ANTHARIKSH

The Space...

DEPARTMENT OF AEROSPACE ENGINEERING

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

MYLAVARAM, ANDHRA PRADESH, INDIA.

Vision of the Department:

To achieve academic excellence and produce highly competent professionals in the field of Aerospace Engineering

Mission of the Department:

DM1: To impart high quality education in Aerospace Technology through class room teaching and laboratory practice
DM2: To develop indigenous Aerospace Technology by carrying out research in collaboration with industry and research organizations
DM3: To train and inspire the student community to possess effective communication and leadership skills with ethical values
DM4: To harness the technological development by being consistently aware of societal needs and challenges

Program Educational Objectives (PEOs)

PEOs	Statement
PEO1	To provide students with sound mathematical, engineering and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems
PEO2	To prepare students to excel in higher education programs and to succeed in industry/academia profession.
PEO3	To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigation of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design

PSO2: To prepare the students to work effectively in Aerospace and Allied Engineering organizations

FOCUS AND SCOPE

A department magazine bridges the gap between students and faculty. Typically, a department magazine consists of Technical articles, ideas, project outcomes, language skills, literary articles, technical updates, success stories, career tips, academic advice, the latest events and happenings related to campus. Cover-stories have to be written in an engaging format. We can also include interviews of former students who have achieved success through dedication and hard work.

PUBLICATION FREQUENCY:

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Send your articles to the following mail ID.

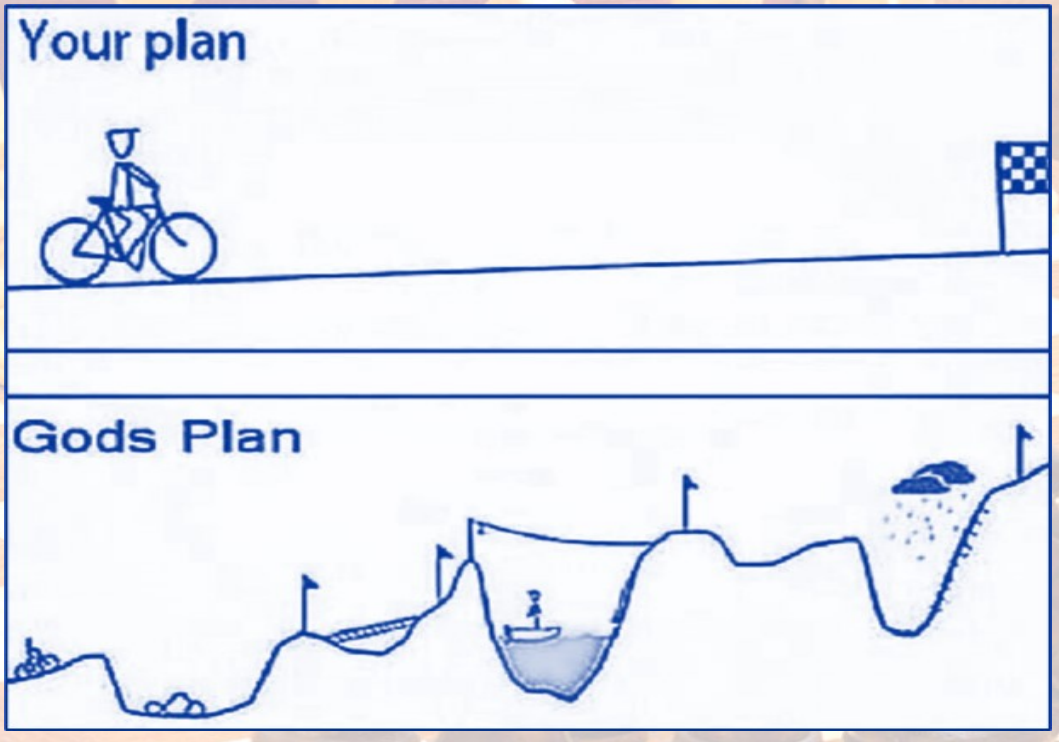
E-Mail: anthariksh.lbrce@gmail.com

Disclaimer

Some of the contents published in this magazine are from open sources. The contents of this magazine are for information purposes only, enabling the faculty and students to have easy and quick access to information and do not have any legal sanctity. This magazine is intended for circulation among students of the Department of Aerospace Engineering of LBRCE only.

FROM HOD's DESK

Reality is the plan created by GOD...
Sometimes God doesn't do the things the way we think he should.
But God has a perfect plan for your life.
He makes us to realize that :
"Life isn't about finding yourself.
Life is about creating yourself."
Life is 10% what happens to you and 90% how you react to it.
So, Trust God and live life honestly...



Dr. P. Lovaraju

WORDS THAT ENLIGHTEN ME

Sushma Swaraj Muni

21761A5627

This is something that inspired me a lot it's a speech of my favourite idol RM from BTS a Korean Boy Band . The whole speech is about loving yourself, believing in yourself and speaking for yourself. This speech literally changed my way of thinking from then. I suggest the person reading this to listen to the speech of RM at UNICEF. In this speech RM speaks about the childhood dreams where we would think that we are the super heroes saving the world which is not stupid it's just pure innocence of the childhood. Then growing up it all changed we started to worry about what other people think of us and started seeing ourselves through their eyes. Then we jam into the moulds that other people made. We stop listening to our own voice and start listening to others. This is how the whole youth is , we don't listen to ourselves. We always doubt ourselves.

We must face many problems to survive in this world. There will be more problems, and everything will have a solution. May be in facing these problems you have made a mistake, IT'S OKAY . RM says a line in the speech " I am who I am with all my mistakes and faults . These faults and mistakes are what i am making up the brightest stars in the constellation of my life".

This was like my agenda or a motivation line that motivates me every time. After listening to this speech, I have come to love myself with all my mistakes and faults. I started loving myself for who I actually am. I started believing in myself that I can do anything if I am interested .I stopped comprising for something that's mine. I learnt to love myself. I wish the person reading this would love him/her self and speak for him/her self .I have many faults but I am learning to embrace all my faults and starting to love myself a little by little . May be the reason why I am writing this article because I believe in myself that I can write this and so did I ....

