



IAS PARLIAMENT

Information is a Blessing

A Shankar IAS Academy Initiative

TARGET 2020

SCIENCE & TECHNOLOGY II

UPTO AUGUST 2020



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TARGET 2020

SCIENCE & TECHNOLOGY

APRIL 2020 TO AUGUST 2020

1. SPACE

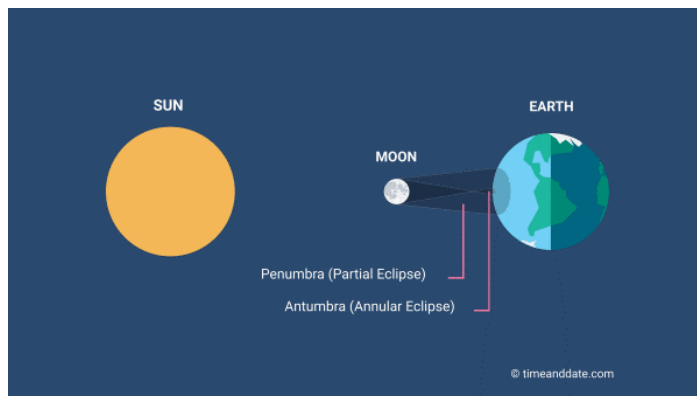
1.1 Super Moon

- A super moon is a full moon or a new moon that nearly coincides with perigee, the closest that the Moon comes to the Earth in its elliptic orbit resulting in a slightly larger-than-usual apparent size of the lunar disk as viewed from Earth.
- The technical name is a perigee syzygy (of the Earth–Moon–Sun system) or a full (or new) Moon around perigee.
- The term super moon is astrological in origin and has no precise astronomical definition.
- The real association of the Moon with both oceanic and crustal tides has led to claims that the super moon phenomenon may be associated with increased risk of events like earthquakes and volcanic eruptions, but no such link has been found.
- The opposite phenomenon, an apogee syzygy or a full (or new) Moon around apogee, has been called a micro moon.



1.2 Umbra, Penumbra and Antumbra

- Like any other opaque objects illuminated by a light source, the Moon and the Earth cast shadows into space as they block the sunlight that hits them.
- Each shadow has 3 different areas - Umbra, Penumbra, and Antumbra.
- Penumbra - It is the *lighter outer part* of a shadow. The Moon's penumbra causes partial solar eclipses, and the Earth's penumbra is involved in penumbral lunar eclipses.
- It is a half-shadow that occurs when a light source is only partly covered by an object – for example, when the Moon obscures part of the Sun's disk.
- Umbra - The shadow's dark center portion.
- Antumbra - The lighter part of the shadow that begins where the umbra ends.



1.3 Primordial Black Holes

- Primordial Black Holes (PBH) were formed during the Hot Big Bang phase.
- PBH can be massively large as 3000kms or be extremely tiny like nucleus of an atom.
- It is believed that they are formed as a result of collapsing radiations as opposed to the collapse of massive stars, which is the case of any other black holes.



- A recent study on Primordial black holes has confirmed that this marginal rise in potential energy resulted in birth of several PBHs and also emitted very powerful gravitational waves.
- Inter University Centre for Astronomy and Astrophysics (IUCAA), has studied primordial black holes that were born as a result of a tiny bump in the potential energy levels of the universe, at a time when it was expanding rapidly.
- After big bang the universe had expanded to nearly 10^{27} times its original size, that too, within just fraction of a second by the time Cosmic Inflation phase concluded.
- Thereafter, the remnant energy possessed by gravitational force got converted mainly into photons (light) in addition to protons, electrons, neutrons and other particles.
- As the universe continued to grow exponentially during the Cosmic Inflation phase, it sent across tiny quantum jitters.
- These fluctuations, released in a specific fashion, when sufficiently large, slowly give birth to galaxies and stars and there is a bump in energy.
- Among those that were significantly large, helped form PBHs.
- The bump in energy then produces PBHs besides triggering very strong gravitational waves.
- While not all declining energy showcased similar energy bumps, and hence, PBHs were not born in all instances.

1.4 Merger of Two Black holes

- For the first time since it started functioning, the gravitational wave observatories at LIGO scientific collaboration have detected a merger of two unequal-mass black holes.
- The event, dubbed GW190412, was detected nearly a year ago, and this is almost five years after the first ever detection of gravitational wave signals by these powerful detectors.
- Subsequent analysis of the signal coming from the violent merger showed that it involved two black holes of unequal masses coalescing, one of which was some 30 times the mass of the Sun and the other which had a mass nearly 8 times the solar mass.
- The actual merger took place at a distance of 2.5 billion light years away.
- The detected signal's waveform has special extra features in it when it corresponds to the merger of two unequal-sized black holes as compared with a merger of equal-sized black holes.
- Pointing out the difference between binary black holes with equal masses and those with different masses, Dominant emission of gravitational waves happens at twice the orbital frequency of the binary.

1.5 Research on Blazars

- Gamma-ray flux variability of luminous and high energy blazars: clues to blazar emission mechanisms
- At the center of most galaxies, there's a massive black hole that can have mass of millions or even billions of Suns that accrete gas, dust, and stellar debris around it.
- As these material falls towards the black hole, their gravitational energy gets converted to light forming active galactic nuclei (AGN).
- A minority of AGN (~15%) emit collimated charged particles called jets, travelling at speeds close to the speed of light.
- Blazars are AGN whose jets are aligned with the observer's line of sight.
- Some blazars are thought to host binary black holes in them and could be potential targets for future gravitational-wave searches.
- Blazars are the most luminous and energetic objects in the known universe were found to be emitters of gamma-rays in the 1990s.
- Researchers from the Indian Institute of Astrophysics (IIA), have conducted the first systematic study on the gamma-ray flux variability nature on different types of blazars.



- Their study could provide clues to the processes happening close to the black hole, not visible through direct imaging.
- One of the open problems in high energy astrophysics is to localize the site for the production of gamma-rays.
- Variability studies in the high energy gamma-ray band can help one to locate the high energy emission site and the high energy emission process.
- Therefore, the variability analysis in the gamma-ray band carried out in this work is significant.

1.6 Gamma Ray Band

- Gamma-ray band is one of the bands of the electromagnetic spectrum on which there is limited knowledge on the flux variability of blazars.
- But this band needs to be explored as this is the energy range where the high energy emission from blazars peaks.
- Exploring this band of the electromagnetic spectrum will provide key inputs to constrain the high energy production site as well as the high energy emission processes.
- The results obtained from IIA's piece of work will provide key inputs to the problem of finding the high energy gamma-ray production site in blazars.
- Thus, it will have direct relevance to the enhancement of the knowledge on blazars.
- The expertise of handling high energy data from celestial sources gained in this work will build capacity to interpret the gamma-ray data that will emerge from India's upcoming facility, the Major Atmospheric Cerenkov Experiment Telescope as well as from any X-ray missions by India in the future.

1.7 Digital Map of Moon

- The first ever digital, unified, global, geological map of the moon was released virtually by the United States Geological Survey (USGS), NASA and the Lunar Planetary Institute.
- The map is a 'seamless, globally consistent, 1:5,000,000-scale geologic map'.
- Unified Geologic Map of the Moon' will serve as a blueprint for future human missions and a source of research and analysis for the educators and the general public interested in lunar geology.
- Surface features of the moon which included crater rim crests, buried crater rim crests, fissures, grabens, scarps, mare wrinkle ridges, faults, troughs, rilles, and lineaments can be found in the map.
- The final map consists of 43 geologic units across the entire lunar surface, broken down into groups based on characteristics like materials of craters, basins, terra, plains and volcanic units.
- The present and future moon mission's success can be further helped by the digital map of the moon.

1.8 Lunar South Pole

- The moon's South Pole is especially interesting because the area is much larger than the North Pole and there could be possibility of presence of water in these permanently shadowed areas.
- Further, the South Pole region also contains the fossil record of the early Solar System.
- ISRO's Chandrayaan 2, is an active mission that targets the Lunar South Pole for exploration.
- Like Chandrayaan, other moon missions like the Artemis (human spaceflight programme), that is a crewed exploration programme of NASA, plan to send humans to the Lunar South Pole by 2024 and in due course of time, establish a permanent presence on the moon.

1.9 Big Bang Nucleosynthesis

- It is the leading explanation about how the universe began.
- At its simplest, it says that the universe started with a small singularity and then inflated over the next 13.8 billion years to the cosmos currently observed.

- It is the production of nuclei other than those of the lightest isotope of hydrogen during the early phases of the Universe.
- Primordial nucleosynthesis is believed by most cosmologists to have taken place in the interval from roughly 10 seconds to 20 minutes after the Big Bang.
- The Universe's light-element abundance is another important criterion by which this theory is verified.
- It is now known that the elements observed in the Universe were created in either of two ways.
- Light elements (namely deuterium, helium, and lithium) were produced in the first few minutes of the Big Bang.
- Elements heavier than helium are thought to have their origins in the interiors of stars which formed much later in the history of the Universe.
- The theory predicts that roughly 25% the mass of the Universe consists of Helium.
- It also predicts about 0.01% deuterium, and even smaller quantities of lithium.

1.10 Planetary Engulfment

- In the universe, planets accompany host stars (like the Sun is the host star for the planets of the Solar system).
- As the host star evolves off the main sequence to become a white dwarf, the planets with sufficiently close orbits can be engulfed during the giant phase.
- Planetary engulfment events involve the chemical assimilation of a planet into a star's external layer.
- This can cause a change in the chemical pattern of the stellar atmosphere in a way that mirrors the composition of the rocky object engulfed.

1.11 Luhman 16A

- Luhman 16 is a binary star system, the third closest system to the Sun after Alpha Centauri and Barnard's star.
- At a distance of about 6.5 light years from the Sun, this pair of brown dwarfs referred to as Luhman 16A and Luhman 16B orbit each other, casting a dim light.
- A group of international astrophysicists have identified cloud bands on the surface of Luhman 16A, one of a pair of binary brown dwarfs in the Vela constellation.
- The researchers have found the actual structure of the clouds that they form bands over one of the pair (Luhman 16A) of brown dwarfs.
- Brown dwarfs are also called failed stars, because their masses are intermediate to the largest planets and the smallest main sequence stars.
- Their masses being too small, they are unable to sustain fusion of their hydrogen to produce energy.
- They have used an idea put forth nearly two decades ago by Indian astrophysicist Sujana Sengupta, that the light emitted by a cloudy brown dwarf, or reflected off an extrasolar planet, will be polarised.
- He suggested that a polarimetric technique could serve as a potential tool to probe the environment of these objects.
- Subsequently, many astronomers detected polarisation of brown dwarfs.



1.12 Regions of the Earth's Magnetosphere

- **Bow shock** - It occurs when the magnetosphere of an Earth interacts with the nearby flowing ambient plasma such as the solar wind.



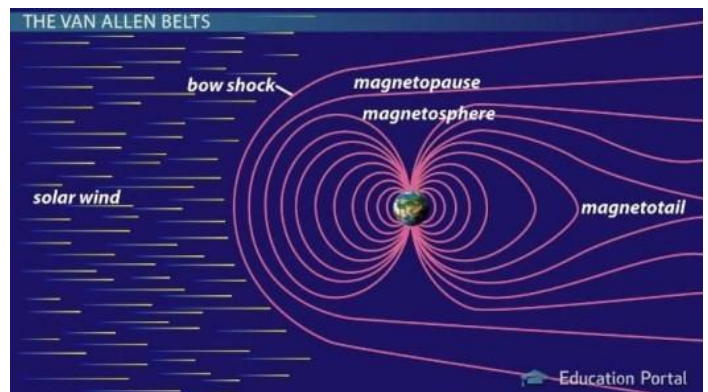
- **Magneto sheath** - It is the region of space between the magnetopause and the bow shock of a planet's magnetosphere.
- **Magnetopause** - It is the boundary between the planet's magnetic field and the solar wind.
- **Magnetotail** - The sun-facing side, or dayside, extends a distance of about six to 10 times the radius of the Earth.
- The side of the magnetosphere facing away from the sun, the night side stretches out into an immense magneto tail, which fluctuates in length and its exact length is not known, this extension of the magnetosphere.
- **Northern tail lobe** - The magnetosphere of the earth contains two lobes, referred to as the northern and southern tail lobes. Magnetic field lines in the northern tail lobe point towards the earth.
- Southern tail lobe - The magnetic field lines in the southern tail lobes point away from the earth. Usually, the tail lobes are almost empty, with few charged particles opposing the flow of the solar wind.
- **Plasma sphere** - The plasma sphere, or inner magnetosphere, is a region of the Earth's magnetosphere consisting of low energy (cool) plasma.
- **Solar winds** - It is a stream of charged particles released from the upper atmosphere of the Sun, called the corona.

1.13 Formation of Earth's Magnetosphere

- Sun is the major source of plasma deposition in space around the Earth.
- Thus, the Sun forces some of its plasma towards the earth in the form of the solar wind.
- Plasma is the most common state of matter in the universe as a whole. It consists of a gas of ions and free electrons.
- The speed of solar wind varies between 300 to 1500 km/s, which carries with it a solar magnetic field, called the Interplanetary Magnetic Field (IMF).
- The interaction of the IMF with the earth's magnetic field creates the magnetosphere of the earth.

1.14 Van Allen Radiation belt

- A Van Allen radiation belt is a zone of energetic charged particles, most of which originate from the solar wind, that are captured by and held around a planet by that planet's magnetic field.
- Earth has two such belts and sometimes others may be temporarily created.
- The discovery of the belts is credited to James Van Allen, and as a result, Earth's belts are known as the Van Allen belts.
- Earth's two main belts extend from an altitude of about 640 to 58,000 km (400 to 36,040 mi) above the surface in which region radiation levels vary.
- Notable feature of Van Allen Radiation Belts are
 1. Most of the particles that form the belts are thought to come from solar wind and other particles by cosmic rays.
 2. By trapping the solar wind, the magnetic field deflects those energetic particles and protects the atmosphere from destruction.
 3. The belts are located in the inner region of Earth's magnetosphere.
 4. The belts trap energetic electrons and protons.
 5. Other nuclei, such as alpha particles, are less prevalent.





6. The belts endanger satellites, which must have their sensitive components protected with adequate shielding if they spend significant time near that zone.

1.15 Super Earth

- All of the planets in our solar system orbit around the Sun, those planets that orbit around other stars are called extra solar planets or exoplanets.
- According to NASA, Super Earths are quite common in our galaxy and these planets can be up to 10 times more massive than Earth. .
- Recently astronomers got success when they found a rare new Super-Earth planet towards the centre of the galaxy.
- The planet is one of 'only a handful of extra-solar planets that have been discovered with both size and orbit comparable to that of Earth.
- According to the researchers, the planet's host star is about 10% the mass of our Sun.
- The Super Earth planet's mass would be somewhere between that of Earth and Neptune, and would orbit at a location between Venus and Earth from the parent star.
- The planet's 'year' would be of approximately 617 days.

1.16 Gravitational Microlensing Technique

- Gravitational microlensing is an astronomical phenomenon due to the gravitational lens effect.
- It can be used to detect objects that range from the mass of a planet to the mass of a star, regardless of the light they emit.
- Typically, astronomers can only detect bright objects that emit much light (stars) or large objects that block background light (clouds of gas and dust).
- These objects make up only a minor portion of the mass of a galaxy. Microlensing allows the study of objects that emit little or no light.
- In the recent research the combined gravity of the planet and its host star caused the light from a more distant background star to be magnified in a particular way, telescopes distributed around the world were used to measure the light-bending effect.
- The microlensing effect is rare, with only about one in a million stars in the galaxy being affected at any given time, this type of observation does not repeat, and the probabilities of catching a planet at the same time are extremely low.

1.17 Entangled Photons

- Entangled photons are twinned light particles whose properties remain intertwined no matter how far apart they are.
- If one of the photons is manipulated, the other will be similarly affected at the very same moment.
- It is this property that lies in the heart of the most secure forms of quantum cryptography (the study of concepts like encryption and decryption).
- If one of the entangled particles is used to create a key for encoding messages, only the person with the other particle can decode them.

1.18 Lithium

- Lithium, a light element commonly used today in communication device technology.
- It was first produced in the Big Bang, around 13.7 billion years ago when the universe came into being, along with other elements.
- The present abundance of lithium in the universe is only four times the original (Big Bang) value.
- It is actually destroyed in the stars.



- The Sun, for instance, has about a factor of 100 lower amount of lithium than the Earth.

