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Contents

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1

Space

1 NASA's Artemis Project

Context: NASA is forging ahead with its 'Artemis program' to land humans on the moon by 2024, but the agency has also just offered its first plan for what a U.S. lunar presence may look like after that milestone.

About:

- NASA is committed to landing American astronauts, including the first woman and the next man, on the Moon by 2024.
- Through the agency's Artemis lunar exploration program, NASA will use innovative new technologies and systems to explore more of the Moon than ever before.

With the Artemis program NASA will:

- Demonstrate new technologies, capabilities, and business approaches needed for future exploration including Mars
- Establish American leadership and a strategic presence on the Moon while expanding our U.S. global economic impact
- Broaden our commercial and international partnerships
- Inspire a new generation and encourage careers in STEM

The new plan:

- The new plan comes from the report, titled "NASA's Plan for Sustained Lunar Exploration and Development".
- It summarizes the vision NASA has laid out for justifying and accomplishing the 2024 moon landing.
- But the report also looks farther out to focus on what a long-term presence on the moon and in lunar orbit would permit the U.S. to accomplish.

Artemis Base Camp

- The star of the report is what NASA has dubbed Artemis Base Camp, meant to be a long-term foothold for lunar exploration, perhaps in Shackleton Crater at the moon's south pole.
- Artemis Base Camp itself would be a lunar foundation surface habitat that could host four astronauts at the south pole for visits of perhaps a week.
- In the long term, the facility would also require infrastructure for power, waste disposal and communications, as well as radiation shielding and a landing pad.

- The base could also be a site for testing new techniques for dealing with pesky lunar dust and the long, cold lunar nights, turning local materials into resources like water, and developing new power and construction technologies.

The camp would be accompanied and supported by two mobility systems:

- a lunar terrain vehicle to facilitate astronaut movement across the surface
- a habitable mobility platform that could support trips away from base for up to 45 days.
- Mobility is a major part of the Artemis Base Camp. Robust mobility systems will be needed to explore and develop the moon.
- The same is true for Mars, making the habitable mobility platform a particularly important element as we will need a similar type of vehicle to explore the Red Planet.

Conclusion:

In the long term, the base camp will need infrastructure for power, waste disposal and communications, besides radiation shielding and a landing pad. The base camp will demonstrate the US's continued leadership in space and will eventually help them prepare to undertake humanity's first mission to Mars.

2 Mismatched Black Holes Merge

Context: Scientists working with the LIGO and Virgo gravitational-wave observatories have detected an oddball event: the merger of two black holes of notably different sizes.

About:

- All 10 black hole mergers detected in the first two observing runs had binary components with similar masses.
- But the new event, called GW190412, involved objects of about 8 and 30 solar masses, respectively.
- This asymmetry made the "hum" of overtones in the gravitational waves clear for the first time, enabling researchers to narrow in on the binary's properties.
- The merger occurred roughly 2 billion light-years away, tilted from our line of sight by about 45°. Before the two black holes came together, the larger one was spinning fairly slowly — roughly 40% the maximum permitted by gravity.
- This is the first time researchers have been able to confidently measure the spin of a black hole about to merge.

GW190412:

- The gravitational-wave observatories detected the signal, designated **GW190412**, at the start of the third observing run, which happened in two segments spanning April 1 to October 1, 2019, and November 1, 2019, to March 27, 2020.
- The third observing run would have run through April, but was suspended due to the COVID-19 pandemic.
- So far the collaboration has 56 confirmed candidates from this run, two of which now have published analyses. Scientists are actively analyzing the rest.

What is a black hole?

- A black hole is a place in space where gravity pulls so much that even light cannot get out. The gravity is so strong because matter has been squeezed into a tiny space.

- This can happen when a star is dying.
- Because no light can get out, people cannot see black holes. They are invisible. Space telescopes with special tools can help find black holes.
- The special tools can see how stars that are very close to black holes act differently than other stars.

3 National Science Day: What is the 'Raman effect'?

Context: In 1986, the Government of India designated February 28 as National Science Day, to commemorate the announcement of the discovery of the "Raman effect".

About

- National Science Day is an occasion to salute the talent and tenacity of our scientists. Their innovative zeal and pioneering research have helped India and the world.
- The theme of this year's science day is "Women in Science".
- Born on November 7, 1888, CV Raman was a physicist of Tamil origin who made a ground-breaking discovery in the spectrum of light scattering.
- The Raman Effect won scientist, Sir CV Raman, the Nobel Prize for physics in 1930.
- The nation honoured him with the Bharat Ratna, its highest civilian award, in 1954.
- CV Raman was appointed to be the first Indian director of Indian Institute of Science (IIS) in 1933.
- After India gained independence in 1947, Raman became the first National Professor of the country.

The Raman Effect

- The Raman Effect is the inelastic scrambling of a photon by molecules which are energised to higher rotational energy or vibrational levels. This effect is also known as the Raman scattering.
- This phenomenon also forms the foundation of Raman spectroscopy which is utilised by physicists and chemists to know more information about materials.
- In 1928, Raman discovered that when a stream of light passes through a liquid, a fraction of the light scattered by the liquid is of a different colour.
- Raman conducted his Nobel-prize winning research at IACS, Calcutta.
- While he was educated entirely in India, Raman travelled to London for the first time in 1921, where his reputation in the study of optics and acoustics was known to physicists such as JJ Thomson and Lord Rutherford.
- A commemorative booklet prepared jointly by IACS and ACS on Raman mentions that his speciality was the study of vibrations and sounds of stringed instruments such as the Indian veena and tambura, and Indian percussion instruments such as the tabla and mridangam.
- Significantly, it notes that the Raman Effect is "very weak" — this is because when the object in question is small (smaller than a few nanometres), the light will pass through it undisturbed.
- But a few times in a billion, light waves may interact with the particle. This could also explain why it was not discovered before.
- In general, when light interacts with an object, it can be reflected, refracted or transmitted.
- One of the things that scientists look at when light is scattered is if the particle it interacts with can change its energy.

- The Raman Effect is when the change in the energy of the light is affected by the vibrations of the molecule or material under observation, leading to a change in its wavelength.

Significance of National Science Day:

- The sole message of National Science Day is to spread the message that Science and Technology should be applied in everyday life.
- On this day, scientists and science enthusiasts come together as programmes are held to bring the scientific community closer.
- Educational institutes also hold science fairs and science researchers get a chance to share their latest work.

4 First-ever Digital Geological Map of Moon

Context: The first ever digital, unified, global, geological map of the moon was released virtually by the United States Geological Survey (USGS), National Aeronautics and Space Administration (NASA) and the Lunar Planetary Institute.

About:

- Called the '**Unified Geologic Map of the Moon**', it is a 'seamless, globally consistent, 1:5,000,000-scale geologic map'.
- The moon the closest cosmic body to Earth through which space discovery can be attempted and documented has always piqued the interest of humanity.
- The researchers built on the original digital renovation of the six 1:5,000,000-scale lunar geologic maps comprising of the near, central far, east, west, north and south sides that was released in 2013.
- 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.
- Data from recent satellite missions to the moon and resources data from NASA's Apollo Missions were used to come up with the map.
- This version of the map is a digital release only available in GIS and PDF formats. The map can be downloaded from the Unified Geologic Map of the Moon website.

The mapping process:

- To make the digital map a reality, scientists used information gathered from six Apollo-days regional maps, interpolated with more recent satellite missions to lunar space.
- The existing historical maps were redrawn to line them up with more modern datasets. This preserved previous observations and geological interpretations.
- In addition to merging new and old data, USGS researchers also worked on a unified description of stratigraphy — also called **rock layers** — on the surface of the moon.
- This helped resolve issues from previous maps, when rock names, ages, and descriptions were periodically inconsistent.

The moon profile:

- The Moon, otherwise known as Luna, is the only natural satellite of Earth.
- It was created 4.6 billion years ago, and it is widely accepted that it was created when Earth collided with a planet-sized object called Theia.
- It's the fifth-largest moon in our solar system and is the second brightest object in the sky (after the Sun).

Orbital characteristics

- **Average distance from Earth:** 238,855 miles (384,400 km)
- **Perigee (closest approach to Earth):** 225,700 miles (363,300 km)
- **Apogee (farthest distance from Earth):** 252,000 miles (405,500 km)
- **Orbit circumference:** 1,499,618.58 miles (2,413,402 km)
- **Mean orbit velocity:** 2,287 mph (3,680.5 km/h)

Moon's 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.

Missions targeting Lunar South Pole:

- The Indian Space Research Organisation (ISRO) 'Chandrayaan 2', is an active mission that targets the Lunar South Pole for exploration.
- Like Chandrayan, 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.
- These present and future moon missions' success can be further helped by the digital map of the moon.

Significance of this new map:

- This map provides vital information for new scientific studies by connecting the exploration of specific sites on the moon with the rest of the lunar surface.
- It has very practical implications. The geology of the moon is very important for planning future missions and establishing scientific objectives.
- It 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.

5 Astronomers find Jupiter-like cloud bands on closest Brown Dwarf

Context: A team of astronomers has discovered that the closest known brown dwarf, Luhman 16A, shows signs of cloud bands similar to those seen on Jupiter and Saturn.

What are Luhman 16A?

- Luhman 16A is part of a binary system containing a second brown dwarf, Luhman 16B.
- At a distance of 6.5 light-years, it's the third closest system to our Sun after **Alpha Centauri** and **Barnard's Star.**
- Both brown dwarfs weigh about 30 times as much as Jupiter.
- Despite the fact that Luhman 16A and 16B have similar masses and temperatures (about 1,900° F or 1,000° C), and presumably formed at the same time, they show markedly different weather.
- Luhman 16B shows no sign of stationary cloud bands, instead exhibiting evidence of more irregular, patchy clouds.

- Luhman 16B therefore has noticeable brightness variations as a result of its cloudy features, unlike Luhman 16A.

Brown dwarfs

- Brown dwarfs are objects heavier than planets but lighter than stars, and typically have 13 to 80times the mass of Jupiter.
- They do not have enough mass to produce energy by nuclear fusion.
- Rather, the small amount of energy emitted by these objects comes almost exclusively from the heat stored in them during the collapse of the parent gas cloud from which they formed.
- Brown dwarfs therefore gradually cool and fade with cosmological time.

The research

- The researchers used an instrument on the Very Large Telescope in Chile to study polarized light from the Luhman 16 system.
- Polarization is a property of light that represents the direction that the light wave oscillates. Polarized sunglasses block out one direction of polarization to reduce glare and improve contrast.
- This is the first time scientists have used the technique of polarimetry to determine the properties of atmospheric clouds outside of the solar system, or exoclouds.

How these findings are significant?

- Subsequently, many astronomers detected polarisation of brown dwarfs. But what is special in the newest study of Luhman 16 is that the researchers have found the actual structure of the clouds — that they form bands over one of the pair (Luhman 16A) of brown dwarfs.
- Understanding the cloud system over a brown dwarf can shed light on the pressure, temperature and climate on the surface of the celestial body.

6 National Space Promotion and Authorization Centre (IN-SPACe)

Context: The Government of India has launched a new initiative by the name Indian National Space Promotion and Authorization Centre (IN-SPACe) to provide a level playing field for private companies to use Indian space infrastructure, which will be extended into the Indian Space Research Organisation (ISRO).

About

- The new Indian National Space Promotion and Authorisation Centre (IN-SPACe), which is expected to be functional within six months, will-
  - assess the needs and demands of private players, including educational and research institutions
  - explore ways to accommodate these requirements in consultation with ISRO
- IN-SPACe is supposed to be a facilitator, and also a regulator. It will act as an interface between ISRO and private parties, and assess how best to utilise India's space resources and increase space-based activities.
- Existing ISRO infrastructure, both ground- and space-based, scientific and technical resources, and even data are planned to be made accessible to interested parties to enable them to carry out their space-related activities.

- National Space, Promotion & Authorisation Centre (IN-SPACe) will help private players through encouraging policies, through a regulatory environment that is friendly as well as guiding private players in space activities.
- Indian Space Research Organisation (ISRO) will remain the basic body that decides what missions are to be undertaken but this new body will help fill the gaps.

Indian Space Research Organization (ISRO)

- India decided to go to space when Indian National Committee for Space Research (INCOSPAR) was set up by the Government of India in 1962.
- With the visionary Dr Vikram Sarabhai at its helm, INCOSPAR set up the Thumba Equatorial Rocket Launching Station (TERLS) in Thiruvananthapuram for upper atmospheric research.
- Indian Space Research Organisation, formed in 1969, superseded the erstwhile INCOSPAR.
- The Indian Space Research Organization (ISRO) is the pioneer space exploration agency of the Government of India, headquartered at Bengaluru.
- The prime objective of ISRO is to develop space technology and its application to various national needs.

What is the need to involve private sector?

- **Low rate of investment:** Indian space industry had a barely 3 percent share in a rapidly growing global space economy which was already worth at least $360 billion.
  - Only 2 percent of this market was for rocket and satellite launch services, which require fairly large infrastructure and heavy investment.
  - The remaining 95 percent related to satellite-based services, and ground-based systems.
- **Less competitive:** Indian industry, however, is unable to compete, because till now its role has been mainly that of suppliers of components and sub-systems.
- **Lack of resources and technologies:** Indian industries do not have the resources or the technology to undertake independent space projects.
- **Insufficient production:** Additionally, the demand for space-based applications and services is growing even within India, and ISRO is unable to cater to this. The need for satellite data, imageries and space technology now cuts across sectors, from weather to agriculture to transport to urban development, and more.

How will it enhance the space game?

- IN-SPACe will ensure equal participation from private players through encouraging policies in a friendly regulatory environment.
- The new initiative will also hand-hold, promote and guide the private industries in space activities.
- With the aid of Indian National Space Promotion and Authorization Centre (IN-SPACe), Indian start-ups and technology entrepreneurs will be linked up with nuclear research facilities through technology development and incubation centres to foster synergies.

7 Detection of fluorine in hot Extreme Helium Stars

Context: 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 Stars.

About

- 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. The origin and evolution of these Hydrogen deficient objects have been shrouded in mystery.
- Their severe chemical peculiarities challenge the theory of well-accepted stellar evolution as the observed chemical composition of these stars do not match with that predicted for low mass evolved stars.

