activity, the somatosensory areas (the areas on the brain where the neurons intake sensations from the associated part of the body) close to that area are expanded. These sensory neurons that intake the stimulus by the new area, draw the sensation both to that area which is still existing and the body part which is lacking or non-functioning. Ramachandran, a neurologist, was the one to put forward the idea that PLS would be caused by the maladaptation of the neural pathways. This was the result of an experiment he once conducted in his lab with some Q-tips and an amputee, where he touched his cheek and got to observe sensations on both the cheek and the phantom limb. He did receive more information from more experiments and the other amputees' questions on why this happens, and so he concluded that phantom limb sensations could be caused by the reorganization in the somatosensory cortex. I can't say what forced Ramachandran into doing such experiment but it sure did pay out. In the experiment, after the upper limb was removed, the

areas close to it on the somatosensory strip expanded onto it (this would be the sensory nerves on the face). So, when the person would be shaving or touching his face in any way, he would have sensations directly at the area where the phantom limb would be.

Treatments
The treatments may be viewed under these three topics: surgical, nonsurgical, pharmaceutical. Even though there are many more protocols that may be followed, the ones that are mentioned above are the ones that showed an inclination to be used.

The Mirror Box.
Despite the innovations of the day, up to 90% of all amputees' experience this. This syndrome, which is mostly narrowed down to being the result of neural plasticity, has multiple treatments. The most common (and successful) one is the use of a mirror for the training of the sensory differentiation. This treatment which was developed in the mid-90s by Ramachandran has been greatly successful especially with the patients that have lost the function of the limb before the amputation. It consists of the protocol of placing the phantom limb behind the mirror and the connected limb at the front*. The movements of the limb alleviated pain by creating a sense of control over the phantom**. Even if the results were not momentary, they showed relief in a considerably short amount of time and lasted for a long time.

Virtual reality -the usage of technology for simulating an environment in a real life like style- has been studied to relieve chronic pain in the cases of PTSD. PTSD stands for "post-traumatic stress disorder". Even though the name gives what it is away, as long as we are concerned, it is a syndrome where cross wiring (the neural connections which are shifted to intersect) also occurs. The hypothesis takes this observation further and applies it to the PLS as the virtual reality not only temporarily but fully relives the pain. This would work -hypothetically- just like the mirror box treatment where the illusion of an existing phantom limb is used. Virtual reality is hypothesized to have a greater sense of reality, but it is not yet proven to be of greater help. It more specifically targets the people who have prosthetic devices. Virtual reality has shown to have effects on making the prosthetic devices be perceived as a part of the physical body.

https://youtu.be/w6AfzCNDmbY
**for visual description check out https://youtu.be/fbzrPX_Urb4*
***this reaction was caused by 'mirror neurons. You can find information about it in the first half of the video https://youtu.be/l80zgw07W4Y*

Prosthesis
PLS has also been approached by the method of usage of a myoelectric prosthesis. "Myoelectric" denotes electric properties of muscles. A myoelectric-controlled prosthesis is an artificial limb that is designed to mimic human form and motion while it is controlled with the electrical signals produced by the residual muscle tissue. By doing this, it activates the neural area by the usage of the existing muscles in the residual limb in order to function, thus, lessens the neuroplastic activity. Sadly, this can only be used by the upper-limb amputees.

Coping Mechanisms
Pharmacological treatments (such as drugs injected through the back of the patient) and stimulation methods such as hypnosis, electrical nerve stimulation, acupuncture, deep brain stimulation, spinal cord stimulations and much more might be effective, but not treatments for the long run.
Some of the pharmacological approaches would most likely include the usage of PreEmptive Analgesia, Acetaminophen, Nonsteroidal Anti-Inflammatory Drugs (NSAIDs), Antidepressants.

—The use of some distinct anesthetics and hormones that were used before the surgery were seen to decrease the probability of developing the syndrome.

