COSMOLOGY AND NATURE'S SECRETS

An Introduction to Space and Nature Studies

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About a hundred years ago, we thought that the known observable universe was about 100,000 light years wide. Now, with the help of advanced telescopes, we estimate that the known universe is **about 93 billion light years wide**. [A light year is the distance light travels in one earth year @ 299,762 kms ~300,000 kms per second or 186,000 miles per second. A light year is about 9.5 trillion kms /6 trillion miles. Nothing can travel faster than light. The speed of light is a universal speed limit in a vacuum, according to Einstein's theory of special relativity. Only massless particles like photons, which make up light, can travel at that speed.]

SUPER-CLUSTERS—THE HOME OF GALAXIES

The visible universe contains about **10 million super clust**ers [such as Saraswati super cluster, Lanikea super cluster and Virgo super-cluster] containing about 200 billion to 2 trillion galaxies. A galaxy is a collection of stars (suns), planets and their moons that are supposedly held together by gravity. Saraswati super-cluster (SC) is about 4 billion light years away. Contains more than 40 galactic clusters in it. It takes about 650 million light years to go from one end to another (width). It contains 386 galaxies in it. Virgo SC contains about 100 galaxy groups and lies in the center of about 10m SC's. Discovered in 2014, **Lanikea Super cluster** is about 520 million light years in width and contains 100,000 galaxies in it. Our Milky Way galaxy is just one of them and like a tiny dot in it. It is the home of our solar system. The MW galaxy is located within a Local group which is a cluster of more than 54 galaxies including our own. Astronomers have also discovered a colossal structure in the universe named 'Quipu' after an Incan measuring system. Spanning 1.3 billion light years, it dwarfs our Milky way galaxy by a factor of 13,000. It may however break apart into smaller units over time.

Whirlpool Galaxy contains 80 billion stars. Its Diameter is 60,000 LYs
Milky Way Galaxy 250 billion stars Diameter 100,000 LYs
Hoag's Object 250 billion stars Diameter 121,000 LYs
Cartwheel Galaxy 300 billion stars Diameter 130,000 LYs
Pinwheel Galaxy 800 billion stars, Diameter 185,000 LYs
Andromeda Galaxy 1 trillion stars Diameter 220,000 LYs
Tadpole Galaxy 800 billion stars, Diameter 220,000 LYs
Caldwell 30 Galaxy 1 trillion stars, Diameter 370,000 LYs
NGC 6872 2 trillion stars , Diameter 522,000 LYs
Malin 13 trillion stars, Diameter 650,000 LYs
NGC 262,15 trillion stars, Diameter 2,600,000 LYs
IC1101, 100 trillion stars, Diameter 5,800,000 LYs

JWST spotted a chain of 20 galaxies, dubbed as Cosmic Vine in 2023, which stretches 13 million LYs across and dates back to just 3 billion years after the Big Bang, challenging models of early galaxy clustering.

Pin-wheel galaxy has about a trillion stars. It is about 70% larger than the Milky Way galaxy at a diameter of about 170,000 lightyears. It is located at 21 million light years from Earth in the constellation of Ursa Major. NASA recently showed the image of a spiral galaxy with yellow, red, purple and blue stars at the center and along its spiral arms. The blue stars at the end of the spiral arms are fading into the darkness of outer space.

Akyoneus is an elliptical galaxy and lies about 3 billion LYs away from us. Its mass is 400 times the mass of our sun. It is 16.3 m LYs in length. 100 million Milky Way can fit into Akyoneus. Farthest galaxy in the constellation of Lynx. Contains 2 trillion galaxies. IC1101 is one of the largest galaxies. 6 million LYS across (takes 9m billion years to cross it) and has 100 trillion stars in it.

Alpha-zuben-el -genubi is a bright star about 75.8 LYs from the earth in the constellation of Libra. Alpha-zuben is a two star system. In Vishaka naksatra, there are four stars. It is said that Baba told there is developed life on that star and in planet of Ashwin in the constellation of Aeries. In comparison, Alpha Centauri is only 4 LYs away from Earth. There is an earth-like planet called Proxima B which is orbiting the nearest star to the Sun in the Alpha-Centauri multi-star system.

K2-18-B is a Hycean exo-planet discovered by JWST. It is 120 LYs away from us and may possess life friendly conditions- presence of water, methane, CO2, di-methyl-sulphide.
NGC4423 is a galaxy that lies about 55m LYs away in the constellation of Virgo.

KILONOVA- when two neutron stars collide and merge, they emit more energy in a second what our sun will emit in its entire life span. Produce gamma rays, bursts, sonic booms, gravitational waves, relativistic jets; create heavy metals like gold, platinum, thorium. When two neutrons get close to each other, they spiral around each other at 80,000 times per minute i.e., 1333 times per second.

A **red dwarf star** converts its core hydrogen to helium so slowly that it has an expected life span of over a trillion years. No red dwarf has died so far in the universe. Twinkling stars are usually not planets.

Quasars in the center of active galaxies are the most luminous, powerful and energetic objects known in the universe. JO529-4351 is a “Quasar Galaxy” that has a black hole that can gobble up 370 suns per year i.e., one sun per day. It is the most luminous object ever observed (1980). It has a luminosity of 500 trillion times that of our sun. AGN- means Active Galactic Nucleus- a super massive blackhole. It is 7 LYs in diameter, about 12 billion LYs away from us. In 2019, Hubble discovered its actual luminosity is 11 trillion suns (without lensing). The Pistol Star is also one of

the most luminous stars known. It is 10 million times brighter than our sun. In just 20 seconds, it emits the same energy as emitted by our Sun in a year.

Giant radio sources (GRSs) are likely to be the largest single structures in the universe, with end-to-end extents of millions of light years. They are driven by supermassive black holes with masses ten million to a billion times that of the Sun, residing at the center of the host galaxy. These black holes ionize surrounding matter, developing powerful electromagnetic forces that propel material to the edges, forming jets of hot plasma and huge lobes of radio emission. It is believed that GRSs are the very last stage in the evolution of radio galaxies. Their enormous size makes them interesting for studying the evolution of radio sources and the intergalactic medium. Nevertheless, their detection is difficult due to the bridge emission, which often remains invisible among the two lobes. Low-frequency radio surveys, like TGSS, are more appropriate for searching for these structures than high-frequency ones. Giant Metrewave Radio Telescope, located near Khodad village, about 90 km north of Pune in India is being used to detect these massive structures (GSRs).

A Black Hole wakes up from slumber

The galaxy SDSS1335+0728, located approximately 300 million light-years away in the constellation Virgo, began exhibiting dramatic changes in brightness in late 2019, as detected by the Zwicky Transient Facility. Its core, powered by a black hole one million times the Sun's mass, began radiating intense light across ultraviolet, optical, and infrared wavelengths, and by February 2024, it emitted X-rays, signaling unprecedented activity. This phenomenon, detailed in *Astronomy & Astrophysics*, suggests the black hole started feasting on surrounding gas, transforming the galaxy into one with an active galactic nucleus (AGN).

On July 13,2025 two black holes merged causing blast equal to eight supernovas in a fraction of a second. Cosmic Collision. The new IMBH —intermediate mass black hole is 225 times the size of our sun. It was picked up by the LIGO-Virgo gravitational wave observatories via signal GW231123.

Vera C Rubin Observatory has the largest telescope (largest camera ever built for astronomy) that captures in a single image containing over 10 million galaxies. LSST digital camera that it employs, has an astonishing resolution of 3.2 giga pixels.

MILKY WAY GALAXY AND OUR SOLAR SYSTEM

Milky Way (MW) galaxy is a spiral galaxy and contains 200-400 billion stars. It is 13.63 billion years old. Our sun lies near a small, partial arm called the Orion arm or Orion spur located between the Sagittarius and Perseus arms. Milky way has a diameter of about 200,000 light years. There are at least 3916 solar systems with in the Milky way galaxy. The Orion arm is about 26,000 light years from the center of the MW galaxy. The Orion Nebula is a tumultuous region of dust and gas where thousands of stars are being born. Located 1300 LYs away, it is the nearest area of star formation to Earth. The bright central region is the home of four most

massive stars in the nebula. These stars are called Trapezium because they are arranged in a trapezoid pattern. Sun is older than the Earth but the water molecules on Earth are billions of years older than the sun. Astronomers using ISO have found water vapour in the Orion Nebula.

Milky Way galaxy as a whole is believed to rotate at 270 kms per second (168 miles per second). The Sun takes 225 million years to orbit the Milky Way. It has already completed 20 orbits and has 22 to go before it runs out of fuel and reaches the end of its life. In about 5 billion years, after using up the hydrogen fuel in its core, the Sun will expand into a red giant, possibly engulfing Earth and the other inner planets. It will then shed its outer layers and leave behind a white dwarf—the hot, dense remnant of its stellar life.

The Local Group of galaxies, as a whole, are estimated to be moving at about 630kms/second. In the direction of the constellation Hydra. It is not known to orbit around anything else. [Earth spins on its axis at the equator at about 1600 kms/hour (.46 kms/second). That gives us day and night. Earth goes around the sun at 108,000 kms per hour (29.8 kms/second or 18 miles per second); Sun is orbiting the milky way galaxy at 7,00,000 kms/hour (230 kms/second); Milky way galaxy itself is believed to be moving at 2,500,000 kms/hr (690 kms per second) relative to CMB (Cosmic Microwave Background)]. Some estimate that the milky way galaxy is hurling through space at 2.1 million kms per hour. If we were to mark our position in space at any one moment and return to it in 24 hours, we would be 57.3 m kms away from that spot in the milky way.

Two closest galaxies to Milky Way are: 1) Canis Major Dwarf Galaxy which is 25,000 light years from the sun. 2) Sagittarius Dwarf Elliptical Galaxy which is 70,000 light years from the sun. Our neighbor galaxy is Large and Small Magellenic Cloud. The Large Magellanic Cloud, also called the LMC -- a dwarf galaxy, believed to be 20 times the apparent diameter of the full Moon, has had the majority of its mass blown away due to coming in contact with the Milky Way, which is acting like a 'hairdryer'. Scientists posit that LMC is not in orbit around our galaxy, but is just passing by. However, its closest approach to the much more massive Milky Way has led to most of its spherical halo of gas blown away. Andromeda Galaxy is 2.5 million LYs away. Andromeda galaxy is about 240,000 LYs wide and contains one trillion stars. Triangulum is 2.73 LYs away. It is believed that Andromeda galaxy is moving towards the Milky Way galaxy at the speed of 400,000 kilometers per hour (11.11kms per second). In 4.5 billion years in the future, two may merge into one and the earth may meet its waterloo. Other estimates are that Andromeda galaxy is moving at 120 kms. / second towards Milky Way galaxy.

It takes about 1.3 seconds for the light to reach the moon; 3 minutes to reach Mars; 8 minutes and 20 seconds to reach the Sun from earth.; 32 minutes to reach Jupiter; 500 years to cross the Milky Way vertically; 600 years to reach the Beehive Cluster; 48,000 years to cross the entire galaxy.