Key-findings of the research

- The research which showed fluorine abundances determined from singly ionized fluorine (F II) lines suggest a very high enrichment of fluorine, about a factor of 100 to 10000 times higher than normal stars.
- Severe fluorine enrichment w.r.t normal stars (of the order of 800 – 8000) was observed in the cool EHes along-with the cooler classical hydrogen deficient stars, the RCB variables (R Coronae Borealis Stars) hinting at close evolutionary connection between them.
- The scientists explored the relationship of hot EHes (EHes having e□ective temperature ≥ 14000K), with the cooler EHes, based on their fluorine abundance and spotted it in the former, thus establishing an evolutionary connection across a wide range of e□ective temperature.
- High-resolution echelle spectra of 10 hot EHes were obtained from Hanle Echelle Spectrograph (HESP) mounted on the 2-m Himalayan Chandra Telescope at the Indian Astronomical Observatory (IAO) in Hanle, Ladakh, (remotely operated by IIA) including data from McDonald Observatory, USA, and ESO archives.
- By comparing the observed fluorine abundances with other abundances of the key elements, the scientists could determine the formation channels responsible for fluorine enrichment.
- The varied range of observed fluorine abundance across stars having similar atmospheric parameters points out the difference in the individual star's evolution and the ensuing nucleosynthesis.
- Particularly, the enrichment of fluorine in the atmospheres of carbon-rich EHes and absence of the same in carbon-poor EHes suggest that fluorine is profusely produced during the merger of a He-CO WD resulting in a carbon-rich EHe, whereas He-He WD merger that results in carbon-poor EHes does not account for fluorine overabundance.

Fluorine

- Fluorine is an univalent poisonous gaseous halogen, it is pale yellow-green and it is the most chemically reactive and electronegative of all the elements.
- Fluorine readily forms compounds with most other elements, even with the noble gases krypton, xenon and radon.
- It is so reactive that glass, metals, and even water, as well as other substances, burn with a bright flame in a jet of fluorine gas.

Why Fluorine is important?

- Clues to evolution of extreme helium stars require accurate determinations of their chemical composition, and the peculiarities, if any, become very important.
- Fluorine plays a very crucial role in this regard to determine the actual evolutionary sequence of these hydrogen deficient objects.

Significance of the findings

- **Finding the formation:** The findings make a strong case that the main formation of hot Extreme Helium Stars objects involves a merger of a carbon-oxygen (CO) and a Helium (He) white dwarf.
- **Solving decade-old mystery:** The detection of enhanced fluorine abundances in the atmospheres of hot EHes solves a decade-old mystery about their formation. It firmly places hot EHes in an evolutionary sequence with cool EHes and other hydrogen-deficient stars and zeros in on the evolutionary scenario, which involves the merger of two double de-generate white dwarfs (WDs).

White dwarfs

- A white dwarf is what stars like the Sun become after they have exhausted their nuclear fuel.
- Near the end of its nuclear burning stage, this type of star expels most of its outer material, creating a planetary nebula.
- Only the hot core of the star remains. This core becomes a very hot white dwarf, with a temperature exceeding 100,000 Kelvin.
- Unless it is accreting matter from a nearby star (see Cataclysmic Variables), the white dwarf cools down over the next billion years or so.

8 Comet C/2020 F3 Neowise

Context: The recently discovered comet called C/2020 F3, also known as NEOWISE after the NASA telescope that discovered it, will make its closest approach to the Earth on July 22, 2020.

About

- On July 3, the comet was closest to the sun at 43 million km. On this day, the comet cruised inside Mercury's orbit and, due to its proximity to the sun; its outer layer was released creating an atmosphere (referred to as coma) of gas and dust from its icy surface.
- This atmosphere sometimes leads to the formation of a bright tail of debris that can extend for thousands or millions of kilometres.
- On July 22, the comet, which takes 6,800 years to complete one lap around its orbit, will be at a distance of 64 million miles or 103 million kilometers while crossing Earth's outside orbit.

Comets

- Comets or "dirty snowballs" are mostly made of dust, rocks, and ice, the remnants from the time the solar system was formed over 4.6 billion years ago.
- The word comet comes from the Latin word **"Cometa" which means "long-haired"** and the earliest known record of a comet sighting was made by an astrologer in 1059 BC.
- Comets can range in their width from a few miles to tens of miles wide. As they orbit closer to the sun, they heat up and release debris of dust and gases that form into a "glowing head" that can often be larger than a planet.
- The debris forms a tail that can stretch out to millions of miles. Each time a comet passes the sun, it loses some of its material and it will eventually disappear completely as a result.

- While there are millions of comets orbiting the sun, there are more than 3,650 known comets as of now, according to NASA.
- Comets may be occasionally pushed into orbits closer to the sun and the Earth's neighborhood due to forces of gravity of other planets.
- The appearance of some comets, like those that take less than 200 years to orbit around the sun is predictable since they have passed by before. These may be referred to as **short-period comets.**
- These can be found in the Kuiper belt, where many comets orbit the sun in the realm of Pluto, occasionally getting pushed into orbits that bring them closer to the sun.
- One of the most famous **short-period comets** is called **Halley's Comet** that reappears every 76 years. **Halley's will be sighted next in 2062.**
- The **less-predictable comets** can be found in **the Oort cloud** that is about 100,000 AU from the sun, or 100,000 times the distance between the Earth and the sun.
- Comets in this cloud can take as long as 30 million years to complete one rotation around the sun.

Visibility of the Comet

- Comets do not have the light of their own and what humans are able to see from Earth is the reflection of the sun's light off the comet as well as the energy released by the gas molecules after it is absorbed from the sun.
- The visibility of a comet cannot be precisely predicted since a lot depends on the way the "outbursts" of gas and dust play out determining how much of a "good show" the comet will put out for observers.

Importance of studying and tracking the comets

- Astronomers study comets since they believe that they hold important clues about the formation of the solar system and it is possible that comets brought water and other organic compounds, which are the building blocks of life to Earth.
- **NASA tracks all Near Earth Objects (NEOs)** that includes comets and asteroids using telescopes placed all around the Earth, as part of its **NEO Observation Program.**
  - This program has a congressionally directed objective to find, track, and characterize NEOs that are 140 meters or larger since they can pose a risk to the Earth because of the devastation a potential impact can cause.

9 Starship Spacecraft

Context: Just two days after SpaceX's Crew Dragon capsule landed in the Gulf of Mexico, a prototype of the company's uncrewed "Mars ship", a stainless steel test vehicle called SN5, and which is a part of the Starship spacecraft, successfully flew to an altitude of over 500 feet for a little less than 60 seconds.

What is Starship?

- Designed by SpaceX, Starship is a spacecraft and super-heavy booster rocket meant to act as a **reusable transportation system** for crew and cargo to the Earth's orbit, Moon and Mars.
- SpaceX has described Starship as "the world's most powerful launch vehicle" with an ability to carry over 100 metric tonnes to the Earth's orbit.

- Starship has been under development since 2012 and is a part of Space X's central mission to make interplanetary travel accessible and affordable and to become the first private company to do so.
- Therefore, the company is working on building a fleet of reusable launch vehicles, capable of carrying humans to Mars and other destinations in the solar system.

Why the focus is on 'reusable transportation system'?

- Reusability is at the heart of making interplanetary travel accessible.
- Since a majority of the launch cost is attributed to the expense of building a rocket which is ultimately designed to burn up during re-entry.
- Following the commercial model, a rapidly reusable space launch vehicle could reduce the cost of traveling to space by a hundredfold.

Significance of the Starship

- **Functional at lower cost:** Starship can deliver satellites further and at lower marginal costs than SpaceX's Falcon vehicles and it can ferry both cargo and crew to the International Space Station (ISS).
- **Ability to carry large amounts of cargo:** Once developed, Starship is also expected to help carry large amounts of cargo to the Moon, for human spaceflight development and research.
- **Interplanetary missions:** Beyond the Moon, the spacecraft is being designed for carrying crew and cargo for interplanetary missions as well.

10 Solar Minimum

Context: As per experts report, the sun has gone into a state called the 'solar minimum' and is about to enter the deepest period of 'sunshine recession' as sunspots are virtually not visibly at all.

About:

- Sun has a cycle that lasts on average 11 years, and right now we are at the peak of that cycle.
- Every 11 years or so, sunspots fade away, bringing a period of relative calm. This is called the **solar minimum.** And it's a regular part of the sunspot cycle.
- While intense activity such as sunspots and solar fl ares subside during solar minimum, that doesn't mean the sun becomes dull.
- Solar activity simply changes form.

How does it happen?

- The solar cycle is based on the **Sun's magnetic field**, which flips around every 11 years, with its north and south magnetic poles switching places.
- It's not known what drives these cycles - recent research suggests it has to do with an **11.07-year planetary alignment** - but the poles switch when the magnetic field is at its weakest, also known as solar minimum.
- Because the Sun's magnetic field controls solar activity - sunspots, coronal mass ejections and solar flares - the cycle is detectable as that activity changes.
- During solar minimum, there are, well, minimal sunspots and fl ares. This gradually changes as the Sun ramps up to solar maximum.
- The magnetic field grows stronger, and sunspot and fl are activity increases, before subsiding again for the next solar minimum.

Is it a repeat of Dalton Minimum?

- NASA scientists fear it could be a repeat of the Dalton Minimum, which happened between 1790 and 1830 — leading to periods of brutal cold, crop loss, famine and powerful volcanic eruptions.
- Temperatures plummeted by up to 2 degrees Celsius (3.6 degrees Fahrenheit) over
- 20 years, devastating the world's food production
- On April 10, 1815, the second-largest volcanic eruption in 2,000 years happened at Mount Tambora in Indonesia, killing at least 71,000 people.
- It also led to the so-called Year Without a Summer in 1816 — also nicknamed "eighteen hundred and froze to death" — when there was snow in July.
- So far this year, the sun has been "blank" with no sunspots 76 percent of the time, a rate surpassed only once before in the Space Age — last year, when it was 77 percent blank

The impact:

- **Affecting Earth's upper atmosphere:** Excess cosmic rays pose a health hazard to astronauts and polar air travellers, affect the electro-chemistry of Earth's upper atmosphere, and may help trigger lightning."
- **Affecting radio communication & satellites:** More aurora activity can be noticed during solar maximum, since auroras are generated by solar activity. Increased solar activity can also affect radio communications, and navigation satellites.
- **Affecting higher altitudes:** At solar minimum, solar ultraviolet radiation decreases, but the effect of this primarily hits the stratosphere and higher altitudes.
- **Shrinkage:** It causes Earth's atmosphere to shrink slightly, which reduces drag on satellites.
- **More rainfall:** Conversely, the increase in UV radiation during solar maximum contributes to rainfall, but the effect on temperature is negligible.
- However, nothing the Sun is currently doing is going to create freezing weather, famine, or earthquakes.

11 SunRISE Mission

Context: NASA has announced new SunRISE mission to study giant solar particle storms.

About:

- 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 SunRISE mission is to understand how such storms affect interplanetary space can help protect spacecraft and astronauts.
- NASA designed it to learn more about how the sun generates and throws off giant space weather storms, known as solar particle storms.
- SunRISE will gather information on how the solar system works. Knowing this could help NASA protect astronauts traveling to the Moon and Mars.

What are Solar Energetic Particles (SEPs)?

- Solar energetic particles (SEPs) emitted from the Sun are a major space weather hazard motivating the development of predictive capabilities.

- These events occur when particles (mostly protons) emitted by the Sun become accelerated either close to the Sun during a fl are or in interplanetary space by coronal mass ejection shocks.

The mission layout:

- The mission layout depends on 6 solar-powered CubeSats– each regarding the size of a toaster oven– to concurrently observe radio photos of low-frequency emission from solar task and share them using NASA's Deep Space Network.
- SunRISE contains six CubeSats which will work together as a large radio telescope. Each of the CubeSats would run on solar power and would be of the size of a toaster oven.
- The CubeSats will create 3D maps that pinpoint where giant particle bursts originate on the sun and how they evolve as they expand into space.
- This, in turn, will help determine what initiates and accelerates these giant radiation jets of radiation.
- The spacecraft will also work together to map the magnetic field lines reaching from the sun out into interplanetary space.
- Together, these will observe radio images of low-frequency emission from solar activity and create 3D maps to locate the origin place of a solar particle storm on the Sun. The entire procedure of the storm evolution as it moves outward into the space will be studied too.
- This, consequently, will aid determine what initiates as well as increases these giant jets of radiation.
- The six individual spacecraft will also interact to map, for the very first time, the pattern of magnetic field lines reaching from the Sunlight out right into interplanetary space.

Background:

- NASA had in August 2017 shortlisted SunRISE, along with another Mission of Opportunity proposal, for an 11-month mission concept study. Following the study in 2019, the space agency approved an additional formulation study for another year.
- Missions of Opportunity are part of NASA's oldest continuous program called the Explorers Program.
- These aim at providing low-cost, efficient and frequent access to space for various missions.

Significance of the mission:

- 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.
- Furthermore, it will help scientists understand the complex relationship between the sun's activity and a host of dangerous phenomena around Earth called space weather.

12 ExoMars Mission

Context: The European Space Agency (ESA) announced that its ExoMars Rosalind Franklin rover mission would not fl y this year due to technical issues and the logistical impact.

About:

- The ExoMars rover is Europe's first Mars rover. Named after Rosalind Franklin, a British pioneer of DNA science, the robotic explorer will search for signs of life on the red planet's surface.
- The ExoMars rover is a follow-on to ESA's ExoMars Orbiter mission, which reached the red planet in 2016.

- That mission consisted of two parts:
- The Trace Gas Orbiter (TGO)
- The orbiter is performing science work and will serve as a communications relay for the second phase of the program — a rover and landing surface platform.
- The Schiaparelli lander, a technology demonstrator
- Unfortunately, the Schiaparelli crash-landed during its descent to the Martian surface.
- The Rosalind Franklin rover is a second ExoMars mission to search for signs of life at depths up to two meters below the martian surface.
- It consists of a Russian-led surface platform and the European-led rover, to be launched on a Russian Proton rocket from Baikonur.

The delay:

- The launch of the second ExoMars mission, a collaboration with the Russian Space Agency (Roscosmos), was initially planned for July or August of this year.
- However, the launch has been postponed to 2022 due to technical issues and the logistical impact due to the global Conoavirus outbreak.
- The agency needs more time to troubleshoot issues with the spacecraft's parachute system as well as precise electronics, so the delay is necessary.
- Also, the recent coronavirus outbreak that's spreading around the globe isn't helping.
- So instead of rushing, the team is taking the next two years to conduct extensive testing and make sure they get it right.

Why landing on Mars is challenging?