1.19 Helium Flash in Stars

- A forty-year-old puzzle regarding the production of lithium in stars has been solved by Indian researchers.
- Stars, as per known mechanisms of evolution, actually destroy lithium as they evolve into red giants.
- Planets were known to have more lithium than their stars as is the case with the Earth-Sun pair.
- However, leading to a contradiction, some stars were found that were lithium-rich.
- When stars grow beyond their Red Giant stage into what is known as the Red Clump stage, they produce lithium in what is known as a Helium Flash and this is what enriches them with lithium.

1.20 Helium Stars

- An extreme helium star or EHe is a low-mass supergiant that is almost devoid of hydrogen, the most common chemical element of the universe.
- There are 21 of them detected so far in our galaxy.
- A recent study by the Indian Institute of Astrophysics (IIA) detected the presence of singly ionised fluorine for the first time in the atmospheres of hot Extreme Helium Star.
- It makes a strong case that the main formation of these objects involves a merger of a carbon-oxygen (CO) and a Helium (He) white dwarf.
- IIA is an autonomous institute of Department of Science and Technology.

1.21 South Pole Wall

- Spectacular 3D maps of the universe have revealed inconceivable wall known as South Pole Wall.
- It stretches 1.4 billion light-years across that contains hundreds of thousands of galaxies.
- One light-year is roughly 6 trillion miles, or 9 trillion kilometers, so this "biggest cosmic structure" is mind-bendingly humongous.
- It has been hiding in plain sight, remaining undetected until now because large parts of it sit half a billion light-years away behind the bright Milky Way galaxy and Zone of Avoidance.
- Zone of Avoidance is the disc of our home galaxy, a region thick and bright with dust and gas and stars.
- The South Pole Wall rivals in size the Sloan Great Wall, the sixth largest cosmic structure discovered.
- Other, larger such walls is the Hercules-Corona Borealis Great Wall, which spans 9.7 billion light-years.

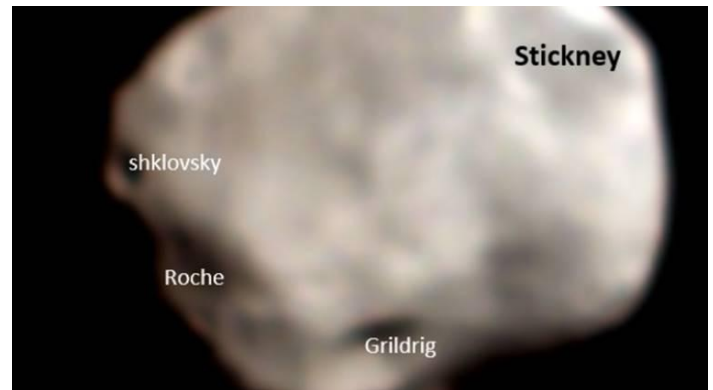
1.22 Cosmic Web

- Astronomers have long noticed that galaxies are not scattered randomly throughout the universe but rather clump together in what's known as the cosmic web.
- Cosmic web is enormous strands of hydrogen gas in which galaxies are strung like pearls on a necklace that surround gigantic and largely empty voids.
- Mapping these intergalactic threads belongs to the field of cosmography, which is "the cartography of the cosmos".

1.23 Phobos

- Phobos is the innermost and larger of the two natural satellites of Mars, the other being Deimos.
- Both moons were discovered in 1877 by American astronomer Asaph Hall.
- Phobos is a small, irregularly shaped object with a mean radius of 11 km (7 mi) and is seven times as massive as the outer moon, Deimos.
- It is largely believed to be made up of carbonaceous chondrites.

- It is so close that it orbits Mars much faster than Mars rotates, and completes an orbit in just 7 hours and 39 minutes.
- Recently, The Mars Colour Camera (MCC) onboard ISRO's Mars Orbiter Mission has captured the image of Phobos, the closest and biggest moon of Mars.
- According to ISRO, the violent phase that Phobos has encountered is seen in the large section gouged out from a past collision (Stickney crater) and bouncing ejecta.
- Shklovsky, Roche, and Grildrig are other craters.



1.24 Asteroid 2020 ND

- NASA has issued a warning that a huge Asteroid 2020 ND is expected to move past the Earth.
- It will be as close as .034 astronomical units (5,086,328 kilometers) to our planet.
- It is travelling at a speed of 48,000 kilometers per hour.
- Its distance from Earth has placed it in the potentially dangerous category.
- Potentially Hazardous Asteroids (PHAs) are those with a minimum orbit intersection distance (MOID) of 0.05 au or less.
- NASA classifies these objects as near-Earth objects (NEOs).
- However, it is not necessary that asteroids classified as PHAs will impact the Earth.
- It only means there is a possibility for such a threat.

1.25 Venus Coronae

- Researchers have recently studied the formation of Venus' ring-shaped volcanic structures called "Coronae".
- They are formed by plumes of molten rock rising from the mantle up through the crust.
- This process is similar to how Earth's volcanos function.
- Interestingly, most of Earth's volcanism occurs along the boundaries of tectonic plates, but modern Venus doesn't seem to possess tectonic plates.
- They identified three dozen features on Venus, which they state could have been created by volcanism.
- If this is true then it will potentially reshape our understanding about the planet and its evolution.
- Venus was earlier determined to be an inactive planet. However, now it is being said that the interior is still churning and can feed many active volcanoes.

1.26 Inter-planetary Contamination in Mars

- Recently, astrobiologists have expressed concerns about possible 'interplanetary contamination' on Mars.
- Interplanetary contamination refers to biological contamination of a planetary body by a space probe or spacecraft, either deliberate or unintentional.
- In the past, space missions have established physical contact with astronomical bodies such as comets and asteroids, and crewed missions have landed on the Moon.
- However, since these bodies are known to be hostile to life, the possibility of their contamination has not been a pressing issue.
- **Type of Contaminations**
 - a) Forward Contamination- It means the transport of Earth-based microbes to other celestial bodies.



b) Back Contamination - It is the transfer of extraterrestrial organisms (if they exist) into the Earth's biosphere.

- 'Planetary protection policy' aims to limit the number of microbes sent to other planets, as well as ensuring that alien life does not cause havoc on Earth.
- The policy was laid down by Committee on Space Research (COSPAR) established by International Council for Science (ICSU).

1.27 Major Atmospheric Cerenkov Experiment Telescope

- Major Atmospheric Cerenkov Experiment Telescope (MACE) is an Imaging Atmospheric Cerenkov telescope (IACT) located at Hanle, Ladakh, India.
- It is the highest (in altitude) Cerenkov telescope in the World and was built by Electronics Corporation of India, Hyderabad, for the Bhabha Atomic Research Centre.
- It was assembled at the campus of Indian Astronomical Observatory at Hanle.
- Operational since 2016, it is remotely operated and runs on solar power.
- The telescope is the second-largest gamma ray telescope in the world and will help the scientific community enhance its understanding in the fields of astrophysics, fundamental physics, and particle acceleration mechanisms.
- The largest telescope of the same class is the 28-metre-diameter High Energy Stereoscopic System (HESS) telescope being operated in Namibia.

1.28 Brown Dwarfs

- Recently, Citizen Scientists and NOIR Lab facilities discovered almost 100 nearby cool Brown Dwarfs.
- Brown dwarf are an astronomical object that is intermediate between a planet and a star.
- They are usually have a mass less than 0.075 that of the Sun, or roughly 75 times that of Jupiter.
- They are outside the solar system, they give off little light and energy and they are challenging to locate.
- Brown dwarfs are also called failed stars, because their masses are heavier than planets but lighter than stars.
- Due to their small masses, they are unable to sustain fusion of their hydrogen to produce energy.
- It is believed that some of the more massive brown dwarfs fuse deuterium or lithium and glow faintly.

1.29 Sarabhai Crater

- Recently, Indian Space Research Organization (ISRO) named a crater as Sarabhai Crater on completion of one year of centenary celebrations.
- A crater is a bowl-shaped depression produced by the impact of a meteorite, volcanic activity, or an explosion.
- The Sarabhai Crater is around 250 to 300 kilometres east of the crater where the Apollo 17 and Luna 21 Missions had landed.
- It is eight kilometres in diameter and located in the Mare Serenitatis in the Northeast quadrant of the Moon.
- The Crater has a depth of around 1.7 Kms taken from its raised rim.
- Chandrayaan 2 orbiter's Terrain Mapping Camera-2 (TMC-2) instrument has captured a photograph of the Sarabhai Crater on the Moon.
- The crater's outer region is dominated by numerous smaller craters of various sizes and is distributed over the flat Mare plains,
- It has defining features like a raised rim, gradient inner walls and the small hummocky floor.



1.30 Mare Serenitatis

- It is one of the lunar mare regions on the Moon which were formed between 3.9 and 3.8 thousand million years ago with vast lava plains creating a flat surface
- It was during this period when the Moon was heavily bombarded by asteroids and the major impact basins on the Moon were formed.
- The Sarabhai crater is an 'excellent example' to study the impact process of the Mare Serenitatis.
- It will help the Space Scientists to understand further the process on the lunar region filled with lava.

1.31 Helium Enhanced Cool Stars

- Indian Institute of Astrophysics (IIA) an autonomous institute of DST, have discover He-enhanced cool bright stars among the metal-rich parts of Omega Centauri globular cluster.
- This is the first time He-abundance has been found in Omega Centauri.
- Globular clusters are the stellar systems with millions of stars formed from the same gaseous cloud.
- Omega Centauri is the brightest and the largest globular cluster in our Milky Way Galaxy.
- Usually, the stars formed will be homogeneous in their chemical composition of elemental abundances.
- But, there are clusters which deviate from this norm.
- The different stars of Omega Centauri do not show the same metal content, a parameter that indicates its age, but a large range in it.
- The study provides a very important clue for the origin of the He-enhanced population establishing that these are the second generation of stars formed from the metal-rich and He-enhanced material from the first generation of stars.

1.32 AR2770 Sunspots

- A Sunspot is an area on the Sun that appears dark on the surface and is relatively cooler than surrounding parts.
- The sun spots are as large as 50,000 km in diameter, are the visible markers of the Sun's magnetic field.
- It forms a blanket that protects the solar system from harmful cosmic radiation.
- Sunspots are the areas where the star's magnetic field is the strongest, around 2,500 times more than the Earth's magnetic field.
- Most Sunspots appear in groups that have their own magnetic field, whose polarity reverses during every solar cycle, which takes around 11 years.
- In every such cycle, the number of Sunspots increases and decreases.
- A massive Sunspot group, AR2770, was observed using images of the Sun's surface from NASA's Solar Dynamics Observatory (SDO).
- This massive sunspot on the Sun will be turning towards earth which could result in major strong flares.
- Sunspots may release a huge amount of energy which in turn will lead to solar flares.

1.33 Solar Flare

- Solar flares are the result of changes in magnetic fields on the sunspots that cause a huge explosion.
- These eruptions may lead to solar flares and storms.
- This phenomenon is called Coronal Mass Ejections (CME).
- These solar flares are often released into space and its radiation can disrupt with earth's radio communication, GPS, Power grids and satellite.
- Solar flares caused by these CMEs can also trigger intense light in the sky, called auroras.



- Recently, scientists developed a new model that can successfully predict seven of the Sun's biggest flares from the last solar cycle, out of a set of nine with the help of NASA's Solar Dynamics Observatory.

1.34 Dwarf Planet Ceres

- Ceres is a dwarf planet and it is the largest celestial object in the asteroid belt between Mars and Jupiter.
- It has a diameter of about 950 km, which is more than one-fourth of Earth's moon.
- It has 92 km wide crater named Occator located in Ceres' northern hemisphere.
- Scientists have recently found that it is said to have salty water underground, by observing the cracks created to form a crater.
- This crater is said to have formed by an impact approximately 22 million years ago.
- The scientists have given Ceres the status of an "ocean world" as it has a big reservoir of salty water underneath its frigid surface.
- This has led to an increased interest of scientists that the dwarf planet maybe habitable or has the potential to be.

1.35 Discovery of Exoplanet using Radio Waves

- An exoplanet is a planet that orbits a star outside the solar system.
- These exoplanets are hard to detect because they are hidden by the bright glare of the stars they orbit around.
- One of the key features of the exoplanet is that its orbit is wobbly because the star's gravitation is not at its center which makes the phenomenon possible.
- Recently, scientists have been able to discover an exoplanet and a wobbly star using just radio waves.
- In this method, scientists detect an exoplanet via auroras formed on it by the interaction of the star and a strong magnetic field around a planetary body.

1.36 Radio Waves

- Radio waves are a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light.
- Radio waves have frequencies as high as 300 gigahertz (GHz) to as low as 30 hertz (Hz).
- The wavelength of a radio wave can be anywhere from shorter than a grain of rice to longer than the radius of the Earth.
- Like all other electromagnetic waves, radio waves travel at the speed of light in vacuum.
- They are generated by electric charges undergoing acceleration, such as time varying electric currents.
- Naturally occurring radio waves are emitted by lightning and astronomical objects.
- Radio waves are generated artificially by transmitters and received by radio receivers, using antennas.

1.37 Dragon Capsule

- Crew Dragon is a part of the Dragon 2, a class of reusable spacecraft developed and manufactured by American aerospace manufacturer SpaceX.
- It is the 5th class of US spacecraft to take human beings into orbit, after the Mercury, Gemini, Apollo and Space Shuttle programs.
- Falcon 9, which carried the spaceship into the orbit, was also built by SpaceX.
- It is done under the Demo-2 Mission of NASA and SpaceX.
- The Demo-2 mission is part of NASA's Commercial Crew Program with the aim of developing reliable and cost-effective access to and from the International Space Station.



- Recently, dragon capsule returned back to earth after its short test flight, this clears the way for possible tourist flights in the near future.
- It was the first splashdown by U.S. astronauts in 45 years, with the first commercially built and operated spacecraft to carry people to and from orbit.
- The last time NASA astronauts returned from space to water was on July 24, 1975, in the Pacific to end a joint U.S.-Soviet mission known as Apollo-Soyuz.

1.38 Coronal Magnetic Field

- International team of solar has measured the global magnetic field of the Sun's corona, or outer atmosphere, for the very first time.
- The team used a technique known as coronal seismology or magneto seismology to measure the coronal magnetic field which has been known for a few decades.
- This method requires the measurement of the properties of magneto hydrodynamic (MHD) waves and the density of the corona simultaneously.
- The team used the improved measurements of the Coronal Multi-channel Polarimeter (CoMP) and advanced data analysis to measure the coronal magnetic field.
- There are two main puzzles about the Sun which this advancement will help address.
- **Coronal Heating Problem** - Though the core of the Sun is at a temperature of about 15 million degrees, its outer layer, the photosphere is a mere 5700 degrees hot.
- However, its corona or outer atmosphere, which stretches up to several million kilometres beyond its surface, is much, much hotter than the surface.
- It is at a temperature of one million degrees or more, attempts to explain this puzzle invoke the magnetic field of the corona.
- **Mechanisms of Eruptions of the Sun** - Solar flares and coronal mass ejections are driven by magnetic reconnections happening in the Sun's corona.
- Magnetic reconnection is a process where oppositely polarity magnetic field lines connect and some of the magnetic energy is converted to heat energy and also kinetic energy which leads to the generation of heating, solar flares, solar jets, etc.
- **India's Contribution** - India's first solar mission, Aditya-L1 satellite will aim to measure the solar coronal magnetic fields regularly.
- This will help understand the spectacular solar eruptions and predictions of space weather and many more things.

1.39 Coronal Multi-channel Polarimeter

- CoMP is an instrument operated by High Altitude Observatory, of the U.S.
- It is located at Mauna Loa Solar Observatory, near the summit of that volcano on the big island of Hawaii.
- It is very important to measure the coronal magnetic fields regularly since the solar corona is highly dynamic and varies within seconds to a minute time scale.
- While photospheric magnetic fields are measured regularly from space.

1.40 AUDFs01

- A team of Scientists from the Inter University Centre for Astronomy and Astrophysics (IUCAA) has discovered one of the earliest galaxies called AUDFs01 using AstroSat.
- The galaxy is located in the Hubble Extreme Deep field, 9.3 billion light-years away from Earth.
- Hubble eXtreme Deep Field (XDF) is a portion of space that contains approximately 5,500 galaxies, the oldest of which are seen as they were 13.2 billion years ago
- XDF is recorded by the Hubble Space Telescope for over 10 years.



- The galaxy was discovered using UltraViolet Imaging Telescope (UVIT) on Astrosat.
- AstroSat detected Extreme Ultraviolet light from the galaxy.
- Earlier, NASA's Hubble Space Telescope (HST), which is significantly larger than UVIT, did not detect any UV emission from this galaxy because it is too faint.
- AstroSat/UVIT was able to achieve this unique feat because the background noise in the UVIT detector is much less than the ones on HST.