Why is the universe always dark when there are so many stars in the sky? Heinrich Olbers paradox. The universe is not static. The age of the observable universe is only 13.8 billion years. The light from the stars farther away is not reaching us. In the early 20th century, astronomer

Hubble discovered the phenomenon of galactic red shift. He observed that all distant galaxies were accelerating away from us. Universe is like an inflating balloon. Space itself might be expanding faster than the speed of light. Dark energy (invisible and mysterious force) is leading to the expansion of the universe.. beyond 46.1 billion light years away, the galaxies are moving farther and faster, beyond the speed of light.. lost to us forever. Expansion of the universe happens only on cosmological scale such as the space between galaxy-clusters. The milky way and andromeda galaxy are not expanding. There is no expansion in the solar system. The gravitational forces are stronger there.

How does fusion produce energy?

Atoms never rest: the hotter they are, the faster they move. In the Sun's core where temperatures reach 15,000,000 °C, hydrogen atoms are in a constant state of agitation. As they collide at very high speeds, the natural electrostatic repulsion that exists between the positive charges of their nuclei is overcome and the atoms fuse. The fusion of light hydrogen atoms produces a heavier element, helium. This energy in the form of photons begins a slow and chaotic journey outward and takes about 17,000 years before it reaches the surface of the sun and then escapes into space at the speed of light. It is estimated that the energy created in the center of the sun takes about 10-100 million years to get out of the sun and then upon exiting, it travels about 93 million miles in 8 minutes and 20 seconds to reach the Earth.
The mass of the resulting helium atom is not the exact sum of the initial atoms, however—some mass has been lost and great amounts of energy have been gained. This is what Einstein's famous formula $E=mc^2$ describes: the tiny bit of lost mass (m), multiplied by the square of the speed of light (c^2), results in a very large figure (E), which is the amount of energy created by a fusion reaction. The Sun is actually not on fire. It is a ball of gas and every second 700 million tons of hydrogen gas gets converted into 695 million tons of helium. When this happens, energy is released as gamma rays, which gets converted to light. So, the Sun emits light and heat, but it is not on fire, because there is no oxygen involved.

LOW, MEDIUM, HIGH & GEO STATIONARY ORBITS

LEO- Low Earth Orbit- space stations
MEO- Medium Earth Orbit – GPS Satellites. Currently, 10,290 satellites remain in the earth's orbit, with nearly 7800 of them are currently operational.
HEO- High Earth Orbit
GEO- Geo Stationary Orbit is about 23,000 miles up.

Electro-magnetic wave spectrum consists of seven types of waves:
1. Radio-waves, which have the longest waves
2. Microwaves are radiations of frequency ranging between 300MHz to 300GHz
3. Infrared- human eyes cannot see it but can detect it as heat.
4. Visible light (vibgyor). Colour with the highest frequency is violet. Red has the lowest energy.
5. Ultra-violet
6. X-rays

7. Gamma rays, have the shortest wave lengths, highest energies and the highest frequencies. Most dangerous to humans and can cause damage by penetrating the skin and harming cells.

For microwaves and radio waves, a home (its walls, glass) is transparent. Glass prevents transmission of heat. Glass blocks UV (ultraviolet).

SPACE TELESCOPES

Hubble Telescope (named after Edwin Hubble) was launched on April 24,1990 and is still operative (expected to do so till 2030-2040). It is currently located 326 miles (525 kms) above Earth's surface in Low-Earth Orbit at an inclination of 28.5 degrees. It has been serviced five times since it was launched and still sending us data. Hubble can see fine details in star-forming nebulae, galaxies, and other cosmic objects. It circles the earth every 96 minutes. It orbits 15 times per day. It was conceived in 1940s and initially called Large Space Telescope. Its original lifespan was expected to be 15 years. 34 years later, it is still providing best resolution in the optical and ultraviolet (UV) wavelength range in the world. Hubble was a joint project of NASA and European Space Agency. Hubble could see objects that were 13.4 billion light years away. The idea of Hubble Telescope came from late Lyman Spitzer. Hubble Telescope was specially designed to see visible light. NASA's Hubble Space Telescope has captured a stunning dance happening in the outer reaches of our Milky Way galaxy.

Arecibo Telescope was built in 1960s in the island of Arecibo, Puerto-rico. Funding by National Science Foundation and US military dropped and telescope went into disrepair. Radio telescope is an echolocator. China has now built even a bigger one, about a mile in circumference (FAST-Five hundred meter Aperture Spherical Telescope) in Guizhou in south west china. Asteroids can be monitored by these radio telescopes. Russia has one too—Galenki RT-70 radio telescope. UK has one called ALMA.

Infra-red telescope was named after Lyman Spitzer and X-Ray telescope named after Chandra (Subrahmanyam Chandrashekhar). **Chandra telescope** lets us see that part of the universe which is unfolding high-energy activity.(x-rays). **Compton telescope** (named after Arthur Compton) specializes in gamma rays and opens up through that window of a particular band of electro-magnetic spectrum. It was followed by Fermi Gamma-Ray Space telescope, launched on June 11,2008 at a cost of 690 million US$.

The **Kepler Space Telescope** is defunct space telescope launched on March 7, 2009 by NASA to discover earth-sized planets (also called exo-planets) orbiting other stars. Named after German astronomer and mathematician, Johannes Kepler (1571-1630), the spacecraft was launched into an earth-trailing helio-centric orbit at a speed of 5.892 km/s at a cost of 550 million US$. The principal investigator was William J Borucki. As of June 2023, the Kepler Space telescope and its follow-up observations detected 2,778 confirmed planets in the circumstellar habitable zones of their host stars. Kepler discovered that planets move in elliptical orbits around the sun and his laws of planetary motion were later used by Isaac Newton to develop his theory of universal gravitation. Among the planets discovered by Kepler telescope, Kepler 452b (discovered in July

2015) is orbiting star 452 and is 1400 light years away in the Cygnus constellation of the Milky Way. The planet is 1.6 times bigger than the earth.

TESS is **Transiting Exoplanet Survey Satellite** is a space telescope for NASA's Explorer Program, designed to search for exo-planets using the transit method in an area 400 times larger than that covered by Kepler mission. It was launched on April 18,2018 and was placed into a highly elliptical 13.70 day orbit around the earth. As of 18 November,2022, 273 confirmed exo-planets discovered by TESS. TESS orbits Earth every 13.7 days. Its closest point to Earth is 67,000 miles or 108,000 kms. Is about triple the distance of geosynchronous orbit where most communications satellites operate. Search for exoplanets continues both in the solar system and beyond.

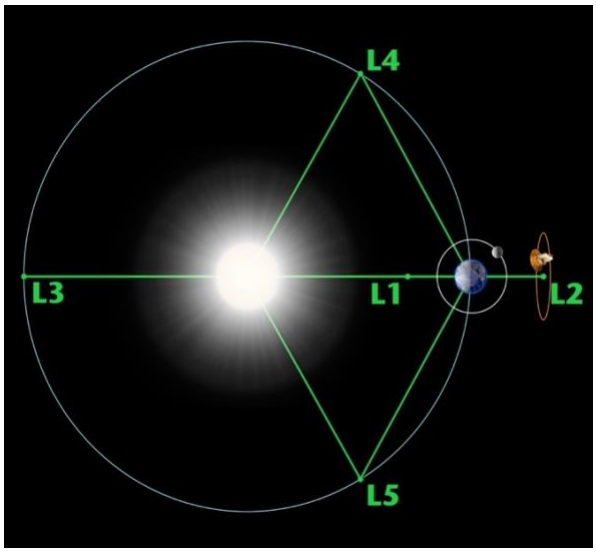
James Webb Space Telescope was launched on December 25,2021 at a cost of 10 billion US $. It allows us to capture images of a star 28 billion light-years away. It also allows us to see what the universe looked like when the first stars and galaxies started to form. It is considered as a successor to Hubble Telescope. Unlike Hubble Space Telescope which orbits the earth, JWST orbits around the sun (not the earth) at 1.5 million kms (920 million miles) away from earth (behind the earth) at the second Lagrange point (L2).

Euclid Telescope is a wide-angle space telescope that was launched on July 1, 2023 by European Space Agency at a cost of 1.4 billion euros. It is expected to remain operational for atleast six years. Its operational orbit will also be at L2 point, at an average distance of 1.5 million kms beyond Earth's orbit. It can see at a distance of 10 billion light years and provide us three dimensional maps of the cosmos we have ever known. It has a 600-megapixel camera to record visible light, a near-infrared spectrometer, and photometer, to determine the redshift of detected galaxies. Euclid was an ancient Greek mathematician. ESA also launched Ariane 6 to launch satellites around GEO Stationary Orbit in 2024.

ESO's **Extremely Large Telescope (ELT**) sits at the peak of Cerro Armazones in Chile. ELT could identify biosignatures (chemical markers of life) on planets in our solar system as well as orbiting Proxima Centauri (the closest star to our Sun) within hours. ELT's giant primary mirror will comprise 798 small mirrors, each equipped with three pistons and 12 edge sensors to maintain its perfect parabolic shape -- collectively measuring about 39.3 metres wide. The dome will reach 22 storeys in length and is expected to be 87 metres in diameter. The 6,000-tonne building will rotate up to a full turn-and-a-half while the telescope inside will spin independently with microscopic precision. It will provide images 16 times sharper than those from the Hubble Space Telescope. ELT is expected to start operations in 2029 with "telescope first light" expected in March 2029, as per the European Organisation for Astronomical Research in the Southern Hemisphere (ESO). Afterwards, the first instruments will be installed and commissioned, leading to "scientific first light" in December 2030.

Lagrange points (named after French Mathematician, Joseph Louis Lagrange (1772), are points in space where the gravitational forces of two large bodies – Sun and earth balance out, creating a region of equilibrium that can be used by a space craft to reduce fuel consumption. According to

scientists, there are five Lagrange points or parking areas where a small object tends to stay put if put there.



VOYAGER 1 and 2

Voyager1 was launched on Sept. 5, 1977. Was sent towards Jupiter and Saturn. Now facing problem in transmitting data. Voyager 1 was the first spacecraft to cross the heliosphere, the boundary where the influences outside our solar system are stronger than those from our Sun. Voyager 1 is the first human-made object to venture into interstellar space. Voyager1 discovered a thin ring around Jupiter and two new Jovian moons: Thebe and Metis. At Saturn, Voyager 1 found five new moons and a new ring called the G-ring. By January 2024, Voyager 1 was about 136 AU (15 billion miles, or 20 billion kilometers) from Earth, the farthest object created by humans, and moving at a velocity of about 38,000 mph (17.0 kilometers/second) relative to the Sun. [An Astronomical Unit (AU) is the average distance between Earth and the Sun, which is about 93 million miles or 150 million kilometers.]. It crossed Jupiter on July 9,1979 Saturn 12 Nov,1980; crossed interstellar space on 14 February,1990 and left Milky way in August 2012. Its lifespan is expected to be 47 years. It takes about 20 hours to establish contact with the earth. In July 2025, it is 25 billion kms (167 astronomical units) away from Earth. Voyager1 is moving at 17 kms per second.

Voyager2 was sent on August 20,1977 to study the outer planets and interstellar space beyond the sun's heliosphere. It crossed Uranus on 25 August,1981 and Neptune in 1989 and crossed interstellar space in November 2018. Voyager2 moves at about 15 kms/sec and is 139 astronomical units (21 billion kms) away from earth

Indian spacecraft landed on the southern polar region of the lunar surface via Chandrayan 3 mission on August 23,2023. Indian Space Observatory in Ladakh is located in Hanle Village. Established in 2001 by the Indian Institute of Astrophysics, it has the second highest optical telescope in the world, at an elevation of 4500 metres.