- Landing a spacecraft on Mars is hard. There are a bunch of challenges with Mars, including its lack of a protective magnetosphere and lower surface gravity.
- But one of the biggest is its thin atmosphere of carbon dioxide.
- The planet's atmosphere is thinner than what we see on Earth, and as such its takes a combination of sophisticated tools, including heat shields, retrorockets, and even giant, inflatable airbags, to safely touch down on the surface open up every two year or so when Earth and Mars are close together.
- ExoMars flew in 2016, InSight in 2018 and the Mars 2020 rover will fl y in 2020.
- The missions follow interplanetary transfer trajectory designed to either get there the fastest, or with the least amount of fuel.
- The ExoMars rover mission was initially scheduled to launch in 2018, but was delayed to
- 2020 due to delays in European and Russian industrial activities. When the Rosalind Franklin rover arrives at Mars it will join the ExoMars Trace Gas Orbiter, which has been in orbit around the Red Planet since October 2016. TGO will act as a relay station for the mission while continuing its own science mission.

13 Mars Lander InSight

Context: NASA's Mars Lander InSight has recorded its first 'Marsquake.' It has recorded a quake of 2 or 2.5 magnitude which is hard to predict on Earth's surface.

About:

- InSight is part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama.
- It will be the first mission to peer deep beneath the Martian surface, studying the planet's interior by measuring its heat output and listening for marsquakes, which are seismic events similar to earthquakes on Earth.
- It will use the seismic waves generated by marsquakes to develop a map of the planet's deep interior.

Significance of the mission:

- The findings of Mars' formation will help better understand how other rocky planets, including Earth, were and are created. But InSight is more than a Mars mission – it is a terrestrial planet explorer that would address one of the most fundamental issues of planetary and solar system science – understanding the processes that shaped the rocky planets of the inner solar system (including Earth) more than four billion years ago.
- InSight would delve deep beneath the surface of Mars, detecting the finger prints of the processes of terrestrial planet formation, as well as measuring the planet's "vital signs": Its "pulse" (seismology), "temperature" (heat flow probe), and "reflexes" (precision tracking).
- InSight seeks to answer one of science's most fundamental questions: How did the terrestrial planets form?
- Previous missions to Mars have investigated the surface history of the Red Planet by examining features like canyons, volcanoes, rocks and soil. However, signatures of the planet's formation can only be found by sensing and studying its "vital signs" far below the surface.
- In comparison to the other terrestrial planets, Mars is neither too big nor too small. This means that it preserves the record of its formation and can give us insight into how the terrestrial planets formed. It is the perfect laboratory from which to study the formation and evolution of rocky planets. Scientists know that Mars has low levels of geological activity. But a lander like InSight can also reveal just how active Mars really is.

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2

Defence

1 AF's famed 18 Squadron to be operationalised yet again

Context: The Indian Air Force's 18 Squadron, which earned the nickname of Defenders of Kashmir Valley for being the first to land and operate from Srinagar, has been operationalised once again at Air Force Station Sulur near Coimbatore.

What is 18 Squadron?

- 18 Squadron was formed on 15 April 1965 with the motto 'Teevra aur Nirbhaya' meaning 'Swift and Fearless'.
- The Squadron was flying MiG 27 aircraft before it got number plated on 15 April 2016.
- The squadron actively participated in the 1971 war with Pakistan and was decorated with the highest gallantry award 'Param Vir Chakra' awarded to Flying Officer Nirmal Jit Singh Sekhon posthumously.

The 1971 War:

- On 14th December 1971, Flying Officer Sekhon had defended the Srinagar airfield from a wave of six Pakistani Sabre aircraft.
- He engaged a pair of the attacking Sabres. In the fight that ensued, he secured hits on one aircraft and set another on fire.
- By this time the other Sabre aircraft came to the aid of their hard pressed companions and Flying Officer Sekhon's Gnat was again outnumbered, this time by four to one.
- Even though alone, Flying Officer Sekhon engaged the enemy in an unequal combat.
- In the fight that followed, at tree top height, he almost held his own, but was eventually overcome by sheer weight of numbers. His aircraft crashed and he was killed.

- In IAF jargon, a squadron which is bereft of aircraft is not retired but 'number-plated'. This means that the squadron exists and could be revived when aircraft are available.
- The Squadron was resurrected on April 1 this year at Sulur. The Squadron was presented with President's Standard in November 2015.
- The squadron will be equipped with LCA Tejas FOC aircraft and will be the second IAF Squadron to fly LCA Tejas.

About Tejas:

- Tejas is an indigenous fourth generation tailless compound delta wing aircraft.
- The aircraft is equipped with fly-by-wire flight control system, integrated digital avionics, multimode radar and its structure is made out of composite material.
- It is the lightest and smallest in its group of fourth generation supersonic combat aircraft.

2 IAF gets Apache attack helicopters from Boeing

Context: Boeing handed over the last of the five AH-64E Apache attack helicopters to the Indian Air Force (IAF), completing the contract for 22 Apaches.

About

- India contracted 22 Apache helicopters and 15 Chinook helicopters from Boeing through the Foreign Military Sales programme of the U.S. government in September 2015 under a $3 billion deal.
- The IAF inducted the first batch of Apaches in September 2019 and based them at Air Force Station, Pathankot, Punjab.
  - While the last five Apaches arrived in India early this year, the handover was slightly delayed due to the COVID-19 lockdown.
- The Apaches were deployed at the Leh airbase as part of the forward movement of assets, amid the stand-off with China in Ladakh.
- Earlier, in March, Boeing handed over the last five of the 15 CH-47F (I) Chinook heavy-lift helicopters to the IAF.

AH-64E Apache Attack Helicopter

- It will replace the Mi-35 fleet.
- Alongside the capability to shoot fire-and-forget anti-tank guided missiles, air-to-air missiles, rockets, and other ammunition, it also has **modern EW [electronic warfare] capabilities** to provide versatility to the helicopter in network-centric aerial warfare.
- The helicopter is capable of delivering a variety of weapons which include air to ground Hellfire missiles, 70 mm Hydra rockets, and air to air Stinger missiles.
- Apache also carries one 30 mm chain gun with 1200 rounds as part of the area weapon subsystem.
- To add to the lethality of the helicopter, it carries **fire control radar,** which has 360° coverage and nose-mounted sensor suite for target acquisition and night vision systems.
- It has an improved **Modernized Target Acquisition Designation System** that provides day, night, and all-weather target information, as well as night vision navigation capability.
- It can be sued for multi missions like for reconnaissance, security, peacekeeping operations, apart from attack operations.

CH-47F (I) Chinook Heavy-lift Helicopters

- It is a **heavy lift, tandem rotor helicopter** that serves armed forces of 19 countries. It will greatly enhance IAF's HADR (humanitarian assistance and disaster relief) capability.
- The Chinook is an advanced multi-mission helicopter that will provide support to the Indian armed forces during disaster relief, medical evacuation, search and rescue missions, aircraft recovery, and parachute drops.
- Each Chinook can carry goods and cargo weighing up to 9.6 tonnes. This includes men and machines—like artillery guns and light armoured vehicles—to high altitudes.

- The Chinook contains a fully integrated, Digital Cockpit Management System, Common Aviation Architecture Cockpit, and advanced cargo-handling capabilities.

3 Spike-LR Anti-Tank Guided Missiles

Context: The Army is set to place a repeat order for Spike-LR (Long Range) Anti-Tank Guided Missiles (ATGM) from Israel as part of emergency procurement. The emergency procurement comes in the backdrop of continuing tensions on LAC with China.

About

- The decision comes days after the Army's decision to place a repeat order for 72,400 Sig Sauer assault rifles from the U.S.
- The Spike order will be a repeat order for 12 launchers and around 250 missiles under emergency procurement.
- Last year, the Army procured 12 launchers and around 250 missiles from Israel under the new financial powers for emergency procurements sanctioned by the Defence Ministry after the Balakot airstrike.
- Under the new emergency powers, armed forces were given a free hand to procure equipment worth up to ₹300 crores on a priority basis with deliveries stipulated to be completed in three months but extendable up to six months. Entirely new systems not in use were also allowed to be procured under the new powers.
- The Army has a much larger requirement for ATGMs which will be met through indigenous Man-Portable ATGM under development by the Defence Research and Development Organisation (DRDO).

Spike-LR long-range Anti-Armour Missile

- Rafael, based in Haifa, Israel, manufactures the Spike family of anti-armor weapons.
- The Spike family includes:
  - Spike-SR with a range of 800m
  - Spike-MR (Gill) with a range of 2,500m
  - Spike-LR with 4,000m range
  - Spike-ER (formerly known as NTD Dandy) with a range of 8,000m.
- Spike-LR is **the 4th generation Anti-Tank Missile**.
- It is a portable anti-armor weapon system with a **range of up to 4km**, which can be operated in fire-and-forget mode and the fire, observe and update mode using the fibre-optic data link.
- Spike-LR is equipped with a **fibre-optic data link guidance system**, which sends commands to the missile from the launch system and receives, into the gunner's field of view, images from the seeker. The gunner can update his aim point while the missile is in flight using the fibre-optic link. As well as update target information, the datalink allows the gunner to switch targets and also receive real-time intelligence and perform battle damage assessment.
- The Spike system can work in **non-line-of-sight (NLOS) mode** allowing the gunner to operate from a covered position.
- Spike-LR, which can also be installed on light combat vehicles, can be used to engage tanks, armored vehicles, hardened shelters, and low flying slow targets such as helicopters.

Sig Sauer SIG716

- Amid the ongoing dispute with China over boundary issues, the Indian Army decided to place another order of 72,000 Sig 716 assault rifles from the United States.

- It will replace the existing Indian Small Arms System (Insas) 5.56x45mm rifles used by the forces and manufactured locally by the Ordnance Factories Board.
- India had acquired the first slot of the rifles under the fast-track procurement (FTP) programme.
- Around 1.5 lakh imported rifles will be used by the troops in the counter-terrorism operations and frontline duties on the Line of Control (LoC), the remaining forces would be provided with the AK-203 rifles, which are to be produced jointly by India and Russia at Amethi ordnance factory.

4 Mine Ploughs for T-90 Tanks

Context: The Acquisition Wing of the Ministry of Defence (MoD) signed a ₹557-crore contract with the Bharat Earth Movers Limited (BEML) for the procurement of 1,512 mine ploughs for T-90 Tanks. The induction is expected to be completed by 2027.

About

- These mine ploughs will be fitted on T-90 Tanks of the Indian Armoured Corps which will **facilitate individual mobility to the tanks** while negotiating mine field.
- Mine ploughs help tanks to clear minefields and minimize risks to men and machines.
- The mobility of the tank fleet will enhance manifold which in turn would extend the reach of the armoured formations deep into enemy territory without becoming a mine causality.
- As per the procedure, the contract has Buy and Make (Indian) categorisation with a minimum of 50% indigenous content in the Make portion.
- It is to be noted that the Russian-origin T-90 main battle tanks were recently deployed by Indian Army in the Galwan Valley sector of Ladakh amid the border dispute with China.

Features of the T-90 Tank

- It has the capability to deal with Biological and Chemical weapons.
- It is the **Main Battle Tank** of the Indian Army and has the best armoured protection.
- This Tank is of **Russian origin.** But is now built-in India and can fire 8 shells in 60 seconds
- It comes with 125 Mm main gun to make surefire and has the capability to launch a missile up to 6 kms.
- It is considered to be the lightest and the strongest tank in the world and weighs around 48 tons.
- With the ability to fight in day/night, it comes with a missile attack shield.
- Has a powerful 1000 horsepower engine and has the capability to run with a speed of 72 km/h. And can cover 550 km at a time.

Bharat Earth Movers Limited (BEML)

- BEML is an Indian Public Sector Undertaking with headquarters in Bengaluru, Karnataka.
- The company manufactures a variety of heavy equipment, such as that used for earth moving, transport and mining.
- BEML has manufacturing plants in Kolar Gold Fields, Bengaluru, Mysore and Palakkad.

5 What are the MH-60R Naval Choppers, AH-64E Apaches India has bought?

Context: United States President announced: "deals to sell over $3 billion in the absolute finest, state-of-the-art military helicopters and other equipment to the Indian Armed Forces."

About:

- Agreements for India to purchase advanced American military equipment, including Apache and MH-60 Romeo helicopters, will enhance our joint defence capabilities as the militaries continue to train and operate side-by-side.

MH-60 Romeo helicopters

- The incoming 24 multirole MH-60 Romeo helicopters are expected to boost the Indian Navy's efforts to expand its role in the Indian Ocean Region.
- The Navy had long asked for these helicopters, and the $2.2 billion deal was cleared by the Cabinet Committee on Security.
- The MH-60 Romeo Seahawk, made by defence giant Lockheed Martin, is one of the most advanced naval helicopters in the world, used by the US Navy among others.
- It will be purchased directly from the US government under a Foreign Military Sales (FMS) agreement with the US Department of Defence (DoD).
- It is the most capable and mature Anti-Submarine Warfare (ASW) Anti-Surface Warfare (ASuW) multi-mission helicopter available in the world today.
- The MH-60 is designed to hunt down submarines and will add to the strategic depth and combat capability of the Indian Navy.
- It is capable of launching Hellfi re missiles from the right and left extended pylons.
- It also has an advanced system for passive detection, location, and identification of emitters.
- It can not only track and hunt ships but is also used by the US Navy as an anti-submarine weapon.
- MH-60 Romeo Seahawks have equipped with anti-submarine Mark 54 torpedoes and ellfi re air-to-surface missiles, along with precision-kill rockets.

Apache helicopters

- The Army will receive six Apache helicopters that will cost approximately $800 million.
- The six choppers for the Army will be in addition to the 22 Apache helicopters that have already been ordered for the Air Force.
- This will be a direct commercial sale.
- The Apaches can operate at high altitudes and will be deployed along the Pakistan border.
- The Army is likely to get the helicopters armed with **Stinger air-to-air** missiles.

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3

Health

1 Cord Blood Banking

Context: Recently, Poona Citizen Doctors' forum dispels beliefs on commercial cord blood banking. It has warned to-be parents against falling prey to the emotional marketing tactics by stem cell banking companies.

About Cord Blood:

- **Cord blood (**short for umbilical cord blood) is the blood that remains in the umbilical cord and placenta post-delivery.
- Cord blood has an abundance of stem cells and immune system cells, and the medical uses of these cells have been expanding at a rapid pace.
- As these cells help the body re-generate tissues and systems, cord blood is often referred to as regenerative medicine.
- Cord blood is currently approved by the FDA for the treatment for nearly 80 diseases, and cord blood treatments have been performed more than 35,000 times around the globe to treat cancers (including lymphoma and leukemia), anaemias, inherited metabolic disorders and some solid tumours and orthopaedic repair.

