



HYPERLOOP 2019

Science and Technology & Gk

CONSOLIDATED CURRENT AFFAIRS FOR ESE 2019

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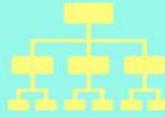
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1. SCIENCE AND TECHNOLOGY

1.1 Recent Developments

1.1.1 SI Units redefined

- The international system of measurements has been overhauled with new definitions based on universal constants
- The most closely watched change was the revision to the kilo, the measurement of mass.
- The countries unanimously approved updates to three other key units-
 - The kelvin for temperature
 - The ampere for electrical current
 - The mole for the amount of a substance.

The Changes

- The kilogram, ampere, kelvin and mole will be defined by setting exact numerical values for the Planck constant (h), the elementary electric charge (e), the Boltzmann constant (k), and the Avogadro constant (N_A), respectively.
- For more than a decade, metrologists have been working on two different experiments meant to relate mass to a universal concept called Planck's constant, which links the energy of a photon to its frequency.
- One experiment, dubbed the Avogadro Project aimed to create a perfect silicon crystal to calculate the exact number of atoms of silicon in a sphere equal in weight to Le Grand K — by using a single isotope, silicon-28
- Another effort began with two incredibly precise scales known as Kibble or watt balances. Kibble balances use magnets, a coil of wire and precise electrical monitoring equipment to tease out the relationship between electrical force and physical weight. The experiment is meant to define Planck's constant to within eight decimal places.

Previous and New definitions:

- The kilogram was equal to the mass of the international prototype of the kilogram called Grand K.
- New Definition of mass: Define mass in terms of the Planck constant. It is defined by taking the fixed numerical value of the Planck constant h to be $6.62607015 \times 10^{-34}$ when expressed in the unit J·s, which is equal to $\text{kg} \cdot \text{m}^2 \cdot \text{s}^{-1}$, where the metre and the second are defined in terms of c and $\Delta\nu_{\text{Cs}}$.
- The ampere was that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 m apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.
- New definition: It is defined by taking the fixed numerical value of the elementary charge e to be $1.602176634 \times 10^{-19}$ when expressed in the unit C, which is equal to A·s, where the second is defined in terms of $\Delta\nu_{\text{Cs}}$.
- The kelvin, unit of thermodynamic temperature, was $1/273.16$ of the thermodynamic temperature of the triple point of water.

- New definition: It is defined by taking the fixed numerical value of the Boltzmann constant k to be 1.380649×10^{-23} when expressed in the unit $\text{J}\cdot\text{K}^{-1}$, which is equal to $\text{kg}\cdot\text{m}^2\cdot\text{s}^{-2}\cdot\text{K}^{-1}$, where the kilogram, metre and second are defined in terms of h , c and $\Delta\nu_{\text{Cs}}$.
- The mole was the amount of substance of a system that contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12.
- New definition: One mole contains exactly $6.02214076 \times 10^{23}$ elementary entities. This number is the fixed numerical value of the Avogadro constant, N_A , when expressed in the unit mol^{-1} and is called the Avogadro number.

Le Grand K

The kilogram was defined as equal to the mass of the international prototype of the kilogram called Le Grand K. The mass of a platinum-iridium lump is kept in a secured vault on the outskirts of Paris.

Impact of Changes:

- The change will have no discernible impact for most people.
- The kilos and grams won't change in supermarkets.

Advantages:

- The formula based measurement will not deteriorate with time – as they are unaffected by dust, decay with time or physical damage.
- It also is expected to be more accurate when measuring very, very small or very, very large masses.
- Accurately calculate an exact kilo without having to measure one lump of metal against another.

Systems of measurements

- The history of system of measurements stretch back across more than 5,000 years of human history, based on common concepts like the length of an arm or the weight of a seed etc.
- Modern measurements strive for more universality.

SI Units

- All SI measurements are meant to be based in universal constants, like the speed of light or the oscillations of an atom of cesium-133.
- In 1960, the metre was redefined in terms of the wavelength of light from a specified source, making it derivable from universal natural phenomena, leaving the prototype kilogram as the only artefact upon which the SI unit definitions depend.
- With the recent redefinition, the SI is for the first time wholly derivable from natural phenomena.

1.1.2 World's smallest optical gyroscope

- Optical gyroscope is a device that helps vehicles, drones and handheld electronic devices know their orientation in 3D space.
- The new gyroscope is 500 times smaller than the current best device.



- It can detect phase shifts that are 30 times smaller than the best systems currently available.
- The new gyroscope achieves improved performance by using a new technique called “reciprocal sensitivity enhancement.”
- It improves the signal-to-noise ratio in the system and enables the integration of the optical gyroscope on to a chip smaller than a grain of rice.

The Sagnac effect:

- Normal optical gyroscopes measure the rate of rotation by exploiting a relativistic phenomenon known as the Sagnac effect
- The Sagnac effect relies on detecting a difference between the two beams as they travel in opposite directions, it is considered nonreciprocal.
- With the development of optic gyroscopes based on the Sagnac effect, the bulky mechanical gyroscope was replaced by optical gyroscopes in many modern inertial navigation systems.

1.1.3 India's Neutrino project

The India-based Neutrino Observatory (INO) project has got a fresh lease of life with the Ministry of Environment and Forests (MoEF) taking it up as a special case and granting it environmental clearance to set up the lab in Bodi West hills.

Highlights:

- The panel was informed that there was no scope for radioactivity and leaching of water and these have been explained to the courts.
- The project proponents clarified that studies showed there would be no impact of blasting on any habitation in the vicinity.

The committee stipulated specific conditions, of which two are key for the project to take off.

1. The consent to establish and operate to be obtained from the Tamil Nadu Pollution Control Board (TNPCB).
2. The INO team has to obtain the necessary forest and National Board for Wildlife clearances as per law

About INO:

- India-based Neutrino Observatory (INO) is a particle physics research project under construction to primarily study atmospheric neutrinos
- It is situated in a deep cave under Ino Peak near Theni, Tamil Nadu, India.
- This project is notable in that it is anticipated to provide a precise measurement of neutrino mixing parameters.
- The project is a multi-institute collaboration and one of the biggest experimental particle physics projects undertaken in India.

1.1.4 LIGO Project

The Environment Ministry has allowed scientists to test the suitability of land in Maharashtra to build Laser Interferometer Gravitational Wave Observatory (LIGO) project

About LIGO:

- The project involves constructing a network of L-shaped arms, each four kilometres long, which can detect even the faintest ripples from cosmic explosions millions of light years away.