EXPLORING THE SUN

Sun is oblate spheroid. Its sharp edge is made of gas. Photosphere is the last layer of sun's atmosphere which is the last point of contact with the photons trying to go out of the Sun. The Sun holds 99.8% of the entire solar system's mass. All the planets, asteroids, comets, dust and ice account for the remaining .2%.

Japan was the first to launch a mission to study solar-flares in 1981. On Dec 2,1995 ESA and NASA launched SOHO-Solar Heliosphere Observatory. In Feb 2020, Solar Orbitor was launched by NASA and in 2022, NASA made history with Parker-Solar Probe being the first to fly through Corona, the outer atmosphere of the Sun. It was launched in 2018. In December 2024, it made its closest approach to 3.8 million miles from the sun's surface. (Earth is 93 million miles from the sun). The probe endured temperature of 1400 degrees C and its radiation. It was protected by 11.5 cms (4.5") thick carbon-composite shield but the spacecraft's tactic was to get in and out fast at a speed of 430,000 mph. Probe passed through sun's outer surface-its corona. The surface of the sun is 6000 degrees C but the corona outer atmosphere reaches millions of degrees. Solar wind is the constant stream of charged particles bursting out from the corona.

Solar system orbits the center of the milky way galaxy at about 515,000 mph/828,000 kms per hour (223 kms per second or 155 miles per second). The Sun carries the Earth and races 6.9 billion kms through the Milky Way each year. It takes about 230 million years to complete one orbit around the galactic center which is called 1 galactic year. Sun flips every eleven years (solar cycle) swapping its north and south pole.

Astronauts are majorly exposed to three types of radiation. These include particles trapped in Earth's magnetic field, solar magnetic particles from the Sun and the galactic cosmic rays.

When these particles interact with earth's magnetic field, the sky lights up with dazzling auroras. Understanding the sun- its activity, space weather, the solar wind is important to everyday life on the earth.

India launched Aditya L1 Mission in September,2023 to serve as a solar-observatory in order to monitor coronal mass ejections (CME's) and to study the impact of solar astrophysics on our daily lives. Its instrument VELC (Visible Emission Line Coronagraph) provides data related to CMEs. CMEs are fireballs weighing up to a trillion kilograms and can attain a speed of 3000 kms/per second (1864 miles per second) while travelling. It can head out in any direction and can threaten Earths power grids, communication satellites and other space and earth infrastructures. At its top speed, it would take only 15 hours to cover the 150 m kms Earth-Sun distance.

At the central region of the Sun, known as the core, the temperature can be as high as 15 million degrees Celsius. At this temperature, nuclear fusion takes place which powers the sun. The outer surface of the Sun called Coronosphere has a temperature of about 1 million degrees Celsius and emits solar flares, coronal rain and consists of plasma (soup of charged particles) coming in contact with magnetic field. What we see as light and feel as warmth is the result of a fusion reaction in the core of our Sun: hydrogen nuclei collide, fuse into heavier helium atoms and release tremendous amounts of energy in the process. Each second 1.5 million tons of solar material shoots off the sun travelling at 100 miles per second. Our earth's magnetic field deflects them away. The visible power of the sun (photosphere) is relatively cool (5500 degrees Celsius). Chromosphere has a temperature of about 10000 degrees Celsius. The outer space has a base line temperature of -270 degrees Celsius.

SUN has a diameter of 1.4 million kms. About a million earth's can fit in the Sun. The blemishes on the sun called sun spots on the sun which are almost the size of the earth. Sun spots are in pairs, with a positive and negative charge. So there are magnets on the sun. Sun has an eleven year cycle with solar flares and solar winds. These can short-cut the sattelites , if they headed towards the earth.

Black hole of the Milky Way has an event horizon diameter of 24 m kms. It can contain 5000 suns. The largest black-hole is TON618 with an estimated event horizon diameter of 390 billion kms (21 quadrillion suns can fit into it). Such is the infinite vastness of our cosmos. The solar system has one star (SUN), 8 planets, 5 dwarf planets (Pluto, Ceres, Makemake, Haumea, and Eris); at least 290 moons; more than 1.3 million known asteroids and about 3900 comets. Kuiper Asteroid belt is a flattened zone with these million asteroids between Mars and Jupiter in an area of 600,000 miles. Planets are moving in an area of 4-5 billion miles. First asteroid was discovered in 1801. Four space-crafts including Voyager 1 and 2 went through asteroid belt and nothing happened to them. Average distances between asteroids is about 600,000 miles.

INTERNATIONAL SPACE STATIONS

International Space Station orbits the earth every 90 minutes at the speed of 5 miles per second. A crew of 7 persons have been working on ISS since November, 2000. ISS has 16 modules and is 109 metres (356 feet) across. ISS is the largest manmade satellite. Chinese TSS Tiangong Space Station has three modules.

Earth is just one out of 3.2 trillion planets in our galaxy. The sun is just one of 200 billion stars in the milky way. The milky way is just one of the 2 trillion galaxies in the observable universe. The vastness of the universe is humbling and awe inspiring. We are all interconnected. Our lives, our stories, and the footprints we leave on earth have meaning too, even in the grand expanse of the universe.

PLANETS OF THE SOLAR SYSTEM

Mercury 0^{o} tilt; 57.9 m kms away from the Sun; has a day temperature of 430^{o}C (800^{o} F)/-180^{o}C night time; 88 earth days; spins slowly around its axis and takes 59 earth days to do so. Unlike Earth, it has **no moons** orbiting it.
Venus 177^{o} degrees tilt; 107.81 m kms. away from the Sun; Hottest planet;462^{o}C (864^{o}F);225 earth days.no moon.
Earth 23^{o} degrees tilt; 149.6 m kms (93 million miles) away from the Sun;-25^{o} C to 50^{o} C; 365 days
Mars 25^{o} degrees tilt; 227.9 m kms. away from the Sun; -62^{o} C (-80^{o} F);689 earth days. Two moons.
Jupiter 3^{o} degrees tilt; 778.6 m kms; strongest gravity;-145^{o} C (-234^{o} F);12 earth years; shortest day 9.9 hrs.
Saturn 27^{o} degrees tilt ; 1427 m kms away from the Sun;-180^{o} C (-290^{o} F);30 earth years
Uranus 98^{o} degrees tilt; 2871 m kms.away from the Sun;-198^{o} C (-328^{o} F);84 earth years. Rotating upside down. Retrograde.
Neptune 28^{o} degrees tilt; 4497 m kms. away from the Sun; -200^{o} C (-330^{o} F);185 earth years
Pluto 120^{o} degrees tilt; 5913 m kms. away from the Sun;-225^{o} C (-375^{o} F);248 earth years

It takes Mercury 88 earth days to orbit (rotate/go) around the Sun; Venus takes 225 earth days to do so; Earth takes 365.25 days; Mars takes 687 earth days; Jupiter (is massive; 1300 earths can fit into it) takes 12 years or 4333 earth days; Saturn (764 earths can fit into it; takes 30 earth years; Uranus (63 earths can fit into it; takes 84 earth years; Neptune (can hold 56 earths in it) takes 185 earth days; Pluto takes 248 earth years to go around the sun. Earth moves about 52 million kms daily. 1.3 million earths can fit in to our Sun.

Mercury and Venus have no moons; Earth has one; Mars has two; Jupiter has 95 moons; Saturn has 146 moons; Uranus has 27 moons; Neptune has 14 moons; and Pluto has 5 moons: Total 290

Mercury is just over a third of Earth's width. It has a heavy metal core so it has planet mass. It is supposed to have a thick layer of diamonds hundreds of miles underneath its surface. Planet Mercury is still shrinking and getting more wrinkles as it does.

Jupiter has the shortest day in the solar system (9.9 hours—the time it takes to rotate or spin around once). Jupiter has 95 moons and Europa is the fourth largest of them. It is the sixth closest moon to the planet. It is also the sixth largest moon in the solar system. Unlike Mars, Jupiter's moon Europa has all the requirements of life—energy, chemistry and an abundance of water in its interior ocean. NASA launched its first mission "Europa Clipper" on Oct 14, 2024 to conduct a detailed scientific investigation of Europa. It will take six years to get there. It will not land there but go almost 25 kms close to it and flybys. Six robotic spacecrafts have explored Europa so far. NASA's Voyager2, Galileo orbiter, the Hubble Space telescope etc. NASA's Pioneer 10 and 11 passed through the Jovian system in 1970s and provided the first distant images of Europa. Galileo spacecraft had given us pictures of it at a kilometer scale and provided the closer views of the icy moon and the strongest evidence of an ocean there. ESA's JUICE Mission is also intended to explore Jupiter and its three icy-moons: Europa, Ganymede, and Callisto.

Earth is orbiting the Sun at 30 kms per second or 18.6 miles per second. Sun is orbiting the center of the Milky Way galaxy at 250 kms/s or 155.3 miles/s. Milky Way is moving through the universe at 600kms/s or 373 miles/s.

Earth's weight is 60 trillion tons and spins at 465m/s, racing 52 million kms daily. What unseen force drives it? Where is it headed?

Earth is in such a perfect position that a mere 10% change in the distance from the Sun would result in intense heat capable of roasting us completely and 10% farther away could freeze the entire planet earth; 10% faster rotation would generate furious winds of 300-400 kms per hour ; 10% slower rotation would mean prolonged exposure to the Sun resulting in scorching day of 60-80 degrees Celsius and -40 to -50 degrees at night; Precise rotation of moon prevents the accumulation of stagnant water and contributes to stability of earth's axis. Jupiter occupies a strategic position to provide protective shield to Earth from asteroids, comets and meteorites. Theologians may call it nothing less that the grace of the Supreme Consciousness.

For the ancients, Greek Word for Wanderer is Planites. That is how we get the word Planet from. It is not an accident that we have seven days in a week. Before Copernicus , we thought there were seven planets called Mercury, Venus, Mars, Jupiter, Saturn, Moon and Sun. Anything that moved or 'wandered' against the background of stars was called Planites. Each day of the week is named after those planets.

Sunday- named after the Sun; Monday- Moon day; Tues (planet Mars, Martes) Norse god is a god of War- Norse God is Tues; Wednesday- Mercules, Mirkoles, Mercury- Norse God is Woden ; Thursday is Thor's day (god of hammer and lightening), Jupiter, Jou dee; Friday- Viernes, Venus- goddess of love and beauty, Norse god is Frigga; Saturday is for Saturn. That is how days of the week were linked with the understanding of seven planets at that time. In Hindi- somvar, mangalvar, buddhavar, veervar (brahspativar), shukravar, shanivar, ravivar.

After Copernicus (mid 1500), we lost sun and the moon but got earth as a planet. William Herschell later discovered Planet George (George of the American Revolution).

How long does it take for the earth to spin around its axis. 23 hours 56 minutes and 4 seconds. Sidereal day. We move a degree in a day. Average length of a day is 24 hours, 365 days of the year. The length of the solar day is changing continuously. Sometimes more and sometimes less. Tides caused by moon can slow the rotation of the earth. Seasonal migration of animals, earthquakes, melting of ice glaciers— all contribute to the slowing of the earth rotation. We throw in a leap second once or twice a year to make it up.

The Earth turns around x2
Once a day, every day, the earth turns around.
The moon goes around the earth x2
Once a month, every month, the moon goes around the earth.
The earth goes around the sun x2
Once a year, every year, the earth goes around the sun.