Why does it not work out for everyone?
The same protocols don't work for everyone. The syndrome may be resolved on its own but is mostly is

Canan Dağdeviren

Canan Dağdeviren created a wide range of piezoelectric systems that can be twisted, folded, stretched/flexed, wrapped, and implanted onto curvilinear surfaces of human body, without damage or significant alteration in device performance. She received her PhD in materials science and engineering from the University of Illinois at Urbana-Champaign with a focus on exploring patterning techniques and creating piezoelectric biomedical systems.

chronic and sometimes resistant to treatment. The options of treatments do not show the same results for everyone and the reason for this most probably overlaps with the variety of causes of PLS. So, for practical reasons, the exact same protocol can never be used on all patients and there have to be at least minor differences even in the testing procedures. The treatment results do not just allow us to learn what can be done for this condition, but also creates a greater understanding of how our bodies are wired, how they work and what they are really built like. Would we have any knowledge of our inner mapping if it was not for these unordinary cases? How do the pharmacological treatments work, and what does that show about us? Why does the illusion create by the mirror box work?

The final is:

As the interpretation of experimental treatments constructs many scientific "facts", I ask one last one here. I do not want to ask this only for the people interested in neurological patterns but also for everyone, since what we live in is a society feeding off of images.

Why and how does body image have this much significance?

If you are interested in seeing more of Ramachandran's studies of some very exceptional cases and the complex way that we are wired, visit the link below. (This may help if you'd want to have a greater understanding of how intricately our neural pathways work)

Deniz Türker

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Can Humans Be Immortal?

Is being immortal possible? If so, how is it going to be? These are the very ancient questions asked in every era of humanity yet could not be answered completely. Some claimed every living being had to die eventually, but some suggested that there were mythical creatures like vampires that were immortal. Fortunately, today scientists have a better theory about how immortality can be achieved. Numerous scientists argue that it is possible to upload human mind to computers by future A.I. technology (Artificial Intelligence). Of course, this does not mean that we can create an

Martine Rothblatt

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USB port in our napes and upload ourselves to computers for a better CSGO[1] experience. Mind uploading is an extremely complex process.

First of all, our brains are information-processing systems and in theory; our brains can be calculated, copied and transferred. Therefore, hypothetically, we can upload our minds to computers and become eternal. In fact, scientists have already produced carbon and silicon based artificial neurons, that can actually work with the real ones. They can convey the exact same information with the real ones when you hear the school bell or got caught while cheating. Until this part, everything may seem cool to you, but there are problems too.

Problem 1: Since brain is a complex organ with numerous, tiny details; scanning it with all of its features can bring about its destruction. In other words, it can literally destroy your brain.

Problem 2: You can face with ''problem of other minds.'' Even though you know you are conscious, you can find yourself in a quandary about whether other people are conscious, too.

Problem 3: It might not be a mind-upload, instead, it can be a mind-copy. If your brain could be rescued during the procedure, then you would have -in theory- two minds. However, since it is scientifically proven that physical objects and living things do not occupy multiple locations at once, you cannot have two original minds at the same time. Moreover, when you once upload your mind into a computer, then you can also upload it to the other computers which -again- brings up the question: Which one is the real mind? Despite some ambiguities, the most reasonable answer would be that the actual person's mind is not uploaded but his/her mind is just copied.

Problem 4: We still don't precisely know all of the brain's features and what properties of brain give rise to thinking, personality, sensations etc. If these properties contain quantum phenomena, then we cannot perfectly upload our brain due to Heisenberg's Uncertainty Principle.

All in all, the answer of immortality is really difficult, yet not impossible. Because the technology develops rapidly, humans might be able to survive brain scanning and distinguish the brain with all of its details in the future. Just like Elon Musk said: ''You're already a cyborg. Most people don't realize you're already a cyborg…It's like a tiny straw of information flow between your biological self and your digital self. We need to make that tiny straw like a giant river, a huge, high-bandwidth interface... and one day if your biological-self dies, you will be able to upload into a new unit, literally.''