Cord Blood Banking:

- **Cord blood banking** is the process of collecting the cord blood and extracting and cryogenically freezing its stem cells and other cells of the immune system for potential future medical use.
- Globally, cord blood banking is recommended as a source of hematopoietic stem cell transplantation for haematological cancers and disorders where its use is recommended.
- For all other conditions, the use of cord blood as a source of stem cells is not yet established.

Concerns:

- Stem cell banking has been aggressively marketed even as its use is still in experimental stages. But these companies charge enormous fees from parents to preserve cells.
- The concern here is that it is merely by emotional marketing that companies convince parents to bank the cells for several years promising future therapeutic use.
- Private companies who have forayed into this field offer packages anywhere between Rs 50,000 and Rs 1 lakh to store and preserve the cells in right conditions.
- So far there is no scientific basis for preservation of cord blood for future self-use and this practice, therefore, raises ethical and social concerns.
- The Indian Council of Medical Research (ICMR) does not recommend commercial stem cell banking.

Uses of Cord Blood

- The umbilical cord fluid is loaded with stem cells. They can treat cancer, blood diseases like anaemia, and some immune system disorders, which disrupt your body's ability to defend itself.
- The fluid is easy to collect and has 10 times more stem cells than those collected from bone marrow.
- Stem cells from cord blood rarely carry any infectious diseases and are half as likely to be rejected as adult stem cells.

2 Kyasanur Forest Disease (KFD)

Context: Recently, the Karnataka government has allocated Rs 15 crore for establishing research centre on Kyasanur Forest Disease (KFD) in Sagar, Karnataka.

About

- Kyasanur Forest Disease (KFD) is caused by Kyasanur Forest disease Virus (KFDV), a member of the virus family Flaviviridae.
- It was first identified in 1957 in a sick monkey from the Kyasanur Forest in Karnataka.
- Since then, about 400-500 human cases per year have been reported.
- It is also called **monkey fever** by locals as KFD is endemic to the Indian state of Karnataka.
- Rodents, shrews, and monkeys are common hosts for KFDV after being bitten by infected Hard ticks (Haemaphysalis Spinigera). KFDV can cause epizootics (outbreak of the disease in animals) with high fatality in primates.

Transmission:

- To humans, it may occur after a tick bite or contact with an infected animal (a sick or recently dead monkey).

Signs and Symptoms:

- After an incubation period of 3-8 days, the symptoms like chills, fever, headache, severe muscle pain, vomiting, gastrointestinal symptoms and bleeding may occur.
- Patients may experience abnormally low blood pressure, and low platelet, red blood cell, and white blood cell count.
- In most cases, patients can recover without complication after 1-2 weeks - but the convalescent period is typically long, lasting for several months.
- The estimated fatality rate is from 2% to 10% for KFD, as per the National Health Portal, India.

Diagnosis:

- It can be diagnosed in the early stage of illness by molecular detection by Polymerase Chain Reaction (PCR) or virus isolation from the blood.
- Later, serologic testing using enzyme-linked immunosorbent serologic assay (ELISA) can be performed.

Treatment and Prevention:

- There is no specific treatment for KFD although a vaccine is available.

Global scenario:

- Initially, the KFD virus was suspected as a **Russian spring-summer (RSS) complex of viruses.** But as of now, this disease is only reported from India.
- The other viruses which are closely related to KFD are
  - **'Omsk hemorrhagic fever'** virus in Siberia
  - **'Alkhurma virus'** in Saudi Arabia
  - **'Nanjianyin virus'** in China

What's worsening the situation?

- Deforestation: Deforestation for cultivation causes changes in tick fauna. It is considered as an important risk factor for outbreaks.
- Climate change: Increase in global warming and changes in normal climate have significantly contributed to the emergence of new types of diseases including KFD.
- Population growth: Moreover, population growth has also played a big role in disease transmission and the gradual expansion of the disease.

3 India's National Research Laboratories to conduct testing for COVID-19

Context: The Indian Council of Medical Research (ICMR) allowed all national research laboratories including those under the Council of Scientific and Industrial Research (CSIR) to conduct testing for the novel coronavirus. Since the CSIR labs will now have access to virus samples, they will be in a position to sequence the genome too.

About:

- Whole-genome sequencing is the method used to determine the complete DNA sequence of a specific organism's genome.
- The approach for sequencing the latest coronavirus involves getting samples from patients that are positive and sending these samples to a sequencing centre.
- The term 'genome' generally refers to the entire sequence of DNA of an organism, including all of its genes.
- Each genome contains all of the information needed to build and maintain that organism.

Sharing of Genome sequencing:

- In March this year, India became the fifth country in the world to sequence the genome of the novel Coronavirus, or Covid-19, and share its data with the international community.
- As on April 7, India has shared nine whole genome sequences of the novel coronavirus (SARS-CoV-2) with the Global Initiative on Sharing All Influenza Data (GISAID).
- All the sequences have been shared by the Pune-based National Institute of Virology.
- So far, 3,086 sequences of the virus isolated from humans have been shared by 57 countries.
- With 621, the U.S. has shared the most number of sequences, followed by the U.K. (350), Belgium (253) and China (242).

What is GISAID?

- Launched in 2008, the GISAID Initiative promotes the international sharing of all influenza virus sequences, related clinical and epidemiological data associated with human viruses, and geographical as well as species-specific data associated with avian and other animal viruses.
- It aims to help researchers understand how the viruses evolve, spread and potentially become pandemics.
- The Initiative ensures that open access to data in GISAID is provided free-of-charge and to everyone, provided individuals identify themselves and agree to uphold the GISAID sharing mechanism governed through its Database Access Agreement.

Significance of this step:

- Sequencing the genome of SARS-CoV-2 will help understand where the virus came from, if there are different strains circulating in India, and how the virus has spread.
- It could open up potential treatment lines against the rapidly spreading Covid-19 in India.
- The sequencing will also enable us to determine the route the virus took to India. That in turn will help us link lineages of patients in the country and respond accordingly.

4 World Rare Disease Day

Context: World Rare Disease Day is observed every year on the last day of February. This year, February 29, the rarest of days, is marked as the International Rare Disease Day.

About

- Rare Disease Day takes place on the last day of February each year. The main objective of Rare Disease Day is to raise awareness amongst the general public and decision-makers about rare diseases and their impact on patients' lives.
- The first Rare Disease Day was celebrated in 2008 on 29 February, a 'rare' date that happens only once every four years.
- Ever since then, Rare Disease Day has taken place on the last day of February, a month is known for having a 'rare' number of days.

What is Rare Disease?

- A rare disease also referred to as an orphan disease, is any disease that affects a small percentage of the population.
- Over 300 million people are living with one or more of over 6,000 identified rare diseases around the world.
- Over 6000 rare diseases are characterised by a broad diversity of disorders and symptoms that vary not only from disease to disease but also from patient to patient suffering from the same disease.
- Relatively common symptoms can hide underlying rare diseases leading to misdiagnosis and delaying treatment.
- Quintessentially disabling, the patients quality of life is affected by the lack or loss of autonomy due to the chronic, progressive, degenerative, and frequently life-threatening aspects of the disease.
- Each rare disease may only affect a handful of people, scattered around the world, but taken together with the number of people directly affected is equivalent to the population of the world's third-largest country.

5 Cytokine Storm

Context: Of all the possible compounding effects of COVID-19, the disease caused by the novel coronavirus, the cytokine storm is one of the most feared.

About:

- Cytokines are small proteins released by many different cells in the body, including those of the immune system where they coordinate the body's response against infection and trigger inflammation.
- The name 'cytokine' is derived from the Greek words for cell (cyto) and movement (kinos). Sometimes the body's response to infection can go into overdrive.
- For example, when SARS -CoV-2 – the virus behind the covid-19 pandemic – enters the lungs, it triggers an immune response, attracting immune cells to the region to attack the virus, resulting in localised inflammation.
- But in some patients, excessive or uncontrolled levels of cytokines are released which then activate more immune cells, resulting in hyperinflammation.
- This can seriously harm or even kill the patient.
- Cytokine storms are a common complication not only of covid-19 and flu but of other respiratory diseases caused by coronaviruses such as SARS and MERS. They are also associated with non-infectious diseases such as multiple sclerosis and pancreatitis.
- The phenomenon became more widely known after the 2005 outbreak of the avian H5N1 influenza virus, also known as "bird flu", when the high fatality rate was linked to an out-of-control cytokine response.
- Cytokine storms might explain why some people have a severe reaction to coronaviruses while others only experience mild symptoms.
- They could also be the reason why younger people are less affected, as their immune systems are less developed and so produce lower levels of inflammation-driving cytokines.

How does our immune system work?

- The immune systems in our bodies protect us from bacteria, viruses, and parasites by removing them from our systems.
- The immune system gets activated by things that the body does not recognise as its own. These things are called antigens, and include bacteria, fungi and viruses.
- An effective immune system response involves inflammation, an important and indispensable part of the process.
- Inflammation has an important protective function. The release of inflammatory mediators increases the blood flow to the area, which allows larger numbers of immune system cells to be carried to the injured tissue, thereby aiding the repairing process.
- However, if this inflammatory response is not regulated, very dangerous consequences can follow.
- This is when a 'cytokine storm' can be triggered. The damage to the surrounding cells can be catastrophic, leading to sepsis and potentially, death.

What is role of cytokines in the immune system?

- Evidence is emerging that a subset of the infected patients develop severe COVID-19 because of an overreaction of their immune systems, which triggers cytokine storm syndrome (CSS).
- While various studies have shown that the disease has more severe consequences for those above the age of 60 years, and especially those with existing co-morbidities such as heart

disease, diabetes, hypertension, chronic respiratory disease and cancer, some countries have also reported deaths of younger people, including teenagers, after catching the infection.

- Cytokines are signalling proteins that are released by cells at local high concentrations — a cytokine storm or CSS is characterised by the overproduction of immune cells and the cytokines themselves because of a dysregulation in the process.
- 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.

6 Can bacille Calmette-Guerin be a cure for Coronavirus?

Context: The Bacillus Calmette-Guerin (BCG) vaccine, administered to millions of Indian children soon after birth to protect against tuberculosis, could be a "game-changer" in the fight against the deadly coronavirus, say US scientists.

About:

- BCG, or bacille Calmette-Guerin, is a vaccine for tuberculosis (TB) disease. BCG vaccine has a documented protective effect against meningitis and disseminated TB in children.
- It is 70-80% effective against the most severe forms of TB, such as TB meningitis. However, it is less effective in preventing the form of TB that affects the lungs.
- The vaccine prevents infant deaths from a variety of causes, and sharply reduces the incidence of respiratory infections.
- It does not prevent primary infection and, more importantly, does not prevent reactivation of latent pulmonary infection, the principal source of bacillary spread in the community.
- The impact of BCG vaccination on transmission of Mtb is therefore limited.
- The biological interaction between Mtb and the human host is complex and only partially understood.
- The bacille Calmette-Guerin (BCG) vaccine has existed for 100 years. The weakened virus was first used in humans in 1921 and was widely adopted after World War II.

How does it stimulate the immune system?

- The BCG vaccine contains live bacteria that have been weakened (attenuated), so that they stimulate the immune system but do not cause disease in healthy people.
- The vaccine seems to "train" the immune system to recognize and respond to a variety of infections, including viruses, bacteria and parasites.
- However the vaccine should not be given to people who are clinically immunosuppressed (either due to drug treatment or underlying illness).
- This is because the vaccine strain could replicate too much and cause a serious infection. This includes babies whose mothers have had immunosuppressive treatment while they were pregnant or breastfeeding.

Can it treat Coronavirus?

- Like other vaccines, BCG has a specific target: TB. But evidence accumulating over the past decade suggests the vaccine also has so-called off-target effects, reducing viral illnesses, respiratory infections and sepsis, and appears to bolster the body's immune system.
- The idea is an offshoot of the "hygiene hypothesis," which suggests that the modern emphasis on cleanliness has deprived children of exposure to germs.

- The lack of "training" has resulted in weakened immune systems, less able to resist disease.
- A recent review by the World Health Organization concluded that BCG had beneficial "off-target effects," and recommended doing more trials of the vaccine against a wider range of infections.

What the study has found?

- The study has found that countries without universal policies of BCG vaccination, such as Italy, the Netherlands, and the United States, have been more severely affected compared to countries with universal and long-standing BCG policies.

> **India & BCG:**
>
> - The BCG vaccine is part of India's universal immunisation programme and administered to millions of children at birth or soon after it.
> - It is the live weakened form of mycobacterium bovis -- the causative agent of tuberculosis in cattle -- related to mycobacterium tuberculosis, the bacteria which causes tuberculosis in humans.
> - India, with the world's highest TB burden, introduced BCG mass immunisation in 1948.

7 Pool testing for Coronavirus

Context: The Indian Council of Medical Research (ICMR) has issued an advisory for using 'pooled samples' for testing of COVID-19.

About:

- The ICMR advisory added that the pool testing algorithm involves the Polymerase Chain Reaction (RT-PCR) screening of a specimen pool, comprising multiple samples.
- In case a pool tests positive, then each sample will be individually tested.
- The RT-PCR test is used to determine whether an individual has contracted Covid-19, caused by the SARS-CoV-2 virus.
- The objective of pool testing is to increase the capacity of laboratories to screen more samples in the same amount of time without doubling the resources needed.

Where it can be used?

- The test is only prescribed to be used in areas with low prevalence of the infection, i.e., with a positivity rate of less than 2 per cent.
- This means that of 1,000 samples in an area, if less than 20 have tested positive for Covid-19, the area is said to have a low positivity rate, and will qualify for pool testing.
- When the disease progresses and probability of positives goes up, the usefulness of the test comes down. One needs to repeat the tests, and conduct all tests individually, if the result is positive.

What the ICMR has recommended?

- ICMR has advised that while more than two samples can be pooled together, the number should not exceed five samples to avoid sample dilution, which can lead to false negatives.
- This method can be used in areas where the prevalence of COVID-19 is low, which means a positivity rate of less than two percent.

- In areas with a positivity rate between two to five percent, sample pooling of PCR screening may be considered in a community survey of surveillance among asymptomatic individuals.
- Andaman and Nicobar Islands and Uttar Pradesh have already embarked on pooled testing to enhance the testing capacity within limited resources.