Sun also has a magnetic field and it flips every eleven years. Sun rotates on its axis once a month (once every 27 days). Considering that the sun is million times larger than the earth, that is amazing. Rotation is detected by observing the motion of the sunspots.

Planets that have solid core do not have any magnetic field. Moon, and Mars do not have magnetic fields. North magnetic pole of the earth moves a mile per week. (30-50 miles per year). It is now on its way to Siberia. Geographic pole is not at the same place as the magnetic pole.

Sun gives more of green-yellow light than any other light in visible light spectrum. Sunlight reaches Earth's atmosphere and is scattered in all directions by all the gases and particles in the air. Blue light is scattered more than the other colors because it travels as shorter, smaller waves. That is why we see a blue sky most of the time.

Circumference of earth at the equator is about 25,000 miles (the diameter is 8000 miles). Earth is moving about 18 miles per second in orbit around the sun. Earth is a pear-shaped oblate spheroid. It bulges at the equator about 5 miles. The sun's edges are made of photosphere—where the photons get emitted from the sun otherwise the sun is made of plasma gas.

Karman line defines where the outer space begins in relation to the earth's atmosphere. Theodore von Ka'rma'n was a Hungarian-American engineer and astrophysicist. His rocket science laboratory became NASA's jet Propulsion Laboratory. He assessed the distance from earth at which aircraft could no longer rely on the force of lift for staying aloft to be 84 kms or 52 miles. Below 80 kms gravitational pull within the earth drags the vehicle back down to the planets surface. Blue Origin flies passengers to an altitude of 100 kms (62 miles), while its competitor Virgin Galactic flies past 85 kms (53 miles) and both claim they carry their passengers to outer space. Karman line is to earth what apple skin is to the apple. Beyond the karman line sky is no longer blue but just dark, pitch black. There is no atmosphere beyond the karman line. So, it is incredibly fragile. Rockets when launched go at a speed from zero to 18000 mph going sideways to the orbit of the earth. The operational definition of Space is 100 kms (62 miles) from the surface of the earth.

Celestial Equator is the line in the sky if we extended the equator line to the sky. The path that the sun takes against the background stars around the earth is called the ecliptic path and 23.5 degrees away from the celestial equator. It is because the earth is titled 23.5 degrees. There is also a North Celestial Pole and South Celestial Pole. North Celestial Pole is near to Polaris. It completes a circle in 26000 years.

Longitude is measured by imaginary lines that run around the earth, vertically, up and down, and meet at the North and the South poles. These lines are called meridians. Each meridian measures one arc degree of longitude. Star Map has coordinates (latitude, horizontal lines, become declination is measured in degrees and longitude vertical lines, become the right ascension is measured in hours). Every coordinate we have for the star in the sky has a date. Spherical

Trigonometry was a graduate course in astrophysics that dealt with these matters. Now the computers make it easier to locate the stars position. The position of stars is never constant. The position of sun in the twelve zodiacs is also not constant but shifting constantly. The sun moves approximately about a degree a day. So in 365 days, sun moves the entire circle which has 360 degrees. The sun has actually thirteen constellations, not twelve.

Beyond earth's Atmosphere: Troposphere, Stratosphere, Mesosphere (Meteor Showers), Thermosphere, Exosphere.

LIFE ON EARTH

It takes about 54 elements from the periodic table of elements for life to exist on the earth. Air on the earth is composed of Nitrogen 78.084%, Oxygen 20.946%, Argon .934%, Neon .0018%, Helium .000524%, Methane .0002, Krypton .000114%, Hydrogen .000095%, Nitrous Oxide .00005, Xenon .0000087%. Of the gases present in variable concentrations are: Water Vapour, Ozone, Carbon Dioxide, Sulphur Dioxide and Nitrogen Dioxide. Beyond 90 kms (55 miles) from the earth's surface, lighter gases Hydrogen and Helium are more abundant. In comparison, Mars has 95.52% Carbon Dioxide, 2.6% Nitrogen, 1.9% Argon, .194 Oxygen, .0747%, Carbon Monoxide 03%, Variable Water Vapours. Every minute, more than 6,210 tons of carbon dioxide are released into the Earth's atmosphere.

Life of the sun is about 10 billion years. Age of the solar system is 4.571 billion years. Sun can hold 1.3 million earths in its volume. Sun has gone around the blackhole of milky way galaxy about 18 trips in its entire history. The proto-stellar cloud that composed the sun initially was composed of light elements like 75% hydrogen, 25% helium and .001% of heavy metals. Heavy Metals now at its core. Sun's circumference is 4379 million kms. Earth's circumference is 40,075 kms (24901 miles). Diameter through earths center is 12,756 kms (7926 miles). Moon's circumference is 10,921 kms (6786 miles). 50 moons can fit into the earth. The volume of the earth is 260 billion cubic miles. The volume of the moon is 5.25b cubic miles. Earth is moving @ 18 miles per second around the sun. Moon's orbital speed is 1.022kms per second. ~3683 kms per hour~ 2288 miles per hour. The Sun is 400 times bigger than the Moon in diameter but coincidentally it is also 400 times farther away from the Earth than the Moon is from Earth. This results in the Sun and Moon to appear same size in the Earth sky.

Moon orbits the Earth. It may be more correct to say that Moon and the Earth orbit their common center of gravity, which is 1000 miles beneath the earth's surface. This is a two-body problem. When Jupiter comes around, it might tug too. Then it becomes a three-body problem.

Earth receives 3.7 m exajoules of energy from the Sun annually. All plants use up only 3000 exajoules through photosynthesis. All human activities and industry use about 500 exajoules annually ~equivalent to what earth receives in 10-90 minutes. The amount of free-energy that hits the earth from the sun (called insolation) is about 1400 watts per square meter. (sol is latin for sun).

8000 million years ago, Earth was a ball of glowing gas; 2330 myrs ago, land mass called Gondwana land was formed (while middle portion of the earth was still in liquid state);300 my ago Belamu Pahar (Ananda Nagar hills with snow covered peaks) ; 30 my ago there was a Plutonic earthquake, Himalayas were created along with Bay of Bengal and Arabian Sea. 15% of the landmass and the human population of the earth lies below the Equator.

The closest black hole to the earth is 1560 light years away from it. Temperature at the accretion disc of a black hole is millions of degrees C. There is no black hole near the solar system.

Albedo is the percent of the light energy that gets reflected. It is a very precise measurement of how reflective something is at a given wave-length. Albedo of 100% is the mirror. Albedo of 0% is that all light energy gets absorbed and nothing is reflected (like a black hole). Albedo of 50% means that 50% of the light gets reflected. Albedo of the moon is .1 (moon is basically dark). Earth has an albido of .3 (three times brighter than the moon). Albedo of oceans is also .3.

Sun is older than Earth but the water molecules on Earth are billions of years older than the sun! Astronomers using ISO have found water vapour in the Orion nebula.

Meteors travelling at 10 miles per second are like balls of fire (shooting or falling star) shooting through space..also sometimes called bolides. When not in flight, they are called meteorite. Meteor showers also exist. To protect itself, Hubble telescope/satellite even have a safe mode. Rocky meteorites are also sometimes magnetic. Asteroids estimated to be moving between 20-50 kms per second are risky and therefore being monitored by Planetary Defense Office in each country. Meteor crater in Arizona is about 1 mile across. As we get closer to January 22, 2032, an asteroid moving towards the earth orbit will be more clearly identified. As for now, there is only 1-2% chance of it hitting the earth.

Aerogels are a class of synthetic porous ultralight material derived from a gel, in which the liquid component has been replaced with a gas, without significant collapse of the gel structure. The result is a solid with extremely low density and extremely low thermal conductivity. Aerogels can be made from a variety of chemical compounds such as silica, carbon, alumina, chromia, tin oxide etc. Silica aerogel is a better insulator than carbon or metallic aerogels. Aerogel is the lowest density solid stuff ever. It has highest insulating properties ever known. It is transparent and very brittle. Used by NASA probes to catch particles of the comets and analyze them later. Science's cotton candy like. Volume-filling strands of molecules. Polymer-chains spin up and liquid is evaporated and what is left is transparent solid aerogel.

Indian astronomers, led by Dr Liton Majumdar from NISER, Odisha, have made an exciting discovery, finding a rare solar system called GG Tau A. This system is unique because it has three stars orbiting each other. Located about 489 LYs away, GG Tau A is a young system, estimated to be only 1 to 5 million years old. Using advanced telescopes in Chile, Dr. Majumdar studied the disk of gas and dust around GG Tau A. They found important molecules in extremely cold regions, which are crucial for planet formation. These molecules freeze into tiny

dust particles that eventually grow into planets.GG Tau A shows that planets can also form in complex multi-star environments.

If you cut a hole between any two points on the earth, it would be a 90-minute trip. Gravitation difference cancels the travel distance.

Located 20 light years away, HD20794d is six times the mass of Earth and could harbor liquid water on its surface. It orbits with in the habitable zone of a star similar to our sun, according to findings from the University of Oxford. Another exo-planet discovered is TOI-1846b and is likely also to be water-rich.and estimated to be 7.2 billion years old. This exo-planet has a radius of about 1792 earth radii and is about 4.4 times more massive than our planet. It orbits its host every 3.93 days, and the equilibrium temperature of the planet is estimated to be 568.1K.

SCIENCE FACTS, TIT BITS AND QUOTES

The Big Bang is the prevailing cosmological model that explains the origin and the evolution of the universe. It describes how the universe expanded from an extremely hot, dense state , often described as singularity, to its current size and temperature.

It is possible that you know enough about a subject to know that you are right but, not enough about the subject to know that you are wrong. ---Neil deGrasse Tyson.

In 1931, Charlie Chaplin and Einstein met in Los Angeles during the premiere of the film City Lights. Einstein said to Charlie Chaplin: “What I most admire about your art is your universality. You don’t say a word, yet the world understands you.” And Charlie Chaplin replied: “True. But your glory is even greater. The whole world admires you, even though they don’t understand a word of what you say.”

In an average adult, there are 7 octillion atoms ~ 10,000 times more atoms than stars in the entire observable universe.

When your education limits your imagination, it is called Indoctrination. – Nicola Tesla.

The illiterate of the 21st century will not be those who cannot read or write, but those who cannot learn, unlearn and relearn. – Alvin Toffler

The fact that jelly fish has survived for 650 million years without having brains is good news for stupid people.

We only know 10% of what the brain is used for? (Not that we only use 10% of the brainpower)

Xenobots are less than 1mm in length..a new class of programmable organisms..containing 3000 living cells ..are biodegradable.

Sodium is a soft metal but poisonous and explodes when it comes in contact with water and Chlorine is a deadly gas. Yet, when both Sodium and Chloride come together, we get Table-Salt.

Oxygen promotes combustion but when it comes in contact with Hydrogen, which is an explosive gas, it becomes water, which can put out fire.

Gravity is the curvature of space and time. Matter tells space how to curve and space tells matter how to move.

We are as amazing or as ordinary as every star in the sky.

There are four fundamental particles in the universe—photons, electrons, quarks and neutrinos.

Every electron that we have ever measured is identical in its properties. Anti-matter particle of electron is positron.

Isaac Newton was the first to discover that white light is composed of colours. Prism experiment. William Herschell comes along later and asks the question if different colours have different temperatures and through his experiment, he discovers 'infrared light'. Newton discovered the laws of gravity around 1687. On a plaque under his statue in a chapel at the University of Cambridge, it says in Latin meaning: "Of all humans, there is no greater intellect".