- The LIGO project operates three gravitational-wave (GW) detectors. Two are at Hanford in the State of Washington, north-western USA, and one is at Livingston in Louisiana, south-eastern USA.
- The LIGO-India project is an international collaboration between the LIGO Laboratory and three lead institutions in the LIGO-India consortium: Institute of Plasma Research, Gandhinagar; IUCAA, Pune; and Raja Ramanna Centre for Advanced Technology, Indore
- The LIGO lab would provide the complete design and all the key detector components.
- Indian scientists would provide the infrastructure to install the detector and it would be operated jointly by LIGO-India and the LIGO-Lab.
- The project, piloted by the Department of Atomic Energy (DAE) and Department of Science and Technology (DST)

1.1.5 Devasthal Optical Telescope

- It is India's largest ground-based optical telescope
- The telescope is the product of an Indo-Belgian collaborative effort.
- It is going to be operated by the Aryabhata Research Institute of Observational Sciences (ARIES), an autonomous research body under the Department of Science and Technology.
- It will also be Asia's largest ground-based optical telescope, succeeding the Vainu Bappu Observatory in Kavalur, Tamil Nadu.



1.1.6 World's second oldest rock is from Odisha

- Scientists have found in the rock a grain of magmatic zircon (a mineral that contains traces of radioactive isotopes) that is an estimated 4,240 million years old.
- The Singhbhum rock was formed from magma.
- The study suggests that the Earth's primitive crust was mafic (rich in iron and magnesium).

Earth BioGenome Project

Scientists launched a vast Earth BioGenome Project on to map the genetic code of all 1.5 million known species of complex life on earth .

About the project:

- They expect to read the full DNA sequence of all the world's eukaryotic species — organisms whose cells have a nucleus enclosed by membranes. These are animals, plants, fungi and protozoa, which encompass all of life except simple microbes (bacteria and archaea).
- Participating institutions aim to raise the required funds from governments, foundations and charities.

Significance of the project:

- The blueprints for all living species will be a tremendous resource for new discoveries.
- It helps for understanding the rules of life, how evolution works, new approaches for the conservation of rare and endangered species, and

- Provide new resources for researchers in agricultural and medical fields.

1.2 Space Explorations

1.2.1 MAVEN spacecraft of NASA

MAVEN (Mars Atmosphere and Volatile Evolution) spacecraft of NASA has beamed back a selfie to mark its four years of orbiting Mars.

About MAVEN:

- The MAVEN mission of NASA was launched on November 18, 2013, and went into Mars orbit on September 21, 2014.
- Its objective was to explore the Martian upper atmosphere and its influence on climate.
- MAVEN has completed its primary mission in November 2015 and has been operating in an extended mission with continuous investigation of Mars upper atmosphere.

MAVEN Findings:

- Found compelling evidence that the loss of atmosphere to space has been a major driver of climate change on Mars.
- It demonstrated that majority of the carbon dioxide (CO₂) on Mars has been lost to space and there is not enough left to support life on the planet by warming it.
- It also discovered two new types of Martian auroras i.e., Diffuse aurora and Proton aurora.

1.2.2 The Chandra X-Ray Observatory

NASA's the Chandra X-Ray Observatory has been observing the universe in high-energy light since 1999. Now it has entered a protective 'safe mode'.

Safety measures:

- During the safe mode, the observatory is put into a safe configuration, critical hardware is swapped to back-up units, the spacecraft points so that the solar panels get maximum sunlight, and the mirrors point away from the Sun.

About Chandra X-Ray Observatory:

- The Chandra X-Ray Observatory is a NASA telescope that looks at black holes, quasars, supernovas, and the like – all sources of high energy in the universe.
- It shows a side of the cosmos that is invisible to the human eye.
- The telescope is named after the Nobel Prize-winning Indian-American astrophysicist Subrahmanyan Chandrasekhar.

1.2.3 BepiColombo mission

The mission is to determine if the Mercury contains water.

Highlights:

- The four-tonne spacecraft will be launched into orbit by Esa's rocket Ariane 5 from the European spaceport
- BepiColombo is a joint mission between ESA and the Japan Aerospace Exploration Agency (JAXA), executed under ESA
- The mission comprises two spacecraft:
 - a. The Mercury Planetary Orbiter (MPO)-study the surface and internal composition of the planet

- b. The Mercury Magnetospheric Orbiter (MMO)-will study Mercury's magnetosphere
- A mission can provide to enhance our understanding of the planet itself as well as the formation of our Solar System

1.2.4 Chandrayaan-II Mission/GSLV-F10

Indian Space Research Organisation (ISRO) is planning to deploy a rover on the lunar surface through Chandrayaan-2 mission.

Highlights:

- It is India's second mission to the Moon is a totally indigenous mission comprising of an Orbiter, Lander and Rover.
- The instruments on Rover will conduct in-situ analysis of elements such as Na, Mg, Al, Si, etc; in the vicinity of landing site.
- The mission will carry a six-wheeled Rover which will move around the landing site in semi-autonomous mode as decided by the ground commands.
- The instruments on the rover will observe the lunar surface and send back data, which will be useful for analysis of the lunar soil.
- The payloads will collect scientific information on lunar topography, mineralogy, elemental abundance, lunar exosphere and signatures of hydroxyl and water-ice.

1.2.5 Chandrayaan-1 data confirms presence of ice on Moon

Scientists have found frozen water deposits in the darkest and coldest parts of the Moon's polar regions using data from the Chandrayaan-1 spacecraft that was launched by India 10 years ago, NASA reported.

Highlights:

- water would possibly be accessible as a resource for future expeditions to explore and stay on the Moon,
- It provides potentially easier to access than the water detected beneath the Moon's surface.
- The ice deposits are patchily distributed and could possibly be ancient
- At the southern pole, most of the ice is concentrated at lunar craters, while the northern pole's ice is more widely, but sparsely spread.

About Chandrayaan-1:

- Launched in 2008 by the Indian Space Research Organisation (ISRO)
- It was uniquely equipped to confirm the presence of solid ice on the Moon.

1.2.6 Reusable Launch Vehicle

India became the fifth nation to successfully conduct the flight demonstration of a scaled down version of a winged-body reusable launch vehicle.