Significance of pool testing:

- This method is effective in two ways.
  - It increases the capacity of testing
  - It saves a lot of resources — time, cost and manpower
- This method is useful when a country has a lower number of positive cases. In case a pool tests negative, all individual samples within the pool are considered to be healthy and not infected by Covid-19.
- Significantly, pooled screening can also help in tracking down the asymptomatic cases of the disease, thereby tracking community transmission.

8 COVID-19 response puts a million kids at risk of contracting measles'

Context: Around 117 million children worldwide risk contracting measles because dozens of countries are curtailing their vaccination programmes as they battle COVID-19.

About:

- Measles, or rubeola, is a viral infection that starts in the respiratory system. It still remains a significant cause of death worldwide, despite the availability of a safe, effective vaccine.
- **Symptoms:** Symptoms of measles generally first appear within 10 to 12 days of exposure to the virus. They include:
  - cough
  - fever
  - runny nose
  - red eyes
  - sore throat
  - white spots inside the mouth
  - widespread skin rash(it is a classic sign of measles)
- Measles is a highly contagious. It is caused by infection with a virus from the **paramyxovirus family**. Viruses are tiny parasitic microbes.
- Once a person gets infected, the virus invades host cells and uses cellular components to complete its life cycle.
- The measles virus infects the respiratory tract first. However, it eventually spreads to other parts of the body through the bloodstream.

Transmission of the disease:

- Measles can be spread through the air from respiratory droplets and small aerosol particles.
- An infected person can release the virus into the air when they cough or sneeze.
- These respiratory particles can also settle on objects and surfaces and infect a healthy person.

- The measles virus can live outside of the body for longer than you may think. In fact, it can remain infectious in the air or on surfaces for up to 2 hours.

Can it occur to animals?

- Measles is only known to occur in humans and not in other animals.
- There are 24 Trusted Source known genetic types of measles, although only 6 are currently circulating.

Why children are more prone to measles NOW?

- Currently 24 countries, including several already dealing with large measles outbreaks, have suspended widespread vaccinations, the World Health Organisation and the UN's children's fund UNICEF said.
- An additional 13 countries have had their vaccination programmes interrupted due to COVID-19.
- It was vital that immunisation capacity was retained during and after the current pandemic.
- Together, more than 117 million children could be impacted by the suspension of scheduled immunization activities.

9 China Publishes Genome Sequencing Data

Context: China has released genome sequencing data for the Coronavirus responsible for a recent outbreak in Beijing, with the WHO and the Global Influenza Data Initiative (GISAID).

About

- The Beijing genome data was based on three samples - two human and one environmental
- According to preliminary genomic and epidemiological study results, the virus is from Europe, but it is different from the virus currently spreading in Europe.
- It's older than the virus currently spreading in Europe.
- The first cluster of new coronavirus infections was traced to the Huanan seafood market in Wuhan in December.
- It has since infected almost 8.5 million people globally. On the origins of the strain that hit Beijing, China claimed it did not originate from the Chinese capital.

What is genome sequencing?

- Genome sequencing is figuring out the order of DNA nucleotides, or bases, in a genome—the order of As, Cs, Gs, and Ts that make up an organism's DNA.
- The human genome is made up of over 3 billion of these genetic letters.

Genetic Sequencing of SARS-CoV-2 virus

- The SARS-CoV-2 virus is primarily made of three important elements-
  - spike proteins that help the virus bind to a living cell
  - ribonucleic acid (RNA) strands that start replicating inside a living cell
  - fatty envelop that holds all the components together

- The RNA strands can be thought of as a code that determines how the virus will behave. Coronaviruses have about 26,000 to 32,000 bases or RNA "letters" in their length.
- The virus multiplies inside living organisms' cells by creating copies for the RNA.
- However, the process it uses to make these copies is not perfect, and often introduces tiny errors in the sequence of 'letters' — much like a game of Chinese whispers.
- These errors are known as mutations, which can introduce slight variations in the behaviour of the virus.

How will it help?

- Virus genome sequencing is a vital and rapidly-developing tool in the diagnosis of the disease COVID-19 and in understanding the spread and control of the new coronavirus.
- Genetic sequencing is important as it helps in finding drugs and vaccines, besides figuring out if there has been a mutation of the virus.
- It is also essential to finding ways to deal with the spread of the virus.

10 The Fifth State of Matter

Context:

- Scientists have generated an exotic fifth type of matter in one of the coldest places in the universe- the Cold Atom Laboratory–aboard the International Space Station and are using it to explore the quantum world.

About:

- Matter, material substance that constitutes the observable universe and, together with energy, forms the basis of all objective phenomena.
- **Composition:** All matter is made up of atoms, which are in turn made up of protons, neutrons and electrons.
- **Energy utilised:** Atoms come together to form molecules, which are the building blocks for all types of matter.
  - Both atoms and molecules are held together by a form of potential energy called **chemical energy**.
  - Unlike **kinetic energy**, which is the energy of an object in motion, potential energy is the energy stored in an object.
- There are four states of matter common in everyday life-
  - Gases
  - Liquids
  - Solids
  - Plasmas
- However, there is also a fifth state of matter — **Bose-Einstein condensates (BECs)**, which scientists first created in the lab 25 years ago.
- When a group of atoms is cooled to near absolute zero, the atoms begin to clump together, behaving as if they were one big "super-atom."

- These are created when a gas of bosons is cooled down nearly to absolute zero. At these extreme temperatures, matter begins to behave oddly and atoms become a single entity showing quantum properties.
- Bose-Einstein condensates straddle the boundary between the everyday world, governed by classical physics, and the microscopic world, which follows the rules of quantum mechanics.
- In the world of quantum mechanics, a particle can behave as if it were spinning in two opposite directions at the same time, or as if it existed in two or more locations simultaneously.
- Because they follow some of these quantum behaviors, Bose-Einstein condensates may offer scientists key clues into the workings of quantum mechanics, potentially helping to solve mysteries such as how to create a "theory of everything" that could explain the workings of the cosmos from the smallest to largest scales.

What's limiting the research?

- Scientists now routinely create Bose-Einstein condensates in hundreds of labs across the world.
- However, one limitation that stands in the way of this research is **gravity.**
- These "super-atoms" are extraordinarily fragile and the setups used to create them are incredibly delicate, so the pull of gravity felt on Earth can disrupt both, making it challenging to learn much about them.
- As such, researchers developed the Cold Atom Lab, which can generate Bose-Einstein condensates in the microgravity found in orbit aboard the space station.

What is the Cold Atom Laboratory?

- The Cold Atom Laboratory (CAL) was launched to the ISS in 2018 to investigate a strange kind of matter, known as a **Bose-Einstein condensate (BEC).**
- This suitcase-sized device chills atoms of rubidium and potassium in a vacuum chamber, using laser light to slow their movement.
- Magnetic fields then contain the resulting cloud of atoms, which is cooled to nearly absolute zero at -273°C, producing a BEC.
- This chilly substance was initially theorised by **Albert Einstein** and **Satyendra Nath Bose** in the early 1920s as the fifth state of matter, following solids, liquids, gases and plasma.
- It is a supercooled gas that no longer behaves as individual atoms and particles, but rather an entity in a single quantum state.
- BECs have been produced in a variety of experiments on Earth since 1995, but these are hindered by gravity, which collapses the clouds in a split second.
- The microgravity environment of the ISS keeps them stable for multiple seconds, allowing them to be studied in more detail.

11 Amoebiasis

Context: A team of researchers from the Jawaharlal Nehru University (JNU) has developed new drug molecules against the protozoa that cause amoebiasis.

About:

- Amoebiasis or amoebic dysentery is a common parasitic enteral infection. It is caused by the protozoan parasite Entamoeba histolytica.
- Amoebiasis is present all over the world. Each year, about 40000 to 110000 people die from amoebiasis infection.

- Amoebiasis may present with no symptoms or mild to severe symptoms including abdominal pain, diarrhea, or bloody diarrhea.
- Severe complications may include inflammation and perforation resulting in peritonitis. People affected may develop anemia.
- Types of clinical spectrum ranges from asymptomatic infection, diarrhoea and dysentery to fulminant colitis and peritonitis as well as extraintestinal amoebiasis.
  - Acute amoebiasis can present as diarrhoea or dysentery with frequent, small and often bloody stools.
  - Chronic amoebiasis can present with gastrointestinal symptoms plus fatigue, weight loss and occasional fever.
  - Extra intestinal amoebiasis can occur if the parasite spreads to other organs, most commonly the liver where it causes amoebic liver abscess.
  - Amoebic liver abscess presents with fever and right upper quadrant abdominal pain

What is Entamoeba histolytica?

- According to the World Health Organization (WHO), Entamoeba histolytica is the third-leading cause of morbidity and mortality due to parasitic disease in humans.
- E. histolytica is classified as a category B biodefense organism because of its environmental stability, ease of dissemination, resistance to chlorine, and it is easily spread through contaminated food products.
- Besides the GI tract, E. histolytica can affect many organ systems.

Treatment

- Prevention of amoebiasis is by improved sanitation. Two treatment options are possible, depending on the location.
- Amoebiasis in tissue is treated with metronidazole, tinidazole, nitazoxanide, dehydroemetine or chloroquine.
- A luminal infection is treated with diloxanide furoate or iodoquinoline. Effective treatment may require a combination of medications.
- Infections without symptoms require treatment, but infected individuals can spread the parasite to others.

The findings

- This protozoan is anaerobic or micro-aerophilic in nature such that it cannot survive high concentrations of oxygen.
- However, during infection, it faces a high surge of oxygen inside the human body. The organism synthesises large amounts of cysteine to counter oxidative stress.
- This pathogen deploys cysteine as one of the essential molecules in its defence mechanism against high oxygen levels.
- Entamoeba expresses two crucial enzymes for synthesising cysteine. Researchers from JNU have characterised and determined the molecular structures of both these crucial enzymes.

12 Scientists identifies new 'Re-assorted' Influenza Virus with Pandemic Potential

Context: Scientists have identified a new 're-assorted' influenza virus from pigs in China that has pandemic potential. The virus has shown 'increased human infectivity' in swine industry workers.

Key-highlights of the Study

- The study was based on extensive surveillance done among pig populations in 10 provinces of China from 2011-2018.
- The serological exercise showed that the new gene of the H1N1 virus has efficient infectivity and transmissibility in ferret models.
- The viruses fell into six different genotypes, with the G4 strain becoming predominant since 2016.
- They found that the G4 strain is a blend of three lineages-
  - one similar to those found in European and Asian birds
  - one linked to the 2009 H1N1 pandemic virus
  - a North American H1N1 triple-reassortant virus that has genes from avian, human, and swine sources
- When they tested the G4 virus in the lab, they found that it had features similar to the 2009 H1N1 virus.

About the new flu strain

- The virus, which the researchers call **G4 EA H1N1**, can grow and multiply in the cells that line the human airways.
- Tests also showed that any immunity humans gain from exposure to seasonal flu does not provide protection from G4.
- It possesses "all the essential hallmarks of being highly adapted to infect humans".
- Current flu vaccines do not appear to protect against it, although they could be adapted to do so if needed.
- The new flu strain that has been identified in China is similar to 2009 swine flu, but with some new changes.

2009 swine flu

- The last pandemic flu the world encountered - the swine flu outbreak of 2009 - was less deadly than initially feared, largely because many older people had some immunity to it, probably because of its similarity to other flu viruses that had circulated years before.
- That virus, called A/H1N1pdm09, is now covered by the annual flu vaccine to make sure people are protected.

- The bad new strain of influenza is among the top disease threats that experts are watching for, even as the world attempts to bring to an end the current coronavirus pandemic.
- So far, it hasn't posed a big threat, but it is one to keep an eye on.

What is reassortment?

- Basically, "reassortment" of viruses is a mechanism through which new strains of virus are generated that have new properties and can cause large scale epidemics; even pandemics.

- The swine influenza viruses have many lineages out of which Eurasian-avian (EA) is the most dominant one.
- The 2009 pandemic virus went back to pig herds after the outbreak.
- Subsequently, re-assortants between the swine EA H1N1 virus and human pandemic/09 H1N1 virus have been sporadically detected in pigs in China and other countries, some of which have caused human infections in China.

13 New tick-borne virus in China

Context: A new infection disease called Severe Fever with Thrombocytopenia Syndrome (SFTS), caused by a tick-borne virus, has killed seven and infected at least 60 in China, setting off alarm bells among health officials in the country.

What is SFTS Virus?

- Severe fever with thrombocytopenia syndrome virus (SFTSV) belongs to the **Bunyavirus family** and is transmitted to humans through **tick bites**.
- The virus was first identified in China over a decade ago. The first few cases were reported in rural areas of Hubei and Henan provinces in 2009.
- **Prime vector:** Virologists believe an Asian tick called **Haemaphysalis longicornis** is the primary vector, or carrier, of the virus.
- **Peak time:** The disease is known to spread between March and November. The total number of infections generally peaks between April and July.
- **Who are vulnerable?** Farmers, hunters and pet owners are particularly vulnerable to the disease as they regularly come in contact with animals that may carry the Haemaphysalis longicornis tick.
- **Transmission:** Scientists have found that the virus is often transmitted to humans from animals like goats, cattle, deer and sheep.
- Despite being infected by the virus, animals generally do not show any symptoms associated with SFTSV.

What are Ticks?

- Ticks are blood-sucking bugs, living by feeding on the blood of mammals, birds, and sometimes reptiles and amphibians.
- They are mostly found in bushes, grass and shrubs. The eight-legged bugs are arachnids -- related to spiders.
- According to the WHO, ticks are vectors of a large number of diseases including
  - relapsing fever
  - Rocky Mountain spotted fever
  - Q fever
  - Lyme disease

Fatality rate

- The current case fatality rate rests between approximately 16 and 30 per cent.

- Due to the rate at which it spreads and its high fatality rate, SFTS has been listed among the top 10 priority diseases blue print by the World Health Organisation (WHO).

What are the symptoms?

- **Incubation period:** The incubation period is anywhere between seven and 13 days after the onset of the illness.
- Patients suffering from the disease usually experience a whole range of symptoms, including, fever, fatigue, chill, headache, lymphadenopathy, anorexia, nausea, myalgia, diarrhea, vomiting, abdominal pain, gingival hemorrhage, conjunctival congestion, and so on.
- Some of the early warning signs of the disease include severe fever, thrombocytopenia or low platelet count and leukocytopenia, which is low white blood cell count.
- The risk factors observed in more serious cases include multi-organ failure, hemorrhagic manifestation and the appearance of central nervous system (CNS) symptoms.

Is it treatable?