MISSIONS

1.41 Apollo Mission to Moon

- After Apollo 11, the successful crewed mission that made Neil Armstrong the first human to set foot on the Moon, NASA sent six more missions between 1969 and 1972.
- Of these, five succeeded (Apollos 12, 14, 15, 16, and 17) at landing humans on the lunar surface.
- By 2024, the space agency plans to send the first woman and the next man aboard the Artemis mission.
- The Apollo 13 mission was launched from the Kennedy Space Centre in Florida on April 11, 1970, aboard the Saturn V SA-508 rocket.
- Apollo 13 was NASA's seventh crewed mission in the Apollo space program and the third that was to land on the Moon.
- Apollo 11 and 12 – the previous two missions had landed on lunar maria, the dark patches on the near side of the Moon which provide comparatively easier landing abilities.
- Apollo 13 was supposed to make a more challenging landing near the Fra Mauro Crater. Two days into the mission, an explosion caused the oxygen tank in the service module to fail.
- While Apollo 13 did not land on the lunar surface, it was able to return photographs that it took when it looped around the Moon.
- **Fra Mauro formation** - The Fra Mauro formation (or Fra Mauro Highlands) is a formation on the near side of Earth's Moon that served as the landing site for the American Apollo 14 mission in 1971.
- It is named after the 80-kilometer-diameter crater Fra Mauro, located within it. The formation, as well as Fra Mauro crater, take their names from a 15th-century Italian monk and mapmaker of the same name.
- Apollo 13 was originally scheduled to land in the Fra Mauro highlands, but was unable due to an in-flight technical failure.

1.42 Tianwen 1

- China National Space Administration (CNSA) has recently launched its first Mars probe named Tianwen 1 or Quest for Heavenly Truth 1.
- It aims to complete orbiting, landing and roving in a single mission.
- It used China's largest and most powerful launch vehicle Long March-5 rocket for the mission.
- The three scientific objectives -
 1. Orbiting the red planet for comprehensive observation,
 2. Landing on Martian soil
 3. Sending a rover to roam the landing site.
- It will conduct scientific investigations into the planet's soil, geological structure, environment, atmosphere and water, media reports said.
- It should arrive in orbit around the red planet in February 2021.
- China's previous attempt to send an exploratory probe to Mars called Yinghuo-1, in a Russian spacecraft in 2011 was failed.



1.43 X-Ray Polarimeter Satellite

- The X-ray Polarimeter Satellite (XPoSat) is a planned space observatory to study polarization of cosmic X-rays.
- It is planned to be launched in 2021, and to provide a service time of at least five years.
- The telescope is being developed by the Indian Space Research Organization (ISRO) and the Raman Research Institute.
- Studying how radiation is polarized gives away the nature of its source, including the strength and distribution of its magnetic fields and the nature of other radiation around it.
- XPoSat will study the 50 brightest known sources in the universe, including pulsars, black hole X-ray binaries, active galactic nuclei, and non-thermal supernova remnants.

1.44 NASA Perseverance Rover

- Mars Exploration Program (MEP) is a long-term effort to explore the planet Mars, funded and led by NASA.
- Formed in 1993, MEP has made use of orbital spacecraft, landers, and Mars rovers to explore the possibilities of life on Mars, as well as the planet's climate and natural resources.
- NASA's 2020 Mars rover Perseverance is a part of NASA's Mars Exploration Program, is scheduled to launch between July 17 and August 5 to hunt for evidence of extraterrestrial life on the red planet.
- It will investigate an astrobiologically relevant ancient environment on Mars and investigate its surface geological processes and history, including the assessment of its past habitability, the possibility of past life on Mars, and the potential for preservation of biosignatures within accessible geological materials.
- It will cache sample containers along its route for a potential future Mars sample-return mission.
- To achieve its objective, NASA's Perseverance rover will have the most advanced pair of "eyes" ever sent to Mars.
- Its Mastcam-Z instrument packs a next-gen zoom capability that will help the mission make 3D imagery more easily.
- It will not only produce images that enable the public to follow the rover's daily discoveries, but it will also provide key data to help engineers navigate and scientists choose interesting rocks to study.

1.45 Endeavour Spacecraft and Crew Dragon capsule

- Recently SpaceX launched two astronauts to the International Space Station.
- This is the first-ever time that a private spacecraft company, Space X used its own rocket to put humans into space.
- The Falcon 9 rocket lifted off from NASA's Kennedy Space Center carrying SpaceX's Crew Dragon capsule into orbit.
- The astronauts have named the commercial spacecraft after one of the retired winged orbiters 'Endeavour'.

The International Space Station (ISS)

- It is a modular space station (habitable artificial satellite) in low Earth orbit.
- The ISS programme is a multi-national collaborative project between five participating space agencies:
 1. NASA (United States),
 2. Roscosmos (Russia),
 3. JAXA (Japan),
 4. ESA (Europe),
 5. CSA (Canada).
- The ownership and use of the space station are established by intergovernmental treaties and agreements.



- It is suited for testing the spacecraft systems and equipment required for possible future long-duration missions to the Moon and Mars.
- It is the largest artificial object in space and the largest satellite in low Earth orbit, regularly visible to the naked eye from Earth's surface.
- It circles the Earth in roughly 93 minutes, completing 15.5 orbits per day.

1.46 Micius Satellite

- Micius is the world's first quantum communications satellite, launched by China in 2016.
- The satellite serves as the source of pairs of entangled photons.
- Recently, it has sent light particles to the Earth to establish the world's most secure communication link.
- It has successfully brought entanglement-based quantum cryptography to its original ground stations 1,200 km apart by sending simultaneous streams of entangled photons to the ground stations to establish a direct link between the two of them.
- The satellite provided entangled photons as a convenient resource for the quantum cryptography and the two ground stations then used them according to their agreed protocol.
- Until now, this had never been done via satellite or at such great distances.
- It has not been specified how the messages were transmitted in this instance but in theory it could be done by optical fibre, another communications satellite, radio or any other agreed method.
- Scientists have started using quantum encryption for securing long-range communication and Micius has been at the forefront of quantum encryption for several years.

1.47 Mission Hope

- United Arab Emirates' (UAE) first mission to Mars "Hope" was recently launched successfully from Japan Tanegashima Space Center.
- The mission was announced in 2015 with the aim of creating mankind's first integrated model of the Red planet's atmosphere.
- It is the Arab world's first mission to Mars and also first interplanetary mission.
- The Al Amal probe, as it is called in Arabic, is expected to reach Mars by February 2021.
- The probe will stay in orbit for a Martian year, equivalent to 687 days on Earth, to gather data about Mars' atmosphere.
- It will carry the following scientific instruments mounted on one side of the spacecraft -
 1. High-resolution camera called Emirates eXploration Imager (EXI),
 2. Far-UV imaging spectrograph called Emirates Mars Ultraviolet Spectrometer (EMUS), and
 3. Emirates Mars InfraRed Spectrometer (EMIRS) and FTIR scanning spectrometer.

1.48 Solar Orbiter Mission

- Solar Orbiter is a joint ESA & NASA mission to study the Sun.
- It was launched in February 2020
- Solar Orbiter will address big questions in Solar System science like how our star creates and controls the giant bubble of plasma that surrounds the whole Solar System and influences the planets within it.
- Recently scientists from NASA and ESA (European Space Agency) released first data captured solar orbiter.
- In mid-June, Solar Orbiter made its first close pass of the Sun, it has captured the closest images ever taken of the Sun.



1.49 Lunar Polar Exploration

- It is a joint mission by ISRO and Japanese Space Agency JAXA.
- It attempts to put lander and rover on Moon's surface.
- The mission will be launched after 2023.
- Japanese would be building the overall landing module and the rover, while ISRO would develop the lander.

1.50 SunRISE Mission

- US space agency National Aeronautics and Space Administration (NASA) has announced that it has selected a new mission SunRISE to study giant solar particle storms.
- The Sun Radio Interferometer Space Experiment (SunRISE) will look into how Sun generates and releases the giant weather storms, known as the solar particle storms, into space.
- The mission will help in greater understanding of the solar system.
- The findings would safeguard astronauts from solar storms while they travel to Mars or the Moon.
- NASA's Parker Solar Probe will be the first-ever mission to "touch" the Sun.

1.51 DEMO Mission

- DEMO mission aims to send astronauts to the International Space Station (ISS) in Low Earth Orbit.
- It was launched by SpaceX's Falcon 9 rocket and Crew Dragon spacecraft, carrying two NASA astronauts from the Kennedy Space Center in Florida.
- Elon Musk's SpaceX has thus become the first private company to launch human beings into orbit.
- It is part of NASA's Commercial Crew Program with the aim of developing reliable and cost-effective access to and from the International Space Station.
- Recently, dragon capsule returned back to earth after its short test flight, this clears the way for possible tourist flights in the near future.
- It was the first splashdown by U.S. astronauts in 45 years, with the first commercially built and operated spacecraft to carry people to and from orbit.
- The last time NASA astronauts returned from space to water was on July 24, 1975, in the Pacific to end a joint U.S.-Soviet mission known as Apollo-Soyuz.

1.52 BeiDou

- China's administration has officially commissioned BeiDou Navigation Satellite System constellation.
- It aims to integrate its application in different sectors, including fishery, agriculture, special care, mass-market applications, forestry and public security.
- It now offers services including accurate positioning, navigation and timing as well as short message communication.
- BeiDou uses a network of satellites and can provide positional accuracies of under 10 meters, whereas GPS provides positioning accuracies of under 2.2 meters.
- Chinese military has employed Beidou-guided conventional strike weapons to counter a US intervention in a potential contingency, if access to GPS is denied.
- Navigation Systems of other countries are as follows
 1. NAVIC – India
 2. GPS - USA
 3. GLONASS - Russia
 4. GALILEO – EU



2. DEFENCE

GOVERNMENT INITIATIVES

2.1 Quadrilateral Security Dialogue

- The Quadrilateral Security Dialogue (QSD, also known as the Quad) is an informal strategic forum between the USA, Japan, India and Australia.
- It is maintained by semi-regular summits, information exchanges and military drills between member countries.
- The dialogue was paralleled by joint military exercises of an unprecedented scale, titled Exercise Malabar.
- The diplomatic and military arrangement was widely viewed as a response to increased Chinese economic and military power.

2.2 US-India Missile Deal

- The U.S. State Department has approved two potential missile deals with India, for an estimated \$92 million and \$63 million.
- AGM-84L Harpoon Block II air launched missiles and related equipment - These missiles can be fitted onto Boeing's 8-PI (Poseidon Eight India) maritime patrol aircraft and are intended to enhance India's capability in anti-surface warfare while defending its sea lanes.
- The other deal contracted with Raytheon Integrated Defense System, is for
 1. MK 54 All Up Round Lightweight Torpedoes (LWT).
 2. MK 54 Exercise Torpedoes.
 3. Recoverable Exercise Torpedoes (REXTORP).
- These torpedoes are expected to enhance India's anti-submarine warfare capability and can be used with the P-8I.
- There are no known offset agreements for both deals, and any offset agreements will be defined in negotiations between India and the contractors.
- The Defense Security Cooperation Agency delivered the required certification to the U.S. Congress, notifying it of the possible sale.
- As per the U.S.'s Arms Export Control Act, U.S Congress has 30 days to raise objections to the sale in the case of India.

2.3 Defence Testing Infrastructure Scheme

- Union Government has approved the launch of Defence Testing Infrastructure Scheme (DTIS).
- It aims to give a boost to domestic defence and aerospace manufacturing.
- It has an outlay of Rs 400 crore for creating state of the art testing infrastructure for defence testing sector.
- It envisages to setup six to eight new test facilities in partnership with private industry.
- This will facilitate indigenous defence production, consequently reduce imports of military equipment and help make the country self-reliant.
- The projects under the Scheme will be provided with up to 75% government funding in the form of 'Grant-in-Aid'.
- The remaining 25% of the project cost will have to be borne by the Special Purpose Vehicle (SPV) whose constituents will be Indian private entities and State Governments.
- The SPVs under the Scheme will be registered under Companies Act 2013 and shall also operate and maintain all assets under the Scheme, in a self-sustainable manner by collecting user charges.



- While majority of test facilities are expected to come up in the two Defence Industrial Corridors (DICs), the Scheme is not limited to setting up Test Facilities in the DICs only.

2.4 Defence Industrial Corridor in India

- Union Government in 2019, has set up defence industrial corridors in Uttar Pradesh and Tamil Nadu.
- These defence corridors will facilitate a well-planned and efficient industrial base that will lead to increased defence production in the country.
- The corridors overlap with existing defence public sector companies, and aim to ensure connectivity among various defence industrial units.
 1. Uttar Pradesh Defence Industrial Corridor includes - Lucknow, Kanpur, Agra, Aligarh, Chitrakoot and Jhansi.
 2. Tamil Nadu Defence Industrial Corridor includes - Chennai, Hosur, Salem, Coimbatore and Tiruchirappalli.

2.5 Operation Samudra Setu

- Indian Navy has launched Operation Samudra Setu - meaning Sea Bridge, as a part of national effort to repatriate Indian citizens from overseas.
- Indian Naval Ships Jalashwa and Magar are presently enroute to Malé in Maldives to commence evacuation operations.
- A total of one thousand persons are planned to be evacuated during the first trip.
- The evacuated personnel will be disembarked at Kochi in Kerala and entrusted to the care of State authorities.
- This operation is being progressed in close coordination with Ministries of Defence, External Affairs, Home Affairs, Health and various other agencies of the Government of India and State governments.

2.6 Operation Sanjeevani

- Under Operation Sanjeevani an Indian Air Force (IAF) C-130J transport aircraft delivered 6.2 tons of essential medicines and hospital consumables to Maldives.
- These medicines and consumables were procured from eight suppliers in India but couldn't be transported through any other means due to the 21-day lockdown imposed to contain the spread of COVID-19.
- At the request of the government of Maldives, the IAF aircraft activated Operation Sanjeevani and lifted these medicines from airports in New Delhi, Mumbai, Chennai and Madurai before flying to the Maldives.
- Among other things, these medicines include influenza vaccines, anti-viral drugs such as lopinavir and ritonavir which have been used to treat patients with COVID-19 in other countries.

2.7 Mission Sagar

- India has sent Indian Naval Ship (INS) Kesari, carrying food items and medical assistance teams, to countries in the southern Indian Ocean to deal with Covid-19 pandemic as part of a "Mission Sagar" initiative.
- The countries including Maldives, Mauritius, Madagascar, Comoros and Seychelles had requested India for assistance in dealing with the Covid-19 pandemic.
- Under the Mission, India will Deploy Medical Assistance Teams in Mauritius and Comoros, helping their Governments deal with Covid emergency and in case of Comoros, with dengue fever also.
- Deliver consignments of Covid related essential medicines to Mauritius, Madagascar, Comoros and Seychelles and about 600 tonnes of food items to Maldives.
- In addition, in case of Mauritius, a special consignment of Ayurvedic medicines is also being sent.
- The consignments also include Hydroxychloroquine tablets.
- This is the first time that a single assistance mission is covering all island countries of the western Indian Ocean in one go (except Sri Lanka, for which a second set of medicines have been airlifted)



- The assistance is in line with India's role as the first responder in the Indian Ocean region.
- The deployment is also in consonance with the Prime Minister's vision of Security and Growth for All in the Region (SAGAR).
- Under the mission INS Magar, is the second Indian Naval ship to reach Male, Maldives for evacuation of Indian citizens.

2.8 Agneeprastha

- Recently, the foundation stone for a missile park "Agneeprastha" was laid at INS Kalinga.
- The Missile Park 'AGNEEPRASTHA' aims to capture glimpses of missile history of INS Kalinga from its establishment in 1981 till date.
- It has been set up with a replica of missiles and Ground Support Equipment (GSE) that showcase the evolution of missiles handled by the unit.
- P-70 'Ametist', an underwater launched anti-ship missile from the arsenal of the old 'Chakra' (Charlie-1 submarine) which was in service with Indian Navy during 1988-91 is the main attraction point in the Park.
- AGNEEPRASTHA will provide a one-stop arena for motivation and stimulation of curious minds regarding the missiles and related technologies, from school children to Naval personnel and their families.
- It will be dedicated to all the officers, sailors and support staff of INS Kalinga.
- It will also commemorate the award of the prestigious Unit Citation to INS Kalinga for the year 2018-19.

INS Kalinga

- INS Kalinga is a premier Naval Establishment located on the Visakhapatnam-Bheemunipatnam beach road under the Eastern Naval Command.
- Recently a 2 MegaWatts (MW) solar photovoltaic plant was commissioned at INS Kalinga.
- This is in tune with the initiative of the Union government to promote solar power and the objective to achieve 100 GW of solar power by 2022 as part of the National Solar Mission.