Highlights:

- Validating the critical technologies such as autonomous navigation, guidance & control, reusable thermal protection system and re-entry mission management.
- It represented the first baby step towards the realisation of a future fully reusable Two Stage To Orbit (TSTO) space transportation system
- A fully reusable Two Stage To Orbit (TSTO) Launch Vehicle, that can launch payloads to Low Earth Orbit with 15 times reusability, is expected to reduce the launch cost by approximately 50 – 60% when compared to that of an expendable launch vehicle.

Benefits:

- Environment friendly
- Low cost on launching the vehicles
- Saves time
- Facilitates more launches

1.2.7 India’s first Indian human mission- Gaganyaan

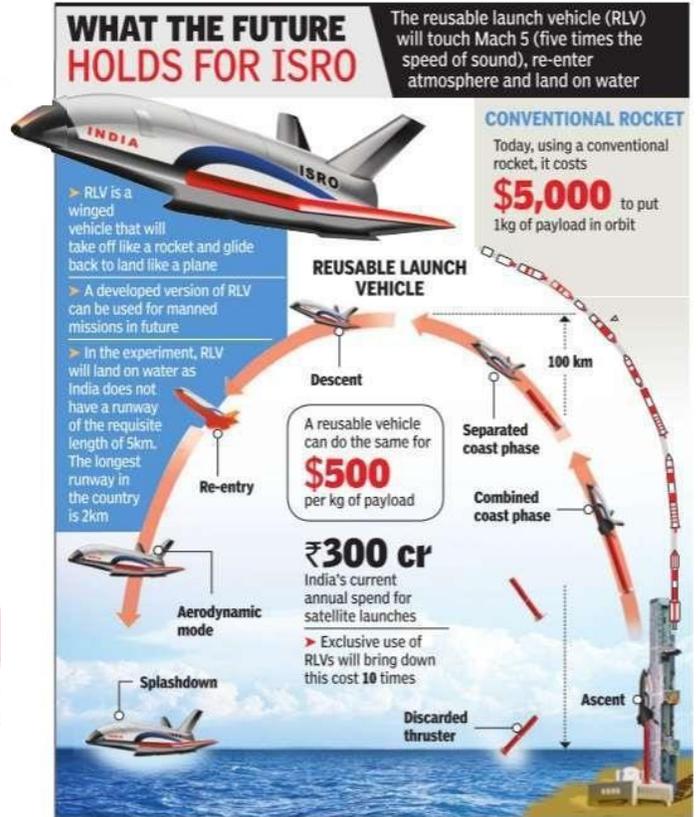
India’s first Indian human mission will be launched by Indian Space Research Organisation (ISRO) by 2022.

Key Facts:

- This is the most ambitious space programme undertaken by ISRO till date and is essential as it will give a big boost to the Science and Technology development within the country
- ISRO has developed some critical technologies like re-entry mission capability, crew escape system, crew module configuration, thermal protection system, deceleration and floatation system, sub-systems of life support system etc. required for this programme.
- GSLV Mk-III launch vehicle, which has the necessary payload capability for this mission, will be used to launch Gaganyaan.
- The mission will aim to send a three-member crew to space for a period of five to seven days

The objectives of the Mission:

- Enhancement of science and technology levels in the country
- A national project involving several institutes, academia and industry
- Improvement of industrial growth
- Inspiring youth
- Development of technology for social benefits



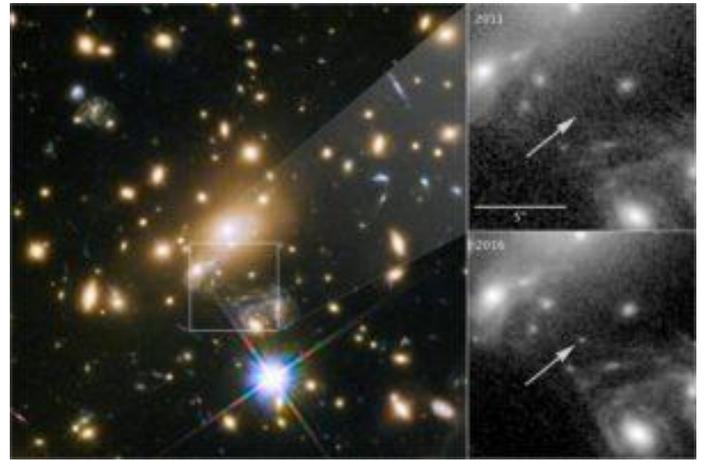
- Improving international collaboration

1.2.8 Icarus- farthest star

NASA's Hubble Space Telescope has discovered the farthest individual star ever seen .

Highlights

- The star, harboured in a very distant spiral galaxy, is so far away that its light has taken nine billion years to reach Earth.
- The star, located in a distant spiral galaxy, is at least 100 times further away than any other star previously observed, with the exception of things like the huge supernova explosions that mark the death of certain stars.



Hubble Space Telescope

- NASA launched Hubble in 1990
- It was built by the United States space agency NASA, with contributions from the European Space Agency.
- Hubble is the only telescope designed to be serviced in space by astronauts.
- Expanding the frontiers of the visible Universe, the Hubble Space Telescope looks deep into space with cameras that can see across the entire optical spectrum from infrared to ultraviolet.
- The Hubble Space Telescope is a large telescope in space.

1.2.9 Black holes in Milky Way

Astrophysicists have detected a dozen black holes at the centre of the Milky Way galaxy.

Highlights

- The find provides the first evidence for a long-held theory that the massive black hole at the core of every large galaxy should be surrounded by thousands of smaller ones
- When the captured star has a low mass, the binary emits X-ray bursts that are weak but consistent and easier to detect.
- The team observed the X-ray signatures of 12 black hole binaries within three light years of Sagittarius A.
- Based on data from studying black holes closer to the earth, they extrapolated there must be about 500 binaries around our galaxy's core in all.



About Milky Way galaxy

- The Milky Way is the galaxy that contains our Solar System.
- The descriptive "milky" is derived from the appearance from Earth of the galaxy – a band of light seen in the night sky formed from stars that cannot be individually distinguished by the naked eye.

1.2.10 NASA's TESS

NASA's Transiting Exoplanet Survey Satellite (TESS) launched on the first-of-its-kind mission to find worlds beyond our solar system, including some that could support life.