In one centimeter of lower colon, there are more microbes than the total number of humans that have ever been born. You are to microbes simply a dark anaerobic vessel of fecal matter. You exist because they do your digesting and they exist because you provide them a vessel for that to happen.

It took 300,000 years for the world population to reach 1 billion but only 218 years to reach 8 billion today. In 1804 (1 billion); 1927 (2 billion);1960 (3 billion); 1974 (4 billion);1987 (5 billion);1999 (6 billion);2011 (7 billion) and 2024 (8 billion). [Now, almost decade increases the world population by a billion.]

Salt and Water never burns. Iron, lead, aluminum, ….do not burn.. get hot but do not burn. Burning is combustion in the presence of oxygen. What are all the things that burn have in common? Carbon molecules which contains chemical energy. Soot is carbon. life is carbon based.

Sound moves through air at 600-700 miles/hour. ~ 10 miles/minute..1/6th mile/second; a mile every six seconds.

There is a lot going on in the frontiers of particle physics.. quantum computing, quantum information, black holes, gravitational astronomy.. collide protons in 16 miles collider..11000

times a second. Rutherford started it.. in 1913. Nucleus is made of protons and neutrons.. quarks. Higgs boson.

Cecilia Payne discovered what stars are made of. She not only discovered the composition of the sun but also laid the foundation for the study of variable stars. It was she who said that hydrogen is the most abundant element in the universe. She was the first woman to be promoted as professor at Harvard University. Her contributions to astronomy are monumental yet she is not celebrated with the respect and recognition she deserves. She died in 1979.

What is great about science is that its objective truths work whether or not we believe in them.

Balls are elastic collisions and so they bounce. Inelastic collisions do not bounce. It absorbs its own kinetic energy.

Astronomically large numbers: **Million** (city population)..**Billion** (number of people on the earth, Go around the earth 200 times plus go and back from earth to moon ten times; **Trillion** second is between 31^{st} and 32^{nd} year)..**Quadrillion**.(estimated number of sounds and words ever uttered by humans on this earth)..**Quintillion**, Grains of Sand on a beach; stars in the universe; **Sextillion**..,There are more molecules of water in a glass of water than the glasses of volumes of water in the entire world's oceans.

There is no angel without a past and no devil without a future.

Nobody can go back and start a new beginning, but anyone can start today and make a new ending. – Maria Robinson.

Planck Length is the smallest length that we can measure. [$1.61625502 \times 10^{-35}$ meters]. In quantum physics, all matter is vibrating at all times. Any particle existing less than the Planck time would be a virtual black hole due to the time-energy uncertainty principle.

Nature creates elements up to 94 and we have now created more till 118. There are discreet number of protons in the nucleus of the atom and that is how we know if there are gaps in the periodic table of elements. One of the last elements to be discovered was Technitium- man made.

Helium-3 is a light, stable isotope of helium with two protons and one neutron. It was discovered in 1939 and found more on the moon than the earth. Nuclear fusion using helium -3 has long been viewed as a desirable future energy source.

Among the pessimistic theories about the end of the universe are: Heat Trap theory; Ripping Apart Theory; Big Crunch; Cycling Universe and the Vacuum Decay. May happen 10^{100} years later. It is all a speculation because we do not know how dark matter and energy may behave and how Higgs field may change. Baba indicated that there will never be a thermal death of the universe.

Pacific Ocean is huge. It covers a third of the entire earth and almost half (46%) of the total water on the earth. Entire land of the earth could fit into it and still have room for 23 Texases. It has three deep trenches. Mariana trench, Philippines trench and Tonga Trench. Entire Himalayas plus two Burj Khalifas, and one and a half Eifel tower could fit in it.

Milky way has residual gas and therefore it can make stellar nursery. No gas in elliptical galaxies and there are no stars to be made there. Gas cloud condenses to make new stars. But in spiral galaxies like Milky way, there is residual gas and so it can make new stars.

The Mystery of Oumuamua: first inter-stellar visitor from outside the solar system in October 2017 and gone by December 2017. It followed a hyperbolic orbit.

The Y chromosome contains SRY gene, which initiates male development in human embryos. Geneticists believe the SRY gene helps transform undifferentiated tissue (tissue without a specific purpose) into testicles. However, over millions of years, the Y has been shedding genes. If this continues, the last of its remaining 55 genes could vanish in 11 million years. Humans could evolve a new sex-determining gene as it has happened in case of rodents in E. Europe and Japan. That might be the beginning of a new human species.

Neil deGrasse Tyson- "I am driven by two main philosophies, know more about today than I knew yesterday. And lessen the suffering of others. You'd be surprised how far that gets you. "

The most successful people in life recognize, that in life they create their own love, they manufacture their own meaning, they generate their own motivation. – Neil deGrasse Tyson

Margaret Mead: Helping someone through difficulty is the starting point of civilization. [A broken femur that healed is the proof that someone took the time to stay with the one who fell, heal the injury, put the person to safety, and cared for him until he recovered.]

The trouble with the world is that the stupid are cocksure and the intelligent are full of doubt- Bertrand Russell

Human behavior flows from three main sources: desire, emotion and knowledge- Plato.

A truth can walk naked but a lie always needs to be dressed- Khalil Gibran

A truly educated person is one who knows how much they do not know- Mortimer J Adler

Math knowledge of ancients: 1. Zero 2. Negative numbers 3. Pythagorian theorem 4. Binary system 5. Decimal system 6. Infinite series 7. Algebra early form 8. Fibonacci sequence.

17 Fundamental Particles of the Standard model of Physics: Six Quarks; Electron, Three electron like particles- Muon, Tao; three neutrinos; Three Forces: electronic magnetic force, weak and the strong force; Higgs Boson.

Bosons are force mitigating particles. Higgs field is a space which is filled it with mass. Even massless particles when they pass through higgs field, it creates drag force which endows it with mass.

“We can talk about the ethical foundations of science but we cannot talk about the scientific foundations of ethics (Einstein).” Science does not give answers to ethical questions. Science does not tell us the purpose of things or ethics (should we or should we not?) of things. Science does not answer: Where do I come from? Where am I going? Why am I here?

LASER (**L**ight **A**mplification by the **S**imulated **E**mission of the **R**adiation) Green laser is two or three times brighter than the red laser light because retina is more sensitive to green light than the red light. Laser can go 60 miles into the sky and point out stars at night.

Bar code is one dimension. QR Code is two-dimensional version of bar code. Laser can read the codes.

Ms. Hypatia was born in Alexandria, Egypt born in 370 AD. Scientist, astronomer, mathematician, physicist. Neoplatonic philosophy school. Was murdered in 415 AD by Cyril.

Earth goes around the sun in 365 days. Not quite. Six hours less. [5 hours and 48 minutes to be exact]. Every four years a day is put back to correct (minimize) the difference. Every century, we accumulate another day and we need to take out one leap year. And every 400 years, again a leap year is put back to correct the difference again.

Plasma Propulsion Rockets could be the next generation rockets. Not using them to launch, though. Exhaust velocity is very high. Magnetic energy is being converted into kinetic energy.

Our brains process information @ 10 bits per second. Our sensory systems receive information @billion bits per second which is 100 million times faster than our conscious thought processes. Humans usually process one thought at a time.

Williamina Paton Steven Fleming was born in Dundee, Scotland in 1857 and moved to USA and worked as a housekeeper for Edward Pickering, director of Harvard College Observatory. She began working in the Observatory in 1881 and identified over 10,000 stars, discovered ten novas, 59 nebulae, and 310 variable stars. She developed a system of classifying stars by their spectra which is still prevalent today. She was later named a honorary member of Royal Astronomical Society and illuminated the path for women who dreamed of exploring the cosmos.

Metric system started in French and implemented in 1789 (French Revolution).

Money metric.. Photograph metric..16mm film.. medicines.. cc cubic centimeter. Dosages. Nutrition labels.. gms..metric bottles of soft drinks.. litres.

Federico Faggin— “New Quantum Science Proves Consciousness Generates Reality.”

Longitudes is (Vertical lines on the world map measured in hours and minutes)-distance between lines is maximum at the equator; and Latitudes in degrees is Horizontal lines-distance between lines is the same. Circumference of the earth is 24,901 miles. [24901/360/60=1.15282407] One knot is 60 minutes (1.15 miles/hour); Old sailing ships would throw out a log with a rope tied to it. There were knots so far apart in the rope, they would count how many knots went over the gun Wales. In a certain amount of time you give them the speed they were travelling! That's why it's called knots. Nautical miles is about 2025 yards vs. a statute mile is 1760 yards. When travelling on the ocean and measuring speed in knots, your distance for a "mile" is also longer vs. travelling on land.

1803 John Dalton (1766-1844) -Solid Sphere Model -Dalton proposed that all matter is made of indivisible particles called atoms. Atoms of same element are identical in mass and properties. Compounds form when atoms of different elements combine in fixed ratios. Laid the groundwork for modern chemistry.

1904 J J Thomson (1856-1940) Model-After discovering the electron, Thomson proposed that atoms are made of a positively charged substance with negatively charged electrons scattered with in it.

1911- Ernest Rutherford Model Nuclear Model – Introduced the concept of a nucleus. Electrons orbit around the nucleus.

1913 Niel Bohr's Model- explained why atoms emit light in specific colours. Introduced the concept of quantized energy levels. Electrons can jump to higher levels when energy is absorbed and fall back down when energy is released as light.

1926 Ervin Schödinger's Model- Quantum Mechanical Model (Electron Cloud Model)- Described the behavior of electrons as waves, not particles in orbits. The exact location and speed of an electron cannot be known at the same time (Heisenberg Uncertainty principle).

In 2015, researchers working on the Borexino experiment in Italy estimated that the average lifespan of an electron is an almost unimaginable 66,000 yottayears—that's 66,000 followed by 24 zeros (6.6×10^{28} years). If the entire history of the universe (13.8 billion years) were just one second, an electron would outlive it by millions of centuries. Electrons are fundamental particles that carry a negative electric charge. According to the standard model of particle physics, they are considered stable and do not decay. The Borexino experiment aimed to detect any potential decay of electrons into lighter particles, such as photons and neutrinos. However, after analyzing data from over a year, no evidence of electron decay was found. If electrons were to decay, it would violate the principle of charge conservation, a fundamental concept in physics. This finding underscores the remarkable stability of fundamental particles and the enduring nature of the universe's building blocks.

A Glimpse of what happens every second in the universe:

1. 4 million tons of the Sun disappears. The sun fuses about 600 million tons of hydrogen each second, converting around 4 million tons of it into energy via Einstein's $E=mc^{2}$. That energy lights and warms our entire solar system.
2. On average, 30 supernovae occur every second in the observable univers, seeding space with heavy metals.
3.About 100 billion neutrinos-mostly from the Sun- pass through our body, completely unnoticed.
4. The universe expands by 74 kilometers per second per megaparsec. Galaxies are racing away from each other due to cosmic expansion. The farther they are, the faster they move. That's Hubble's law in action.

Before the age of 26, Isaac Newton had already discovered the laws of motion, universal law of gravitation, invented differential and integral calculus, laws of optics that showed that white light consisted of different colours.

Microscope and telescope were invented almost 400 years ago. It was magnified in the dawn of 20^{th} century.