2.9 Solar Power Plant of Navy

- Recently Indian Navy inaugurated 3 MW Solar Power Plant at Indian Naval Academy, Ezhimala.
- The solar plant is the largest in the Indian Navy and has an estimated life of 25 years.
- This is in line with the 'National Solar Mission' to achieve 100GW of solar power by 2022.
- All components have been indigenously sourced, including 9180 highly efficient monocrystalline solar panels employing the latest technology.
- The project has been executed by Kerala State Electronics Development Corporation Ltd (KELTRON)

2.10 Draft Defence Production and Export Promotion Policy 2020

- Recently, the Ministry of Defence (MoD) has formulated a draft Defence Production and Export Promotion Policy 2020 (DPEPP 2020).
- It aims to provide impetus to self-reliance in defence manufacturing under Atmanirbhar Bharat Package.
- The policy aims to achieve a turnover of Rs 1,75,000 Cr (US\$ 25Bn) including export of Rs 35,000 Cr (US\$ 5 Billion) in Aerospace and Defence goods and services by 2025.
- **The Policy brings out multiple strategies under the following focus areas:**
 1. Procurement Reforms
 2. Indigenization & Support to MSMEs/Startups
 3. Optimize Resource Allocation
 4. Investment Promotion, FDI & Ease of Doing Business
 5. Innovation and R&D

6. DPSUs and OFB
7. Quality Assurance & Testing Infrastructure
8. Export Promotion

2.11 Srijan Portal

- Defence Ministry has launched 'SRIJAN' portal, a one stop shop online portal.
- The portal provides access to the vendors to take up items that can be taken up for indigenization.
- On this portal, DPSUs/OFB/SHQs can display their items which they have been importing or are going to import which the Indian Industry can design, develop and manufacture as per their capability or through joint venture with OEMs.
- The concerned DPSUs/OFB/SHQs, based on their requirement of the items and their guidelines & procedures will interact with the Indian industry for indigenization.

2.12 Naval Innovation & Indigenization Organization

- Union Defence ministry has launched the Naval Innovation and Indigenization Organization (NIIO).
- Draft Defence Acquisition Policy 2020 (DAP 20) envisaged establishment of NIIO by the Service Headquarters.
- The NIIO is a three-tiered organization.
- 1. **Naval Technology Acceleration Council (N-TAC)** will bring together the twin aspects of innovation and indigenization and provide apex level directives.
- 2. **A working group** under the N-TAC will implement the projects.
- 3. **A Technology Development Acceleration Cell (TDAC)** has also been created for induction of emerging disruptive technology in an accelerated time frame.
- The NIIO puts in place dedicated structures for the end users to interact with academia and industry towards fostering innovation and indigenization for self-reliance in defence.

2.13 DB Shekatkar Committee

- *Defence Minister Rajnath Singh has recently approved the abolition of 9,304 posts in the Military Engineering Service.*
- An official statement said that there was a proposal of Engineer-in-Chief of Military Engineering Services (MES) for optimisation of more than 9,300 posts in the basic and industrial workforce.
- It is in line with the recommendations of the **DB Shekatkar Committee**.
- The Committee of Experts (CoE) constituted by the Ministry of Defence under the chairmanship of **Lt. Gen (Retd) DB Shekatkar** was mandated to recommend measures **to enhance combat capability and rebalance defence expenditure** of the armed forces.
- It submitted its report in December 2016.



MISSILES & DEFENCE SYSTEMS

2.14 Astra Missiles

- Astra missiles are Beyond Visual Range (BVR) air-to-air missile.
- It is designed to be mounted on a fighter aircraft and is also designed to engage and destroy highly manoeuvring supersonic aircraft.
- It has a range of over 70 km and can fly towards its target at a speed of over 5,555 km per hour.
- The missile has all-weather day and night capability.
- The missile has been indigenously developed by DRDO, along with almost 50 other public and private organizations.

2.15 Pinaka Ammunition

- The Pinaka weapon system is an all-weather, indirect fire, free flight artillery rocket system.
- It consists of Multi Barrel Rocket launcher, Battery Command Post, Loader cum Replenishment Vehicle, Replenishment Vehicle and Digi Cora MET Radar.
- It is developed by Defence Research and Development Organization (DRDO).

2.16 Dhruvastra

- Recently trials of India's Helicopter-launched Nag Missile anti-tank guided missile (HELINA), were successfully conducted.
- HELINA now known as Dhruvastra, is developed by DRDO.
- It is a third-generation fire and forget class anti-tank guided missile (ATGM) system that has been mounted on the Advanced Light Helicopter (ALH).
- The system consists of all the weather day and night capability and can easily defeat battle tanks with a conventional armor and explosive reactive armor.
- The missile can also engage targets both in the direct hit mode and as well as top attack mode.

2.17 Tsirkon Hypersonic N-Missile

- Russian administration announced on Russian Navy would be equipped with hypersonic nuclear strike weapons and underwater nuclear drones.
- Tsirkon hypersonic cruise missile is designed to be carried on surface ships, it is under final phase of testing.
- The combination of maneuverability, speed, and altitude of the hypersonic missiles makes them capable of traveling at more than five times the speed of sound and therefore difficult to track and intercept.
- Poseidon underwater nuclear drone is intended to be carried by submarines is another weapon under testing.

2.18 Man-Portable Anti-Tank Guided Missile

- The MPATGM, or Man Portable Anti-Tank Guided Missile, is an Indian third-generation fire-and-forget anti-tank guided missile derived from Nag ATGM.
- It is currently under development by the DRDO.
- It is fitted with high-explosive anti-tank (HEAT) warhead.
- The MPATGM is equipped with an advanced imaging infrared (IIR) sensor and integrated avionics.
- It reportedly share many similarities with Spike (ATGM).

2.19 Spike Missiles

- Spike is an Israeli fire-and-forget anti-tank guided missile and anti-personnel missile.

- It was developed and designed by the Israeli company Rafael Advanced Defense Systems.
- It is available in man-portable, vehicle-launched, and helicopter-launched variants.
- Indian Army is planning to place orders for more Spike anti-tank guided missiles from Israel under the emergency financial powers granted to the services.

2.20 DRDO Jets for Indian Navy

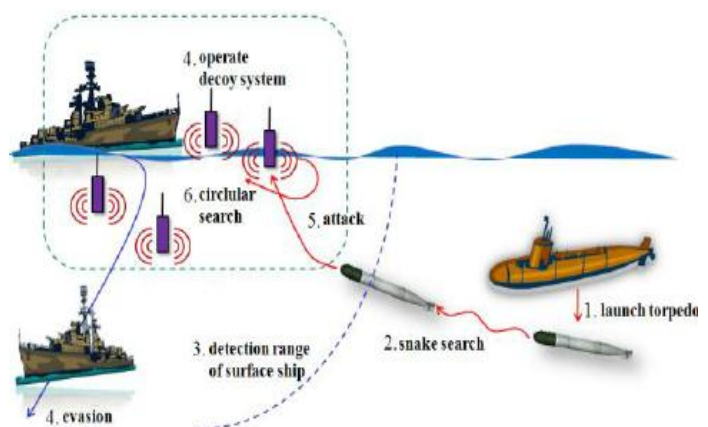
- Indian Navy expects to have the first Indigenous Aircraft Carrier (IAC-I) Vikrant operational by 2022.
- It currently operates Russian-origin carrier INS Vikramaditya
- With a second carrier to come in, the Navy is already evaluating a global tender for 57 carrier-based twin-engine fighter aircraft.
- Based on new demand, DRDO has offered to develop a twin-engine deck-based fighter for the Navy, which will be ready by 2026.
- It will replace the MiG-29Ks in service which are scheduled to start going out by 2034.

2.21 Heron UAV

- The IAI Heron is a medium-altitude long-endurance unmanned aerial vehicle (UAV) developed by the Israel Aerospace Industries.
- It is capable of Medium Altitude Long Endurance (MALE) operations of up to 52 hours' duration at up to 10.5 km (35,000 ft).
- It has demonstrated 52 hours of continuous flight, but the effective operational maximal flight duration is less, according to payload and flight profile.
- Heron unmanned aerial vehicles are already in use with Indian Air Force, Navy, and the Army.
- It is being used extensively at the moment by both Army surveillance and Air Force in the Ladakh sector.
- Indian forces are working towards inducting an armed version of the UAV, under the ambitious 'Project Cheetah' spearheaded by the Indian Air Force.

2.22 Maareech

- It is an Advanced Torpedo Defence System (ATDS) that is capable of being fired from all frontline ships.
- It has been designed and developed indigenously by DRDO.
- It is capable of detecting, locating and neutralizing incoming torpedoes.
- It applies counter-measures to protect the naval platform against attack.
- Bharat Electronics Limited, a Defence PSU, would undertake the production of this decoy system.
- Torpedoes are self-propelled weapons with a warhead and can be used under or on the water surface.
- They are one of the mainstay of sea-warfare attack systems.



2.23 ICGS Sachet

- Recently, the Defence Minister of India has commissioned Indian Coast Guard Ship (ICGS) Sachet and two Interceptor Boats (IBs) C-450 and C-451 in Goa via video conference.



- It is the first in the series of five Offshore Patrol Vessels (OPVs) and has been designed and built indigenously by Goa Shipyard Limited (GSL) and is fitted with state-of-the-art navigation and communication equipment.
- The 105 metre long ship is designed to carry a twin-engine helicopter, four high speed boats, one inflatable boat for swift boarding and search and rescue operations.
- The ship is also capable of carrying limited pollution response equipment to undertake oil spill pollution response at sea.
- It is for the first time in Indian maritime history that a ship was commissioned through digital medium, maintaining strict protocol of social distancing in the backdrop of Covid-19 pandemic.

2.24 RV Sindhu Sadhana

- CSIR- NIO acquired India's first multidisciplinary oceanographic research vessel, RV Gageshani, in 1976.
- The vessel enhanced the capabilities of Indian oceanographers and enabled the development of multi-disciplinary oceanographic research in the country.
- After rendering commendable service for 18 years, during which time over 200 cruises were undertaken in all parts of the Indian Ocean, R.V. Gageshani was decommissioned in 1994.
- In 2012, a new multi-disciplinary oceanographic research vessel Sindhu Sadhana was acquired by NIO.
- It will have capabilities to undertake basin scale observations and will enable Indian oceanographers to take up studies not only in the seas around India, but also in any part of the Indian Ocean.
- It is aimed to serve as a stable platform allowing operation of sensible equipment and underway data acquisition.
- Another research vessel of NIO is "Sindhu Sankalp".

2.25 Ninja UAVs

- Recently, Indian Railways started deploying "Ninja UAVs" for establishing a drone-based surveillance system.
- It will be deployed in railway areas like station premises, Railway track sections, yards, workshops, etc.
- They are capable of real-time tracking, video streaming and may be operated on Automatic Fail-Safe mode
- They can be used to launch surveillance on criminal and anti-social activities like gambling, throwing of garbage, hawking etc in Railway premises.
- It can be used at disaster sites for helping in rescue, recovery and restoration and coordination in efforts of various agencies.
- A team of Railway Protection Force (RPF) has been trained for drone flying, surveillance and maintenance.

2.26 Sarthak

- Sarthak is an offshore Patrol Vessel (OPV), 4th in the series of five OPVs deployed by the Coast Guard to enhance maritime security.
- The Ship is fitted with state-of-the-art Navigation and Communication equipment, sensor and machinery.
- The ship is designed to embark and carry a twin-engine helicopter, four high speed boats and one inflatable boat for swift boarding and Search & Rescue operations.

2.27 Hammer Missile

- Highly Agile Modular Munition Extended Range Missiles (HAMMER) is a medium-range modular air-to-ground weapon designed for the French Air Force and the Navy.
- It a rocket-enabled precision missile with a range of 60 km perfectly suited for high altitude.
- India has decided to fit HAMMER missiles on the newly-acquired Rafale jet aircraft
- Earlier Rafale jets with HAMMER missiles carried out airstrikes in Libya, Afghanistan, Iraq, and Syria.

- Apart from the HAMMER missiles, the Rafale aircraft will also be armed with beyond-visual range missiles like Meteor, SCALP, and MICA, increasing their ability to take on incoming targets from a distance.

2.28 Munitions and their origins

- **HAMMER** - Highly Agile Modular Mmunition Extended Range Missile - Made in France
- **MICA** - Fire and Forget short and Medium-Range Missile System - Made in France
- **Meteor** - Radar guided beyond-visual-range air-to-air missile - Made in France
- **SCALP** - Beyond visual range air to air missile - Made in France
- **SPICE** - Smart, Precise Impact, Cost-Effective Air-to-Surface missile - Made in Israel
- **Storm Shadow** - General Purpose Long Range Cruise Missile - Made in UK

S.No	Exercise	Countries	Highlights
1.	Malabar	India, US and Japan – Naval exercise	Started in 1992 between India and US Expanded to trilateral format in 2015. Planning to include Australia.
2.	Pitch Black	Multilateral Air combat training hosted by Australia.	2020 edition cancelled due to Covid 19. Biennial exercise. Note – AUSINDEX – Naval exercise between India and Australia.
3.	Red Flag	USA's flagship multilateral Air exercise	India joined the exercise in 2008 and take part in it with its Sukhoi Su-30 fighter jets
4.	PASSEX	India and US Navy	Conducted near Andaman and Nicobar islands India also conducted similar PASSEXs with the Japanese Navy and the French Navy in the recent past.
5.	Kavkaz 2020	Multilateral strategic command-post exercise held in Russia	18 countries including China, Iran, Pakistan and Turkey apart from other Central Asian Republics part of the SCO. India also take part in the exercise.

3. HEALTH

3.1 Syndemic

- World Health Organization (WHO) announced that Covid-19 less likely to be eliminated (i.e. may become endemic).
- The possibilities of Covid-19 being syndemic have been raised in the backdrop of the announcement.
- Classification of Diseases based on spread and occurrence
 1. **Pandemic** - A pandemic is declared when a new disease for which people do not have immunity spreads around the world beyond expectations.
 2. **Epidemic** - An epidemic is a large outbreak, one that spreads among a population or region. It is less severe than pandemic due to a limited area of spread.
 3. **Endemic** - A disease is called endemic when the presence or usual prevalence of its infectious agent is constant within a given geographical area or population group.



4. **Syndemic** - A Syndemic is a situation when two or more epidemics interact synergistically to produce an increased burden of disease in a population.

- The least possibility of elimination of Covid-19 pandemic and warning about the second wave of Covid-19 infections worldwide have reinforced the presence of Covid-19 for the long term.
- Meanwhile, the alarm is being raised about diseases like dengue and malaria emerging with the upcoming monsoon season in tropical South Asia.
- Thus, there is a possibility that the world will face increased burden of the diseases and thus the situation of syndemic.
- The second wave of infection due to Covid-19 is suspected to be seen in those with weakened immunity.
- At the same time, the world already faces antibiotic resistance and if Covid-19 deepens as a syndemic in populations with antibiotic resistance, the world will face comorbidities (Co-morbidity is the presence of one or more additional conditions co-occurring with a primary condition)

3.2 B814 Virus

- The first human coronavirus was discovered in 1965 by scientists DJ Tyrell and ML Bynoe, years after the disease was found in animals.
- They isolated a virus from the nasal washings of a male child who had symptoms and signs of a common cold.
- It was found that the washings were able to induce common colds in volunteers intranasally.
- The duo called the virus B814, and found that while they were able to cultivate the virus in human embryo tracheal organ tissue, they were unable to do so in routine cell lines.
- At the time of delivery, B814 strain was a virus virtually unrelated to any other known virus of the human respiratory tract.

3.3 Latent Virus

- A latent viral infection is an infection that is inactive or dormant.
- Latent infections are essentially static which last the life of the host and occur when the primary infection is not cleared by the adaptive immune response.
- Examples are
 - a) Herpes simplex viruses type 1 and 2,
 - b) Varicella-zoster virus,
 - c) HIV,
 - d) Epstein-Barr virus (human herpesvirus 4),
 - e) Cytomegalovirus.
- Latent viral infections can be reactivated into a lytic form (the replication of a viral genome).
- The ability to move back and forth from latent to lytic infections helps the virus spread from infected individuals to uninfected individuals.
- Scientists speculate that SARS-CoV-2 is a latent virus infection which can recur.