- TESS is expected to find thousands of new exoplanets orbiting nearby stars
- two-year survey mission
- TESS will be watching for phenomena called transits. A transit occurs when a planet passes in front of its star from the observer's perspective, causing a periodic and regular dip in the star's brightness.
- The brightness of these target stars will allow researchers to use spectroscopy, the study of the absorption and emission of light, to determine a planet's mass, density and atmospheric composition.
- Water, and other key molecules, in its atmosphere can give us hints about a planets' capacity to harbor life.

1.2.11 Discovery of new planet - EPIC

A team from the Physical Research Laboratory, ISRO, Ahmedabad, has spotted for the first time a distant planet six times bigger than Earth and revolving around a Sun-like star about 600 light years away. Both the planet and the star have been named EPIC.

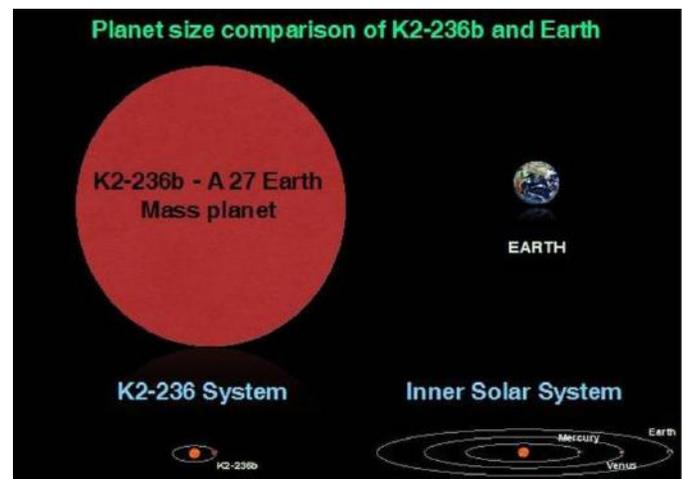
- With this discovery India has joined a handful of countries which have discovered planets around stars
- The spectrograph is the first of its kind in the country which can measure the mass of a planet going around a star.
- Measured the mass of the planet using the indigenously designed PRL Advance Radial-velocity Abu-sky Search or PARAS spectrograph integrated with the 1.2-metre telescope located at PRL's Gurushikhar Observatory in Mount Abu, Rajasthan.

Physical Research Laboratory(PRL)

PRL, described as the cradle of space sciences in India, conducts fundamental research in a host of physical sciences including astronomy and space.

1.2.12 Ralph

NASA's Ralph – a space instrument that has travelled as far as Pluto – is set to explore Jupiter's Trojan asteroids, which are remnants from the early days of the solar system.



Highlights:

- It was first launched aboard the New Horizons spacecraft in 2006.
- It revealed images of Jupiter and its moons and Pluto.
- In 2021, Ralph is set to journey with the Lucy mission to Jupiter's Trojan asteroids.
- It will study this diverse group of bodies and will detect trojan asteroid's chemical foot prints.
- It allows scientists to interpret data provided by the Sun's reflected light that are the fingerprints of different elements and compounds.

1.2.13 Lucy Mission

Lucy is a planned NASA space probe that will tour five Jupiter trojans, asteroids which share Jupiter's orbit around the Sun, orbiting either ahead of or behind the planet.

Highlights:

- Lucy is planned to launch in 2021.
- IT will explore the environment of Jupiter's Trojan asteroids.
- Lucy will be the first space mission to study the Trojans.
- Trojans are bodies that are present in Lagrange points.

1.2.14 NASA's Dawn asteroid mission

Dawn mission, launched in 2007 to study the protoplanet Vesta and the dwarf planet Ceres ending a historic 11-year mission.

Key Facts:

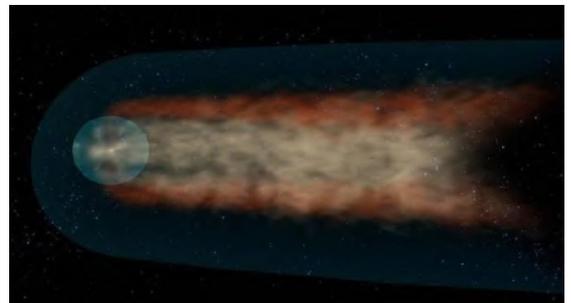
- After the flight team eliminated other possible causes for the missed communications, mission managers concluded that the spacecraft finally ran out of hydrazine, the fuel that enables the spacecraft to control its pointing.
- Dawn became the only spacecraft ever to orbit a cosmic body in the main asteroid belt between Mars and Jupiter in 2011 when it began circling the asteroid Vesta
- The first spacecraft to visit a dwarf planet and the only spacecraft to orbit one.
- The unmanned spacecraft has travelled 4.3 billion miles (6.9 billion kilometers) since its launch in 2007.

About Dawn Mission:

- NASA's Dawn mission will study the asteroid Vesta and dwarf planet Ceres, celestial bodies believed to have accreted early in the history of the solar system.
- The mission will characterize the early solar system and the processes that dominated its formation.

1.2.15 IMAP to study cosmic rays in heliosphere

NASA is targeting 2024 for the launch of a new mission to learn more about the generation of cosmic rays in the heliosphere, a sort of magnetic bubble surrounding and protecting our solar system.



Highlights:

- The Interstellar Mapping and Acceleration Probe (IMAP) mission will help researchers better understand the boundary of the heliosphere.
- Heliosphere is the region where the constant flow of particles from our Sun, called the solar wind, collides with material from the rest of the galaxy.
- This collision limits the amount of harmful cosmic radiation entering the heliosphere. IMAP will collect and analyse particles that make it through.
- IMAP is critical to broadening the understanding of how this 'cosmic filter' works
- The spacecraft will be positioned about 1.5 million kilometres away from Earth towards the Sun at what is called the first Lagrange point or L1.
- Cosmic rays created locally and from the galaxy and beyond affect human explorers in space and can harm technological systems, and likely play a role in the presence of life itself in the universe.

1.2.16 NASA's InSight spacecraft

NASA launched its latest Mars lander, InSight, designed to perch on the surface of the red planet and listen for 'Marsquakes'.