Asya Ülger

[1]Counter-Strike: Global Offensive (CS:GO) is a very popular multiplayer first-person shooter video game

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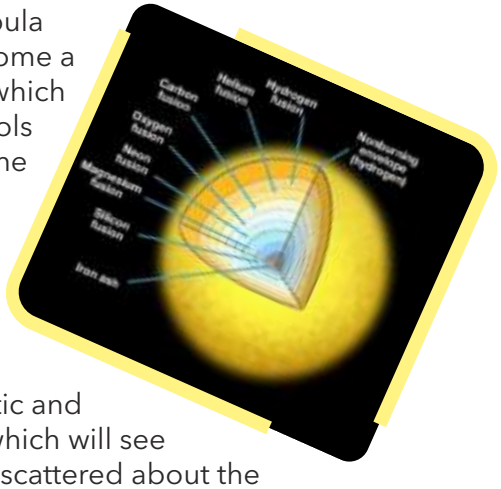
Life Cycle of a Star

Stars are formed in clouds of gas and dust, known as nebulae. Nuclear reactions at the center of stars provide enough energy to make them shine brightly for many years. The exact lifetime of a star depends primarily on its size. Massive stars burn their fuel much faster than smaller stars and may only last a few million years. Smaller stars; however, will last for several billion years, because they burn their fuel much more slowly, and have a smaller amount of mass that they have to sustain.

Eventually; however, the hydrogen fuel that powers the nuclear reactions within stars will begin to run out, and they will enter the final phases of their lifetime. Over time, they will expand, cool and change color to become red giants. The cycle the stars will go through after this stage depends on their mass.

Small stars, like the Sun, will undergo a relatively uneventful death that sees them pass through a planetary nebula phase to become a white dwarf, which eventually cools down over time turning into a brown dwarf. Massive stars, on the other hand, will experience a more energetic and violent end, which will see their remains scattered about the cosmos in an enormous explosion, called a supernova. Once the dust clears, the only thing remaining will be a very dense star known as a neutron star. Known as pulsars, these can often be spin rapidly. If the star which explodes is especially large, it can even form a black hole.



A Star is Born - The first stages in a star's life

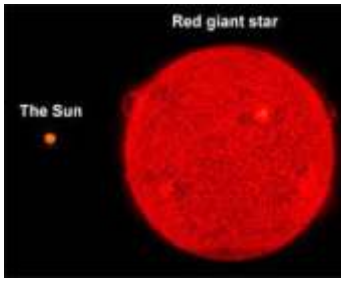
Now, we will explore the possible paths a star candidate could take during its journey in more detail. First of all, the formation of a star can occur naturally. This process starts at extremely cold conditions (10 [-263.15¡C] to 20K [-253.15¡C]) and in dense regions of interstellar gas clouds named a nebula. At such cold temperatures, gases become molecular and atoms bond together. As a result, Helium and other ionized gases and Hydrogen are the most common gases in nebulae.

When the dust and gas in the nebula start to collapse, star formation begins. As the nebula's core collapses, cloud fragments depart from the main core. After a time period of 10 million years, the cloud fragments form a nebular disk around a denser central region, which is named a protostar with its own unique gravity. The central region's size increases with the fall of matter from the surrounding areas. After some time, the Helium molecules take over the center of the star and start thermonuclear fusion, which accelerates the star's growth. The infall of matter stops only when the inward pressure of the matter and the outward pressure of the radiation from the core reach an equilibrium. This is called a hydrostatic balance. The next phase in the early life of a star is the T-

Tauri phase. The T-Tauri phase is when a star has multiple eruptions and flares in its surface, strong stellar winds and irregular light curves. T-Tauri stars are always found embedded in the clouds of gas from which they were born. One example is the Trapezium cluster of stars in the Orion Nebula.

The second way star formation can begin is through the explosion of a massive star, which is known as a supernova. This phenomenon is called supernova induced star formation. The supernova creates shock waves which trigger molecular clouds, causing nearby gas to compress and form more stars. This allows a type of stellar coherence (young stars are found near other young stars) to build up and is responsible for the pinwheel patterns we see in galaxies.

The Life Cycle of an Average Star



An average star (intermediate-mass star) is a star with an initial mass of 0.5 to 8 times that of the Sun. It spends most of its time in the main sequence as an orange or yellow star.