Satyendra Nath Bose was born on January 1,1894 in Calcutta. Bose excelled in mathematics and physics from early on and became a lecturer at the University of Dhaka. In 1924, he made a breakthrough: deriving Planck's law of blackbody radiation using a novel statistical method for indistinguishable particles- without classical assumptions. This became the foundation of Bose-Einstein statistics. Bose sent his paper to Einstein, who immediately recognized its importance, translated it into German, and got it published. Einstein extended the idea to atoms, predicting a new state of matter now known as BEC-Bose Einstein Condensate. Bosons are particles with integer spin that follow Bose-Einstein statistics, meaning they can occupy the same quantum state simultaneously. This contrasts with fermions, which avoid one another due to Pauli exclusion principle (spin ½, 3/2, etc.) The first Bose-Einstein condensate was created experimentally in 1995, a milestone that earned a 2001 Nobel Prize. Bose's insight transformed our understanding of quantum mechanics by recognizing particle indistinguishability and its statistical consequences. It paved the way for technologies like lasers, super-conductors, quantum fluids, and contributed to quantum computing research. Bose's elegant yet ground breaking 1924 argument about indistinguishable particles led to a new class -bosons-central to the laws of nature. His partnership with Einstein brought forth BEC-a quantum state still at the heart of modern physics. Today, bosons- from photons to the Higgs—remain vital in shaping our universe and driving cutting-edge technologies.

Quantum Entanglement (way European robin migrates from Scandinavia to Mediterranean every autumn while responding to sensing weak earth's magnetic field. Inside the retina of robin is a protein called cryptochrome which is light sensitive -pair of electrons who are quantum entangled).

Photosynthesis utilizes quantum coherence. Thus, Quantum mechanics have a role in biology.

There are four fundamental particles in the universe. Photons, Electrons, Quarks and Neutrinos. Atoms in Greek means Indivisible. But now we know that atoms are divisible.

Galileo saw the universe with a telescope as no one had ever seen before. He noticed the sun spots and saw the mountains, valleys and craters on the moon. He noticed that Venus goes through phases and that Jupiter had stars of its own. He discovered the Jovian moons- Io, Europa, Ganymede and Callisto. He wrote up his results in a book titled 'Siderius Nuncius"- The Starry Messenger.

Put your hand on a hot stove for a minute and it seems like an hour. Sit with a pretty girl for an hour, and it seems like a minute. That's relativity. -Albert Einstein

Milankovitch Cycles: Three cycles that affect the earth's axis.. Change in the tilt; Ice Age cycles; Precession 26,000 year cycle ; Astronomical cycles; Change in the shape of the earth elliptical, not circular.

"God is in every receding pocket of scientific ignorance." Was there something before nothing? God of the gaps.

NATURE SECRETS, TIT BITS and QUOTES

Creature with most powerful sting:

Bullet Ant: It is a large, black or reddish-brown ant with a prominent stinger. It is the most powerful sting of any insect. Rated 4 on the Schmidt-Sting-Pain Index. Entomologist Justin Schmidt described the pain as "pure, intense, brilliant" pain. The pain can last up to 12 hours. The venom of the bullet-ant contains a neuro-toxin that binds to sodium channels in nerve cells, causing them to open more easily and stay open. The sting is not fatal and not known to cause any permanent damage. These ants live primarily in the humid low-land rainforests of Central and South America.

Amazing Facts about The Amazon River

Second longest river after Nile; 6400 kilometers long; contains about 20% of the world's river water. It pumps 200,000 liters of fresh water into the ocean every second. The river's width is 1-6.2 miles during dry season and over 30 miles wide in some parts during the rainy season. The Amazon basin is the largest drainage system in the world by volume and basin area. The Amazon is home to a wide range of wild life, including pink dolphins, piranhas, macaws, snakes, amphibians etc. It was originally known as Maranon River. Francis de Orellana, the first Spanish explorer renamed it, after he encountered the indigenous Pira-tapuya people.

Congo River is 4200 kms long. 2nd largest in Africa, passes equator twice. 7th largest in the world. Discharges 14 million litres per second water into the Atlantic Ocean. 2nd most voluminous river after Amazon. At places, it is 220 meters deep.

Most dangerous birds

1. Cassowary is considered the reincarnation of dianosour.
2. Ostrich 8ft. 150 kgs.
3. Martial Eagle can see its prey from 3 kms.
4. Bearded Vulture ..can eats bones of animals
5. Barred Owl
6. Harpy Eagle..sky's tiger
7. Australian Mapei
8. Hooded Pitohui – full of poisonous toxins..

A new born blue whale is enormous. It can weigh around 2800-3000 kgs.(6170-6610 lbs.) and measure up to 8 metres (26 feet) in length, roughly the length of 5 adult humans stacked head to toe. This huge baby is equivalent in weight to about 1000 human newborns.

Fast Moving Animals

African Wild Dog 50 kms per hour
Kangaroo 60 kms/hr
Horses 50-75kms/hr
Blue Wildbeast 90 kms/hr
Springbok & Lion 80 kms/hr
Blackbuck. 80-90kms/hr
Cheetah 100-120 kms/hr.
Pronghorn Antelop 100kms/hr.

Fastest flying bird

Peregrine Falcon 320 kms/hr

Most Beautiful Birds

Golden Pheasant; Blue jay; Flamingo; Resplendent Quetzal; Wood Duck; Indian Peacock; Scarlet Macaw; Mute Swan; Kingfisher; Atlantic Puffin.

Different Varieties of Beautiful Peacocks

1.Indian Green Peacock- India, SE Asia
2.Yellow Pea Fowl- Thailand, Myanmar
3.Bronze Peacock – Asia, Africa
4.Opel Peacock- Australia, Europe breeding programs
5.Rainbow Peacock – genetic cross breeding
6.Red Peacock – south America, rare
7.White Peacock – genetic variation of Indian variety, srilanka
8.Great Argus Peacock -Malaysia, Indonesia 2 metres length

Crows, highly intelligent birds, possess remarkable facial recognition abilities, allowing them to remember human faces for years, potentially decades. This cognitive skill, studies in corvids like crows and ravens, stems from their advanced brain structures, particularly the nidopallium caudolaterale, akin to the human prefrontal cortex. Crows can also communicate threat information within their social groups, forming a “crow community” awareness.

Fish has fat eye ball lens and that is why it can see underwater very clearly. Goggles do the same for humans under water.

Nature creates elements up to 94 and we have now created more till 118. There are discreet number of protons in the nucleus of the atom and that is how we know if there are gaps in the periodic table of elements. One of the last elements to be discovered was Technitium- man made.

Unique Trees in the world

1.Silver Birch Tree, N Europe
2.Great Banyan tree- 4.6 acres spread out; West Bengal
3.Wisteria -purple flowers; fragrant flowers
4.Silk Cotton tree ..ancor watt ..roots long
5.President tree-sicoaia tree..3200 years old,247' high
6.Cherry Blossom tree of Japan
7.Jacotibaca=jam,wine..grape like fruits
8.Baobab tree Madagascar..stores water thousands 30 metres tall medicine
9.Rainbow Euclayptus- Australia, SE Asia;paper
10. Socotra Dragon tree- yemen red fluid, thousands yrs old

The fastest animal-Cheetah; Peregrine Falcon, Marlin
The tallest animal-Giraffe
The Biggest animal-Blue Whale
The smallest animal- The fairy fly
The most sluggish- sloth
The Poisonous- Box jelly fish
The Most beautiful- Peacock
The Most Aggressive- The Hippopotamus
The Neatest- European Honey bee
The Dirtiest Animal- Pigs

Most Poisonous Creatures

Harpey eagle – most dangerous ; 40-50kms speed;
Vampire Bats (chamgadar) –
Poison dart frog
Vampire fish- amazon;
Black caiman- crocodile; 355 kgs. amazon rain forest
Bull shark- 300 kgs. 11 feet
Bullet ant

Elephants remain in the womb for 22 months. Elephants sleep only 2-3 hours per day and sleep while standing. Their memory is sharp and remember their acquaintances for many years.. They make infra sound which humans cannot hear and use this capability to communicate with other elephants. When elephant dies, the group of elephants remain around the dead elephant, touch its body and sometimes even cover it with leaves. Adult Elephants trunk serves like a human arm.

It can also store about 9 litres of water in it. Elephants trunk contains more than 40,000 muscles (humans have about 600 muscles) and that gives it unique functional characteristics. Elephant can swim 6-8 hrs at a time @ 2-3 kms/hr. Its lungs are also bigger. On land, elephant can run at 30-40 kms per hour.

Diphylleia Grayi is a flower plant in Northern Japan and forests of China. It looks normal but its petals become transparent when they come in contact with water.

Nepenthes rajah is the largest known carnivorous plant on Earth. Native to the mountains of Borneo, this plant belongs to the Nepenthaceae family. It grows in nutrient-poor soils, so it evolved a special way to survive; by eating animals. Its huge pitcher-shaped leaves can hold up to 2 liters of water. These pitchers trap insects, spiders, and even small vertebrates like frogs and mice. The inside of the pitcher is slippery and filled with digestive fluids. Once prey falls in, it cannot escape. It developed this ability through millions of years of evolution. In harsh environments, plants that could digest animals had a better chance to survive. Over time, the pitchers became larger and more efficient. This plant is not dangerous to human beings, but it plays an important role in eco-system. It helps control insect populations and provides shelter for some animals.

The nine species who play a vital role in the eco-system:
1. Bees-are pollinating insects and vitally important to the life-cycles of some plant species.
2. Sharks-are apex-predators in oceans and regulate the population of some species.
3. Fungi-release nutrients back in to the food chain wnen plants and animals die.
4. Bats-their bug-munching habits help regulate insect population.
5. Earthworms-aerate the soils and enrich it with much needed organics and minerals from their excrement.
6. Phytoplankton – in oceans produce more oxygen than all forests combined.
7. Ants- recycling activities in eco-systems.
8. Coral Reefs -provide sheltered lagoons behind them and act as a foundation for complex food webs.
9. Cyanobacteria – are nitrogen fixers

“The remarkable discovery made in 2020 of an extensive eight-mile-long canvas in Amazon region featuring intricate depictions of Ice Age creatures such as sloths and mastodons is a significant contribution to our understanding of prehistoric life. This artwork, dating back over 12,600 years, not only showcases the artistic capabilities of early humans but also offers invaluable insights into the fauna that once roamed the Earth. The presence of such ancient creations within the vast Amazon rainforest prompts further inquiry into the potential for uncovering additional historical artifacts and secrets that may lie hidden within this enigmatic ecosystem. The rich biodiversity and dense vegetation of the Amazon could very well conceal more wonders yet to be discovered, underscoring the importance of ongoing research and exploration in this area.” – Melas Orani

ANCIENT ROCK ART

The massive rock art site is located in Serranía de la Lindosa, in the Colombian Amazon region near the Guayabero River. This area lies on the edge of the Amazon rainforest.

When Discovered:
Although local communities have long known about some of the art, an international team of archaeologists more formally documented and publicized the find around late 2020. Research continued in subsequent years to study the art and its context in greater detail.

Age & Cultural Significance
Some of the paintings date back more than 12,000 years, placing them in the late Pleistocene era, when the last Ice Age was receding. The dating is based on archaeological context, soil analysis, and correlation with artifacts and charcoal found at nearby excavation sites.