Highlights:

- Its name, InSight, is short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport.
- The project aims to expand human knowledge of conditions on Mars, inform efforts to send human explorers there, and reveal how rocky planets like the earth formed billions of years ago. The lander should settle on Mars on November 26.
- The key instrument on board is a seismometer, called the Seismic Experiment for Interior Structure. After the lander settles on the Martian surface, a robotic arm is supposed to emerge and place the seismometer directly on the ground.
- The second main instrument is a self-hammering probe that will monitor the flow of heat in the planet's subsurface.
- The probe will bore down 10 to 16 feet below the surface, NASA said, 15 times deeper than any previous Mars mission

1.2.17 Parker Solar Probe**1.2.18 NASA's Parker Solar Probe humanity's first mission to the Sun.**

- After launch, it will orbit directly through the solar atmosphere the corona closer to the surface than any human-made object has ever gone.
- The mission will reveal fundamental science behind what drives the solar wind, the constant outpouring of material from the Sun that shapes planetary atmospheres and affects space weather near Earth.

1.2.19 NASA's Kepler space telescope to retire

The Kepler space telescope has run out of fuel and will be retired after a 9 1/2 year mission.

Highlights:

- It detected thousands of planets beyond our solar system and boosted the search for worlds that might harbour alien life.
- Currently orbiting the sun 156 million km from the earth, the spacecraft will drift further from our planet.
- The telescope laid bare the diversity of planets that reside in our Milky Way galaxy, with findings indicating that distant star systems are populated with billions of planets.
- It helped pinpoint the first moon known outside our solar system.
- The Kepler telescope discovered more than 2,600 of the roughly 3,800 exoplanets — the term for planets outside our solar system — that have been documented in the past two decades.

About Kepler telescope:

- Launched in 2009
- The Kepler mission is specifically designed to survey our region of the Milky Way galaxy to discover hundreds of Earth-size and smaller planets in or near the habitable zone and determine the fraction of the hundreds of billions of stars in our galaxy that might have such planets.

1.2.20 ExoMars

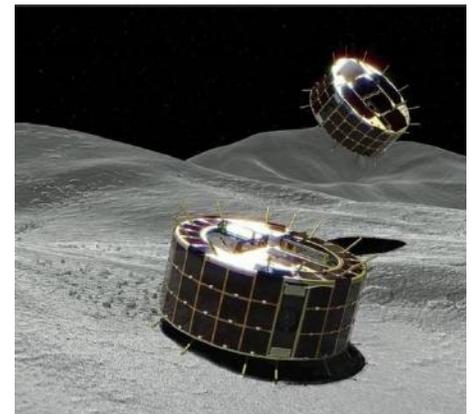
ExoMars is a joint space venture between European Space Agency and Russian space agency Roscosmos to Mars.

Key Facts:

- The ExoMars programme comprises 2 missions.
 1. The first mission was launched in 2016 and consists of the Trace Gas Orbiter (TGO) and Schiaparelli, an entry, descent and landing demonstrator module.
 2. The second mission is planned to be launched in 2020 and comprises a rover and surface science platform.
- The rover that will carry a drill and a suite of instruments dedicated to search for possible existence of life beyond earth and geochemistry research.
- It is likely to land on Mars' equator called Oxia Planum, which had housed a massive pool of water in the prehistoric era.

1.2.21 Japan's rovers successfully land on asteroid

- Two robotic rovers have become world's first to successfully land on the surface of an asteroid
- MINERVA-II1 is the world's first rover to land on the surface of an asteroid.
- This is also the first time for autonomous movement and picture capture on an asteroid surface



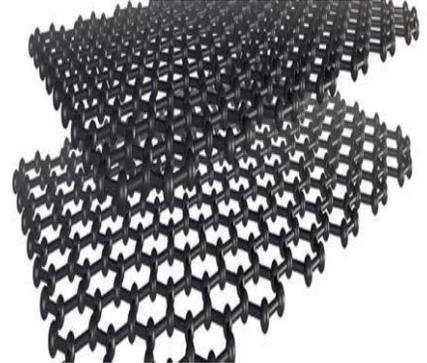
1.3 Material Science

1.3.1 Graphene

The 21st century seems set to become the age of graphene, a recently discovered material

About graphene

- Is made from honeycomb sheets of carbon just one atom thick.
- It is a two-dimensional form (allotrope) of carbon that consists of a single layer of carbon atoms arranged in a hexagonal lattice.
- Graphene has been described as wondrous stuff — of being the strongest material ever tested, almost 300 times stronger than steel.
- It is also the best heat- and electricity-conducting material to be discovered.
- It could also become a valuable aid in filtering water



1.3.2 A new, robust form of gold

Researchers from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, have developed a new type of gold in the form of very small crystals — microcrystallites.

Highlights:

- The microcrystal gold has been found to be nobler than gold
- It do not dissolve in mercury and Aqua regia (a mixture of nitric acid and hydrochloric acid), and showed the least interaction with copper.
- The microcrystallites were synthesised by decomposing an organic complex containing gold and other ions under controlled conditions.
- Normal gold has a (face-centered) cubic structure, while the new ones exhibit deformed cubic structure — tetragonal and orthorhombic cells.

1.3.3 A superhydrophobic coating

A polymeric coating that is extremely water-repelling (superhydrophobic) and will allow water to roll off from the surface like in the case of a lotus leaf or stick to the surface as in the case of rose petals has been synthesised.

- It can be spray-coated on various surfaces (glass, plastic, metal, wood and concrete) of diverse chemical composition, texture (smooth or rough surface), geometry (plain sheet or complex shape such as shoes), and size.
- By modulating the functionality of the coating with small amine molecules, the coated surface was made to behave either as non-adhesive superhydrophobic coating (where water rolls off as in a lotus leaf) or adhesive superhydrophobic coating where the droplets stick to the surface like in the case of rose petals.
- There is a fundamental difference in the way the trapped air is present at the interface between the surface and water droplets and this makes the coated surface either adhesive or non-adhesive superhydrophobic

- The superhydrophobic coating was prepared by mixing a polymer (branched poly(ethyleneimine)) and a reactive small molecule (dipentaerythritol penta-acrylate) in different alcoholic solvents — ethanol to pentanol.

Applications

- The superhydrophobic coating has diverse applications depending on whether it is made adhesive or non-adhesive.
- The non-adhesive one can be used for oil-water separation and making the surface self-cleaning.
- The adhesive coating can be used in open microfluidic devices for diagnostic purposes

1.3.4 Artificial enzyme

The researchers from Indian Institute of Science (IISc), Bengaluru have produced the new nanozyme nanomaterial with enzyme-like activity by using vanadium pentoxide nanocrystals of just 150-200 nm size.