3.4 African Swine Flu

- ASF is a highly contagious and fatal animal disease that infects domestic and wild pigs, typically resulting in an acute form of hemorrhagic fever.
- It was first detected in Africa in the 1920s.
- The mortality is close to 100 per cent, and since the fever has no cure, the only way to stop it spreading is by culling the animals.
- ASF is not a threat to human beings since it only spreads from animals to other animals.



- According to the FAO, its extremely high potential for transboundary spread has placed all the countries in the region in danger and has raised the spectre of ASF once more escaping from Africa.
- It is a disease of growing strategic importance for global food security and household income.
- Around 2,800 pigs have died in Assam since February due to African Swine Fever virus, making the state the epicenter of ASF in India.

3.5 Parkinson Disease

- Parkinson's disease is a chronic, degenerative neurological disorder that affects the central nervous system.
- It damages nerve cells in the brain dropping the levels of dopamine. Dopamine is a chemical that sends behavioral signals from the brain to the body.
- The disease causes a variety of "motor" symptoms (symptoms related to movement of the muscles), including rigidity, delayed movement, poor balance, and tremors.
- Medication can help control the symptoms of the disease but it can't be cured.
- It affects the age group from 6 to 60 years.
- An aggregation of a protein called Alpha-synuclein (ASyn) plays a crucial role in the development of Parkinson's disease.
- Protein aggregation is a biological phenomenon in which destabilized proteins aggregate (i.e., accumulate and clump together) leading to many diseases.
- Alpha-synuclein is a protein found in the human brain, while smaller amounts are found in the heart, muscle and other tissues.
- Recently, scientists from IIT (Indian School of Mines) Dhanbad and CSIR-Indian Institute of Chemical Biology (Kolkata) have developed the Z-scan method to monitor the origin as well as the progression of Parkinson's disease in human beings.
- The discovered Z-scan method is expected to help in monitoring both the early as well as late stages of the aggregation of ASyn and death of neuronal cells.

3.6 Sickle Cell Disease

- It is a blood disorder that arises when both parents have the problem gene and pass it on to their child.
- If only one parent has the problem gene, then the child will not have symptoms but will have the gene called the 'sickle cell trait'.
- With sickle cell disease, the red blood cells have an abnormal crescent shape, taking the shape of a sickle, hence, its name.
- The sickle shape results in the red blood cells becoming rigid and sticky, getting stuck in the smaller blood vessels as they circulate in the body.
- This disrupts the supply of oxygen to parts of the body and results in symptoms such as anemia, episodes of pain due to bone and joint damage, swelling in the extremities, increased risk of infections, hampering of normal growth, and problems with the vision.
- In India, it is more common in south Gujarat, north Maharashtra, Madhya Pradesh, Chhattisgarh, and western Odisha with a smaller concentration in the southern regions in India.
- In 2008, the UN General Assembly recognized it as a public health problem and "one of the world's foremost genetic diseases".
- World Sickle Cell Day is observed on 19th June each year to raise awareness of sickle cell at a national and international level.

3.7 Rheumatoid Arthritis

- Rheumatoid arthritis (RA) is a long-term autoimmune disorder that primarily affects joints.
- It typically results in warm, swollen, and painful joints.



- Most commonly, the wrist and hands are involved, with the same joints typically involved on both sides of the body.
- This may result in a low red blood cell count, inflammation around the lungs, and inflammation around the heart.
- While the cause of rheumatoid arthritis is not clear, it is believed to involve a combination of genetic and environmental factors.
- Pain medications, steroids, and NSAIDs are frequently used to help with symptoms.

3.8 G4 Virus

- Recently, scientists have identified a “newly emerged” strain of influenza virus that is infecting Chinese pigs and that has the potential of triggering a pandemic.
- Named G4, scientists believe that it has descended from the H1N1 strain that was responsible for the 2009 swine flu pandemic.
- A Pandemic happens if a new strain emerges that can easily spread from person to person.
- It has the capability of binding to human-type receptors (like, the SARS-CoV-2 virus).
- However, it is not clear whether the new strain can transmit from one human to another.

3.9 H1N1 Pandemic

- Swine flu is a respiratory disease of pigs, caused by a strain of H1N1 virus, which was transmitted from human to human.
- It was known in the past to occur in people who had been in the vicinity of pigs.
- While humans typically do not get infected by such a virus that circulates among pigs, when they do, it is called “variant influenza virus”.
- The virus is transmitted by short-distance airborne transmission, particularly in crowded enclosed spaces.
- The treatment includes antiviral therapy with medicines like Oseltamivir (Tamiflu), peramivir (Rapivab).

3.10 Measles and Rubella Elimination

- Recently, the Maldives and Sri Lanka have become the first two countries in the World Health Organisation’s South-East Asian Region (WHO SEAR) to have eliminated both measles and rubella ahead of the 2023 deadline.
- The Maldives reported its last endemic case of measles in 2009 and of rubella in October 2015.
- Sri Lanka reported the last endemic case of measles in May 2016 and of rubella in March 2017.
- In September 2019, member countries of WHO SEAR set 2023 as the target for the elimination of measles and rubella.
- Earlier Bhutan, DPR Korea and Timor-Leste are countries in the region which have eliminated measles.
- Earlier Bangladesh, Bhutan, Maldives, Nepal, Sri Lanka and Timor-Leste have controlled Rubella.
- A country is verified as having eliminated measles and rubella when there is no evidence of endemic transmission of the respective viruses for over three years in the presence of a well-performing surveillance system.

Measles

- It is a highly contagious viral disease and is a cause of death among young children globally.
- It is particularly dangerous for children from the economically weaker background, as it attacks malnourished children and those with reduced immunity.
- It can cause serious complications, including blindness, encephalitis, severe diarrhoea, ear infection and pneumonia.



Rubella

- Rubella is a contagious, generally mild viral infection that occurs most often in children and young adults.
- It is also called German measles.
- Rubella infection in pregnant women may cause death or congenital defects known as Congenital Rubella Syndrome (CRS) which causes irreversible birth defects.

3.11 Ovarian Cancer

- Ovarian cancer affects the female organs that produce eggs (ovaries).
- Ovarian cancer often goes undetected until it has spread within the pelvis and stomach.
- At this late stage, ovarian cancer is more difficult to treat and can be fatal.
- Ovarian cancer often has no symptoms in the early stages.
- Later stages are associated with symptoms, but they can be non-specific, such as loss of appetite and weight loss.
- The symptoms of this cancer tend to mimic other gastrointestinal conditions acidity, ascites or a bloated feeling.
- Surgery and chemotherapy are generally used to treat ovarian cancer.
- The crude incidence rate for ovarian cancer in India is 5 to 6 per 1,00,000. Stage IIIC cancers account for nearly 75%, with survival among them being around 30-40%.

3.12 Bubonic plague

- Bubonic plague is a rare but serious zoonotic disease.
- It is caused by bacterial infection and transmitted by fleas from rodents.
- It mainly results from the bite of an infected flea, and also from exposure to the body fluids from a dead plague-infected animal.
- There are no reports of human to human transmission of bubonic plague.
- It is one of the three plagues caused by bacterium *Yersinia pestis*.
- The other two being Septicaemic plague and Pneumonic plague.
- According to the WHO it can kill an adult in less than 24 hours, if not treated in time.
- Vaccine for the bubonic plague is available for individuals with high exposure to the plague.
- Recently a city in northern China sounded an alert after a suspected case of bubonic plague or 'Black Death' was reported.

3.13 Kawasaki Disease

- Around the world, children with Covid-19 infection have often shown some symptoms similar to those associated with a rare illness called Kawasaki disease
- It typically affects children aged under five with symptoms like red eyes, rashes, and a swollen tongue with reddened lips often termed strawberry tongue and an inflamed blood vessel system all over the body.
- There is constant high fever for at least five days, it also affects coronary functions in the heart.
- The causes of the Kawasaki Disease are not yet known.
- The strawberry tongue may or may not be present in those with Covid-19.
- In Covid-19 cases, even adolescents are presenting these symptoms.
- Steroids remain a key treatment to reduce inflammation.



3.14 Nano Medicine for Visceral Leishmaniasis

- Visceral Leishmaniasis (VL) is also called as Kala- Azar is one of the most neglected tropical diseases.
- It is characterized by irregular bouts of fever, substantial weight loss, swelling of the spleen and liver, and anaemia (which may be serious).
- If the disease is not treated, the fatality rate in developing countries can be as high as 100% within 2 years.
- Around 95% of which is reported from Bangladesh, Brazil, China, Ethiopia, India, Kenya, Nepal, Somalia, South Sudan, and Sudan.
- Scientists from the Institute of Nano Science & Technology (INST), have developed an oral Nano medicine, for combating Visceral Leishmaniasis (VL).
- The Oral Nano medicine has been developed with the help of surface-modified solid lipid nanoparticles based combinational cargo system.
- The oral therapeutics could help in the control and elimination of VL.

3.15 Plasmodium Vivax Malaria

- Plasmodium vivax is a protozoal parasite and a human pathogen.
- This parasite is the most frequent and widely distributed cause of recurring malaria.
- Recently, an international team has developed a system to breed the parasite Plasmodium vivax in the lab and then infect cultured human liver cells with it.
- The parasite can remain in the liver in a dormant stage and relapse later.
- It can be difficult to detect P. vivax, since it usually circulates at low levels in the blood.
- 4 countries account for more than 80% of estimated cases of P. vivax cases (Ethiopia, India, Indonesia, and Pakistan).
- Certain malaria-endemic countries have even abandoned chloroquine for P. vivax treatment but fortunately chloroquine is still effective in India.
- The currently used anti-relapse drug, Primaquine, has many undesirable side-effects, especially in patients with a genetic defect called

3.16 G6PD deficiency

- Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an inherited condition usually occurring in males.
- It is condition causing red blood cells to break down in response to certain medication, infections or other stresses.
- It's more common in those of African and Mediterranean descent.
- Triggers include infections, stress, fava beans, aspirin and other drugs.
- When symptoms are triggered, they include fever, dark urine, abdominal and back pain, fatigue and pale skin.
- Most people recover in a few days without treatment.
- However, patients are at risk of recurrent episodes, so avoidance of triggers is critical.
- The deficiency is chronic and cannot be cured.

3.17 Yellow Fever

- Yellow fever is caused by a virus that is spread by the Aedes aegypti mosquito.
- These mosquitoes thrive in and near human habitations where they breed in even the cleanest water.
- It is endemic in 34 countries in the sub-Saharan African region, despite the existence of a vaccine for the disease.
- There are three transmission 'cycles' for the disease in Africa - Urban, zoonotic and intermediate.



- The urban cycle mediated by *Aedes aegypti* mosquitoes is responsible for explosive outbreaks.
- According to new study the disease is projected to shift to Central and East Africa from West Africa by 2050.
- The study also highlighted that vaccination is the most important and effective measure against yellow fever.

3.18 India TB Report 2020

- The report was released recently by the Union Minister of Health & Family Welfare.
- According to the report, National Tuberculosis Elimination Programme has comprehensively moved closer to near-complete online notification of all TB cases in the country through the NIKSHAY portal.
- Under the programme, in 2019, Nagaland and Tripura have been awarded for being the best performing among small states (Population - less than 50 lakh)
- Gujarat, Andhra Pradesh and Himachal Pradesh were awarded as best performing States among larger states (Population - more than 50 lakh)
- Dadra & Nagar Haveli and Daman & Diu were chosen as the best performers in the category of Union Territory.

3.19 Magnetic Hyperthermia-Mediated Cancer Therapy (MHCT)

- Scientists from Institute of Nano Science & Technology (INST) are making efforts to make magnetic hyperthermia-mediated cancer therapy as desired therapy for inoperable tumours.
- INST is an autonomous institute of Department of Science and Technology (DST).
- Magnetic hyperthermia-mediated cancer therapy (MHCT) is a non-invasive cancer treatment.
- The technique involves the delivery and localization of magnetic materials within the targeted tumour site followed by subsequent application of an alternating magnetic field (AMF), thereby generating heat at the tumour site.
- It can efficiently act against deep-seated inaccessible solid tumours like glioblastoma and is highly thermo-sensitive towards normal cells with minimal toxicity against healthy counterparts.
- Scientists are on the lookout for new materials which can make this treatment more efficient.

3.20 Project AHANA

- Mother to child transmission is a major cause of HIV in children.
- AHANA, a flagship national programme, is working for a world where no child is born with HIV/Acquired Immunodeficiency Syndrome (AIDS).
- It focuses on the elimination of mother-to-child transmission of HIV and is implemented by Plan India with support from The Global Fund.
- AHANA is being implemented in close coordination with the National AIDS Control Organisation (NACO) and National Health Mission (NHM) to influence policies and strategies in both the design and implementation phases of the National Health Mission Programme.
- AHANA aims to cover 55% of India's annual pregnancy load and reach 16.5 million annual pregnancies across 357 districts in 14 states each year with HIV testing.
- AHANA also provides care and support to HIV exposed babies until they are 18 months old, along with facilitating postpartum care for the lactating mother.

3.21 Global Nutrition Report 2020

- In 2012, the World Health Assembly identified six nutrition targets for maternal, infant and young child nutrition to be met by 2025.
- According to the report, India will miss targets for all four nutritional indicators - stunting among under-5 children, anaemia among women of reproductive age, childhood overweight and exclusive breastfeeding.



- India is identified as among the three worst countries, along with Nigeria and Indonesia in the category of Stunting.
- It also identified the country as one with the highest rates of domestic inequalities in malnutrition.

COVID - 19

3.22 Intensification of Research in High Priority Area (IRPHA)

- Science and Engineering Research Board (SERB) is an autonomous body under DST.
- Under its Intensification of Research in High Priority Area (IRPHA) scheme, SERB had invited competitive proposals having a strong interdisciplinary component to ramp up national R&D efforts for epidemiological studies such as
 1. Studies on immune response and immunity during respiratory viral infections,
 2. New anti-viral, vaccines
 3. Affordable diagnostic against COVID-19 and related respiratory viral infections.
- Apart from this, SERB also invited short-term 'Core Research Grant Special Call on COVID-19' to meet the current requirements of the health workers such as
 1. Affordable and portable rapid diagnostic kits or tools,
 2. Computational identification and validation of COVID-19 molecular targets,
 3. Drug repurposing against key COVID-19 targets and in-vitro/clinical dose testing of nutritional supplements for immunity.
- Tracking and trailing the virus through a data-driven approach is an important step to contain its spread. In this direction, SERB has announced short-term project on mathematical modeling of COVID-19 spread;
- In the absence of preventive and curable measures, mathematical models may help in assessing the potential for sustained transmission to occur in new areas.

3.23 Reverse Zoonosis

- Zoonosis is an infectious disease caused by a pathogen that has jumped from an animal to a human.
- When the pathogen is transmitted from human to animals, it is known as reverse zoonosis.
- The animal infected through the process may in turn re-transmit the infection to humans under some circumstances.
- Recently novel coronavirus SARS-CoV-2 has begun infecting minks farms in the Netherlands.
- It could largely have been transmitted through indirect routes such as through feed or bedding material, infectious droplets or by contaminated dust from the bedding.
- Literature has shown that the phenomenon of reverse zoonosis can also happen in case of other pathogens such as resistant bacteria.
- This can add to the greater spread of bacterial infections in animals.
- It can also involve an increased use of antibiotics to treat or prevent such infections, eventually contributing to another slow pandemic of antimicrobial resistance.

3.24 COVID-19 Transmission to New Born

- Recently a three-day-old baby and his mother tested positive for COVID-19 in a private lab in Mumbai, but subsequently tested negative later in another hospital.
- A virus may be transmitted after delivery either from mother during breastfeeding or from the hospital environment.
- The World Health Organization notes that there is no evidence yet to show that pregnant women are more vulnerable or are at a higher risk of severe illness from COVID-19 than the general population.



- While there is no concrete evidence for vertical transmission of SARS-CoV2 from mother to foetus, it is known that pregnancy involves a risk, after birth, of adverse outcomes from many respiratory viral infections.
- It has, however, advised pregnant women to wash their hands frequently, to avoid crowded spaces and to practice respiratory hygiene.
- In India, efforts have been made to create a pregnancy registry at the Indian Council of Medical Research.
- So far, no reliable evidence recommends any specific COVID-19 treatment for pregnant women.