Artistic Depictions:
The rock art includes handprints, geometric patterns, and detailed depictions of animals such as fish, turtles, birds, monkeys, tapirs, and what appear to be Ice Age megafauna (e.g., giant sloths or mastodons). Human figures and hunting scenes also appear.

Cultural Insights:
The variety of subjects suggests these ancient people had a close relationship with the local fauna and environment. The art may represent mythological or spiritual beliefs, daily life, successful hunts, or significant ritual practices.

Scale & "8-Mile Canvas" Nickname
Extent of the Rock Art:
The paintings stretch along multiple rock faces in a series of cliff overhangs and vertical walls, spanning a distance of roughly eight miles (about 13 kilometers) in total. This is why it's often referred to as an "8-mile canvas."

Preservation Factors:
Many of the paintings remain in relatively good condition thanks to the rock's natural shelter from rain and extreme weather. However, ongoing research and conservation efforts are crucial to protect the art from environmental damage and human interference.

Research & Future Study
Archaeologists continue excavations in surrounding areas, searching for tools, food remains, and evidence of habitation that can clarify how these communities lived and why they created such extensive art.

Significance for South American Prehistory:
The find contributes to a better understanding of the peopling of South America—the timing of human arrival, cultural practices, and how early inhabitants adapted to Amazonian ecosystems.

Challenges:
Dense rainforest, remote locations, and sometimes challenging security conditions (due to historical conflict in parts of Colombia) make extensive fieldwork difficult. International support and collaboration with local communities are vital for protection and research.

Tourist & Cultural Impact
Although the region is remote, interest in "archaeological tourism" has grown. Balancing public access with preservation will be an ongoing effort for local authorities, indigenous communities, and archaeologists.

Key Takeaways
The "8-mile canvas" in the Colombian Amazon is one of the largest-known collections of prehistoric rock art in the world, featuring thousands of paintings from over 12,000 years ago. Its discovery sheds light on the lifestyle, environment, and artistic expression of some of the earliest inhabitants of the Amazon. Continued research is expected to offer deeper insights into South American prehistory, while conservation efforts aim to protect the rock art from environmental and human-related risks. This extraordinary ancient "gallery" provides a vivid window into the lives and imaginations of prehistoric communities—reminding us how long humans have inhabited and documented the Amazon's rich landscape.

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The west African lungfish can survive up to three years without food or water. When rivers dry out, it buries itself in mud and forms a protective mucus cocoon to breathe, making it one of nature's most extreme survivors.

Bats (Myotis lucifugus..little brown bat) can consume up to 1000 mosquito-sized insects (moths, mosquitoes, beetles) in an hour. They play a crucial role in sustaining healthy eco-systems).

Humans have highest brain to body-weight ratio among mammals only. Magpai has a higher brain to body weight ratio than humans. Some species of ants have the highest brain to body weight ratio (almost 15% of their body weight is the brain).

It is possible that you know enough about a subject to know that you are right but, not enough about the subject to know that you are wrong. ---Neil deGrasse Tyson.

In 1931, Charlie Chaplin and Einstein met in Los Angeles during the premiere of the film City Lights. Einstein said to Charlie Chaplin: "What I most admire about your art is your universality. You don't say a word, yet the world understands you." And Charlie Chaplin replied: "True. But your glory is even greater. The whole world admires you, even though they don't understand a word of what you say."

In an average adult, there are 7 octillion atoms ~ 10,000 times more atoms than stars in the entire observable universe.

When the power of love overcomes the love of power, the world will know Peace. -Jimi Hendrix

When your education limits your imagination, it is called Indoctrination. – Nicola Tesla.

The illiterate of the 21st century will not be those who cannot read or write, but those who cannot learn, unlearn and relearn. – Alvin Toffler

The fact that jelly fish has survived for 650 million years without having brains is good news for stupid people.

We only know 10% of what the brain is used for? (Not that we only use 10% of the brainpower)

Xenobots are less than 1mm in length..a new class of programmable organisms..containing 3000 living cells ..are biodegradable.

Sodium is a soft metal but poisonous and explodes when it comes in contact with water and Chlorine is a deadly gas. Yet, when both Sodium and Chloride come together, we get Table-Salt.

Oxygen promotes combustion but when it comes in contact with Hydrogen, which is an explosive gas. Together, Hydrogen and Oxygen becomes water, which can then put out fire.

Gravity is the curvature of space and time. Matter tells space how to curve and space tells matter how to move.

Either write something worth reading or do something worth writing -Benjamin Franklin.

Aerogels are a class of synthetic porous ultralight material derived from a gel, in which the liquid component has been replaced with a gas, without significant collapse of the gel structure. The result is a solid with extremely low density and extremely low thermal conductivity. Aerogels can be made from a variety of chemical compounds such as silica, carbon, alumina, chromia, tin oxide etc. Silica aerogel is a better insulator than carbon or metallic aerogels. Aerogel is the lowest density solid stuff ever. It has highest insulating properties ever known. It is transparent and very brittle. Used by NASA probes to catch particles of the comets and analyze them later. Science's cotton candy like. Volume-filling strands of molecules. Polymer-chains spin up and liquid is evaporated and what is left is transparent solid aerogel.

We are as amazing or as ordinary as every star in the sky.

Every electron that we have ever measured is identical in its properties. Anti-matter particle of electron is positron.

Isaac Newton was the first to discover that white light is composed of colours. Prism experiment. William Herschell comes along later and asks the question if different colours have different temperatures and through his experiment, he discovers 'infrared light'. Newton discovered the laws of gravity around 1687. On a plaque under his statue in a chapel at the University of Cambridge, it says in Latin meaning: "Of all humans, there is no greater intellect".

Every minute, more than 6,210 tons of carbon dioxide are released into the Earth's atmosphere.

In one centimeter of lower colon, there are more microbes than the total number of humans that have ever been born. You are to microbes simply a dark anaerobic vessel of fecal matter. You exist because they do your digesting and they exist because you provide them a vessel for that to happen.

It took 300,000 years for the world population to reach 1 billion but only 218 years to reach 8 billion today. In 1804 (1 billion); 1927 (2 billion);1960 (3 billion); 1974 (4 billion);1987 (5 billion);1999 (6 billion);2011 (7 billion) and 2024 (8 billion). [Now, almost decade increases the world population by a billion.]

Salt and Water never burns. Iron, lead, aluminum, ….do not burn.. get hot but do not burn. Burning is combustion in the presence of oxygen. What are all the things that burn have in common? Carbon molecules which contains chemical energy. Soot is carbon. life is carbon based.

Sound moves through air at 600-700 miles/hour. ~ 10 miles/minute..1/6th mile/second; a mile every six seconds.

There is a lot going on in the frontiers of particle physics.. quantum computing, quantum information, black holes, gravitational astronomy..collide protons in 16 miles collider..11000 times a second. Rutherford started it.. in 1913. Nucleus is made of protons and neutrons.. quarks. Higgs boson.

Cecilia Payne discovered what stars are made of. She not only discovered the composition of the sun but also laid the foundation for the study of variable stars. It was she who said that hydrogen is the most abundant element in the universe. She was the first woman to be promoted as professor at Harvard University. Her contributions to astronomy are monumental yet she is not celebrated with the respect and recognition she deserves. She died in 1979.

What is great about science is that its objective truths work whether or not we believe in them.

Balls are elastic collisions and so they bounce. Inelastic collisions do not bounce. It absorbs its own kinetic energy.

Astronomically large numbers: **Million** (city population)..**Billion** (number of people on the earth, Go around the earth 200 times plus go and back from earth to moon ten times; **Trillion** second is between 31st and 32nd year)..**Quadrillion**.(estimated number of sounds and words ever uttered by humans on this earth)..**Quintillion**, Grains of Sand on a beach; stars in the universe; **Sextillion**..,There are more molecules of water in a glass of water than the glasses of volumes of water in the entire world's oceans.

Dark energy (invisible and mysterious force) is leading to the expansion of the universe..beyond 46.1 billion light years away, the galaxies are moving farther and faster , beyond the speed of light..lost to us forever.

There is no angel without a past and no devil without a future.

Nobody can go back and start a new beginning, but anyone can start today and make a new ending. – Maria Robinson.

Planck Length is the smallest length that we can measure. [$1.61625502 \times 10^{-35}$ meters]. In quantum physics, all matter is vibrating at all times. Any particle existing less than the Planck time would be a virtual black hole due to the time-energy uncertainty principle.

Initially, Oxford and Cambridge used to be Bible schools (seminaries) in early 1600s. The first non-religious department was started in 1631 (Arabic Studies). Cambridge started Arabic Studies Dept. in 1632 and began translating Arabic books into Latin. Department of Mathematics was established in Oxford in 1666. Department of Physics was established in 1671. Dept. of Chemistry was opened in 1693.- Dr Zulfiqar Ali Shah

One of the oldest universities in the Muslim world was started by Fatima Al-Fihriyyah in 859 AD in Fez, Morocco with the inheritance from her husband and father. She had moved from Kairouan in Libya to Morocco at a young age. Al-Qarawiyyin University educated hundreds of thousands including famous historian Ibn Khaldun and Mohammed Abdelktin el-Khattabi. It was here that the early form of algebra was developed.

MRI is Magnetic Resonance Imaging that is used in the medical field is based on principles of physics called Nuclear Magnetic Resonance.

Do not die from something stupid. Avoid what reduces our healthy life span. Body is good at hiding diseases.

Brazil is the 5th largest country in area with a population of 220 miliion people. It covers 48% of South America.

The Tara River Canyon, located in Montenegro, is the deepest canyon in Europe, reaching up to 1300 metres deep. It is part of Durmitor National Park and is protected as a UNESCO World Heritage Site.

The Alps are the highest and most extensive mountain range system that stretches about 1200 kms. across and are found in the following countries: Austria (28.7% of the range's area); Italia (27.2%); France (21.4%); Switzerland (13.2%); Germany (5.8%); Slovenia (3.6%); Liechtenstein (0.8%) and Monaco (0.001%). Alp gets its name from the Swiss/German word Alpen, which is the plural form of Alp, meaning a mountain pasture. The Rocky Mountains are a much larger

mountain range than the Swiss Alps, covering more area and extending all the way from Canada to New Mexico. Alps are much older than Himalayas.

1994 Yahoo; 1998 Google; 2003 Skype; 2004 Facebook; 2005 You-tube ;2006 Twitter; 2009 Whatsapp; 2010 Instagram; 2011 Wechat (China); 2011 Snapchat USA) ;

Paincavati- vat (banyan indica), shyalmali (silk cotton), neem (margosa indica), asvastha (fig tree) and Bel (Wood apple).

Why is it difficult to go beyond 12.2 kms under the earth?

I have traveled to about 3.5 kilometers beneath the surface at the Western Deeps mine in South Africa. The problems of going deeper were obvious.

We had to descend three separate shafts to reach the face, which took over an hour. Shafts are limited to about 2,500 meters depth because the weight of the wire rope holding the man-carrying cage exceeds the strength of the rope. Even to reach that depth it is necessary to have a tapered rope.

The rock temperature was over 60 degrees C (140 degrees F). The mine pumped thousands of tons of slurried ice down the mine every day in order to maintain the air temperatures at workable levels.

Such depths are only possible because the rock surrounding the gold reefs is very strong. However the rock is subject to immense stress. Sometimes it breaks explosively in a 'rockburst'. A month earlier a rockburst had killed three miners.