Highlights:

- The nanozyme was able to act like the natural antioxidant enzyme glutathione peroxidase in our body.
- Nanozymes with tunable catalytic properties are emerging as the next generation of artificial enzymes that find applications in neuroprotection, cardioprotection and cancer therapy.

1.4 Medicine

1.4.1 New type of DNA

Scientists have identified an entirely new kind of DNA inside humans.

Highlights:

- The i-motif looks like a twisted knot, as opposed to DNA's well-known double helix structure.
- In the knot structure, C [cytosine] letters on the same strand of DNA bind to each other .
- To find the i-motifs, the scientists engineered antibodies into tiny probes that would attach themselves only to i-motifs.

1.4.2 Navigating nanomotors within living cells

Magnetic-material-coated silica nanomotors

- Less than 3 microns in length, they can be used for targeted drug delivery, nanosensing and in therapeutics.
- They found that nanomotors could move inside the cells when a rotating magnetic field of less than eighty Gauss
- Three types of cell lines human cervical cancer cells, human embryonic kidney and endothelial cells from cattle were used for the study.
- The nanomotors can be used as a new imaging tool to study the organelles of the cell up-close

1.4.3 CRISPR Technology

CRISPR stands for Clustered, regularly interspaced, short palindromic repeats

- CRISPR-associated protein 9 (Cas9) system has revolutionised genetic manipulations and made gene editing simpler and faster

Applications

- To repair defective genes
- To produce gene-edited cells for cancer and HIV-1 therapy.

2.GENERAL KNOWLEDGE

2.1 International Affairs

2.1.2Koreas aim for denuclearisation

The leaders of North and South Korea embraced to work for the “complete denuclearisation of the Korean peninsula”.

Highlights:

- They would work with the U.S. and China this year to declare an official end to the 1950s Korean War.
- The Panmunjom Declaration, named after the truce village that hosted the talks, included promises to pursue phased arms reduction, cease hostile acts, transform their fortified border into a peace zone and seek multilateral talks with other countries, including the U.S.

2.1.2 US withdraw from the Iran nuclear deal

The JCPOA (Joint Comprehensive Plan of Action) – as the Iran deal is formally known – was signed between Iran, the US, Russia, China, Britain, France, Germany and the EU.

- The 2015 agreement was reached after more than two years of negotiations.
- The United States will now reimpose the stringent sanctions it imposed on Iran before the deal and is considering new penalties.

2.1.3 Shanghai Cooperation Organisation (SCO)

India and Pakistan become full members of the Shanghai Cooperation Organisation (SCO).

About SCO:

- The SCO was formed in 2001, with the intent of calming the Eurasian borders strained by the Sino-Soviet rivalry of the Cold War.
- Is an economic, political and security organisation headquartered in Beijing, China.
- The six founding states are Russia, China, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan.
- The main objective is military cooperation between members.
- It also works towards intelligence-sharing, counter-terrorism operations in Central Asia.
- The full members of the organization are China, Russia, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, India and Pakistan.
- Afghanistan, Belarus, Iran and Mongolia currently enjoy observer status of SCO.
- Sri Lanka, Turkey, Azerbaijan, Armenia, Cambodia and Nepal are dialogue partners of SCO.

2.2 Arms and Ammunition

2.2.1 Nuclear-capable Agni-5

Long-range ballistic missile Agni-5 was successfully test fired off Odisha.

Highlights:

- This is the sixth successful test of the missile and the



second in its pre-induction configuration.

- Agni-5 can carry nuclear warhead weighing 1.5 tonnes to a distance of over 5,000 km and is the longest missile in India's arsenal.
- The missile features many new indigenously-developed technologies, including the very high accuracy Ring Laser Gyro based Inertial Navigation System (RINS).
- The most modern and accurate Micro Navigation System (MINS) which improves the accuracy of the missile.
- Agni-5 is expected to be inducted into the Strategic Forces Command very soon.
- The indigenously designed and developed carbon-carbon composite heat shield continues to burn sacrificially, protecting the payload and maintaining the inside temperature below 50 degrees Celsius.

About Agni Missile:

- The Agni missile is a family of medium to intercontinental range ballistic missiles developed by India, named after one of the five elements of nature.
- Agni missiles are long range, nuclear weapons capable surface to surface ballistic missile. The first missile of the series,
- Agni-I was developed under the Integrated Guided Missile Development Program and tested in 1989. After its success, Agni missile program was separated from the IGMDP upon realizing its strategic importance.
- It was designated as a special program in India's defence budget and provided adequate funds for subsequent development.

2.2.2 Rani Rashmoni commissioned

The last of the five Fast Patrol Vessel (FPV) project of Indian Coast Guard 'Rani Rashmoni' was commissioned into the Indian Coast Guard.

Highlights:

- The ships such as ICGS Rani Abbakka, ICGS Rani Avanti Bai, ICGS Rani Durgavati and ICGS Rani Gaidinliu, have been commissioned.
- The FPVs are equipped with advanced sensors and state-of-the-art equipment and are designed to perform multifarious tasks such as surveillance, interdiction, search and rescue, anti-smuggling and anti-poaching, operations
- The patrol vessel is fitted with an advanced Global Maritime Distress and Safety System (GMDSS), to carry out search and rescue operations
- Other features include Integrated Bridge System (IBS), Machinery Control System, Infra-red Communication System and the armament includes one CRN 91 Naval Gun along with its fire control system.

2.2.3 India's first missile tracking ship

- It is being built for the National Technical Research Organisation, the technical intelligence agency by Hindustan Shipyard Limited (HSL).



