YEARLY COMPILATION

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IAS 2021

PRELIMS SAMPOORNA

UPDATED till AUGUST, 2021

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SCIENCE & TECHNOLOGY

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PRELIMS SAMPOORNA

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1 INFORMATION TECHNOLOGY & COMMUNICATION

1 5G Countdown

Context: Reliance Jio has declared that they will launch 5G in the 2nd half of 2021.

What is 5G?

- 5G is the 5th generation of mobile networks, a significant evolution over today's 4G LTE networks.
- 5G uses radio waves or radio frequency (RF) energy to transmit and receive voice and data connecting our communities

Pros of 5G Technology

- Greater Transmission Speed
- Lower Latency: Latency refers to the time interval between an order being received and the given instruction being executed.
- Increased Connectivity
- Energy Efficiency Plans

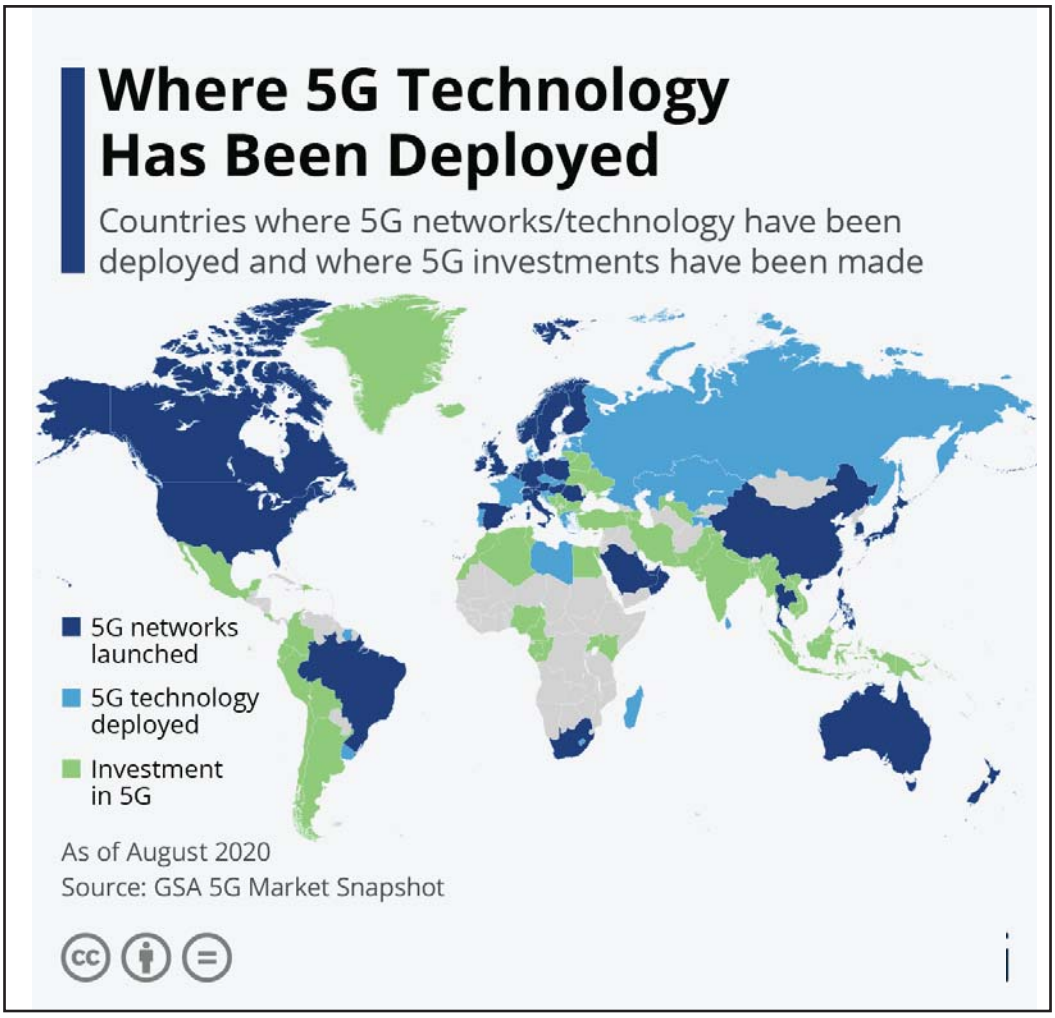
Cons of 5G Technology

- High Cost of Establishment
- Lack of Information
- Limited Coverage
- Overcrowded Radio Frequency
- Security and Privacy Issue

Which countries have already launched 5G services?

Globally, 5G network deployment is rapidly moving from trials to early commercialization.