Red Giant (RG) stars result from low and intermediate mass main sequence stars of around 0.5-5 solar masses. After billions of years of core nuclear fusion reactions converting hydrogen (H) to helium (He) whilst on the main sequence, the hydrogen supply in the core is exhausted and there is nothing left to counter the effects of gravity. As the degenerate He core starts to shrink, heat is released due to the sudden compression of the layers of gas. The center of the core collapses rapidly and the hydrogen 'shell burning' commences in a shell layer around the core once the layer reaches sufficient density and temperature. The increasing core temperature results in an increasing luminosity (brightness), while the resulting radiation pressure from the shell burning causes the outer diffuse envelope of the star to expand to hundreds of solar radii, hence gets the name 'Giant'. The increasing size of the star outweighs the increase in luminosity, the effective temperature decreases to around 3000 K and the star takes on a redder appearance (in practice, red giants can appear to be orange or red). Stars are thought to typically spend 1 % of their lives in the RG phase.

The dying star then becomes a planetary nebula. Planetary nebulae are shells of gas and dust that have been ejected from a star during the process of its evolution from a hydrogen-burning main sequence star into a red giant and eventually into a white dwarf. The lifetimes of planetary nebulae are relatively short, 20,000 years, so they are relatively rare with about 1,500 known in the Galaxy.

White dwarf star any of a class of faint stars representing the endpoint of the evolution of intermediate- and low-mass stars, are characterized by a low luminosity, a mass on the order of that of the Sun, and a radius comparable to that of Earth. Because of their large mass and small dimensions, such stars are dense and compact objects with average densities approaching 1,000,000 times that of water. White dwarfs have exhausted all their nuclear fuel and so have no residual nuclear energy sources. Following the complete exhaustion of this

[1]Fusion a type of nuclear reaction where two nuclei come together to form the nucleus of a different element.

reservoir of thermal energy, a process that takes several additional billion years, the white dwarf stops radiating and has by then reached the final stage of its evolution and becomes a cold and inert stellar remnant. Such an object is sometimes called a black dwarf. White dwarf stars are occasionally found in binary systems, as is the case for the white dwarf companion to the brightest star in the night sky, Sirius. White dwarf stars also play an essential role in Type Ia supernovae and in the outbursts of novae and of other cataclysmic variable stars, which will be explored in detail later in this article.

Caroline Lucretia Herschel

Caroline Lucretia Herschel (16 March 1750 – 9 January 1848) is considered to be the world's first professional woman astronomer, also the first woman to receive a salary as a scientist and to receive honorary membership into Britain's prestigious Royal Society. Several comets, including the periodic comet 35P/Herschel–Rigollet and three new nebulae (hazy clouds where stars form) are amongst her discoveries. She catalogued the discoveries she had made and two of her astronomical catalogues are still in use today. She received the King of Prussia's Gold Medal of Science for her lifelong achievements.

The Life Cycle of a Massive Star

The life cycle of massive stars, which are 8–40 solar masses in size, diverges from that of low mass stars after the stage of carbon fusion. In low mass stars, once helium fusion has occurred, the core will never get hot or dense enough to fuse any additional elements, so the star begins to die. However, in high mass stars, the temperature and pressure in the core can reach high enough values that carbon fusion can begin, and then oxygen fusion can begin, and then even heavier elements—like neon, magnesium, and silicon—can undergo fusion, continuing to power the star. When a massive star exhausts its hydrogen fuel, it it evolves off of the main sequence, and transitions to fusing helium within its core thus, becomes a red supergiant. As the aforementioned events occur, the star's radius expands, causing its temperature to plummet. Red supergiant are among the coldest and most physically massive stars known.

A supernova is an event that occurs upon the death of certain types of stars. There are two main types of supernovae: Type Ia and Type II.