UNIVERSE EXPANSION

Sarawani Manikonda

21761A5622

We all know that a star will convert into a black hole when all of its fuel's used up. Then it'll create a strong attractive force, at which even the light can't escape. That means if we consider the speed of light versus the speed of black hole attraction, we can understand that speed of light is lesser in comparison. This could even be applied to the expansion of our universe.

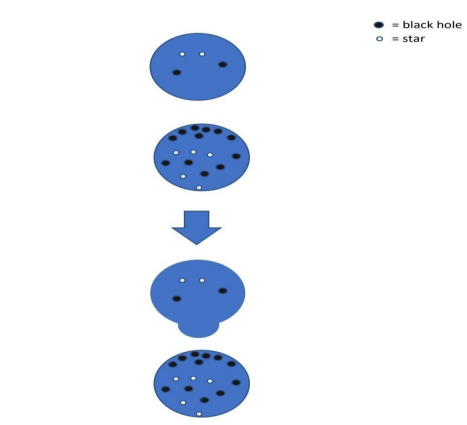
If we consider multiverse, our universe could be imagined as a bubble that's floating in between several other universes, while expanding. This can be explained as below.

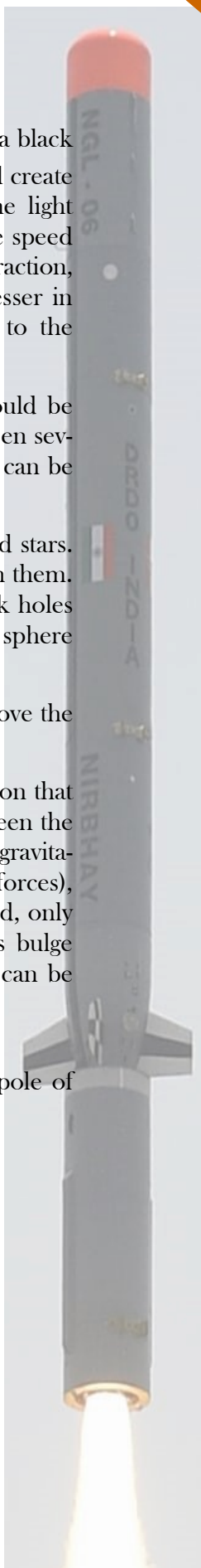
Any universe, contains both black holes and stars. Black holes have a lot of attraction power in them. If we think in this way, like density of black holes hanging over the north pole of a universal sphere (purely logical imagination)

then the other universe which is floating above the former one, gets attracted towards it.

Due to inertia, or could be due to the reason that there's no particular string connection between the heavenly bodies (in that universe) but weak gravitational force (which is the weakest of all forces), instead of getting whole of it's bubble moved, only a part of it moves, like a new bulge. This bulge occurrence, I believe, is faster than light, can be called as expansion of the universe

This bulge, if we imagine, is in the south pole of the latter universe.





METHODS OF SPACE TRAVEL IN FUTURE

M.Bhuvaneshwari
T846

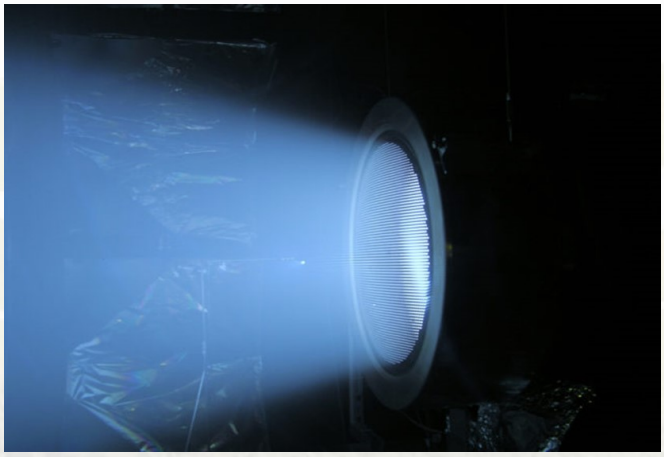
Ion Thrusters

Ion thrusters shouldn't be a new concept to Star Wars diehards, because they power TIE Fighters. They're a real thing that was used on NASA's Dawn probe that was launched in September 1997 to study the dwarf planets Vesta and Ceres. Ion thrusters work when xenon atoms are hit with electrons, forming ions. At the back of the engine, there are metal grids charged to about 1,000 volts that shoot out ions at 90,000 miles per hour. The thrust is quite small, but since space is a frictionless environment with zero gravity it gradually builds up. The top speed of Dawn is 24,000 miles per hour.

Ion thrusters require minimal fuel. In fact, they're 10 times more effective than chemical fuels. They get their power from large solar panels, so there's no need to build storage for fuel. That also gives them an inexhaustible source of energy. The current problem with ion thrusters is that they're a bit too slow to transport humans. With, they could be used to transport supplies to, say, a settlement on Mars.

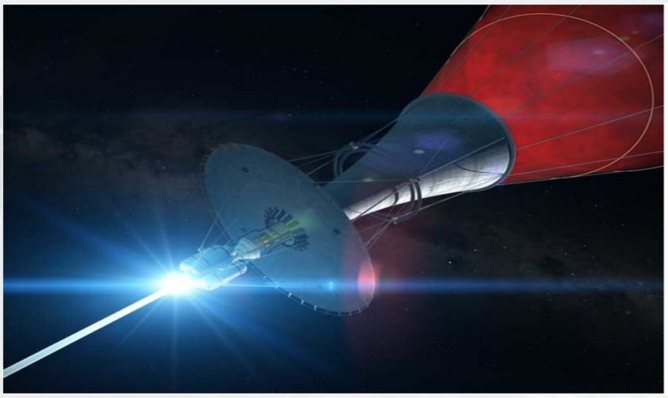
2. Bussard Ramjet

As alluded to above, one of the biggest problems



facing space travel is the amount of fuel needed. One attempt to overcome this came from the 1960s and was called the Bussard Interstellar Ramjet. The idea is that the spacecraft would pick up protons in the universe while traveling. If these protons could then be fused together, the spacecraft could use nuclear rockets.