- It will be named after its induction into the Indian Navy. For now, it is simply referred as VC 11184.
- It will be the first of its kind ocean surveillance ship being built as part of the efforts
- It has the capacity to carry 300-strong crew with hi-tech gadgets and communication equipment, powered by two diesel engines, and a large deck capable of helicopter landing.
- It would put India in the elite of club of a few countries that have such a sophisticated ocean surveillance ship

2.2.4 Successful Flight Test of Prahar

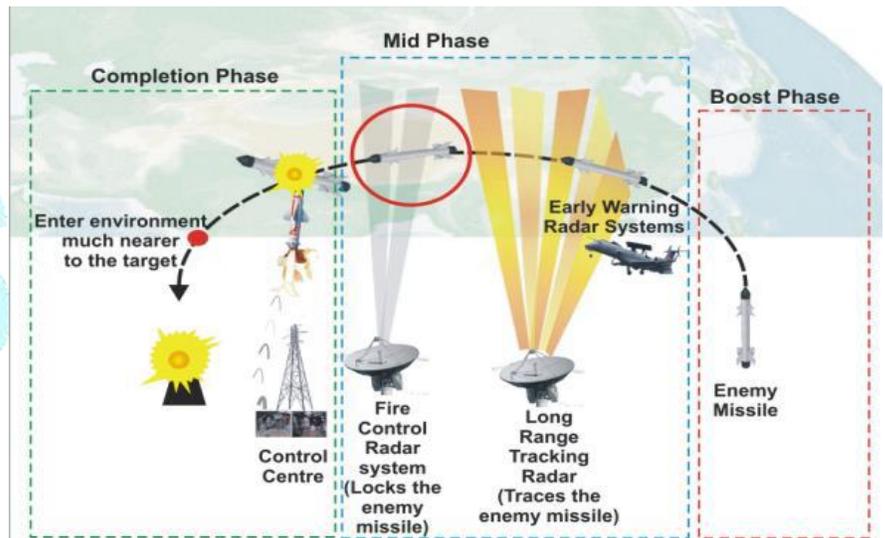
- Defence Research and Development Organisation (DRDO) successfully flight tested the indigenously developed surface-to-surface tactical missile ‘Prahar’, from Launch Complex-III, ITR, Balasore
- ‘Prahar’ is a contemporary weapon system capable of carrying multiple types of warheads and neutralizing a wide variety of targets.

2.2.5 Prithvi Defence Vehicle (PDV) Mission

India successfully conducted an interceptor missile test off the Odisha coast, achieving a major milestone in developing a two-layer Ballistic Missile Defence system.

Highlights:

- The interceptor was launched from Abdul Kalam Island, earlier known as Wheeler Island.
- PDV mission is for engaging the targets in the exo-atmosphere region at an altitude above 50 km of the earth’s atmosphere DRDO.
- The PDV is slated to replace the existing Prithvi Air Defence (PAD)/Pradyumna Ballistic Missile Interceptor, which has a maximum interception altitude of 80 kilometers.
- The new two-stage solid fuelled PDV interceptor is fitted with an Imaging Infrared (IIR) seeker, developed by DRDO, to distinguish between incoming warheads and decoys.
- It is guided by high-accuracy Inertial Navigation System (INS) supported by Redundant Micro Navigation System for estimating point of



2.2.6 India declares nuclear triad operational

India declared that its nuclear triad, stated in its nuclear doctrine, is operational after indigenous ballistic missile nuclear submarine INS Arihant achieved a milestone by conducting its first deterrence patrol.

Highlights:

- INS Arihant is now prowling the deep seas carrying ballistic missiles equipped with nuclear warheads
- INS Arihant is the first of five nuclear missile submarines planned for induction.
- It is to be equipped with K 15 (or BO-5) short range missiles with a range of over 700 km and the K 4 ballistic missile with a range of 3,500 km.

Nuclear triad:

- A nuclear triad refers to the nuclear weapons delivery via land, air and sea i.e. land-based intercontinental ballistic missiles (ICBMs), strategic bombers, and submarine-launched ballistic missiles (SLBMs).

2.3 Joint Military Exercises**2.3.1 Nomadic Elephant-2018**

- Exercise Nomadic Elephant is an annual, bilateral exercise since 2006 which is designed to strengthen the partnership between Indian Army and Mongolian Armed Forces.
- The exercise will see them improve their tactical and technical skills in joint counter insurgency and counter terrorist operations in rural and urban scenario under United Nations mandate.

2.3.2 Yudh Abhyas 2018

- Exercise Yudh Abhyas 2018 a joint military exercise of Indian and US armies
- At Chaubattia, Uttarakhand

2.3.3 MILEX – 2018

- The Inaugural Edition of the BIMSTEC Nations Military Field Training Exercise

2.3.4 Exercise Aviaindra-18

- Exercise Aviaindra is an Air Force level exercise between India and the Russian Federation.
- First Aviaindra was conducted in 2014 and has been planned as a bi-annual exercise.
- Exercise Aviaindra 18 is being conducted at Lipetsk, Russia

2.3.5 Kazind 2018

- Indian Army and Kazakhstan Army completed the third edition of their joint military Exercise KAZIND 2018 in Otar Military area, Kazakhstan

2.3.6 JIMEX 18

- Bilateral Maritime Exercise Between Japan and India (JIMEX 18) was held at Visakhapatnam.
- It aimed to enhance interoperability, improve understanding and imbibe the best practices of each other.
- To enhance safety and security of the global commons in keeping with 'rule based order'

2.3.7 Dharma Guardian- 2018

- To promote Military cooperation, India and Japan held the first ever joint military exercise 'DHARMA GUARDIAN-2018'.
- Emphasis will be laid on increasing interoperability between forces from both countries.

- Both sides will jointly train, plan and execute a series of well developed tactical drills for neutralisation of likely threats that may be encountered in urban warfare scenario.

2.3.8 SIMBEX 18

- The 25th edition of SIMBEX, an acronym for “Singapore-India Maritime Bilateral Exercise”
- The 2018 edition marks the Silver Jubilee of SIMBEX.
- To undertake continuous and institutionalised naval engagements in their shared maritime space including establishing maritime exercises with like-minded regional / ASEAN partners.
- It will witness a diverse range of exercises at sea ranging from live weapon drills including multiple missile firings.

2.3.9 INDRA 2018

- The joint military exercise between Indian and Russia EXERCISE INDRA 2018 on combating insurgency under the aegis of United Nations (UN) is being conducted at Babina Field Firing Ranges.
- The aim of the exercise is to practice joint planning and conduct to enhance interoperability of the two Armies in the peacekeeping/ enforcement environment under the aegis of the UN.
- It focuses upon training on enhancing team building, special tactical level operations such as Cordon and Search, house intervention, handling and neutralisation of Improvised Explosive Devices and integrated employment of force multipliers.
- The primary focus of the tactical field exercise is to share best practices amongst the militaries and hone existing skills of the troops in the backdrop of interoperability between the two Armies in the peace keeping/ enforcement environment.

2.4 Awards

2.4.1 Ramon Magsaysay Awards-2018

- Sonam Wangchuk, and educational reformer from Ladakh, is one of two Indians named for the 2018 Ramon Magsaysay Awards.
- Bharat Vatwani, a psychiatrist who works for mentally ill street people in Mumbai is the second person.