3.25 Hydroxychloroquine

- Hydroxy-chloroquine is an oral drug used in the treatment of malaria and some autoimmune diseases such as rheumatoid arthritis.
- Malaria is a disease caused by mosquito bite of female Anopheles and spreads through parasites.
- Autoimmune diseases are in which the body's immune system attacks healthy cells.
- Rheumatoid arthritis is a chronic inflammatory disorder affecting many joints, including those in the hands and feet.
- Recent studies show that the HCQ drug alone or in combination with azithromycin appears to reduce the virus quickly.
- Further, the study suggests that prophylaxis (treatment given to prevent disease) with hydroxy-chloroquine at approved doses could prevent SARS-CoV-2 infection.
- Although the drug has some side effects, it is linked to instances of cardiac arrhythmia and liver damage.
- Wide use may handicap the people's ability to fight the disease.
- Recently, India revoked its earlier ban on the export of malaria drug hydroxychloroquine (HCQ), which is being used to treat Covid-19.
- Earlier, the government of India placed HCQ on a restricted items list, and later put a blanket ban on any export of the drug.

3.26 June Almeida

- June Almeida was a UK based virologist who visualized the first human coronavirus.
- Almeida was also responsible for the first visualization of the rubella virus.
- She was also instrumental in figuring out that there are two distinct components of the Hepatitis-B virus, one on the surface of the particle, and one internally.
- She went on to not only identify viruses whose structures were previously unknown, but her work also shed light on the pathogenesis of viral infections.
- She pioneered the technique of electron microscopy, used for viral diagnosis, and became the first individual to see the human coronavirus.
- She was also one of the contributors who helped shape the World Health Organization's (WHO) 1979 manual for rapid laboratory viral diagnosis.
- In 1967, Almeida collected the samples of B814 and attempted to visualize them using a microscope, through a technique she pioneered called electron microscopy.
- She found the virus in the samples were morphologically identical to the viruses of avian bronchitis and mouse hepatitis.
- She called it the "coronavirus" due to the protrusions on its surface which made it look like an emperor's crown, the name was accepted a year later in 1968.

3.27 Hypoxia

- Recently medical practitioners have reported a condition called silent or happy hypoxia, in which Covid-19 patients have extremely low blood oxygen levels, yet they do not show signs of breathlessness.



- It is a condition wherein there is not enough oxygen available to the blood and body tissues.
- Hypoxia can either be generalized, affecting the whole body, or local, affecting a region of the body.
- Normal arterial oxygen is approximately 75 to 100 millimeters of mercury (mm Hg) and normal pulse oximeter readings usually range from 95 to 100%, Values under 90% are considered low.
- When levels fall below 90%, patients could begin experiencing lethargy, confusion or mental disruptions because of insufficient quantities of oxygen reaching the brain.
- Levels below 80% can result in damage to vital organs.
- Silent Hypoxia is a form of oxygen deprivation that is harder to detect than regular hypoxia because patients appear to be less in distress.
- In many cases, Covid-19 patients with silent hypoxia did not exhibit symptoms such as shortness of breath or coughing until their oxygen fell to acutely low levels, at which point there was a risk of acute respiratory distress (ARDS) and organ failure.
- The reason why people are left feeling breathless is not because of the fall in oxygen levels itself but due to the rise in carbon dioxide levels that occur at the same time, when lungs are not able to expel this gas efficiently.
- A medical device called a pulse oximeter can be used in the early detection of silent hypoxia.

3.28 Antibody Testing for COVID-19

- In the COVID-19 fight, the Indian Council of Medical Research (ICMR) had advised States to use antibody testing for surveillance.
- Antibody tests, also called serological tests, have usually been the time-tested approach to finding out the presence of a virus in the body.
- They do so by detecting the presence and quantity of antibodies that are produced by the immune system to battle an infection.
- It is an indirect test because it cannot find the virus, but it can determine if the immune system has encountered it.
- Antibodies can show up between nine to 28 days after an infection has set in; by that time, an infected person, if not isolated, can spread the disease.
- Sometimes the antibodies may be produced in response to a closely-related pathogen and sometimes they may not be the right kind to counter the infection.
- These are the factors that can make an antibody test erroneous.
- Antibody tests are fast and relatively inexpensive.
- Two kinds of antibodies result from an infection: Immunoglobulin M and Immunoglobulin G (IgM and IgG).
- In response to an infection, the IgM is first produced within a week of infection.
- Two weeks later, the levels of IgM reduce and are replaced by IgG.
- The latter is a longer-lasting antibody and, depending on the infectious agent involved, can offer different durations of immunity.

3.29 RT-PCR Tests

- In an RT-PCR test, a nasal or throat swab is taken from a patient suspected of having the disease.
- The test involves extracting RNA or ribonucleic acid, the genetic material of the virus, and checking if it shares the same genetic sequence as the SARS-CoV-2 virus.
- If it is a match, the sample is deemed positive.
- The only way such tests turn negative is if the actual sample does not have the virus or the swab was not properly administered and too little of the virus was gleaned.
- The RT-PCR tests began to be followed as the 'gold standard' in detecting the virus.



- The current RT-PCR technology requires RNA extracting machines, a specialized laboratory, and trained technicians.
- And at least a minimum of 30 samples are needed to make the process economically viable.
- The tests are done in batches and it can take up to four hours to confidently test for the presence of a virus from a batch.

3.30 Project Praana

- IISc Bengaluru has developed an indigenous ventilator prototype under project Praana in view of COVID-19 crisis.
- The project is a voluntary effort to help the nation at the time of crisis.
- The ventilator has been developed using materials readily available in India.
- The prototype has mass flow sensors and controllers which accurately tell how much oxygen is flowing and what volume the patient is inhaling in one breath.
- Pneumatics is built around mass produced water filter hardware.
- The control system is built around open source industrial controller.
- In a large country like India, the biggest challenge is the manufacturing of such ventilators on a mass-scale due to limited access to pneumatic and electronic hardware, sensors and actuators in the global marketplace.
- The indigenous ventilator prototype build under Project Praana will address the issue.
- **Ventilator**
 - A ventilator, also known as a respirator or breathing machine, is a medical device that provides a patient with oxygen when they are unable to breathe on their own.
 - The ventilator gently pushes air into the lungs and allows it to come back out like the lungs would typically do when they are able.
 - During any surgery that requires general anesthesia, a ventilator is necessary.
 - There are also times when a ventilator is required after surgery, as the patient may not be able to breathe on their own immediately after the procedure.

3.31 Jeevan Ventilators

- Railways' Rail Coach Factory (RCF) has invented a ventilator prototype that has an original design and will cost a fraction of what regular ventilators cost.
- The prototype named Jeevan will now go for final testing at the Indian Council of Medical Research (ICMR) before being put to production to aid the country's fight against COVID-19.
- The cost will be under Rs.10,000 without the compressor.
- It can be used as an emergency ventilator, its production is easy and can be done with locally sourced components.
- The heart of the device is the Compressed Air Container to work the ambu bag with air without any moving parts like servo motor or piston or link mechanism.
- It is very silent and it is not reverse engineering, this is an original design from scratch.
- The intellectual property rights relating to the ventilator belong to the RCF.

3.32 COVID Kavach Elisa

- National Institute of Virology (NIV) at Pune has developed and validated the indigenous IgG ELISA test "COVID KAVACH ELISA" for antibody detection for COVID-19.
- The robust indigenous IgG ELISA test for antibody will play a critical role in surveillance of proportion of population exposed to SARS-CoV-2 Coronavirus infection.



- The test kit has the advantage of testing 90 samples together in a single run of 2.5 hours, so that healthcare professionals can proceed quickly with necessary next steps.
- This kit was validated at two sites in Mumbai and has high sensitivity and accuracy.
- The ELISA-based testing is easily possible even at district level.
- Developed in a month's time, the testing kit would help to study the presence of anti-SARS-CoV-2 IgG antibodies in the Indian population.
- It is cost-effective, sensitive, rapid, and a large number of samples can be tested at any level of clinical setting, public health centers and hospitals.
- There are also minimal bio-safety and bio-security requirements for the test as compared to the real-time RT-PCR test.

3.33 Ultraviolet Germicidal Radiation

- Scientists are studying the use of ultraviolet germicidal radiation (UVGI) to detect Coronavirus in schools, restaurants and other public places.
- Through this method, ultraviolet (UV) lights would be able to disinfect contaminated public spaces to stop the transmission of the virus.
- UVGI uses the “destructive properties” of UV light to target pathogens.
- UVGI replicates UV wavelengths that disinfects contaminated spaces, air and water.
- UVGI lamps can also be installed in the corners of a room and alternatively, can be installed in air ducts of ventilation systems or portable or fixed air cleaners.

3.34 ATULYA

- Defence Institute of Advanced Technology (DIAT), Pune has developed a microwave sterilizer to kill the coronavirus.
- DIAT is a deemed university supported by the Defence Research and Development Organization (DRDO).
- The microwave sterilizer has been named ATULYA a cost-effective solution to disintegrate corona virus.
- This microwave sterilizer can be operated in portable or fixed installations and helps in disintegrating the virus by differential heating in the range of 56 to 60 Celsius temperatures.
- This system was tested for human/operator safety and has been found to be safe.
- The sterilization time can range from 30 to 60 seconds depending on the size and shape of objects.
- Weighing three kilos, it can be used for sterilizing non-metallic objects only.
- **SHUDH**
- IIT Kanpur has developed an Ultraviolet (UV) sanitizing product named SHUDH.
- It is a smartphone operated Handy Ultraviolet Disinfection Helper (SHUDH).
- It has six UV lights of 15 Watts each that can be individually monitored from a distance.
- The device at its full operation can disinfect a 10x10 squared feet room in about 15 minutes.
- SHUDH can assist in killing the spread of corona virus at the highly prone places such as hospitals, hotels, malls, offices and schools.



3.35 Covid-19 and Type-1 Diabetes

- Recent findings highlights the evidence that novel coronavirus might actually be triggering diabetes in some people who have so far remained free of it.
- These patients typically develop type-1 diabetes, the virus seems to be causing diabetes spontaneously in people.
- Type-1 diabetes is caused when the body's immune system begins to attack and destroy the beta cells, which produce the hormone insulin in the pancreas.
- With the destruction of beta cells, the amount of insulin produced is reduced, and hence, the ability of the body to control blood sugar is compromised leading to type-1 diabetes.
- The 2002 SARS coronavirus, too, caused acute-onset diabetes in patients.

Type -2 Diabetes

- Type II diabetes arises when body develops insulin resistance.
- Insulin is produced by the pancreas and is necessary for getting glucose from the bloodstream to cells to be used for energy.
- With type II diabetes, cells do not respond as they should to the insulin, and the pancreas becomes less and less able to keep up.
- When the insulin does not take glucose from the blood to cells, blood sugar levels rise.

3.36 COVID-19 Air Borne Disease

- Recently, WHO has acknowledged that there is a possibility that COVID-19 might be spread in the air under certain conditions.
- The WHO has said that the airborne spread i.e. particularly in specific indoor locations, such as crowded and inadequately ventilated spaces over a prolonged period of time with infected persons cannot be ruled out.
- The WHO's stance also recognized the importance of people spreading COVID-19 without symptoms.
- The transmission of the virus by aerosols may have been responsible for outbreaks of Covid-19 reported in some closed settings.
- There is a mounting evidence which has suggested that in crowded indoor spaces, the virus can stay aloft for hours and infect others, and may even seed so-called superspreader events.
- A susceptible person could inhale aerosols, and could become infected if the aerosols contain the virus in sufficient quantity to cause infection within the recipient.
- **Europe's First COVID-19 Free Country**
- **Montenegro** is the first country in Europe to declare itself coronavirus-free.
- Montenegro is a Balkan country with rugged mountains, medieval villages and a narrow strip of beaches along its Adriatic coastline.
- 1,300m-deep Tara River Canyon encompasses the country.
- Tourism operators have already seized the opportunity to brand Montenegro as "Europe's First COVID-19 Free Country".
- To prevent any backsliding on the health front, Montenegro will only allow visitors from countries that have kept coronavirus cases low at under 25 patients per 100,000 people.
- In picturesque coastal city Kotor there have been no reported cases of coronavirus.
- Montenegro's size has certainly been of aid in its fight against the virus: the country is one of the smallest in the world with only about 630,000 people.

3.37 Indo-Israel Rapid Test Partnership

- Israel and India partners to develop rapid testing for COVID-19 in under 30 seconds.
- The Israeli delegation along with DRDO will conduct a series of tests to determine the effectiveness of a number of rapid diagnostic solutions.
- AI based Voice & Breathalyzer test - The voice test analyses recording of a human voice to identify changes in the patient's voice and/or deterioration in the condition of his/her respiratory system.
- It is as part of system developed for detecting the virus using Terra-Hertz (THZ) waves.



- Isothermal testing - It allows detection of the virus in a saliva sample with the help of a chemical reaction and produces a result within 30 minutes.
- Testing using Polyamino acids to detect virus proteins in a saliva sample in a few minutes.

3.38 DRUVS Cabinet

- Defence Research and Development Organization (DRDO) premier lab, Research Centre Imarat (RCI), has developed an automated contactless UVC sanitization cabinet, called Defence Research Ultraviolet Sanitizer (DRUVS).
- It has been designed to sanitize mobile phones, iPads, laptops, currency notes, cheque leaves, challans, passbooks, paper, envelopes, etc.
- The DRUVS cabinet is having contactless operation which is very important to contain the spread of virus.
- The proximity sensor switches, clubbed with drawer opening and closing mechanism, makes its operation automatic and contactless.
- It provides 360 degree exposure of UVC to the objects placed inside the cabinet.
- Once the sanitization is done, the system goes in sleep mode hence the operator need not wait or stand near the device.



3.39 Sero-Surveillance Study

- Recently, the National Centre for Disease Control (NCDC) conducted a Sero-surveillance study for Covid-19 in New Delhi.
- NCDC is under administrative control of the Directorate General of Health Services in the Union Ministry of Health and Family Welfare.
- Serosurveillance provides estimates of antibody levels against infectious diseases and is considered the gold standard for measuring population immunity due to past infection or vaccination.
- ELISA (Enzyme-Linked Immunosorbent Assay) is a test that detects and measures antibodies in blood.
- IgG (Immunoglobulin G) is a type of antibody which develops in most Covid-19 patients (infections) at around two weeks after infection and remains in the blood even after recovery.
- **Highlights of recent Sero-survey are**
 - Detects Specific Antibodies- It seeks to assess the prevalence of disease in a population by detecting the presence of specific antibodies against the virus.
 - Immunity Check- It can also be conducted to check if a person has developed immunity to certain diseases.
 - Past Infections - It indicates past infections (and which triggered an immune response), and is not used to detect active infections.
 - Tested Immunoglobulin G Using ELISA- The Sera (a part of blood) of samples were tested for IgG antibodies and Covid-19 infection using CovidKavach ELISA kits approved by ICMR.
 - Result - 23.48% of the people surveyed had developed IgG antibodies, indicating they had been exposed to the novel coronavirus (SARS-CoV-2) that causes Covid-19, with a large number showing no symptoms (asymptomatic).

3.40 Flavonoids

- Flavonoids are part of the polyphenol class of phytonutrients (plant chemicals) found in almost all fruits and vegetables.
- Along with carotenoids (organic pigments), they are responsible for the vivid colours in fruits and vegetables.
- Polyphenols have historically been used in Chinese and Ayurvedic medicine and are associated with skin protection, brain function, blood sugar and blood pressure regulation.



- These are powerful antioxidants with anti-inflammatory and immune system benefits as well.
- A diet rich in flavonoids can protect from diseases related to heart, liver, kidney, brain and other infectious diseases.
- Recently, scientists from Agharkar Research Institute (ARI), found the first synthetic route for producing flavonoids molecules related to the treatment of tuberculosis and chikungunya.
- It will ensure their availability at all seasons without the dependence on natural timings of the plantations.
- It is for the first time that scientists have been able to synthesize the flavonoid molecules such as rugosa flavonoids, podocare flavone and isoflavone in a lab.
- These three molecules have so far been isolated from plants only and are found to inhibit tuberculosis and chikungunya.

3.41 Pavitrapati and Aushadatarā

- Pune based Defence Institute of Advanced Technology, developed an Ayurvedic based Biodegradable Nanofibres Face Mask “Pavitrapati”.
- **Pavitrapati** acts a virus neutralizer to resist against the bacteria / virus.
- It has also developed an anti-microbial body suit in the name of “Aushadatarā”.
- **Aushadatarā** suit has super hydrophobic, breathing, anti-microbial, comfort feeling properties.
- The fabric material of the suit has the approval for fighting against the COVID-19.
- The suit had cleared the splash resistant tests and it has got good repellent property of any fluids.
- The above two products are the Trademarked products of DIAT (DU).