However, there are several problems with the Ramjet. Only a certain number of protons could be picked up, and a lot of drag would be generated when the vessel would collect protons. Also, there's the little matter of getting a stable nuclear fusion device functioning.

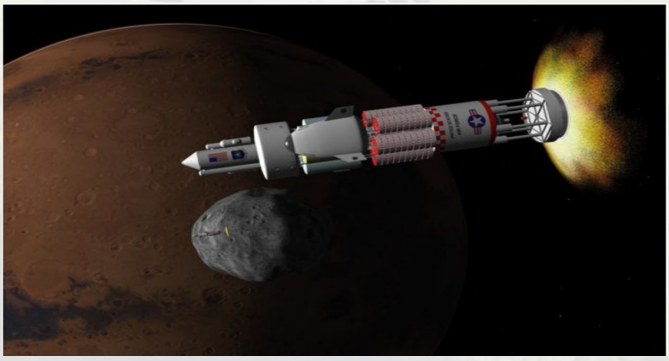


3.Nuclear Pulse Propulsion

The idea of using nuclear power to launch spaceships dates back to the 1950s. Project Orion was an endeavor by NASA that entailed a ship the size of the Empire State Building being launched by exploding a nuclear bomb under it. You can probably guess some of the problems with this. For starters, this method would leave a tremendous amount of radiation behind and give the astronauts radiation poisoning.

When the bomb went off, it would create an electromagnetic pulse that would wipe out all the onboard electronics. That's if the launch was successful and didn't result in a deadly accident. Despite all of this, Project Orion was considered because it could travel to Mars and back in three months, while it would take a spacecraft using normal propulsion 18 months to do the same trip.

Orion was abandoned, but ideas from the project lived on. *Voyager 1, Voyager 2* and the *Cassini* spacecraft use a form of nuclear power that takes decaying plutonium and converts it to electricity.

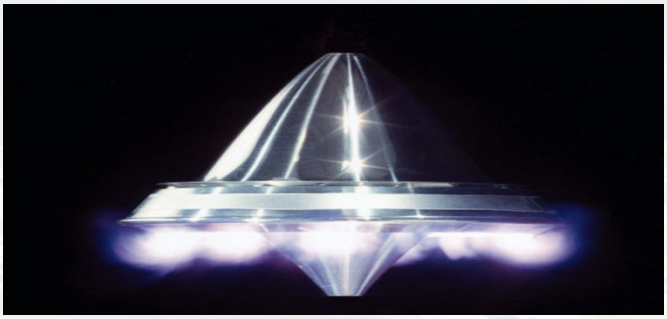


[P.T.O]

4.Laser Beamed-power Propulsion

Aerospace engineer and awesomely named Leik Myrabo got the idea of using laser beamed-power propulsion in 1988 when he was working on the Star Wars missile defense project. Myrabo's craft would be conical. A powerful laser beam would be fired into the narrow end of the cone, which would contain a parabolic reflector.

This would heat the air inside to about 30,000 degrees, which would cause explosions that would create thrust. Myrabo believes that he could have a



spacecraft ready in 20 years, but his peers are skeptical as to

5.Daedalus Interstellar Spacecraft

The British Interplanetary Society conducted a five-year study beginning in 1973 to see if it was possible for humans to travel to Barnard's Star, which is about six light years away. Their solution was the Daedalus Interstellar Spacecraft. The Daedalus was a huge spacecraft, also nearly the size of the Empire State Building, and would need to be constructed in the Earth's orbit.

Like Project Orion, it would use fusion engines. Pellets of fuel would be injected at high velocity into a reaction chamber, where high-energy electron beams would ignite them. The first stage would launch from Earth with 46,000 tons of fuel, and then once in space it would launch a smaller part of the ship that would carry 4,000 tons of fuel. The fuel needed was Helium-3. Helium-3 is incredibly rare on Earth, but it's believed there's quite a bit on the moon, and there are also clouds of it in space. Collecting enough could take 20 years. Helium-3 is also the most difficult fusion fuel to ignite because of the incredible amount of heat needed. However, if it worked, the spacecraft would eventually travel at 12.2 percent of the speed of light, meaning it would get to Barnard's Star in 50 years.

In 2009, an update called Project Icarus began its five year study to see how interstellar travel might now be done after years of scientific advancement. Hopefully they're putting more thought into the science than the name.

6.Asteroid Hopping

One of the big problems with traveling in space is exposure to cosmic rays. If a person were to do a 1,000 day round trip to Mars, they would be exposed to so much radiation that it would increase their chances of getting cancer from one to 19 percent. Spacecraft are made of light material, and radiation shields are too heavy. That's why a professor of physics at MIT believes the best way to travel would be to land on an asteroid and then tunnel below its surface.

The asteroid would need to be 33 feet wide and pass within a couple million miles of both Earth and Mars for the plan to work. There are five known asteroids that would be excellent candidates that will pass by Earth before 2100. The trip would only be one way, because there isn't an asteroid that would make a round trip feasible. However, new discoveries are being made all the time, so it's possible there's an asteroid that will head back towards Earth that we haven't discovered yet.

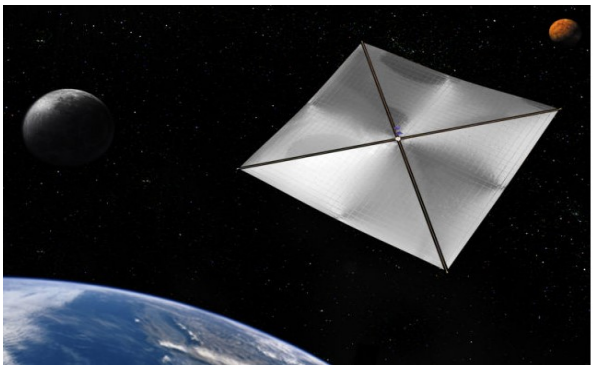
[P.T.O]

7.Solar Sail

While sails are low-tech by today's standards, they're getting a modern update in space travel. Instead of using wind, these sails would use the power of the sun. Solar sails would only give a spacecraft a small push, but since there's no friction in space the sails would continually build up speed. For example, a solar sail that's 1,300 feet wide could travel 1.3 billion miles per year. That's faster than a vessel using chemical propulsion. That would also be relatively cheap compared to fuel use.