- While a vaccine to treat the disease is yet to be successfully developed, the antiviral drug **Ribavirin** is known to be effective in treating the illness.
- In order to avoid contracting the illness, various government authorities, including China's Centers for Disease Control and Prevention (CDC), urges the general public to avoid wearing shorts while walking through tall grass, the woods, and any other environment where ticks are likely to thrive.

14 Cord Blood Banking

Context: Recently, Poona Citizen Doctors' forum dispels beliefs on commercial cord blood banking. It has warned to-be parents against falling prey to the emotional marketing tactics by stem cell banking companies.

Cord Blood:

- **Cord blood** (short for umbilical cord blood) is the blood that remains in the umbilical cord and placenta post-delivery.
- Cord blood has an abundance of stem cells and immune system cells, and the medical uses of these cells have been expanding at a rapid pace.
- As these cells help the body re-generate tissues and systems, cord blood is often referred to as regenerative medicine.
- Cord blood is currently approved by the FDA for the treatment for nearly 80 diseases, and cord blood treatments have been performed more than 35,000 times around the globe to treat cancers (including lymphoma and leukemia), anaemias, inherited metabolic disorders and some solid tumours and orthopaedic repair.

Cord Blood Banking:

- **Cord blood banking** is the process of collecting the cord blood and extracting and cryogenically freezing its stem cells and other cells of the immune system for potential future medical use.
- Globally, cord blood banking is recommended as a source of hematopoietic stem cell transplantation for haematological cancers and disorders where its use is recommended.
- For all other conditions, the use of cord blood as a source of stem cells is not yet established.

Uses of Cord Blood

- The umbilical cord fluid is loaded with stem cells. They can treat cancer, blood diseases like anaemia, and some immune system disorders, which disrupt your body's ability to defend itself.

- The fluid is easy to collect and has 10 times more stem cells than those collected from bone marrow.
- Stem cells from cord blood rarely carry any infectious diseases and are half as likely to be rejected as adult stem cells.

15 Spike Protein of 2019-NCOV

Context: Researchers in the United States have unveiled the structure of the "spike protein" of 2019-nCoV, the virus behind the current coronavirus disease outbreak.

ABOUT

- Coronaviruses are a family of viruses that cause illnesses ranging from the common cold to more severe diseases such as **severe acute respiratory syndrome (SARS)** and the **Middle East respiratory syndrome (MERS).**
- The World Health Organization (WHO) has declared the virus a global health emergency. Also, the WHO announced an official name for the disease- coronavirus disease 2019, abbreviated as **COVID-19**.
- In COVID-19, 'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for the disease. Formerly, this disease was referred to as "2019 novel coronavirus" or "2019-nCoV."

What is a spike protein?

- A viral spike protein is like a key that "unlocks the door" to gain access to the cells of a specific host — humans, in this case.
- The researchers defined the structure of 2019-nCoV's spike protein using a technique called **cryogenic electron microscopy**, or "**Cryo-EM**".
- This involves cooling the protein to below -150 degree Celsius so that it crystallises and then its structure can be determined with near-atomic resolution.

Significance of the discovery:

- Knowing the structure of the virus's spike protein gives us crucial information about exactly how the virus infects host cells.
- The discovery of the 2019-nCoV spike protein structure, therefore, represents both good news and bad. The good news is now we know what it looks like, it will be easier to find the most suitable weapon against the virus.
- The bad news is the enemy is much stronger than we thought, and our current ammunition depot doesn't have anything efficient against it.

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4

New Technology/ Discovery/Governance/ Miscellaneous Topics

1 The Contact Tracing Technology

Context: Global technology giants Apple and Google have announced that they are partnering on developing contact tracing technology to help governments and health authorities tackle the novel coronavirus pandemic.

About:

- The World Health Organization (WHO) defines contact tracing as the process of identifying, assessing, and managing people who have been exposed to a disease to prevent onward transmission.
- Via contact tracing, people who have come into contact with a person carrying a disease are alerted and identified.
- In its 2015 guidelines for contact tracing during the Ebola epidemic in West Africa, the WHO underlined the importance of the practice:
- "Identifying people at the onset of symptoms and promptly isolating them reduces exposure to other persons, preventing subsequent EVD (Ebola Virus Disease) infections. Additionally, prompt isolation and admission of the symptomatic person to a treatment facility decreases the delay to supportive treatment, which improves the likelihood of survival."

How will the coronavirus new technology?

- The new contact tracing technology will use Bluetooth signals to track if users have been in contact with anyone exposed to coronavirus.
- By May, both companies (Google and Apple) will release application programming interfaces (APIs) that would enable interoperability between Android and iOS devices using apps from public health authorities.
- The official apps will be available for users to download via their respective app stores, as per the press release.
- When this step is realised, phone-based matching via official apps will help alert people if they have come in contact with someone diagnosed with COVID-19.
- For this to work, COVID-19 patients would have to declare their status to the respective apps voluntarily.

- Following this, all people whose Android/iOS smartphones were detected nearby such patients, would get notified.
- This means, you will be notified even if you were around a stranger who has tested positive for the disease.

The privacy issue:

- The planned technology also throws the weight of the tech leaders into a global conflict between privacy advocates who favor a decentralized system to trace contacts and governments in Europe and Asia pushing centralized approaches that have technical weaknesses and potentially let governments know with whom people associate.
- To be effective, the Silicon Valley system would require millions of people to opt in the system, trusting the technology companies' safeguards, as well as smooth oversight by public health systems.

Significance of the technology:

- Contact tracing is considered essential for bringing epidemics under control, and is expected to help governments in relaxing lockdown orders.
- The technology will help to slow the spread of the coronavirus by allowing users to opt into logging other phones they have been near.

2 Feluda

Context: Scientists at Delhi's CSIR-IGIB have developed a paper-based test strip for Covid-19, and named it after the fictional detective created by Satyajit Ray.

About:

- The 'Feluda' test strip has been invented by a team led by two Bengali-origin scientists- Dr Souvik Maiti and Dr Debojyoti Chakraborty, at the Council of Scientific & Industrial Research's Institute of Genomics and Integrative Biology (CSIR-IGIB) in New Delhi.
- The simple paper-based test strip could also reduce Covid-19 testing costs — the real-time polymerase chain reaction test (RT-PCR) used currently requires machinery worth lakhs of rupees and its price is capped at Rs 4,500 in private labs, but the 'Feluda' test could cost as little as Rs 500.
- It can be used in a way similar to pregnancy test strips widely available over the counter.

How does it work?

- This strip will be similar to a pregnancy test strip, and will not require any specialised skill and machines to perform, as is the case with other PCR-based tests.
- This strip will just change colour, and can be used in a simple pathological lab. The most important part is it will be 100 per cent accurate.

CRISPR technology:

- The test kit uses **CRISPR gene-editing technology** to get results, though the difference to the kits being developed at Stanford and MIT is in the proteins used.
- CRISPR technology recognises specific genetic sequences and cuts them in short time.
- The CRISPR reaction is specific, and can be done in 5-10 minutes. It is a powerful technique that worked in detecting the Zika virus too.
- Feluda uses cutting-edge gene-editing CRISPR-CAS-9 technology to target and identify genomic sequence of the novel coronavirus in suspected individuals. No other laboratory in India is developing test kit using CRISPR technology.

What are genome editing and CRISPR-Cas9?

- Genome editing (also called gene editing) is a group of technologies that give scientists the ability to change an organism's DNA.
- These technologies allow genetic material to be added, removed, or altered at particular locations in the genome. Several approaches to genome editing have been developed.
- A recent one is known as CRISPR-Cas9, which is short for clustered regularly interspaced short palindromic repeats and CRISPR-associated protein 9.
- The CRISPR-Cas9 system is faster, cheaper, more accurate, and more efficient than other existing genome editing methods.
- CRISPR-Cas9 was adapted from a naturally occurring genome editing system in bacteria. The bacteria capture snippets of DNA from invading viruses and use them to create DNA segments known as CRISPR arrays.
- The CRISPR arrays allow the bacteria to "remember" the viruses (or closely related ones). If the viruses attack again, the bacteria produce RNA segments from the CRISPR arrays to target the viruses' DNA.
- The bacteria then use Cas9 or a similar enzyme to cut the DNA apart, which disables the virus.

How Feluda is different from others?

- Unlike Stanford and MIT, which use CAS-12 and CAS-13 proteins to detect the presence of the novel coronavirus, Feluda uses CAS-9 protein technology. And unlike the PCR test, there is no need for probes.
- A few other labs have been developing test kits, but they are largely based on PCR technology. The problem with PCR is that it is costly — one machine costs Rs 14-15 lakh, and imported probes have to be used, of which there is a shortage. It takes several hours.
- Feluda does not require any 'level 2' or 'level 3' lab to test, unlike most PCR-based tests. This can be done in any simple pathological lab.

3 Artificial Neural Networks based global Ionospheric Model

Context: Researchers from Indian Institute of Geomagnetism (IIG), Navi Mumbai, an autonomous institute of the Department of Science & Technology, Govt. of India, have developed a global model to predict the ionospheric electron density with larger data coverage, a crucial need for communication and navigation.

About:

- The new **Artificial Neural Networks based global Ionospheric Model (ANNIM)** is developed using long-term ionospheric observations to predict the **ionospheric electron** density and the peak parameters
- ANNs replicate the processes in the human brain (or biological neurons) to solve problems such as:
  - pattern recognition
  - classification
  - clustering

- generalization
- linear and nonlinear data fitting
- time series prediction

- Currently, very few attempts have been made to model the global ionosphere variability using ANNs.

How they did it?

- The researchers developed **a neural network-based global ionospheric model** by using:
  - an extensive database consisting of nearly two decades of global **Digisonde** (an instrument that measures real-time on-site electron density of the ionosphere by sending the radiofrequency pulses)
  - Global Navigation Satellite System (GNSS) radio occultation
  - topside sounders observations
- These datasets were processed with various quality control measures to eliminate spurious data points (outliers) and prepared for the training.
- Day number, Universal Time, latitude, longitude, F10.7 index (responsible for Photo-ionization), Kp (represents the disturbed space weather conditions), magnetic declination, inclination, dip latitude, zonal and meridional neutral winds were taken as inputs in the study.
- The target (output) of ANNs is the electron density as a function of altitude for any given location and time.
- The data was trained with the ANNs using high-performance computer at IIG to develop the ANNIM.

What is ionosphere?

- A dense layer of molecules and electrically charged particles, called the ionosphere, hangs in the Earth's upper atmosphere starting at about 35 miles (60 kilometers) above the planet's surface and stretching out beyond 620 miles (1,000 km).
- Ionosphere overlaps the mesosphere, thermosphere, and exosphere. It is a very active part of the atmosphere, and it grows and shrinks depending on the energy it absorbs from the sun.
- In the ionosphere, charged particles are affected by the magnetic fields of both Earth and the sun.
- This is where auroras happen. Those are the bright, beautiful bands of light that you sometimes see near Earth's poles.
- They are caused by high-energy particles from the sun interacting with the atoms in this layer of our atmosphere.

Why tracking the variability is important?

- Tracking the variability of the Ionosphere is important for communication and navigation.
- The ionospheric variability is greatly influenced by both solar originated processes and the neutral atmosphere origin, therefore, difficult to model.
- Scientists have tried to model the ionosphere using theoretical and empirical techniques; however, the accurate prediction of electron density is still a challenging task.
- In recent years, the Artificial Neural Networks (ANNs) are showing potential to handle more complex and non-linear problems.
- Keeping these aspects in mind, a novel machine learning approach was implemented by the IIG team in the ionospheric model development using global ionospheric observations.

How will it benefit?

- It can capture the general morphological features of the ionosphere during the disturbed space weather periods, such as geomagnetic storms which occurs when the magnetic cloud originated from Sun (known as Coronal Mass Ejection (CME)) interacts with the Earth's magnetosphere.
- The model may be utilized as a reference model in the ionospheric predictions and has potential applications in calculating the **Global Navigation Satellite System (GNSS)** positioning errors.

4 'Hydrogen Fuel Cell'

Context: NTPC Ltd, India's largest power producer and a central PSU under Ministry of Power, has invited Global Expression of Interest (EoI) to provide 10 Hydrogen Fuel Cell (FC) based electric buses and an equal number of Hydrogen Fuel Cell based electric cars in Leh and Delhi. The EoI has been issued by NTPC's wholly owned subsidiary, NTPC Vidyut Vyapar Nigam (NVVN) Limited.

About:

- A fuel cell is a device that converts chemical potential energy (energy stored in molecular bonds) into electrical energy.
- A PEM (Proton Exchange Membrane) cell uses hydrogen gas (H2) and oxygen gas (O2) as fuel. The products of the reaction in the cell are water, electricity, and heat.

Hydrogen + Oxygen = Electricity + Water Vapour

- This is a big improvement over internal combustion engines, coal burning power plants, and nuclear power plants, all of which produce harmful by-products.
- Since O2 is readily available in the atmosphere, we only need to supply the fuel cell with H2 which can come from an electrolysis process (see Alkaline electrolysis or PEM electrolysis).

What is Hydrogen?

- Hydrogen is the simplest element. An atom of hydrogen consists of only one proton and one electron.
- It's also the most plentiful element in the universe. Despite its simplicity and abundance, hydrogen doesn't occur naturally as a gas on the Earth – it's always combined with other elements.
- Water, for example, is a combination of hydrogen and oxygen (H2O).
- Hydrogen is high in energy, yet an engine that burns pure hydrogen produces almost no pollution.
- NASA has used liquid hydrogen since the 1970s to propel the space shuttle and other rockets into orbit.
- Hydrogen fuel cells power the shuttle's electrical systems, producing a clean byproduct – pure water, which the crew drinks.

Key-highlights:

- The initiative, which has been undertaken with support of Ministry of New and Renewable Energy, will also harness renewable energy for generation of hydrogen and develop it's storage and dispensation facilities as part of pilot projects at Leh and Delhi.
- The PSU has been taking various technology initiatives to provide complete e-Mobility solution for public transport including creation of public charging infrastructure and providing electric buses to State/City Transport Undertakings.

- In this regard, 90 public charging stations in various cities and battery charging and swapping station at Faridabad for e-3-wheelers have already been commissioned.
- Similarly, e-Bus solution for Andaman & Nicobar Administration is under implementation.

Significance of the move:

- The move to launch hydrogen powered vehicles aims at decarbonizing mobility segment.
- The move to procure Hydrogen Fuel Cell based vehicles is first of its kind project in the country, wherein a complete solution from green energy to the fuel cell vehicle would be developed.
- Direct emissions from a fuel cell vehicle are just water and a little heat. This is a huge improvement over the internal combustion engine's litany of greenhouse gases. Fuel cells have no moving parts. They are thus much more reliable than traditional engines.