A type Ia supernova is a type of supernova that

[2]Main sequence stars fuse hydrogen atoms to form helium atoms in their cores. About 90 percent of the stars in the universe, including the sun, are main sequence stars. These stars can range from about a tenth of the mass of the sun to up to 200 times as massive.
[3]The solar mass is a standard unit of mass in astronomy, equal to approximately 2×10^{30} kg. It is used to indicate the masses of other stars, as well as clusters, nebulae, and galaxies. It is equal to the mass of the Sun.
[4]A binary system is one that consists of two stars that are gravitationally bound.

occurs in binary systems in which one of the stars is a white dwarf. The other star can be anything from a giant star to an even smaller white dwarf. Physically, carbon–oxygen white dwarfs with a low rate of rotation are limited to below 1.44 solar masses. Beyond this, they reignite and, in some cases, trigger a supernova explosion. If a white dwarf gradually accretes mass from a binary companion, its core will reach the ignition temperature for carbon fusion as it approaches the limit. However, if the white dwarf merges with another white dwarf, which is a very rare event, it will momentarily exceed the limit and begin to collapse, again raising its temperature past the nuclear fusion ignition point. Within a few seconds of initiation of nuclear fusion, a substantial fraction of the matter in the white dwarf undergoes a reaction, releasing enough energy to unbind the star in a supernova explosion.

When iron builds up in the core of a high mass star, a Type II supernova occurs. This causes a chain reaction: core collapses, iron fusion rate increases, pressure decreases, which causes the star's core to collapse in on itself instantaneously. For a brief period of time, the amount of light generated by one star undergoing a supernova explosion is greater than the luminosity of 1 billion stars like the Sun. These explosions are so bright that they are visible at immense distances. The elements that are lighter than iron are created by fusion reactions inside of massive stars. After the core collapse, when the shockwave is moving outwards through the outer layers of the exploding star, very high temperatures are reached. Not only do supernovae serve as the mechanism for the creation of these heavy elements, but they also serve as the mechanism for their dispersal. The elements got dispersed by the supernova explosion and became mixed in with the gas in molecular clouds. Thus, when the next generation of stars formed, the gas in the molecular cloud has already contained some heavy elements. Since the Earth are made of heavy elements, life would not be possible without the occurrence of supernovae prior to the formation of our Sun.

When the core of a massive star undergoes a supernova at the end of its life, protons and electrons are scrunched together, leaving behind a neutron star. Neutron stars cram roughly 1.3 to 2.5 solar masses into a city-sized sphere perhaps 20 kilometers across. This makes neutron stars one of the densest objects in the galaxy. Most known neutron stars belong to a subclass known as pulsars. These relatively young objects rotate extremely rapidly. The magnetospheres of some pulsars accelerate particles to such high energies that they are relatively bright gamma-ray sources.

Another outcome of a supernova is the formation of a black hole. A black hole is a place in space where gravity pulls so much that even light can not get out. The gravity is so strong because the matter has been squeezed into a tiny space. Because no light can get out, black holes are invisible. The largest black holes are called "supermassive." These black holes have masses that are more than 1 million suns together. Scientists have found proof that every large galaxy contains a supermassive black hole at its center.

Alara Balcısoy

[5]A magnetosphere is a region of space surrounding an astronomical object in which charged particles are manipulated or affected by that object's magnetic field.
[6]A gamma ray is a penetrating electromagnetic radiation arising from the radioactive decay of atomic nuclei. It consists of the shortest wavelength electromagnetic waves and so imparts the highest photon energy.