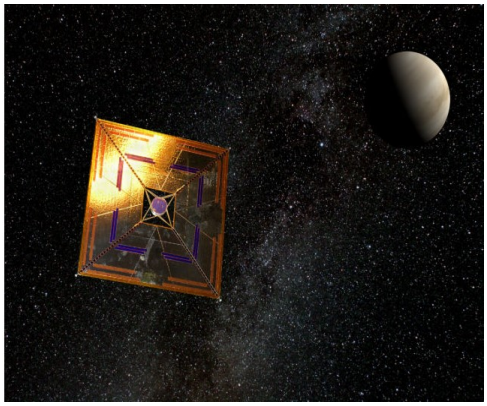
There are currently several projects using solar sails. One comes from NASA and is called the Sun jammer, after a short story by Arthur C. Clarke. The Sun jammer sail would be made from a material called Kapton and be just five microns (about 0.0002 inches) thick, weigh less than 70 pounds and be about the size of a dishwasher when packed up.

It's suggested that, while it make take a few centuries to develop, a solar sail could be used to carry a spacecraft into another solar system. This sail would need to be the size of Texas, and a strong laser would need to shine on it as it got further away from the sun.



8.Magnetic Sail

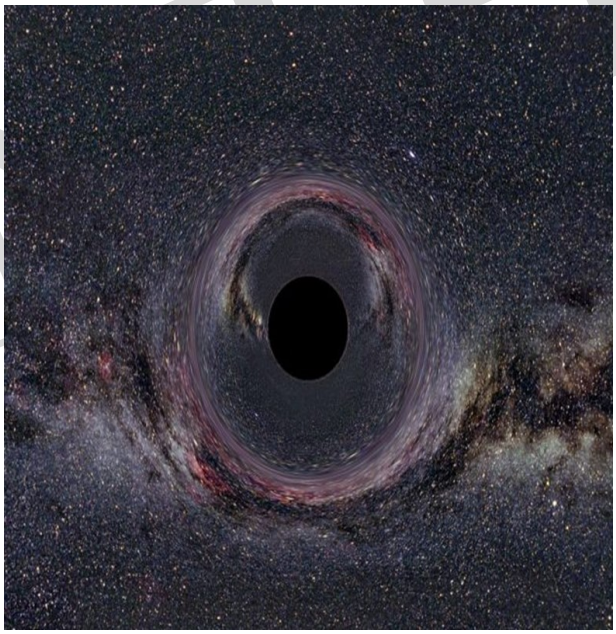
The sun releases mostly protons and electrons at speeds that range from 248 to 370 miles per millisecond. A magnetic sail would use this energy and push against it. A loop of conducting material would produce a magnetic field that's perpendicular to the solar wind, and this would push the craft to the desired location. The problem is that to do this, the sail would need to be 62 miles long. The technology to make the superconducting material for a sail of that size, and keep it at the right temperature, just isn't available right now. Magnetic sails are just a theory until better technology is developed.



9.Wormhole

A staple of science fiction, wormholes have fascinated people ever since they were first theorized in 1921. While they're believed to exist, there's no visible evidence. Wormholes are essentially tunnels in space, which objects could theoretically travel through. But wormholes are unstable — if someone were to travel through them, the walls would probably collapse.

To safely travel through, the craft would use an anti-gravitational force. Physicists say we most likely wouldn't be able to collect enough energy. If there was a wormhole humans could travel through, it wouldn't naturally occur; it would have to be constructed by an advanced civilization. So, until we either get to that point or someone constructs a wormhole for us, it will remain in the realm of science fiction.



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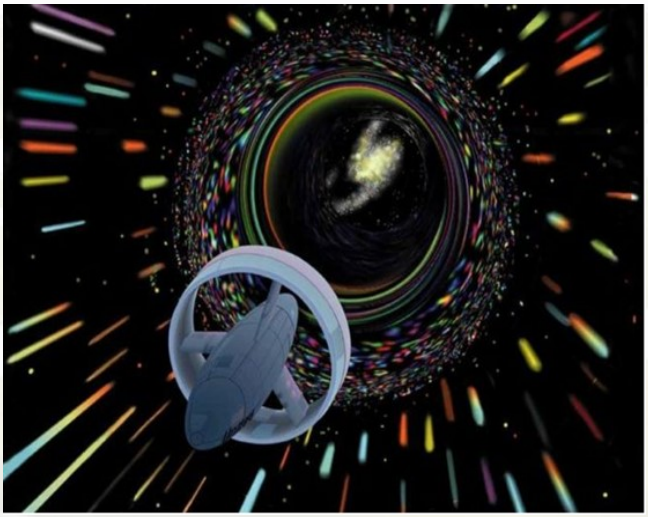
10.Warp Drive

Made popular by *Star Trek*, a warp drive allows for faster than light travel. It's often thought to be impossible because of the incredible amount of energy needed to run a drive. However, researchers believe that they've found a way. The first idea was to use a design by physicist Miguel Alcubierre, who proposed a spacecraft shaped like an American Football with a flat circular ring around it. But to power that design, you would need a ball of antimatter the size of Jupiter.

To make the spacecraft more feasible, NASA's Dr. Harold White tweaked the design. In theory, the modified ship would require much less antimatter, about 500 kilograms. The proposed spacecraft would warp space-time and reach speeds 10 times the speed of light. It would make trips to the closest star about four or five months long.