4. BIO-TECHNOLOGY

4.1 Initiative on Earth Bio Genome Sequencing

- IIEBS is a nationwide project to decode the genetic information of all known species of plants and animals in the country.
- The project is part of the Earth Bio Genome Project, an international initiative which aims to sequence the genetic codes of all of earth's eukaryotic biodiversity over a period of 10 years.
- The whole genome sequencing of 1,000 species of plants and animals will be taken up in the initial phase of IIEBS to be completed over a period of five years at an estimated cost of ₹ 440 crore.
- The National Institute of Plant Genome Research, New Delhi is the coordinating center for the nationwide project involving a total of 24 institutes.
- The Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) has been selected as one of the Biological Knowledge and Resource Centers of the Indian Initiative on Earth Bio Genome Sequencing (IIEBS).
- The project is planning for a nationwide project to decode the genetic information of all known species of plants and animals in the country.
- The digital repository of genome sequences is expected to provide the critical infrastructure for better understanding of ecosystems and conservation of biodiversity as well as the development of new treatments for infectious and inherited diseases, agricultural products, biomaterials and biological fuels.

4.2 Indian Biosafety Knowledge Portal

- It was launched in 2019 through which the Department receives all new applications related to research proposals.
- This has made the whole process transparent and time bound.



- It is a webbased portal, with a major thrust to reach out to researchers, industry and other stakeholders to provide latest scientific information and regulatory guidance related to authorization of Genetically Modified Organisms/Living Modified Organisms (GMOs/LMOs) and products thereof.
- **Indian Bio resource Information Network (IBIN)**
- Indian Bio resource Information Network (IBIN) is a larger project of Department of Biotechnology (DBT).
- IBIN is proposed to be uniquely placed as a single portal data provider on India's bio resource - plant, animal, marine, spatial distribution and microbial resources.

4.3 National Bio Pharma Mission

- It is an Industry-Academia Collaborative Mission of Department of Biotechnology (DBT).
- It aims for accelerating discovery research to early development for Biopharmaceuticals approved by the Cabinet for a total cost US\$ 250 million.
- It is 50% co-funded by the World Bank is being implemented at Biotechnology Research Assistance Council (BIRAC).
- This program is dedicated to deliver affordable products to the nation with an aim to improve the health standards of India's population.
- Vaccines, medical devices and diagnostics and bio therapeutics are few of its most important domains, besides, strengthening the clinical trial capacity and building technology transfer capabilities in the country.

4.4 Guidelines for Recombinant DNA Technology

- Biosafety refers to policies and procedures adopted to avoid risk to human health and safety and to the conservation of the environment as a result of the use of GMOs for research and trade
- Under the Biosafety Research programme, main emphasis is given to facilitate the implementation of biosafety procedures, rules and guidelines under Environment (Protection) Act 1986 and Rules 1989 to ensure safety from the use of GMOs and products thereof in research and application to the users as well as to the environment.
- A three tier mechanism comprising
- Institutional Biosafety Committees (IBSC) at the Institute/company.
- Review Committee on Genetic Manipulation (RCGM) in the Department of Biotechnology.
- Genetic Engineering Approval Committee (GEAC) in the Ministry of Environment & Forests (MoE&F) for granting approval Genetically Engineered (GE) crops.

4.5 Plasma Bank

- For the first time in India, Delhi Administration has inaugurated a plasma bank in the city and urged recovered Covid-19 patients to donate their plasma.
- Delhi's Plasma Bank is opened at the Institute of Liver and Biliary Sciences (ILBS).
- The Plasma Bank is a first-of-its-kind initiative in the entire country and appealed to recovered patients to donate their plasma.
- The recovered Covid-19 patients can donate their plasma after 14 days of their COVID-19 negative report.
- A healthy person between the age group of 18-60 years and with no comorbidities can be a donor and the patient should have recovered at least three weeks before donating and tested negative for Covid-19 twice.

4.6 Convalescent Plasma Therapy

- It is a passive immunisation process.
- Active immunization is the induction of immunity after exposure to an antigen.



- Passive immunisation in general, could be either natural or acquired. When an infant receives antibodies from the mother's milk or placenta, it is natural. On the contrary, in convalescent plasma therapy, the transfer happens artificially.
- It is simply the transfusion of plasma containing antibodies from immune survivors of infectious diseases to the affected individuals.
- Plasma is a light yellowish fluid which makes more than half of the blood's volume.
- Besides plasma, various other components of blood such as sera, immunoglobulins and monoclonal and polyclonal antibodies have been used to passively transfer antibodies

4.7 Cytokine Storm Syndrome

- Cytokines are inflammatory immunological proteins that are there to fight off infections and ward off cancers.
- CSS is characterized by the overproduction of immune cells and the cytokines themselves because of a dysregulation in the process.
- A cytokine storm can occur due to an infection, auto-immune condition (when the body's immune system attacks healthy cells as in case of coeliac disease- an immune disorder that primarily affects the small intestine), or other diseases.
- Signs and symptoms include high fever, inflammation (redness and swelling), severe fatigue, and nausea.
- In the case of any flu infection, a cytokine storm is associated with a surge of activated immune cells into the lungs, which, instead of fighting off the antigen, leads to lung inflammation and fluid build-up, and respiratory distress.
- A severe immune reaction, leading to the secretion of too many cytokines in the bloodstream, can be harmful since an excess of immune cells can attack healthy tissue as well.
- The damage to the surrounding cells can be catastrophic, leading to sepsis and potentially, death.
- Sepsis occurs when the body's response to infection is out of balance, triggering changes that can damage multiple organ systems.
- Accumulating evidence suggests that a subset of patients with severe Covid-19 might have a "Cytokine Storm Syndrome" (CSS).
- Cytokine storms are not exclusive to coronavirus patients.
- It is an immune reaction that can occur during other infectious and non-infectious diseases as well.

4.8 Report on API's

- Active Pharmaceutical Ingredient (API) is a substance or mixture of substances contained in a medicine that is intended to cause pharmacological activity.
- Technology Information, Forecasting and Assessment Council (TIFAC) has recently released a report on 'Active Pharmaceutical Ingredients'.
- Highlights - The pharmaceutical industry in India is third largest in the world, in terms of volume, behind China and Italy, and fourteenth largest in terms of value.
- However due to availability of cheap imports, the local manufacturing of APIs is very less.
- Of the total imports of APIs and intermediates into India, China accounts for 65-70%.
- The report has recommended to create mega drug manufacturing clusters with common infrastructure in India.
- Along with the report, a white paper titled 'Focused Interventions for Make in India : Post COVID 19' was also released.

4.9 Human Growth Hormone (hGH)

- Human Growth Hormone (hGH) is produced in the body and secreted by the pituitary gland near the base of the brain.



- hGH helps in bone, organ and cartilage growth and also helps in repairing damaged muscles.
- When the gland releases the growth hormone, it results in the secretion of a protein called IGF-1 from the liver.
- The IGF-1 protein is what ultimately stimulates the growth of bones, muscle, and other tissues.
- hGH is banned both in-competition as well as out-of-competition by the World Anti- Doping Agency (WADA) as hGH is known to increase muscle mass, strength as well as tissue-repairing effects.
- Recently a 2018 Commonwealth Games silver medalist, has been handed a provisional four-year suspension after his blood sample tested positive for human Growth Hormone (hGH).

4.10 Inflammageing

- Inflammageing refers to the inhibition of one's immunity as the body's inflammation reaches higher levels as one ages.
- As this happens, our bodily defence systems respond more slowly to bacterial and viral infections, leaving the elderly more vulnerable.
- It is characterized by chronic low-grade inflammation, which occurs without an infection.
- While inflammation is essential to the immune response, inflammageing is not.
- The state of elevated inflammation can worsen many age-related diseases, and further inhibit the response from an already declining immune system.
- The most severe Covid-19 cases have occurred mostly in older people, researchers are investigating whether inflammageing has a role.

4.11 Bio-Markers

- A biomarker is a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes or pharmacological responses to a therapeutic intervention.
- Biomarkers may be used alone or in combination to assess the health or disease state of an individual.
- Researchers at the Cancer Institute (WIA) have identified a panel of five protein markers in the blood that can help with an early diagnosis of a common and lethal form of ovarian cancer.
- Combination of five markers - CA125, IGFBP2, SPP1, TSP1 and ADI were used for the study.

4.12 Fluorometer

- It is a device used to measure parameters of visible spectrum fluorescence i.e. intensity and wavelength.
- These parameters are used to identify the presence and the amount of specific molecules in a medium. E.g. The fluorometer can be used to detect biomolecules and proteins using the copper nanoparticles.
- The device can also be modified to detect other substances such as lead and mercury.
- Fluorometer can also be deployed as a screening tool for environmental and food quality testing.
- Recently, researchers at the Indian Institute of Science (IISc), Bengaluru have developed a low-cost Fluorometer using copper nanoparticles to detect the presence of melamine (adulterate) in milk and dairy products.
- Researchers were able to detect up to 0.1 parts per million (ppm) of melamine in water and milk, which is much lower than the acceptable limit of 1 ppm.
- Melamine is an organic base chemical most commonly found in the form of white crystals rich in nitrogen.
- Earlier, Food Safety and Standards Authority of India (FSSAI) had imposed a ban on all milk and milk products from China in September 2008.
- In April 2019, FSSAI had recommended the extension of the ongoing ban till labs at Indian ports are equipped for melamine testing.



4.13 T-Cell Responses

- T cells (also called T lymphocytes) are one of the major components of the adaptive immune system.
- Their roles include directly killing infected host cells, activating other immune cells, producing cytokines and regulating the immune response.
- According to recent research natural exposure or infection with the novel coronavirus may “prevent recurrent episodes of severe COVID-19”.
- The study found SARS-CoV-2-specific T cells even in family members who have been exposed to the virus but have tested negative on antibody blood tests.
- All categories of people recovered from moderate or severe COVID-19 disease, or in the convalescent phase after mild or severe disease or exposed family members or healthy people exhibited “robust memory T cell responses months after infection, even in the absence of detectable circulating antibodies specific for SARS-CoV-2.
- This indicates a previously unanticipated degree of population-level immunity against COVID-19.
- This implies that seroprevalence (the level of a pathogen in a population, as measured in blood serum) as an indicator may underestimate the extent of immunity in the population.
- Even as antibodies wane with time, robust T cell memory formed after SARS-CoV-2 infection suggests that “potent adaptive immunity is maintained to provide protection against severe re-infection”.

4.14 Flavonoids

- Flavonoids are part of the polyphenol class of phytonutrients (plant chemicals) found in almost all fruits and vegetables.
- Along with carotenoids (organic pigments), they are responsible for the vivid colours in fruits and vegetables.
- Polyphenols have historically been used in Chinese and Ayurvedic medicine and are associated with skin protection, brain function, blood sugar and blood pressure regulation.
- These are powerful antioxidants with anti-inflammatory and immune system benefits as well.
- A diet rich in flavonoids can protect from diseases related to heart, liver, kidney, brain and other infectious diseases.
- Recently, scientists from Agharkar Research Institute (ARI), found the first synthetic route for producing flavonoids molecules related to the treatment of tuberculosis and chikungunya.
- It will ensure their availability at all seasons without the dependence on natural timings of the plantations.
- It is for the first time that scientists have been able to synthesize the flavonoid molecules such as rugosa flavonoids, podocare flavone and isoflavone in a lab.
- These three molecules have so far been isolated from plants only and are found to inhibit tuberculosis and chikungunya.

5. NUCLEAR TECHNOLOGY

5.1 Kakrapar Atomic Power Plant

- Kakrapar Atomic Power Plant is the country’s first 700 MWe (megawatt electric) unit, located in Gujarat.
- It is the biggest indigenously developed variant of the Pressurized Heavy Water Reactor (PHWR).
- The operationalization of India’s first 700MWe reactor marks a significant scale-up in technology.
- It has recently achieved its criticality, which is a landmark event in India’s domestic civilian nuclear programme.
- It is significant in terms of optimization of its PHWR design.
- It addresses the issue of excess thermal margins and an improvement in the economies of scale, without significant changes to the design of the 540 MWe reactor.



- 'Thermal margin' refers to the extent to which the operating temperature of the reactor is below its maximum operating temperature.
- The 700MWe capacity would constitute the biggest component of the expansion plan of India to ramp up its existing nuclear power capacity of 6,780 MWe to 22,480 MWe by 2031.
- **Criticality** - The normal operating condition of a reactor, in which nuclear fuel sustains a fission chain reaction.
- A reactor achieves criticality when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions.

5.2 Barakah Nuclear Power Plant

- Barakah is the Arab world's first nuclear reactor started by UAE.
- Barakah, means "blessing" in Arabic, it was built by a consortium led by the Korea Electric Power Corporation.
- Recently the power plant achieved its criticality, the first step towards power production.
- **Criticality of a nuclear power plant** - A nuclear reactor is said to be critical when the nuclear fuel inside a reactor sustains a fission chain reaction.
- Each fission reaction releases a sufficient number of neutrons to sustain a series of reactions.
- Heat is produced in the event, which is used to generate steam that spins a turbine to create electricity.

5.3 Zero yield

- U.S. state department suspects that China may have secretly set off low-level underground nuclear test explosions despite claiming to observe an international pact banning such blasts.
- Zero yield refers to a nuclear test in which there is no explosive chain reaction of the type ignited by the detonation of a nuclear warhead.
- U.S. concerns about Beijing's possible breaches of a "zero yield" standard for test blasts have been prompted by activities at China's Lop Nur nuclear test site throughout 2019.
- China's possible preparation to operate its Lop Nur test site year-round, its use of explosive containment chambers, extensive excavation activities at Lop Nur and a lack of transparency on its nuclear testing activities raise concerns regarding its adherence to the zero yield standard.
- Beijing's lack of transparency included blocking data transmissions from sensors linked to a monitoring centre operated by the international agency that verifies compliance with a treaty banning nuclear test explosions.

5.4 ITER

- International Thermonuclear Experimental Reactor (ITER) is world's largest experimental fusion facility in France.
- It is most complex science project in human history, started in 2010.
- It will use hydrogen fusion, controlled by superconducting magnets, to produce massive heat energy.
- The magnetic fusion device has been designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy based on the same principle that powers our Sun and stars.
- This nuclear fusion facility is an international cooperation among the European Union, Russia, the US, Japan, China, India and South Korea.
- It is the first industrial-scale fusion reactor and it will illuminate the way to produce clean, cheap, and abundant energy for millions of years.
- It will start generating a molten mass of electrically-charged gas "plasma" inside a core by 2025.



6. OTHERS

6.1 CollabCAD

- CollabCAD is an indigenous three dimensional computer aided design system which helps the used to build models in virtual 3d space and create and engineering drawings for shop floor which makes it a complete package for smart manufacturing.
- It is jointly launched by Atal Innovation Mission, NITI Aayog and National Informatics Centre (NIC).
- CollabCAD initiative aims to provide a great platform to students of Atal Tinkering Labs (ATLs) across country to create and modify 3d designs with free flow of creativity and imagination.
- This software would also enable students to create data across the network and concurrently access the same design data for storage and visualization.
- NIC is playing a crucial role in pushing the online module to reach to the students all across the country by providing a huge source of data through this software CAD system.
- CollabCAD will be used by around 5000 schools where Atal Tinkering Labs are established.

6.2 Interoperable Set Top Boxes

- Recently, the Telecom Regulatory Authority of India (TRAI) has recommended that all Set Top Boxes (STBs) in the country must be made interoperable.
- It means that consumers should be able to use the same STB across different DTH (Direct to Home) or cable TV providers.
- As of now STBs deployed in the cable TV networks are non-interoperable.
- STBs in the DTH players comply with license conditions to support common interface module based interoperability.
- So, in practice, they are also not readily interoperable.
- Lack of interoperability deprives the customer of the freedom to change her/his service provider.
- The Ministry of Information and Broadcasting has been suggested to make the required amendments in licensing and registration conditions to make interoperability mandatory.
- It has also been recommended to set up a coordination committee to steer implementation of revised STB standards for both the DTH and the cable TV segments.
- The committee may maintain continuous oversight for setting up of the digital TV standards by Bureau of Indian Standards (BIS).

6.3 Draft Rules for Unlinking TV channels

- Information Broadcasting Ministry has drafted new guidelines for up linking TV channels.
- Guidelines to uplink and down link satellite television channels were last issued by the I&B Ministry in 2011.
- The highlights of the new draft guidelines are
- There will be no need for channels to get mandatory clearance every year.
- Permits will be given to Indian teleports to uplink foreign channels to facilitate more business.
- As of now, the channels registered under the 'news' category can live-telecast events.
- But the rest needs a written "temporary up linking" permission from the ministry and local administration, even to telecast live events such as reality shows.
- According to the new draft, such non-news channels can live telecast an event (other than in the nature of news and current affairs) after registering itself online on 'Broadcast Seva, a ministry portal, at least five days before the event.
- This would facilitate the live telecast of many sporting events, award functions, socio-religious and cultural programmes and even radio addresses that are not qualified as news.