About award:

- It is an annual award established to perpetuate former Philippine President Ramon Magsaysay's example of integrity in governance, courageous service to the people, and pragmatic idealism within a democratic society.

2.4.2 National Sports Awards

- Rajiv Gandhi Khel Ratna Award is given for the spectacular and most outstanding performance in the field of sports by a sportsperson over a period of four years
- Arjuna Award is given for consistency outstanding performance for four years,
- Dronacharya Award for coaches for producing medal winners at prestigious International sports events
- Dhyani Chand Award for lifetime contribution to sports development
- Rashtriya Khel Protsahan Puruskar is given to the corporate entities (both in private and public sector) and individuals who have played a visible role in the area of sports promotion and development.

- Overall top performing university in inter-university tournaments is given Maulana Abul Kalam Azad (MAKA) Trophy.

Rajiv Gandhi Khel Ratna 2018

- Ms. S. Mirabai Chanu – Weightlifting
- Shri Virat Kohli – Cricket

2.4.3 United Nations 'Champion of Earth' award

United Nations Environment has bestowed Prime Minister Narendra Modi and French president Emmanuel Macron with the 2018 'Champion of the Earth' award for their leadership in promotion of solar energy.

Highlights:

- UN Environment is recognising Indian Prime Minister Narendra Modi for his bold environmental leadership on the global stage. Under Modi's leadership, India pledged to eliminate all single-use plastics in the country by 2022.
- For supports and champions the International Solar Alliance, a global partnership to scale up solar energy.
- Cochin International Airport Limited has also been recognised for becoming the first airport in the world to run its entire operations on solar energy.

About International Solar Alliance:

- The International Solar Alliance is an alliance of more than 121 countries, most of which lie between the equator and the tropics of Cancer and Capricorn and hence receive very high sunshine throughout the year.
- Founded in Paris, ISA is headquartered in Gurugram.

2.4.4 Sikkim wins FAO's award

India's first "100 per cent organic state" Sikkim has won the "Oscar for best policies" conferred by the Food and Agriculture Organisation.

The Award:

- The award for world's best policies promoting agro ecological and sustainable food systems
- The award is co-organised by the Food and Agriculture Organisation of the United Nations (FAO), the World Future Council (WFC) and IFOAM - Organics International.
- Sikkim is the first organic state in the world
- Sikkim's approach reaches beyond organic production and has proven truly transformational for the state and its citizens.

2.4.6 2018 Seoul Peace Prize

The Seoul Peace Prize Committee has decided to confer the 2018 Seoul Peace Prize on Prime Minister Shri Narendra Modi.

Highlights:

- In recognition of his dedication to improving international cooperation, raising global economic growth, accelerating the Human Development of the people of India by fostering economic growth.

- Furthering the development of democracy through anti-corruption and social integration efforts.
- Proactive foreign policy with countries around the world under the 'Modi Doctrine' and the 'Act East Policy.'

About The Seoul Peace Prize:

- Established in 1990 to commemorate the success of the 24th Olympic Games held in Seoul, Republic of Korea.
- The Prize has been awarded biennially to those individuals who have made their mark through contributions to the harmony of mankind, reconciliation between nations and to world peace.

2.4.7 CAPAM Awards, 2018

- The Commonwealth Association for Public Administration and Management (CAPAM) Awards celebrate the spirit of innovation in the public service by recognizing organizations that have made significant contributions to improve governance and services in the public sector.
- The initiative entitled "Unnayan Banka- Reinventing Education Using Technology of Banka District, State of Bihar has been awarded under the Category "Innovation Incubation".
- The initiative entitled "Unified Agriculture Markets" of Co-operation Department of Government of Karnataka has also been selected under the Category 'Innovation in Public Service Management'. This initiative has also been awarded the overall Gold Award.

Unnayan Banka:

- It is an initiative which envisages "Quality education for all" especially for those at the bottom of the Pyramid, using latest technologies.
- It's a holistic model of overall development of youths from Education to Employability.

2.4.8 Carnot Prize

Minister of Railways and Coal Piyush Goyal will receive the University of Pennsylvania's top prize in energy policy.

Highlights:

- Leadership in reforming India's power sector
- Spearheading efforts to fast-track electrification of thousands of remote villages
- Expanding renewable energy in the country.

About Carnot Prize:

- The Carnot Prize is named in memory of French scientist Sadi Carnot, who in 1824 published Reflections on the Motive Power of Fire, which is recognised as the first statement of what is now known as the second law of thermodynamics.
- The Carnot Prize is intended to honour those leading revolutions in energy policy to further progress and prosperity.

2.4.9 CSE gets 2018 Indira Gandhi Prize

Centre for Science and Environment (CSE), the New Delhi (India)-based independent research and advocacy think tank, has been named the recipient of the prestigious Indira Gandhi Prize for Peace, Disarmament and Development for the year 2018.

About prize

- The award is accorded annually by the Trust to individuals or organisations.

- In recognition of creative efforts toward promoting international peace, development and a new international economic order, ensuring that scientific discoveries are used for the larger good of humanity, and enlarging the scope of freedom

About CSE:

- Established in 1980.
- It has worked on extending awareness and education about environmental issues, on air and water pollution, wastewater management and industrial pollution, food safety and energy, climate change.
- Influencing official policy and public actions for sustainable development.

2.5 Miscellaneous

2.5.1 World Heritage sites

Mumbai's Victorian and Art Deco buildings

- It will be India's 37th World Heritage site
- The city has Art Deco buildings of the 20th century
- The Walled City of Jaipur, Rajasthan, India" has been proposed for World Heritage.

About UNESCO World Heritage:

- A World Heritage site is a landmark or area which is selected by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as having cultural, historical, scientific or other form of significance
- They are legally protected by international treaties.
- The sites are judged important to the collective interests of humanity

2.5.2 Statue of Unity

The Prime Minister, Shri Narendra Modi dedicated the world's tallest statue, the 'Statue of Unity', to the nation.

Highlights:

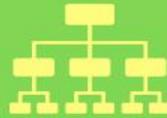
- The 182 metre statue of Sardar Vallabhbhai Patel
- Located in Gujarat's Narmada district
- The world's tallest statue of 182 meters (about 600 feet).
- It is double the height of New York's world famous Statue of Liberty
- The Gujarat government has promoting the statue as a major tourism destination.



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