Unfortunately, antimatter is incredibly volatile. Just one third of a gram could release the same amount of energy that was released during the bombing of Hiroshima. The amount of antimatter that White's design needs would be the equivalent of 1.5 million Hiroshima's, enough to destroy the Earth.

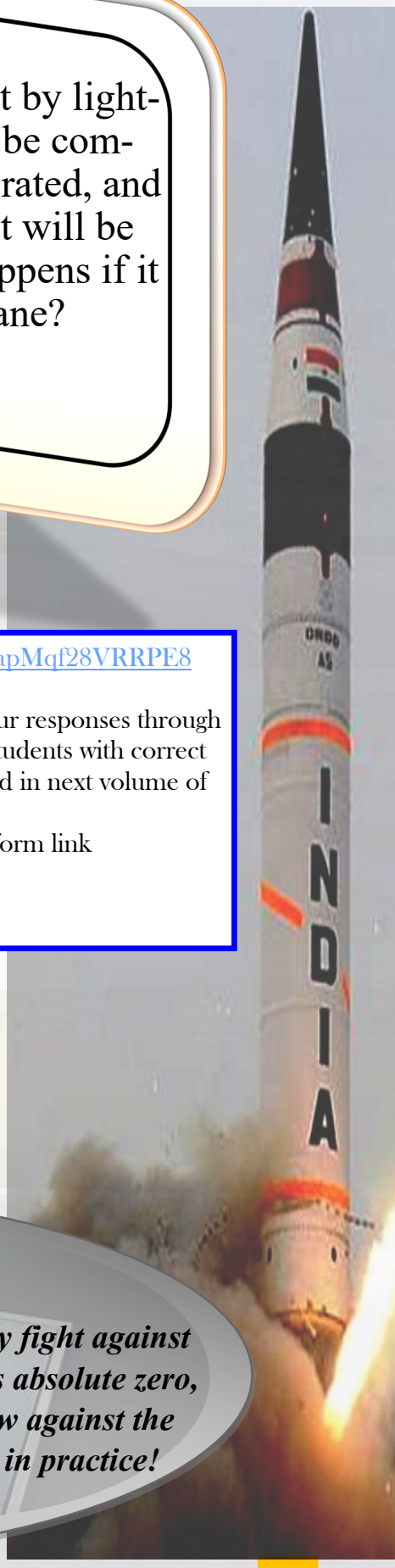


If a person hit by lightning, it can be completely evaporated, and nothing of it will be left. What happens if it is airplane?

https://forms.gle/XNkHapMqf28VRRPE8

You people can send your responses through the given link. First 10 Students with correct responses will be featured in next volume of our Magazine

1. Click on the google form link
2. Send your answer.



DID YOU KNOW?

Helium is one of the only known elements to actively fight against gravity. By cooling the gas down to what is known as absolute zero, helium turns into a liquid. This liquid will then flow against the natural force of gravity – it's really strange to see in practice!

ORION NEBULLA

Kanigiri Roshini
20761A5620

The Orion Nebula (also known as Messier 42, M42, or NGC 1976) is a diffuse nebula situated in the Milky Way, being south of Orion's Belt in the constellation of Orion. Before going to know about the this Orion Nebula let us know **what is ORION?**

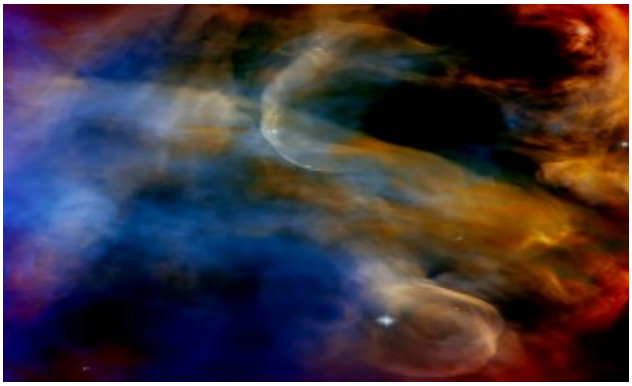
Orion is a prominent constellation located on the celestial equator and visible throughout the world. It is one of the most conspicuous and recognizable constellations in the night sky. It is named after Orion, a hunter in Greek mythology. Its brightest stars are blue-white Rigel .

It is one of the brightest nebulae and is the closest region of massive star formation to Earth. The M42 nebula is estimated to be 24 light-years across. It has a mass of about 2,000 times that of the Sun.

The Orion Nebula is visible with the naked eye even from areas affected by some light pollution. It is seen as the middle "star" in the "sword" of Orion, which are the three stars located south of Orion's Belt. The "star" appears fuzzy to sharp-eyed observers, and the nebulosity is obvious through binoculars or a small telescope.

The peak surface brightness of the central region of M42 is about 17 Mag/arcsec^2 and the outer bluish glow has a peak surface brightness of 21.3 Mag/arcsec^2 .It contains a very young open cluster, known as the Trapezium Cluster due to the asterism of its primary four stars within a diameter of 1.5 light years. The stars of the Trapezium Cluster, along with many other stars, are still in their early years. The Trapezium Cluster is a component of the much larger Orion Nebula, an association of about 2,800 stars within a diameter of 20 light years.

The first discovery of the diffuse nebulous nature of the Orion Nebula is generally credited to French astronomer Nicolas-Claude Fabri de Peiresc , on November 26, 1610, when he made a record of observing it with a refracting telescope



purchased by his patron Guillaume du Vair.

The first published observation of the nebula was by the Jesuit mathematician and astronomer johann Bapist Cysat of Lucerne in his 1619 monograph on the comets (describing observations of the nebula that may date back to 1611). He made comparisons between it and a bright comet seen in 1618 and described how the nebula appeared through his telescope as: one sees how in like manner some stars are compressed into a very narrow space and how round about and between the stars a white light like that of a white cloud is poured out.