5 NIF boosts new varieties of Anthurium

Context: National Innovation Foundation-India (NIF) has recently boosted new varieties of Anthurium. These flowers with high market value, help to purify air are cultivated by a lady innovator from Kerala.

About:

- Anthurium (Anthurium spp.) is a vast group of beautiful blooming plants available in a wide range of colors.
- Anthurium is one of the best domestic flowering plants in the world. They are beautiful but also purify the surrounding air and remove harmful airborne chemicals like **formaldehyde, ammonia, toluene, xylene, and allergens.**
- Its importance of removing toxic substances from the air, NASA has placed it in the list of air purifier plants.
- Anthurium has larger economic importance because of its eye-catching and beautiful inflorescence and fetches a good market price.

The new development:

- D Vasini Bai, a women innovator from Thiruvananthapuram, Kerala, has developed ten varieties of Anthurium by cross-pollination.
- The uniqueness of these varieties are large and medium-size flowers with uncommon color combinations of spathe and spadix (viz. light and dark orange, magenta, green and rose color combination, dark red and white colors).
- She has also developed a new method for raising the seedlings in limited space using corrugated asbestos sheets.
- For transplanting grown-up seedlings, she uses concrete troughs instead of pots.
- These methods have helped her in growing more plants in limited space, thus reducing the costs and maintenance and increasing the income at the same time.
- She sells the Anthurium flowers and plants to local florists as well as in cities like Pune and Mumbai at an average price of rupees 60-75 per flower.

Significant achievements of Vasini Bai:

- Vasini Bai has received a number of awards and recognition for developing the Anthurium varieties.
- In 2017, she was awarded with state award at the Ninth National Biennial competition organized by National Innovation Foundation-India (NIF) by the then President of India Shri Pranab Mukherjee.
- Her interest in developing new Anthurium variety instigated in the late 1970s. In 1980, she manually cross-pollinated for the first time.
- After years of experiments in 1985, she developed the first variety of Anthurium- Dora (single plant with 8-10 leaves and multiple flowers with orange-colored spathe).
- She continued her work, and during 1985–2000, she developed another five varieties viz. Dora- I, Dora –II, Dora –III, Dora –IV and Dora – V.
- The other five varieties Akash, George, Giant Pink, JV Red, and JV Pink were developed later through manual cross-pollination.

National Innovation Foundation (NIF):

- The National Innovation Foundation (NIF) is India's national initiative to strengthen the grassroots technological innovations and outstanding traditional knowledge.
- Its mission is to help India become a creative and knowledge-based society by expanding policy and institutional space for grassroots technological innovators.
- It was set up with the support of **Honey Bee Network**.
- NIF scouts, supports and spawns' grassroots innovations developed by individuals and local communities in any technological field, helping in human survival without any help from formal sector.

6 IFLOWS-Mumbai

Context : The state government of Maharashtra launched an Integrated Flood Warning System called 'IFLOWS-Mumbai'.

About

- IFLOWS is a monitoring and flood warning system that will be able to relay alerts of possible flood-prone areas anywhere between six to 72 hours in advance.
- It is a joint initiative between the Ministry of Earth Sciences (MoES) and Brihanmumbai Municipal Corporation (BMC).
- The system can provide all information regarding possible flood-prone areas, likely height the floodwater could attain, location-wise problem areas across all 24 wards and calculate the vulnerability and risk of elements exposed to flood.
- Mumbai is only the second city in the country after Chennai to get this system.
- Similar systems are being developed for Bengaluru and Kolkata.

Working of the system

- **Sources:** The primary source for the system is the amount of **rainfall**, but with Mumbai being a coastal city, the system also factors in **tidal waves** and **storm** tides for its flood assessments.

- The system has provisions to capture the urban drainage within the city and predict the areas of flooding.
- The system comprises seven modules-
  - Data Assimilation
  - Flood
  - Inundation
  - Vulnerability
  - Risk
  - Dissemination Module
  - Decision Support System
- The system incorporates weather models from the **National Centre for Medium Range Weather Forecasting (NCMRWF), India Meteorological Department (IMD)**, field data from the rain gauge network of 165 stations set up by **Indian Institute of Tropical Meteorology (IITM),** BMC and IMD.

The need

- Mumbai, the financial capital of India, has been experiencing floods with increased periodicity. The recent flood on 29 August 2017 had brought the city to a standstill.
- Last year, post-monsoon and unseasonal rainfall as late as October, two tropical cyclones in the Arabian Sea had caught authorities off guard and left a trail of destruction.
- The flood during 26th July 2005, when the city received a rainfall of 94 cm, a 100 year high in a span of 24 hours had paralyzed the city completely.
- Urban flooding is common in the city from June to September, resulting in the crippling of traffic, railways and airlines.

How will it benefit the state?

- As advance preparedness for floods before they occur, the system will help in warning the citizens so that they can be prepared in advance for flooding conditions.
- It is designed to generate flood warnings for specific geographical areas of the city. The system, initially only to be accessed by the civic body will enable them to issue alerts for citizens who can then avoid such zones.

7 National Science Technology and Innovation Policy (STIP 2020)

Context: The Office of the Principal Scientific Adviser to the Government of India (Office of PSA) and the Department of Science and Technology (DST) have jointly initiated a decentralized, bottom-up, and inclusive process for the formulation of a new 'national Science Technology and Innovation Policy (STIP 2020)'.

About S&T Policy

- The fifth S&T policy of India is being formulated at a crucial juncture when India and the world are tackling the COVID-19 pandemic.
- This is only the latest among the many important changes in the past decade that have necessitated formulation of a new outlook and strategy for Science, Technology, and Innovation (STI).

- As the crisis changes the world, the new policy with its decentralized manner of formation will reorient STI in terms of priorities, sectoral focus, the way research is done, and technologies are developed and deployed for larger socio-economic welfare.
- The STI Policy for the new India will also integrate the lessons of COVID-19 including building of an Atmanirbhar Bharat (self- reliance) through ST&I by leveraging our strengths in R&D, Design, S&T workforce and institutions, huge markets, demographic dividend, diversity and data.

The formulation process

- The STIP 2020 formulation process will be six-months long.
- It is organised into 4 highly interlinked tracks, which will reach out to around 15000 stakeholders for consultation in the policy formulation.
  - Track I involves an extensive public and expert consultation process through Science Policy Forum - a dedicated platform for soliciting inputs from larger public and expert pool during and after the policy drafting process.
  - **Track II** comprises experts-driven thematic consultations to feed evidence-informed recommendations into the policy drafting process. Twenty-one (21) focused thematic groups have been constituted for this purpose.
  - **Track III** involves consultations with Ministries and States
  - **Track IV** constitutes apex level multi-stakeholder consultation

Department of Science and Technology (DST)

- Department of Science & Technology (DST) was established in May 1971.
- The organisation aims to promote new areas of Science & Technology and to play the role of a nodal department for organising, coordinating and promoting S&T activities in the country.

8 Black Rock Android malware

Context: Security firm ThreatFabric has alerted about a new malware, called BlackRock, which can steal information like passwords and credit card information from about 377 smartphone applications, including Amazon, Facebook, Gmail and Tinder.

About

- BlackRock is not exactly a new malware. In fact, it is based on the leaked source code of the Xeres malware, itself derived from malware called LokiBot.
- The only big difference between BlackRock and other Android banking trojans is that it can target more apps than previous malwares.
- According to the Threat Fabric the malware can be used to send and steal SMS messages, hide notifications, keylogging, AV detection, and much more.
- The new malware is so powerful that it makes antivirus applications useless.
- BlackRock isn't limited to online banking apps and targets general purpose apps across various categories of Books & Reference, Business, Communication, Dating, Entertainment, Lifestyle, Music & Audio, News & Magazine, Tools, and Video Players & Editors.

How it works?

- Once installed on a phone, it monitors the targeted app. When the user enters the login and/or credit card details, the malware sends the information to a server.

- BlackRock uses the phone's Accessibility feature, and then uses an Android DPC (device policy controller) to provide access to other permissions.
- When the malware is first launched on the device, it hides its icon from the app drawer, making it invisible to the end-user. It then asks for accessibility service privileges.
- Once this privilege is granted, BlackRock grants itself additional permissions required to fully function without having to interact any further with the victim. At this point, the bot is ready to receive commands from the command-and-control server and execute overlay attacks.

Protection from BlackRock Android malware

- Download apps only from the Google Play Stores, use strong passwords, beware of spam and phishing emails, use an antivirus app if possible, and check app permissions.

9 Spyware, stalkerware apps gaining traction during lockdown

Context: Global Cyber-security leader Avast has warned in a note that there was a 51-percent increase in the use of spy- and stalkerware since the lockdown in March until June.

What are spy and stalkerware apps?

- Spy and stalkerware apps, like viruses and other malware, infect devices that are connected to the internet. While viruses and malware can be detected by antivirus software, spyware and stalkerware apps disguise themselves as useful and send-out stolen data to central servers without the users' knowledge.
- A spyware app can also be installed remotely while a stalkerware app can be installed only when someone has physical access to the digitally connected device.

How do such apps work?

- For spyware apps, the easiest method is to disguise the spying code inside the unauthorised versions of other apps and then try and market such premium apps.
- Stalkerware apps on the other hand, seek explicit permissions at the time of their installation. Once the app is installed in the phone, it can be hidden from the apps menu into the background, from where they continue functioning.

Reason for increased usage

- Increased usage of internet by everyone due to various lockdown measures in place. This provides enough opportunities for cyber criminals.

10 AJO-Neo

Context: The device called "AJO-Neo" is developed by researchers from S.N. Bose National Centre For Basic Sciences (SNBNCBS), Kolkata.

About

- SNBNCBS developed a "No-touch" & "Painless" device for non-invasive screening of bilirubin level in new-borns.
- The operation of the device is based on **non-contact and non-invasive spectrometry-based techniques** for **measurement of neonatal bilirubin level as an alternative of total serum bilirubin (TSB)** test without limitations of other available bilirubin meters.

- The newly developed device (AJO-Neo) is reliable in measuring bilirubin levels in preterm, and term neonates irrespective of gestational or postnatal age, sex, risk factors, feeding behavior or skin color.
- The device is found to deliver an almost instantaneous report (about 10 seconds) to a concerned doctor, who is sitting 10000 km away from the point of care. This is a significant achievement compared to the conventional "blood test" method, which may take more than 4 hours to generate the report.
- It has to be noted that detection of neonatal blood bilirubin (Hyperbilirubinemia) faster is extremely important for therapeutic management in order to avoid Kernicterus leading to Neuo-psychiatry problems in neonatal subjects.
- AJO-Neo also shows several advantages compared to other similar imported devices in the market.
- Careful screening of bilirubin level in new-borns is mandatory as per American Academy of Paediatrics (2004), to reduce incidents of a type of brain damage called kernicterus that can result from high levels of bilirubin in a baby's blood. Although invasive capillary collection of blood and the subsequent biochemical test is considered a gold standard for jaundice detection in neonates, transcutaneous bilirubin measurement using non-invasive instruments has obvious added advantages.

11 Ammonium nitrate linked to catastrophic Beirut explosion

Context : Beirut was declared a "disaster city", in the wake of a huge explosion in the port of the Lebanese capital that left at least 135 people dead and 5,000 injured, caused by over 2,700 tonnes of ammonium nitrate kept in storage for over six years.

Ammonium nitrate, the substance

- In its pure form, ammonium nitrate (NH_4NO_3) is a white, crystalline chemical which is soluble in water.
- It is the main ingredient in the manufacture of commercial explosives used in mining and construction.
- In India, The Ammonium Nitrate Rules, 2012, under The Explosives Act, 1884, define ammonium nitrate as the-
- "compound with formula NH_4NO_3 including any mixture or compound having more than 45 per cent ammonium nitrate by weight including emulsions, suspensions, melts or gels but excluding emulsion or slurry explosives and non explosives emulsion matrix and fertilizers from which the ammonium nitrate cannot be separated".

Regulation of Ammonium Nitrate in India

- The manufacture, conversion, bagging, import, export, transport, possession for sale or use of ammonium nitrate is covered under The Ammonium Nitrate Rules, 2012.
- The rules also make storage of ammonium nitrate in large quantities in populated areas illegal in India.
- For the manufacture of ammonium nitrate, an Industrial licence is required under the Industrial Development and Regulation Act, 1951.
- A license under the Ammonium Nitrate Rules, 2012 is also required for any activity related to ammonium nitrate.

Is it explosive?

- Pure ammonium nitrate is not an explosive on its own. It is classified as an **oxidiser (Grade 5.1)** under the **United Nations classification of dangerous goods**.
- If mixed with ingredients like fuel or some other contaminants, or because of some other external factors, it can be very explosive.
- However, for combinations to explode, triggers like detonators are required. Many Improvised Explosive Devices (IEDs) used by terrorists around the world have ANFO as the main explosive, triggered by primary explosives like RDX or TNT.

Is stored ammonium nitrate a major fire hazard?

- Large quantities of stored ammonium nitrate are regarded as a major fire hazard.
- The explosion of large storage can happen primarily in two ways.
  - **Contact with explosive mixture:**One is by some type detonation or initiation because the storage comes in contact with explosive mixture.
  - **Fire or heat generation:** Second, the blast can result due to a fire which starts in the ammonium nitrate store because of the heat generated due to the oxidation process at large scale.
- There are several documented examples of deadly ammonium nitrate fire and explosion incidents in the past, some with large numbers of fatalities like in China in 2015 and in Texas in 1947.

12 Ultraviolet germicidal irradiation (UVGI)

Context : Scientists are studying the use of ultraviolet germicidal irradiation (UVGI) to detect the virus 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.

ABOUT:

- Ultraviolet germicidal irradiation (UVGI) is the use of ultraviolet (UV) energy (electromagnetic radiation with a wavelength shorter than that of visible light) to kill or inactivate viral, bacterial, and fungal species.
- UVGI is a method of disinfection that uses short wavelength ultraviolet light (UV-C) to inactivate or kill microorganisms and pathogens.
- Essentially, UVGI is the use of UV light with suffi ciently short wavelengths to disinfect surfaces, air, and water.
- The effectiveness of germicidal UV light depends on the length of time a microorganism is exposed to UV, as well as the intensity and wavelength of the UV radiation.

What is UV light?