- The channels can make a calendar of sorts of all the non-political events they would want to show, and proceed with the registrations beforehand.
- To broadcast an event like IPL or any traditional sport which was watched enthusiastically, channels had to pay Rs 1 lakh a day each and also wait for days for a written permission, now it has been done away.
- The decision as to whether or not the event being uplinked live is of the nature of news and current affairs will be of the central government, and shall be binding on the channel.
- The preference to Indian satellites was part of the government's policy since 1997, this time the ministry has made it explicit that a satellite channel can only be uplinked on 'C' band or 'Ku' band, but not both simultaneously, and the latter will be restricted only to Indian satellites.
- The new rules also permit a company or limited liability partnership (LLP) to launch a teleport, hub or uplink a channel.
- The ministry has retained the rule for security clearances for TV channels, the clearance is granted by the home ministry.
- It is valid for ten years, but can be revoked if the home ministry sees repeated violations.

Up linking and Down linking

- The communication going from a satellite to ground is called downlink, and when it is going from ground to a satellite it is called uplink.
- When an uplink is being received by the spacecraft at the same time a downlink is being received by Earth, the communication is called two-way.
- If there is only an uplink happening, this communication is called upload.
- If there is only a downlink happening, the communication is called one-way.

6.4 NanoBlitz 3D

- International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) has developed an advanced tool NanoBlitz 3D.
- It is used for mapping Nano-mechanical properties of materials like multi-phase alloys, composites, and multi-layered coatings.
- The tool has been found to yield excellent results on a wide range of material systems, including glass-fibre-reinforced polymer composites, dual-phase steels, softwood and shale.
- It can measure hardness and elastic modulus of a given material.

6.5 Geo-Fencing

- Geo-fencing is a location-based service in which an app or other software uses GPS, RFID, Wi-Fi or cellular data to trigger a pre-programmed action when a mobile device or RFID tag enters or exits a virtual boundary set up around a geographical location, known as a geo-fence.
- The "geo-fencing" is accurate by up to 300 m.
- Depending on how a geo-fence is configured it can prompt mobile push notifications, trigger text messages or alerts, send targeted advertisements on social media, allow tracking on vehicle fleets, disable certain technology or deliver location-based marketing data.
- To make use of geo-fencing, an administrator or developer must first establish a virtual boundary around a specified location in GPS- or RFID-enabled software.
- This virtual defense will then trigger a response when an authorized device enters or exits that area, as specified by the administrator or developer.
- **Other applications of geo-fence** - Social networking, Marketing, Audience engagement, Smart appliances, Human Resource management, Telematics, Security
- Based on Geo-Fencing, union government has tested an application that triggers e-mails and SMS alerts to an authorized government agency if a person has jumped quarantine or escaped from isolation, based on the person's mobile phone's cell tower location.



- The States have been asked to seek the approval of their Home Secretaries under the provisions of Section 5(2) of the Indian Telegraph Act, 1885, for the specified mobile phone numbers to request the DoT to provide information by email or SMS in case of violation of “geo-fencing”.

6.6 Coir Geo Textile

- Coir is a 100% natural fiber, obtained from a renewable source – the coconut husk.
- Coir Geo Textile is naturally resistant to rot, molds and moisture, and free from any microbial attack hence it needs no chemical treatment.
- 1. It has a permeable, natural and strong fabric with high durability.
- 2. It protects the land surface and promotes quick vegetation.
- 3. It is totally biodegradable, and helps in soil stabilisation.
- 4. It can dissipate the energy of flowing water and absorb the excess solar radiation.
- The IRC has now accredited coir Geo textiles for construction of rural roads.

Geo Textiles

- Geo Textiles are synthetic including polyester and polypropylene or man-made materials that have varying degrees of permeability.
- Permeability means their surfaces have very small openings that allow liquid or gases to pass through.
- Special characteristics of geo-textiles
 1. It has the ability to separate, filter, reinforce, protect and drain when used in association with soils.
 2. It drains areas where water pools while keeping soil in place.
 3. It serves as effective filters, catching some materials to prevent drains from clogging.
 4. It reinforces earthen structures like drains by holding layers in place.
 5. It protects against erosion in places like roads and beaches.
- These functions make Geo Textile fabrics useful in many industries, especially construction and civil engineering.

6.7 ANITA - Antarctic Impulsive Transient Antenna

- Antarctic Impulsive Transient Antenna (ANITA) is a radio telescope instrument to detect ultra-high energy cosmic-ray neutrinos from a scientific balloon flying over the continent of Antarctica.
- It involves an array of radio antennas attached to a helium balloon which flies over the Antarctic ice sheet at 37,000 meters.
- At such a height, the antennas can listen to the cosmos and detect high-energy particles, known as neutrinos, which constantly bombard the planet.
- It is the first NASA observatory for neutrinos of any kind.
- ANITA detects neutrinos pinging in from space and colliding with matter in the Antarctic ice sheet through the Askaryan effect.
- Recently, NASA's Antarctic Impulsive Transient Antenna (ANITA) has detected the unusual upward movement of neutrinos in Antarctica.
- Instead of the high-energy neutrinos streaming in from space, they seem to have come from the Earth's interior, before hitting the detectors of ANITA.
- Usually, the high-energy particles move top to bottom (i.e. from space to the earth).
- However, ANITA has detected an anomaly i.e. particles have been detected travelling bottom to top.



6.8 Askaryan Effect

- The Askaryan effect is the phenomenon whereby a particle traveling faster than the phase velocity of light in a dense dielectric (such as salt, ice or the lunar regolith) produces a shower of secondary charged particles.
- When neutrinos smash into an atom, they produce a shower of detectable secondary particles. These detectable secondary particles allow us to probe where they came from in the universe.
- However, neutrinos pose no threat to human beings and pass through most solid objects. Additionally, they rarely do interact with matter.
- It is named after Gurgen Askaryan, a Soviet-Armenian physicist who postulated it in 1962.

6.9 Quantum Entanglement

- It is the physical phenomenon that occurs when a pair or group of particles is generated and they interact in such a way that the quantum state of each particle of the pair or group cannot be described independently of the state of the others.
- In this quantum mechanical phenomenon, the quantum states of two or more objects have to be described with reference to each other, even though the individual objects may be spatially separated.
- This leads to correlations between observable physical properties of the systems.
- Albert Einstein dismissed this idea as a 'spooky action'.
- Entangled states are key resources to facilitate many quantum information processing tasks and quantum cryptographic protocols.
- The entangled pairs of electrons can be safely used as resources for facilitating quantum information processing tasks.
- Entanglement is fragile and is easily lost during the transit of photons through the environment.
- Hence, it is extremely important to know whether a pair of photons is entangled, in order to use them as resources.
- Verification of entanglement requires the use of measurement devices, but such devices may be hacked and cannot be trusted fully.

6.10 Device Independent Self Testing (DIST)

- Recently, the scientists from S.N. Bose National Centre for Basic Sciences (SNBNCBS), Kolkata have developed a novel protocol to find out whether a pair of electrons is in an entangled state.
- This novel protocol to measure the status of entanglement is known as Device Independent Self Testing (DIST) method.
- This method can be used to overcome safety concerns in quantum entanglement as it enables the verification of entanglement in an unknown quantum state of two photons without having direct access to the state, or complete trust in the measurement devices.
- In several practical situations, one of the parties may be fully trusted, whereas, the other may not be trusted like in the case of server-client relationship in banking transactions.

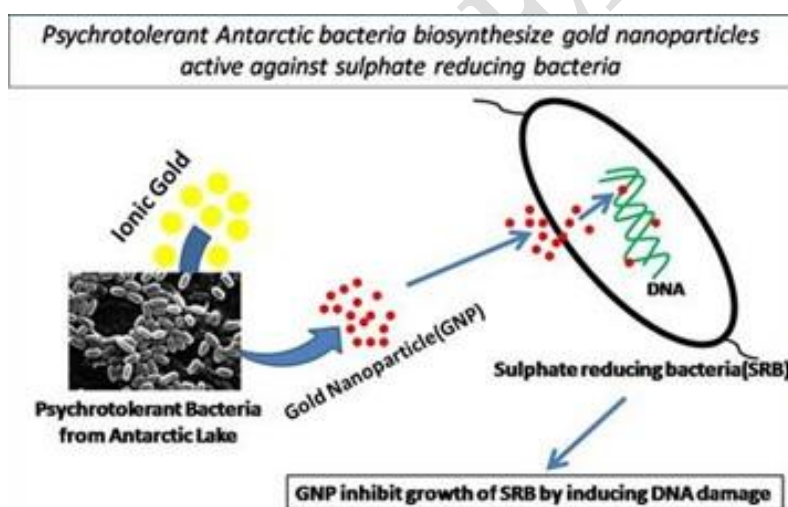
6.11 Sonic Boom

- Sonic Booms are shockwaves produced by planes or other objects that are flying at a speed equal to or greater than the speed of sound (supersonic, >1225 kmph at sea level)
- Recently, sonic boom (a loud sound) was heard in Bengaluru which emanated from an Indian Air Force (IAF) test flight involving a supersonic profile.
- When an airplane travels through the air, it produces sound waves.
- If the plane is traveling slower than the speed of sound, then sound waves can propagate ahead of the plane.
- If the plane breaks the sound barrier and flies faster than the speed of sound, it produces a sonic boom when it flies past.

- The boom is the plane's sound waves combined together propagated at once.
- Air reacts like fluid to supersonic objects. As those objects travel through the air, molecules are pushed aside with great force and this forms a shock wave.
- The bigger and heavier the aircraft, the more air it displaces.
- There are several factors that can influence sonic booms like weight, size, and shape of the aircraft or vehicle, plus its altitude, attitude, and flight path, and weather or atmospheric conditions.
- The direction of travel and the strength of shock waves are influenced by wind, speed, and direction, as well as by air temperature and pressure.

6.12 Gold Nanoparticles

- National Centre for Polar and Ocean Research (NCPOR) and Goa University (GU) has successfully synthesized gold nanoparticles.
- They used psychrotolerant Antarctic bacteria through a non-toxic, low-cost, and eco-friendly way for the synthesis.
- The study revealed genotoxic effect of GNPs on a Sulphate reducing bacteria (SRB).
- It displayed enough anti-bacterial properties by inhibiting the growth of SRB and its sulphide production by damaging the genetic information of the DNA of the bacterial cell.
- Geno toxicity describes the property of a chemical agent that is capable of damaging the genetic information of DNA and thus causing mutation of the cell, which can lead to cancer.
- These GNPs can be used as a composite therapeutic agent clinical trials, especially in anti-cancer, anti-viral, anti-diabetic, and cholesterol-lowering drugs



6.13 Dhruva Chip

- It is a home-grown receiver chip developed by IIT-Bombay.
- It can be used in smartphones and navigation devices to find locations and routes within the country.
- It will receive signals from India's NAVIC group of navigation satellites as well as the US GPS-based satellites to determine these accurately under all weather conditions.
- It can receive in multiple frequency bands and handle weak signals.
- Such signals can be converted into digital bits and processed by any standard digital signal processor (DSP) to determine one's location precisely.
- It will help receive and clean up the signals received from NAVIC, which are 36,000 km above from the earth's surface.
- This Project was funded by the Ministry of Electronics and Information Technology (MeitY).
- SAMEER (Society for Applied Microwave Electronics Engineering and Research) is the nodal agency.
- NAVIC - Navigation with Indian Constellation is India's geo-positioning system with 9 satellites designed by ISRO to provide accurate positioning within the country.



6.14 Water Electrolysis

- Researchers from the IIT- Madras are collaborating with their counterparts in Germany, to develop alternative technologies to produce green hydrogen.
- It is to help the transition to hydrogen-based economy.
- The project is taken up under the Scheme for Promotion of academic and Research Collaboration or SPARC.
- Conventional methods of generating hydrogen result in a large quantity of carbon dioxide, a greenhouse gas that imposed serious environmental concerns.
- Electrochemical splitting of water, called 'Water Electrolysis' (WE), is clean, facile, and highly efficient technology for large-scale production of high-purity H₂.

6.15 Zinc Gluconate

- Element Zinc is vital for maintaining normal bone homeostasis, and its levels are reported to get reduced in rheumatoid arthritis patients and arthritis-induced animals.
- It is also known that oral supplementation of zinc in the form of zinc gluconate have very low bioavailability in humans.
- Institute of Nano Science & Technology (INST) has formulated nanoparticles with chitosan and loaded these nanoparticles with zinc gluconate for reducing the severity of rheumatoid arthritis.
- Zinc gluconate-loaded chitosan nanoparticles exerted superior therapeutic effects compared to the free form of zinc gluconate.
- Chitosan is nontoxic, biocompatible, biodegradable natural polysaccharide.
- It is one of the most abundant biopolymers obtained from the exoskeleton of crustaceans have shown absorption promoting characteristics.

6.16 Innovation in Super Capacitor

- Super Capacitor / Ultra capacitors are next-generation energy storage device.
- They have ultrafast charging characteristic as compared to conventional capacitors and lithium-ion batteries (LIB).
- In a super capacitor, electrode, electrolyte are the pivotal components which directly determine the electrochemical behavior of the super capacitors.
- Recently International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) has developed a low-cost, environmentally friendly, super capacitor electrode.
- It is derived from industrial waste cotton which can be used as an energy harvester storage device.
- Natural seawater is explored as an alternative aqueous electrolyte.
- It may replace the existing aqueous-based electrolytes for the economic fabrication of supercapacitor.
- The device shows great potential for practical application, and integration with solar cell.

6.17 Ammonium Nitrate

- Ammonium nitrate (NH₄NO₃) is one of the world's most widely used fertilizers.
- It is produced as small porous pellets, or 'prills',
- Ammonium nitrate does not burn on its own, instead it acts as a source of oxygen that can accelerate the combustion (burning) of other materials.
- Ammonium nitrate prills provide a much more concentrated supply of oxygen than the air around us.
- This is why it is effective in mining explosives, where it's mixed with oil and other fuels.
- At high enough temperatures, however, ammonium nitrate can violently decompose on its own.
- This process creates gases including nitrogen oxides and water vapour.



- It is this rapid release of gases that causes an explosion.
- Recently there was an ammonium nitrate blast in Lebanese capital Beirut injured many.

6.18 Nitrogen di-oxide

- Nitrogen dioxide (NO_2) is a red, bad-smelling gas.
- An ammonium nitrate explosion produces massive amounts of nitrogen oxides.
- Nitrogen oxides are commonly present in urban air pollution, and can irritate the respiratory system.
- Elevated levels of these pollutants are particularly concerning for people with respiratory conditions.

6.19 Hydrogen Evolution Reaction

- Hydrogen is projected as one of the next generation low carbon fuels.
- The future of use of hydrogen as a fuel lies in the design of efficient electro catalysts for facilitating electrochemical splitting of water to produce hydrogen.
- The effectiveness of the electro catalyst for the hydrogen (H_2) evolution reaction (HER) largely depends on its ability to lower the potential of an electrochemical reaction maximally, and cost of synthesis (production).
- The commercially used Platinum (Pt) / Carbon (C) catalysts are efficient but expensive and suffer from metal ion leaching or electro catalyst corrosion when used for long duration.
- Metal-organic frameworks (MOFs) and coordination polymers (COPs) are envisioned as the next generation catalysts.
- Centre for Nano and Soft Matter Sciences (CeNS) an autonomous institute under Department of Science and Technology, have synthesized a novel COP consisting of palladium Pd(II) ions.
- The recent invention serve as a source of active sites for H-adsorption, and benzene tetra mine (BTA) chelating ligands capable of better charge transfer.

6.20 BlackRock

- It is a new malware that targets more android apps than previous malwares.
- It can steal information like passwords and credit card information from about 377 smartphone applications, including Amazon, Facebook, Gmail and Tinder.

6.21 BeIYo

- It is India's first Covid-19 blockchain platform.
- It is developed by BelfricsBT, a global blockchain start-up along with IIT Bangalore.
- It can convert Covid-19-related clinical and vaccination data of citizens currently from the physical form into digital assets.
- It uses contact tracing apps like AarogyaSetu via application programme interface (API) for tracing.
- It will be able to simplify the tracking of all the Covid-19 patients in India from symptoms to vaccination certificate in a decentralised manner, without compromising on privacy of data.

6.22 Cessna Caravan

- It is the **world's largest all-electric aircraft "Cessna Caravan"**.
- It is about to take to the skies for the first time.
- This will be the largest aircraft ever to fly on electric power.
- It is believed to be the first complete civilian unmanned flight over a populated area.
- It is a four-seat, single-engine plane that is among the most common aircraft model in existence.