చిన్ని పాదాలు కందకుండా
నా బాల్యం చెదరకుండా
చిరు నవ్వులు చేజారకుండా
ప్రతిక్షణం నీడలా
మనలోని ఆత్మలా
కలసి కలగలసి పోయి
మన జీవితం కోసం
తన జీవితం అర్పించేవాడు.
-"నాన్న"

Krishna Mohan
21761A5606

PLACEBO EFFECT

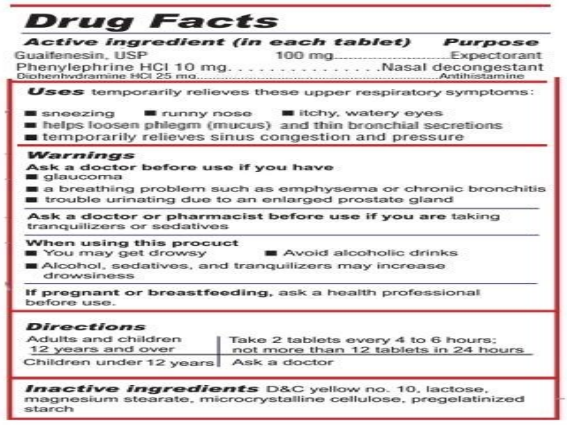
U. Sai Sanjay Vardhan

21761A5645

Have you ever heard about Joe Dispenza , the man who cured his crucial spine problem himself which was even gaveup by doctors. Did Joe have any superpowers or did he know any other medications which the doctors don't? What mad him to get rid of his spine problem?

Does our brain has a role in treating our health?

The answer is YES. It plays a major role in healing our health issues . When we take medicine our brain releases hormones which take part in the medication . The medicine we take will generally have active ingredient and inactive ingredient .Active ingredient is the real medicine andinactive ingredient is that which is added to get shape, colour and taste for medicine .The medicines which are made of only inactive ingredient is called Placebo which does not any qualities of



Drug Facts

Active ingredient (in each tablet) **Purpose**
Guaifenesin, USP 100 mg Expectorant
Phenylephrine HCl 10 mg Nasal decongestant
Dichenhydramine HCl 25 mg Antihistamine

Uses temporarily relieves these upper respiratory symptoms:
- sneezing
- runny nose
- itchy, watery eyes
- helps loosen phlegm (mucus) and thin bronchial secretions
- temporarily relieves sinus congestion and pressure

Warnings
Ask a doctor before use if you have
- glaucoma
- a breathing problem such as emphysema or chronic bronchitis
- trouble urinating due to an enlarged prostate gland

Ask a doctor or pharmacist before use if you are taking tranquilizers or sedatives

When using this procuct
- You may get drowsy
- Avoid alcoholic drinks
- Alcohol, sedatives, and tranquilizers may increase drowsiness

If pregnant or breastfeeding, ask a health professional before use.

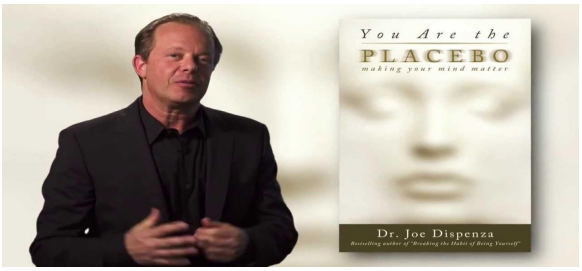
Directions
Adults and children 12 years and over: Take 2 tablets every 4 to 6 hours; not more than 12 tablets in 24 hours
Children under 12 years: Ask a doctor

Inactive ingredients D&C yellow no. 10, lactose, magnesium stearate, microcrystalline cellulose, pregelatinized starch

treating our health issues. The researchers discovered that the placebo was 50% as effective as the real drug. Not only about medicines , this effects plays a major role in crucial surgeries too. Placebo effect is nothing but believe system. When we strongly believe that we'll be cured , we will. When we start to believe , our brain releases the hormones which cures us. The institute of Noetic Sciences collected the of 3500+ patients reports who are treated with placebo effect . Many of them are with heart problems , kidney failure ,B.P, HIV ,cancer and many more.

Many experiments were conducted on this and one of them was- a group of six patients whose are suffering from headache were separated into two groups. Both the groups were given some placebo pills .For the first group, it was said that their headache will be cured and for the other group it was said that the headache will be cured and fall into deep sleep. The result was the first group was cured as the second but additionally the patients of second group fall into deep sleep. Here they strongly believed what was said to them , so their brains started to think about what was said and worked for it.

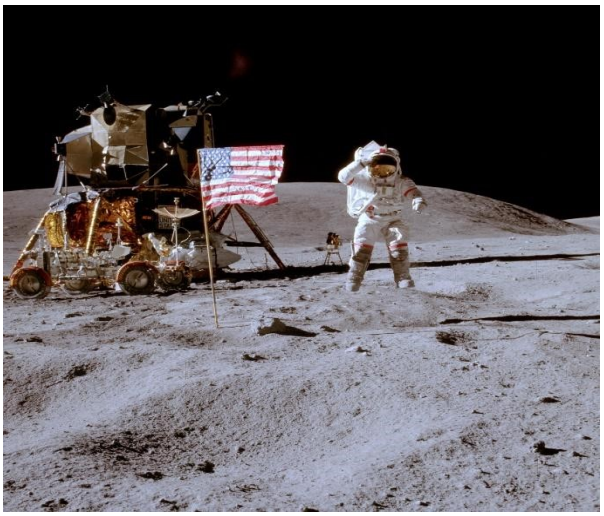
In the time of second world war, most of the soldiers were injured heavily. There isn't enough Morphine for the soldiers. But without morphine, the soldiers can't be cured. The American doctor, Henry Beecher had an idea of injecting normal saline water instead of morphine. Surprisingly, the pain of soldiers was reduced. This is because of the placebo effect, the soldiers believed that they were given morphine which would reduce their pain. As they believed their brain worked for it , so their pain was reduced. Here saline water is placebo. Coming back to Joe, when he was in a bicycle race he was hit by a car with a speed of 80kmph. His spine was effected and his doctors said he need Harrington rod surgery but he won't be walk again. But Joe did not accept this. Joe believe that our brain has the power of healing our health issues . Many days he sat alone in his wheelchair and imagine that his spine problem is getting to normal state. After few days he could move his body. After ten weeks he could stand and after twelve weeks he could walk. He believed that he'll be normal and his brain worked for it, the rest is he is back to his normal life. He wrote a book – You are the Placebo , to expose the world about this effect.