- Ultraviolet light from the sun has shorter wavelengths than visible light and, therefore, is not visible to the naked eye.
- The full spectrum of UV radiation is sourced from the sun and can be subdivided into:
  - UV-A rays
  - UV-B rays
  - UV-C rays

- In this spectrum, UV-C rays are the most harmful and are completely absorbed by the Earth's atmosphere.
- Further, while both UV-A and UV-B rays are harmful, exposure to UV-B rays can causeDNA and cellular damage in living organisms.
- UV light kills cells. Increased exposure to it can cause cells to become carcinogenic, thereby increasing the risk of getting cancer.
- In fact, it is the increased direct exposure to UV rays from the sun that most commonly causes skin cancers.
- UV light with wavelengths less than 290nm are considered to have "germicidal" properties (more on this later).
- Earth's atmosphere absorbs ultramagnetic radiation with wavelengths less than 290nm,meaning that most of the UV-C and UV-B generated by the sun is blocked by our planet's ozone.

How does UV Light Kill Viruses and Bacteria?

- Ultraviolet light kills cells by damaging their DNA.
- Exposure to the electromagnetic radiation (light) at certain UV wavelengths modifi es the genetic material of microorganisms and destroys their ability to reproduce.
- The UV energy triggers the formation of specific c thymine or cystosine dimers in DNA and uracil dimers in RNA, which causes the inactivation of microbes by causing mutations and/or cell death as well as failure to reproduce.

How does UVGI work?

- Ultraviolet germicidal irradiation (UVGI) uses destructive properties of UV light to target pathogens.
- It is thus considered effective in disinfecting the air and helps in preventing certain infectious diseases from spreading.
- UVGI replicates UV wavelengths that disinfect contaminated spaces, air and water.
- It is a promising method for disinfection but the efficacy of it depends on its dose.

Are UV Lighting and UVGI the same thing?

- UVGI is a specific method of sterilization that uses UV lighting. In essence, UV lighting is a component of UVGI.
- UVGI is just one method of sterilization/decontamination using lighting.

Can it prevent infection?

- UVGI is most effective in preventing infections that are chiefly spread through smaller droplets and not by direct contact or larger respiratory droplets.
- While using UVGI, it is important to consider factors such as the sensitivity of microorganisms to UVGI, the dose of UVGI required to kill them, humidity and weather conditions.
- Further, UVGI relies on air circulation in a room, which means the circulation of air needs to be such that air from below the room, where the pathogen is generated reaches the upper-portions of the room, where the UVGI can trap the pathogen.
- Even so, using UVGI on a mass-scale, in public spaces such as schools, universities, restaurants and cinema halls may not be the most cost-effective way to approach disease prevention.

13 Scientist Unlock Enzyme that reorganises Paternal Genome

Context : Scientists have unlocked enzyme 'SPRK1' that reorganises paternal genome during fertilisation. The enzyme makes way for the first step, folding and packaging the sperm so that it fi ts in the egg.

ABOUT:

- A person's genome is inherited from the parents — during fertilisation, half of the father's genome is mixed with half of the mother's.
- A sperm carries half as much genetic material as a regular cell and needs to be folded and packaged in a way that it fits in the egg.
- It is the enzyme SPRK1 that makes way for this first step, by reorganising paternal genome during the first moments of fertilisation.
- The enzyme does it in a matter of few hours.
- The study, published in journal Cell, was carried out by researchers at University of California San Diego School of Medicine discovered.
- Until now, enzyme SPRK1 was studied for its ability to splice ribonucleic acid (RNA) — an important step that enables translation of genes to proteins.
- But SRPK1 leads a double life, swapping protamines for histones once the sperm meets egg.
- SPRK1 most likely started out playing this role in early embryogenesis, and later evolved the ability to splice RNA. That was how SPRK1 got to do the latter even when it was no longer needed for embryogenesis.

Understanding the science behind it:

- Our standard knowledge of human reproduction is clear: sperm, fertilize the egg, the embryo develops, and finally a new baby is born.
- However, scientists did not know exactly the process of how half the genome of sperm from the father and half of the egg from the mother came together.
- Sperm can be up to 20 times smaller than a normal cell in the body. And while sperm arry only half as much genetic material as a regular cell, it needs to be folded and packaged in a special way in order to fit.
- One way nature does this is by replacing histones - proteins around which DNA is ound, like beads on a necklace, with a different type of protein called protamines.

Significance of the discovery:

- The scientists have uncovered a step that might malfunction for some people, and contribute to a couple's difficulty in conceiving. The discovery could help study infertility in certain cases.
- To date, researchers did not really know much about these relatively brief, yet crucial, incipient moments in fertilisation. The discovery simply answers a fundamental question about the beginning of life.

14 Scientists Discover Animal that doesn't Breathe Oxygen

Context : Scientists at Tel Aviv University have discovered a jellyfish-like parasite that doesn't need oxygen because it doesn't breathe. Its life is entirely free of dependency on oxygen.

About:

- The discovery was made by accident as the team was sequencing the genome of a ommon salmon parasite called **Henneguya salminicola.**
- When they searched for a **mitochondrial genome**, they didn't fi nd anything.
- The discovery has enormous ramifi cations for not just one's understanding of life on Earth, but also for astrobiology and one's search for non-oxygen dependent life forms on other astronomical objects, possibly within the solar system.

What is Mitochondria?

- Mitochondria are organelles that trap oxygen and help to break it down to provide energy for the cell.
- Mitochondria are membrane-bound cell organelles (mitochondrion, singular) that generate metabolic energy in eukaryotic cells needed to power the cell's biochemical reactions.
- Chemical energy produced by the mitochondria is stored in a small molecule called **adenosine triphosphate (ATP).**
- Mitochondria contain their small chromosomes. Generally, mitochondria, and therefore mitochondrial DNA, are inherited only from the mother.

15 Cryptocurrency

Context: Recently, Supreme Court has set aside an RBI's April 2018 circular banning regulated financial institutions such as Banks and NBFCs from trading in virtual currency/cryptocurrency.

Cryptocurrency

- Cryptocurrency is a type of digital currency that uses cryptography for security and anti-counterfeiting measures.
- It is normally not issued by any central authority, making it immune to government interference or manipulation.
- The control of each cryptocurrency works through distributed ledger technology called blockchain.
- Examples include Bitcoin, Ethereum, Ripple etc.
- Various benefits of cryptocurrencies include: o Difficult to counterfeit as compared to physical currency.
- There aren't usually transaction fees for cryptocurrency exchanges because the miners are compensated by the network.
- Benefits for customers: The rise of cryptocurrencies offers ordinary people the rare opportunity to choose among multiple currencies in the marketplace.
- Blockchain technology can be used for enhancing the efficiency of the financial system

16 Inflight WIFI

Context : Union government recently issued a notification to announce that all airlines operating in India can now provide in-flight wi-fi services to its passengers.

About:

- The Civil Aviation Ministry specified that the availability of the Wi-Fi during flights will be broadly subjected to two conditions:
- The main captain will have the authority to switch on or switch off the Wi-Fi in flights, and the captain will be required to follow certain guidelines on this matter. For example, Wi-Fi would be switched on only when the plane is at the cruising speed and not during take-off or landing.
- Each plane that offers in-flight Wi-Fi will have to be certified by DGCA for this purpose before fliers in it can enjoy connectivity.

How does Inflight Wifi work?

- There are two operating systems for airplane WiFi: Air-to-ground WiFi System
- It works in a similar way to a cell phone.
- Airplanes have an antenna located underneath their body, which links up with cell towers on the ground.
- As the aircraft travels, it simply connects to the nearest transmitter/towers on a rolling basis.
- The airplane becomes a hotspot, so passengers can access internet.
- However, this system can't work when the plane is flying over large expanses of water or particularly remote terrain, like on transatlantic routes.

17 Indian Initiative on Earth Biogenome Sequencing (IIEBS)

Context : Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) is selected to take part in Indian Initiative on Earth BioGenome Sequencing (IIEBS).

Indian Initiative on Earth BioGenome Sequencing (IIEBS)

- This project aims to decode the genetic information of all known species of plants and animals in the country.
- The National Institute of Plant Genome Research, New Delhi is the coordinating centre involving a total of 24 institutes.
- 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 project is part of the Earth BioGenome Project. Significance of the project
- The project will enable collection and preservation of endangered and economically important species.
- The decoded genetic information will also be a useful tool to prevent biopiracy.
- Biopiracy is exploitative use of genetic code of plants or animals, without compensating the countries from which the material or relevant knowledge is obtained.
- India's participation in the EBP would provide a boost for the field of genomics and bioinformatics within the country.

Earth BioGenome project

- It is a global effort launched in 2018, involving scientific partners and funders from around the globe.

- It aims to sequence, catalogue and characterise genomes of all of Earth's eukaryotic biodiversity over a period of ten years.
- Vision- Create a new foundation for biology to drive solutions for preserving biodiversity and sustaining human societies.

18 Scientists discover animal that doesn't breathe oxygen

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About:

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What if, mitochondria are not present?

- The presence of mitochondria helps in harnessing oxygen and breaking it down for energy. Then, life took a dramatic turn and erupted.
- Unlike bacteria, all eukaryotic cells have mitochondria.
- Every cell in every plant or animal contains mitochondria, which generates fuel for the cell to burn and obtain energy.
- The lack of mitochondria implies that the animal does not use oxygen to function, as no other organelle or process in a cell is capable of breaking it down.
- It is not entirely known how the creature (parasite) obtains energy. It may be possible that it does so by absorbing molecules from the salmon that already produces energy.
- There are known organisms who have adapted to thrive in a low oxygen environment but until this study, whether there have been animals that don't use oxygen has been a question that hadn't been answered.

Aerobic respiration:

- Aerobic respiration is a chemical reaction that transfers energy to cells.
- Plants and animals transport glucose and oxygen to tiny structures in their cells, called mitochondria.
- Here, glucose and oxygen take part in a chemical reaction.
- The reaction is called aerobic respiration, and it produces energy which transfers to the cells.
- The waste products of aerobic respiration are carbon dioxide and water.

Significance of the discovery:

- The discovery indicated that evolution can go in strange directions. It also brings into question the definition of 'animal' itself as breathing in oxygen is a part of it.
- The findings indicate that there might be many more such animals to be found that counter our understanding of life.

19 CollabCAD

Context: Atal Innovation Mission, NITI Aayog and National Informatics Centre (NIC) jointly launched CollabCAD.

About:

- CollabCAD is a collaborative network, computer enabled software system, providing a total engineering solution from 2D drafting & detailing to 3D product design.
- The aim of this initiative is 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.
- ATLs established across India, provide tinkering spaces to children to hone their innovative ideas and creativity.
- A customized version of CollabCAD for ATLs with features that are most relevant to school students to materialize their ideas and creativity into physical solutions has been developed to enable designing without constraints and, thus, allowing creativity and innovation to thrive.

What is 3D Printing?

- 3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file.
- The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created.
- Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.
- 3D printing is the opposite of subtractive manufacturing which is cutting out / hollowing out a piece of metal or plastic with for instance a milling machine.
- 3D printing enables you to produce complex shapes using less material than traditional manufacturing methods.

- Examples of 3D Printing include consumer products (eyewear, footwear, design, furniture), industrial products (manufacturing tools, prototypes, functional end-use parts), dental products, prosthetics, architectural scale models & maquettes, reconstructing fossils, etc.

2D Drafting:

- 2D Drafting is the creation of accurate representations of objects for manufacturing and engineering needs.
- It is used to fully and clearly define requirements for concepts or products so as to convey all the required information that will allow a manufacturer to produce that component.

Significance of the initiative:

- AIM's collaboration with NIC's CollabCAD is a great platform for students to utilize indigenous, state-of-the-art made-in-India software for 3D modeling/slicing to use 3D Printing.
- 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.

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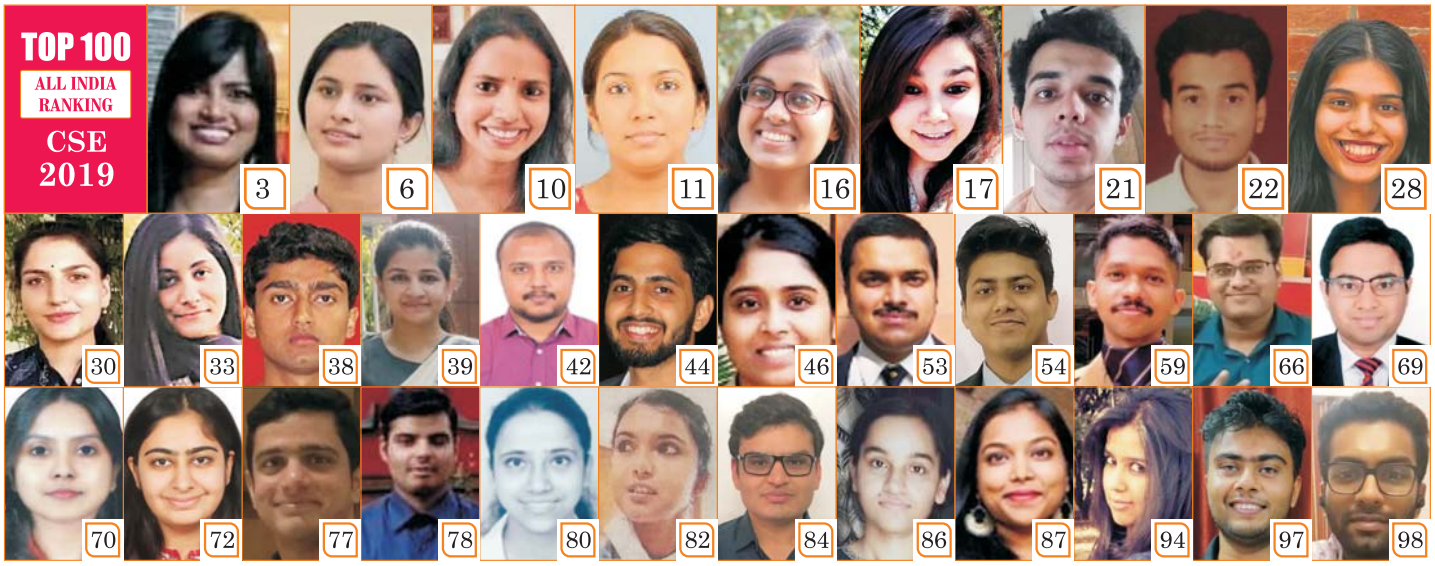
GS SCORE
An Institute for Civil Services

CSE RESULTS



SUCCESS IS A PRACTICE WE DO!