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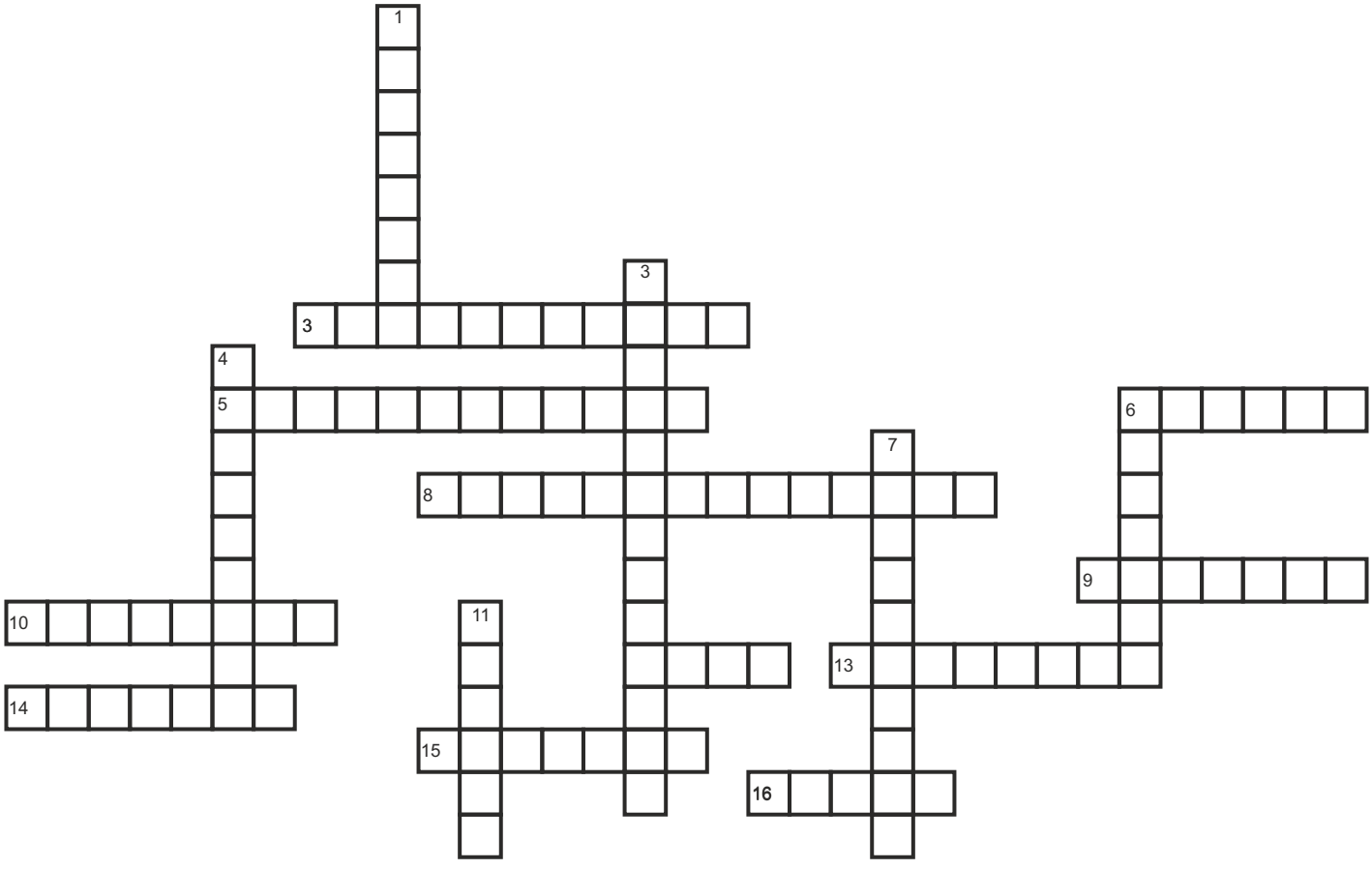
Astronomical and Cosmological Terms

Prepared by İdil Kolabaş



ACROSS

3 The same at all locations.
5 When the earth passes between the sun and the moon and casts a shadow on the moon
6 A collection of stars, star systems, dust, and gas bound together by gravity
8 Or Ho. the ratio of velocity to distance in the expansion of the Universe, so v = HD.
9 Theory that an explosion created the universe many billions of years ago
10 Rocky objects revolving around the sun that are too small and numerous to be considered planets
12 The periodic rise and fall of the sea level under the gravitational pull of the moon
13 A very high energy photon, more energetic than an X-ray.
14 19th century physicist who discovered the variation in the wavelength of waves caused by motion of the source.
15 A neutron or a proton - one of the particles inside an atomic nucleus.
16 A ball of dust and ice that orbits the sun

DOWN

1 Result of spreading out light by wavelengths.
2 An imaginary pattern of stars in the sky
4 An object so massive and dense that even light cannot escape its gravity
6 The force of attraction between all masses in the universe
7 A form of matter that does not emit light, absorb light, or scatter light. Its only interactions are gravitational.
11 A huge cloud of dust and gas in space

By Berktan Demirel

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