When we strongly believe about something, our brain works for it and make changes in our body. That is why we are mostly said to be positive, when we have enough positivity we could over come our problems. Our brain itself have the healing mechanism and can help us to get rid of health issues getting severe. It's important to be confident and positivity to lead good life.

APOLLO MOON FLAGS STILL STANDING

Kalisetty Bhanu Prakash
20761A5619



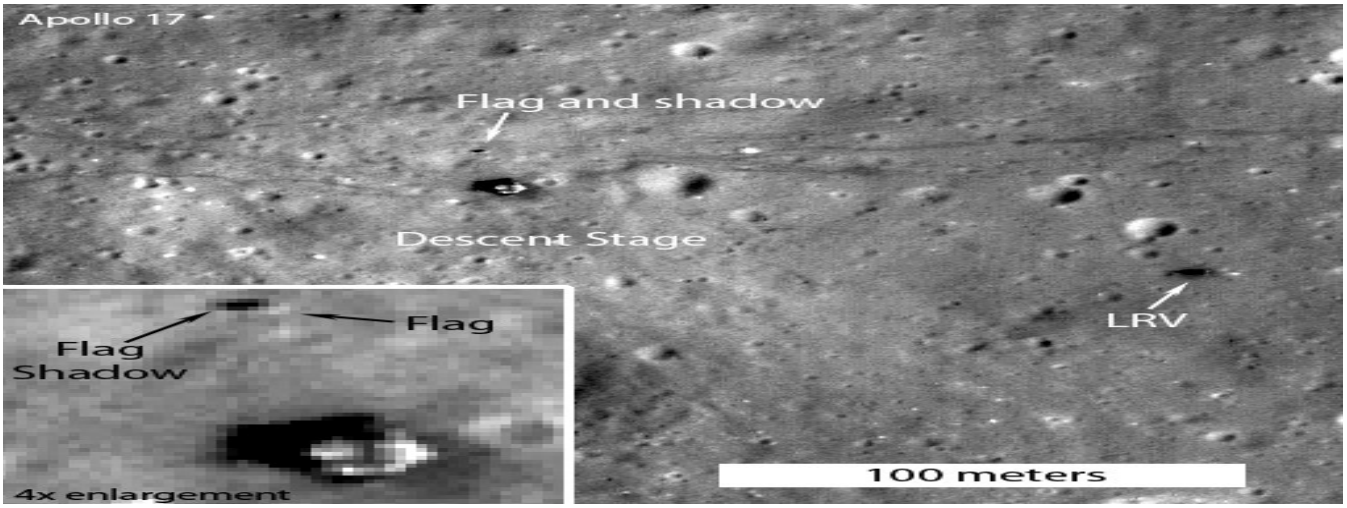
LRO was designed to produce the most detailed maps yet of the lunar surface. Not only did the spacecraft image the Apollo sites, but it captured details like the Lunar Module descent stages, rover tracks, flags.

Images taken by the Lunar Reconnaissance Orbiter (LRO) have shown that the American flags left on the Moon by Apollo astronauts are still standing– except for the Apollo 11 mission, which Buzz Aldrin reported as being knocked over by engine exhaust as Apollo 11 lifted off.

Each of the Apollo missions to the Moon planted an American flag in the soil. By studying photos of the Apollo landing sites taken at different times during the day, scientists observe circling the points where the flags are thought to be.

"From the LROC images it is now certain that the American flags are still standing and casting shadows at all of the sites, except Apollo 11," writes Mark Robinson, chief scientist for the LROC camera. "Personally I was a bit surprised that the flags survived the harsh ultraviolet light and temperatures of the lunar surface, but they did. What they look like is another question." The flags may in fact be badly faded.

LRO slewed 19° down-Sun allowing the illuminated side of the still standing American flag to be captured at the Apollo 17 landing site.



NO ONE CAN JUDGE YOU,
NO ONE CAN GUIDE YOU,
NO ONE CAN MOTIVATE YOU,
NO ONE CAN CHANGE YOU ,
UNLESS YOU GIVE A CHANCE.

-KANULLA DINESH BABU
20761A5621

3D Bio-printing

MARAM MAHENDRA REDDY
20761A5631

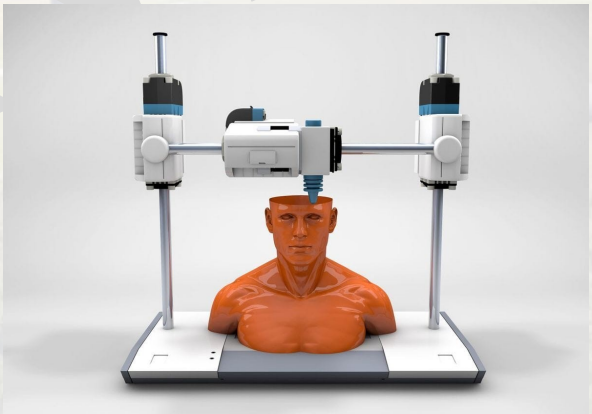
The field of Tissue engineering and regenerative medicine that work toward creating functional tissue-constructs mimicking native tissue for repair and/or replacement of damaged tissues or whole organs have evolved rapidly over the past few decades. However, traditional tissue engineering approaches comprising of scaffolds, growth factors and cells showed limited success in fabrication of complex 3D shapes and in vivo organ regeneration leading to their non-feasibility for clinical applications from a logistical and economical viewpoint. In this regard, 3D bioprinting, which is an extended application of additive manufacturing is now being explored for tissue engineering and regenerative medicine as it involves the top-down approach of building the complex tissue in a layer by layer fashion, thereby producing precise geometries due to controlled nature of matter deposition with the help of anatomically accurate 3D models of the tissue generated by computer graphics. Here, we aim to provide a comprehensive review of the 3D bioprinting technology along with associated 3D bioprinting strategies including ink-jet printing, extrusion printing, stereolithography and laser assisted bioprinting techniques. We then focus on the applications of 3D bioprinting technology on con-

struction of various representative tissue and organs, including skin, cardiac, bone and cartilage etc.