The workings at the Mponeng shaft at that mine have now reached 4.2 kilometers below the surface.

The Russians drilled (not dug) a deeper hole at the Kola Superdeep hole. They had planned to go to 15 kilometers but stopped at 12.26 kilometers because the rock at 180 degrees C was hotter than expected. In a 23 cm (9 inch) wide hole it is not possible to pump down enough drilling fluid to keep the drill head cool.

Drilling so deep is tedious and expensive. Pulling out the 600 or so drill pipes in the string is very time-consuming every time the drill head needs replacing. Maintaining as straight a hole as possible when it is 12,000 meters long but only 23 centimeters wide is difficult. Too many turns and kinks in the hole cause unsustainable friction and forces on the drill pipe.

The temperature of the rock causes difficulties with drill fluid chemistry and degrades the strength of the drilling head and the drill pipe.

The same problem of supporting the weight of the pipe occurs and the hole must be tapered.

In short, a hole to a depth of 12 kilometers pushes drilling technology to the limit. In 1994 the Germans drilled a hole to 9100 meters using a rig. Someone suggested using a Tunnel Boring Machine (TBM) to open a spiral ramp down which vehicles could be driven. TBMs used to make spiral ramps are quite common in mining, but there are many practical difficulties using them beyond about 1500 metre depth. Typically 10% is about the steepest grade that can be achieved. To get to 12 kilometre depth, you would need to excavate a 120 kilometre long tunnel. Many kilometres of this would be through rock at temperatures above 100 degrees C. Disposing of the huge heat load would be difficult. Then the rock at 12 kilometres depth is under a pressure of about 45,000 psi. At these pressures it will break into the cavity, perhaps explosively. Of course TBMs typically have a support system immediately behind them. However necessarily there is an unsupported section. The face itself cannot be supported because the TBM is digging into it. Behind the face there is some length which is not yet supported.

Lake Baikal is considered the deepest lake in the world. Located in Siberia, Russia, it has a maximum depth of 1,642 meters. It has a staggering volume of 23,615 cubic kilometers of water, which accounts for about 20% of the world's defrosted freshwater reserve, more than all of the Great Lakes of North America combined. This ancient lake, over 25 million years old, is located in a rift valley formed by the Baikal Rift Zone, where tectonic activity continuously pulls from the Earth's crust.

Some facts about bamboo

1.Fast Growth: Bamboo is the fastest-growing plant in the world. It has been recorded at growing 47.6 inches in 24 hours. Some species can even grow over a meter per day under optimal conditions. A new bamboo shoot reaches its full height in less than a year.
2. Oxygen Release: A grove of bamboo releases 35% more oxygen than any other tree out there.
3. Carbon Dioxide Absorption: Bamboo absorbs carbon dioxide at a rate of 17 tons per hectare every year. It can act as a valuable carbon sink given how fast the plant grows.
4. No Fertilizer Required: Bamboo doesn’t need fertilizer to grow. It can self-mulch by dropping its leaves and use the nutrients to grow.
5. Drought Resistance: Bamboos are drought-tolerant plants. They can grow in the desert.
6. Wood Replacement: Bamboos can be harvested in 3-5 years compared to the 20-30 years of most softwood trees.
7. Building Material: Bamboo is incredibly strong and sturdy. It has been used as support for concrete as well as scaffolding, bridges, and houses.
8. Soil Stability: Bamboo has a wide network of underground roots and rhizomes that prevent soil erosion.

9. Natural Air Conditioner: Bamboo cools the air surrounding it by up to 8 degrees in the summer.
10. Invasiveness: Some species of bamboo, especially 'running' bamboos, can be invasive due to their extensive root systems, which allow them to spread rapidly. However, not all species are invasive, and with proper management, the environmental impact can be minimized.
Among all the shapes, for given amount of material, the round shape (sphere) contains the largest volume. Largest number who can come together close to the center is a sphere. Ceres became a dwarf planet. Pluto satisfied that criterion of roundness to be a planet but did not meet the other criterion. Contest of forces at all times. In the universe, forces conspire to be round shape. Rocks do not have gravity to overcome the odd shape. Everything is trying to get to the center of gravity.

Onions in the gas that it releases when it is cut has Sulphur atoms..it mixes with tears with any moisture in the eyes..it creates sulphuric acid and irritates the eyes and makes you cry. .

Distance makes the heart grow fonder. What is the force which gets stronger with distance. Like the stretched rubber band.. a spring; a rocking chair.. harmonic motion; oscillator.

Major Earthquakes

1. Philippines.	8.0 on Richter Scale.	1976.	**DeathToll**	4791 Pacific Ring of Fire (PRF)
2. Sothern MEXICO	8.0.	1985.	45,000	
3. italia.	7.1	1908	200,000. (Eurasian Plate)	
4. USA.	7.9.	1906.	3000+	
5. Peru	7.9	1970	70,000	
6. Japan.	8.6.	1498,2011.	31,000/20,000. (PRF)	
7. Turkey.	7.5.	115AD	260,000	
8. Iran	7.9	856 AD	200,000	
9. Indonesia.	9.1-9.3	2004	227,898. Tsunami	
10. W.China.	7.5	1976	3,00,000+	
11. Myanamar/Thai.	7.7	2025	1600	

India, Ethiopia, Armenia, Chile, Nepal, …….

Dopamine is throughout the brain. It does different things at different places. Dopamine is a feel-good hormone. The degradation of cells in the basal ganglia leads to Parkinson and effects our gait. Music or auditory stimulation can activate the family of neurons in the basal ganglia. Connectome is parallel to genome and relates to how neurons connect with each other.

Bone flutes have been discovered to exist 40,000-60,000 years old. Music encodes language. Prabhat Samgiita is one such example.

Wealth held by the top 1% of the population in Asian countries

India 42.1%; China 32.3%; Qatar 29.0%; Kuwait 28.1%; South Korea 24.0%; Turkey 23.4%; UAE 22.8%; S.Arabia 22.8%; Pakistan 22.4%; Indonesia 22.3%; Bahrain 21.8%; Philippines 21.0%; Thailand 20.2%.
USA 31.0%

After all is said and done, there is usually more said than done. Well done is better than well-said. Actions speak louder than words. It is not important just to dream and think or say what what we do or have done. Between the great things we cannot do and the little things that we did not do, there is the danger of doing nothing. Little things when done solves more problems than the thought 'something must be done'. We should utilize the gifts that God has given us to serve others. Amen.

About social media apps

Yahoo 1994; Google 1998; Skype 2003-2025; Facebook 2004; You tube 2005; Twitter 2006; Whatsapp 2009; Instagram 2010; Snapchat 2011; Wechat 2011;

Cows open their eyes immediately after birth; dogs after two hours; cats after six hours; (humans after they get married. Hahahaha!)

We learn 10% from what we read; 20% from what we hear; 30% from what we see; 50% from what we see and hear; 70% from what we discuss; 80% from what we experience; and 95% from what we teach others.

0-1 Infant; 103 Toddler; 3-5 Pre-schooler; 6-12 Child; 13-19 teenager; 20-35 Yound Adult; 36-55 Middle Aged; 56-75 Senior; 76-..Elderly.

Basic Definitions in Classical Physics:

Force: A push or pull on an object that can change its state of motion or shape.

Work: Work is said to be done when a force is applied on an object and the object moves in the direction of the applied force.

Power: The rate of doing work or the rate at which energy is transferred.

Speed: The distance travelled per unit time.

Velocity: The displacement per unit time in a specific direction.

Acceleration: The rate of change of velocity with time.

Momentum: The product of mass and velocity of an object.

Inertia: The tendency of a body to resist a change in its state of motion or rest.

Newton's First law: A body remains at rest or in uniform motion unless unless acted upon by an external force.

Newton's Second Law: The rate of change of momentum of a body is directly proportional to the applied force.

Newtons Third Law of Motion: For every action, there is an equal and opposite reaction.

Gravitational Potential Energy: Energy possessed by a body due to its position in a gravitational field.

Kinetic Energy: Energy possessed by a body due to its motion.

Density: Mass per unit volume of a substance.

AVOID: 1. Complaints; 2.Never Compare yourself with anyone;3. STOP Blame game; 4. Getting Up Late (Indiscipline); 5. Success comes when work is started and it is finished. No results without finish.

Spices

Cumin, coriander, turmeric, ajwain, black pepper, black salt, ginger, green chilli, asfoetida (hing), curry patta, tamarind (imli), nutmeg, cinnamon, cloves, elaichi (cardamom), aamchur (mango-powder)

Creatures and their life spans

1. Boher Whale. 200 years
2. Greenland Shark. 400 years
3. Akuhag claim. 500 years
4. Fresh water pearl masel. 250 years
5. Tube worm 300 years
6. Tortoise kathchua 200-250 years
7. Antartic Spunge. 10,000-15000 years
8. Teutro tupsey dohni jelly fish. Never dies.

Organoid (organ-like) is a clump of cells that are cultured in a dish in a three dimensional structure that models parts or features of a stem cell. Any cell that is differentiated can be brought back to the original stem cells. Stem cells can renew themselves and can stay for a long time. They are fed glucose, amino acids and lipids (fats)..Cells have a signature, genes that it expresses. Cortical cells are inverted pyramid like. Excitary (that causes epilepsy) and inhibitory neurons in the cortex. Inhibitory neurons are in the deep side of the brain. They collaborate.

Madame Marie Sklodowska Curie was a Polish scientist. Discovered Radium and Polonium. Later one element was named in her honour- Curium. Got two nobel prizes- one she shared with her husband in 1903. Curie Museum in Paris. 45 women in her network. She was the first woman to teach at the University of Paris. She died of aplastic anemia.. her body could not create red blood cells. Every X-ray technician owes a debt to her as she created their job. Women in Warsaw were not allowed to attend the university even in late 1800's.

Octopuses are not just intelligent —they are biologically extraordinary. In a ground breaking 2015 study published in Nature, scientists from the University of Chicago and Okinawa Institute of Science and Technology sequenced the full genome of the California two spot octopus. This species has 33000 genes—10000 more than humans. These creatures can solve puzzles, use tools and escape enclosures with uncanny intelligence. They have large brains, closed circulatory systems, eyes with irises and lenses all evolved independently. They can edit their own RNA. Their suckers can taste and their camouflage skin changes textures and color in milliseconds.

Ginger contains magnesium and zinc which helps in blood circulation. It has many other health benefits.

Lyre bird can make diverse sounds like the human baby crying, gun shots, police siren etc.

USA spent $10 trillion (1000 billion $) during the cold war for military build-up.

Uranium comes in three varieties: Uranium 234, 235 and 238. They all have 92 protons, rest are neutrons (called isotopes). Nucleus is positively charged and so are protons. So they are repelled as they go close to nucleus. Neutrons are neutral. They are unstable and go right into the nucleus. Uranium 235 alone has the property of chain reaction that is used for making atomic bomb and nuclear energy. It all depends on the purity of the uranium. U235 needs to be siphoned off from U238 through a centrifuge process. Anything that is radioactive, it emits energy.

Ten largest empires in world history

1. British (33.7 million sq. kms)
2. Mongol (24.0 million sq.kms)
3.Russian (22.8)
4.Spanish (19.0)
5.French (12.0)
6. Qing Dynasty (12.0)
7. Umayyad Caliphate (11.1)
8. Portuguese (10.4)
9. Ottoman (5.0)
10. Roman (5.02)