3D bioprinting has emerged as a promising new approach for fabricating complex biological constructs in the field of tissue engineering and regenerative medicine. It aims to alleviate the hurdles of conventional tissue engineering methods by precise and controlled layer-by-layer assembly of biomaterials in a desired 3D pattern. The 3D bioprinting of cells, tissues, and organs Collection at Scientific Reports brings together a myriad of studies portraying the capabilities of different bioprinting modalities. This Collection amalgamates research aimed at 3D bioprinting organs for fulfilling demands of organ shortage, cell patterning for better tissue fabrication, and building better disease models.

The discovery of a 3D printer dates back to early 1980s when Charles Hull, an American engineer, built the 1st 3D printer, capable of creating solid objects by following a computer-aided design (CAD). The printer deposited successive layers of an acrylic-based photopolymer which was then simultaneously crosslinked by UV light, thus creating a solid 3D object. This simple technology, called stereolithography (SLA), revolutionized the additive manufacturing industry. Gradually, by the late 1990s, 3D printing made its appearance in healthcare where surgeons began 3D printing dental implants, custom prosthetics, and kidney bladders. Subsequently the term '3D bioprinting' emerged where the material being
printed, called 'bioink'1, consisted of living cells, biomaterials, or active biomolecules. Analogous to additive manufacturing, 3D bioprinting involves layer-by-layer deposition of bionic to create 3D structures, such as tissues and organs.

3D bioprinting can be broadly categorized as either extrusion3, droplet4, or laser-based bioprinting. Extrusion based bioprinting employs mechanical, pneumatic or solenoid dispenser systems to deposit bioinks in a continuous form of filaments, while droplet based bioprinting relies on the generation of bioink droplets by thermal, acoustic or electrical stimulation. Laser based bioprinting utilizes laser power to 3D print structures

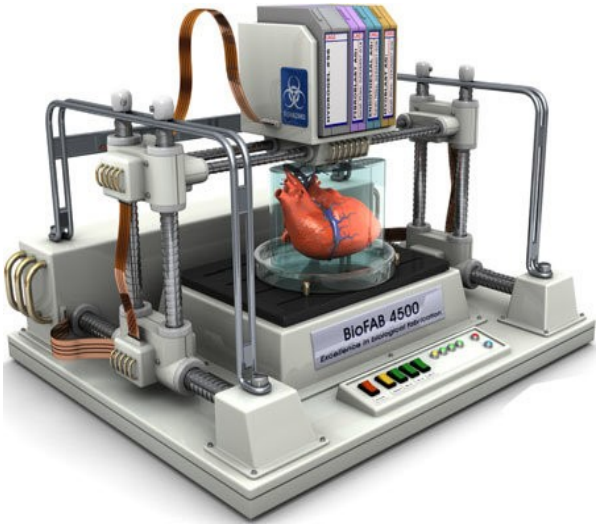


such as in SLA by a photopolymerization principle.

[P.T.O]

It can also be used for precise positioning of cells such as in laser direct-write and Laser Induced Forward Transfer (LIFT). The selection of "bioinks" for each of these different bioprinting modalities usually varies based on the ink's rheology, viscosity, crosslinking chemistry, and biocompatibility Apart from organ printing, bioprinting is also being used to fabricate in-vitro tissue models for drug screening, disease modelling, and several other in-vitro applications.

The 3D bioprinting of cells, tissues and organs Collection at Scientific Reports is dedicated to this field of research. This collection clearly portrays the diverse



applications of different bioprinting modalities and how they could be utilized for improving various aspects of healthcare.

The bioprinting enables the homogenous distribution of cells representing the macro-architectural properties, it lacks control of the tissue micro-architecture such as orientation of cells within the bioprinted constructs.

It is important to note that the applications of 3D bioprinting are not limited to organ printing. It also holds great promise in less explored avenues, such as using scaffolds for drug delivery, studying disease mechanisms, or creating personalized medicines.

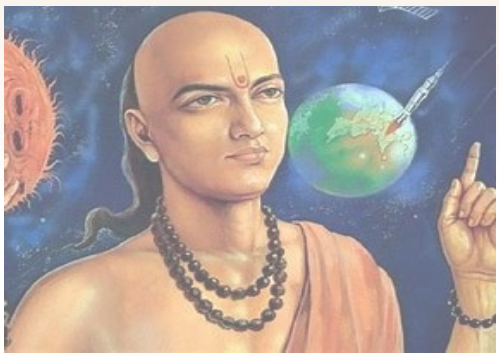
Even though 3D bioprinting is advancing at a commendable rate with researchers trying to develop new printing modalities as well as improve existing modalities, there still remains a multitude of challenges that need to be overcome. Currently, a limited number of bioinks exist which are both bioprintable and which accurately represent the tissue architecture needed to restore organ function post-printing. While bioinks made from naturally derived hydrogels are conducive to cell growth, synthetic hydrogels are mechanically robust. Overall, 3D bioprinting is a rapidly evolving field of research with immense challenges, but tremendous potential to revolutionize modern medicine and healthcare.

References

Hospodiuk, M., Dey, M., Sosnoski, D. & Ozbolat, I. T. The bioink: a comprehensive review on bioprintable materials. Biotechnol. Adv. 35, 217–239 (2017)

INDIA'S CONTIBUTIONS TO THE WORLD

- **India never invaded any country in her last 10000 years of history.**
- **India invented Number System. Zero was invented by Aryabhatta.**
- **Sanskrit is the mother of all European languages.**
- **The art of Navigation was born in the river Sindh 6000 years ago.**
- **Chess (Shataranja or AshtaPada) was invented in India.**
- **The place value system, the decimal value system was developed in India in 100BC.**



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