- In April 2019, South Korea and the U.S. became the first countries to commercially launch 5G services.
- China too has handed out commercial 5G licenses to its major carriers earlier than expected.
- Other countries include Japan, Australia, United Kingdom, Qatar, Kuwait, the United Arab Emirates



2 DRDO achieves milestone in key Quantum Technology

Context: The Defence Research and Development Organisation (DRDO) achieved a milestone in Quantum Key Distribution (QKD) technology

What is Quantum Key Distribution (QKD)?

- QKD is a secure communication method that uses cryptographic protocol involving components of quantum mechanics.
- The technology enables two communicators to produce a random secret key known only to them and later it can be used to encrypt and decrypt messages.

What makes QKD unbreakable?

- The security of QKD stems from the ability to detect any intrusion on the QKD transmission.
- Because of the unique and fragile properties of photons, any third party who tries to read or copy the photons in any way will change the photons' state.
- The change will be detected by the endpoints, alerting them that the key has been tampered with and must be discarded.
- A new key is then transmitted. Moreover, since the keys generated are truly random, they are protected from future hacking attempts.

3 AI & Robotics Technologies Park (ARTPARK) set up in Bengaluru

Context: The Indian Institute of Science (IISc) Bangalore has set up an Artificial Intelligence and Robotics Technologies Park (ARTPARK).

What is ARTPARK?

- ARTPARK is a unique not-for-profit foundation established by the Indian Institute of Science (IISc), Bengaluru with support from AI Foundry in a public-private model.
- Under the National Mission on Inter-disciplinary Cyber-Physical Systems (NM-ICPS), it will bring about a collaborative consortium of partners from industry, academia, and government bodies.

What ARTPARK will do?

- ARTPARK will develop AI & Robotics facilities to support technology innovations as well as capacity building through advanced skills training of students and professionals in these areas.
- Some of these facilities will be key enablers for whole new sets of technologies, products, and services.
- **DataSetu:** It will develop DataSetu - that will enable confidentiality and privacy-preserving framework to share data and run analytics spurring the data-sharing ecosystem and create a data marketplace, boosting AI applications and solutions.
- **BhashaSetu:** One such service will be BhashaSetu - which will enable real-time Indic language translation, both of speech to speech and speech to text.
  - This will further unlock the economic potential of the country, and enable all Indian citizens to equitably participate in the economic progress, regardless of their language.

5 EU Cyber Sanctions

Context: The European Union has imposed 'first-ever' cyber sanctions to protect itself from increasing cyber-attacks.

About EU's Cyber Sanctions

- The restrictive measures were imposed against six individuals and three entities responsible for or involved in various cyber-attacks.
- These include the attempted cyber-attack against the
  - **OPCW** (Organisation for the Prohibition of Chemical Weapons) and those publicly known as-
    - WannaCry
    - NotPetya
    - Operation Cloud Hopper

- **WannaCry:** WannaCry is an example of crypto ransomware, a type of malicious software (malware) used by cybercriminals to extort money. Ransomware that uses encryption is called crypto ransomware. The type that locks you out of your computer is called locker ransomware.

- **NotPetya:** The malware spread like wildfire across the world, eating into every electronic equipment, computers, extracting data and demanding exorbitant amounts for recovery in form of Bitcoins
- **Operation Cloud Hopper:** The hacking campaign includes hacking of the world's biggest technology service providers.

6 Spyware, stalkerware apps gained 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?

- Spyware or stalkerware refers to tools - apps, software programs, and devices - that let another person (such as an abuser) secretly monitor and record information about your phone activity.
- 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?

- Spyware: For spyware apps, the easiest method is to disguise the spying code inside the unauthorized versions of other apps and then try and market such premium apps.
- Stalkerware: 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.

7 The landscape of Cyber Security in India

Context:

- As the world gets absorbed by the COVID-19 pandemic, cyberattacks have become a critical area for all technology-focused organizations in India. In the evolving situation, India needs an updated cybersecurity situation.

Types of Cybercrime

- DDoS Attacks
- Botnets
- Identity Theft
- Cyberstalking
- PUPS (Potentially Unwanted Programs)

- Phishing
- Online Scams

Indian laws concerning Cyber Security

- **Information Technology Act, 2000:** The act provides legal recognition to e-commerce and e-governance and facilitates its development as an alternative to paper-based traditional methods.
- **Crime and Criminal Tracking Network System (CCTNS):** It is a nationwide network infrastructure for the evolution of an IT-enabled state-of-the-art tracking system around "investigation of crime and detection of criminals".
- **National Cyber Security Policy, 2013:** It provides for:
  - To build secure and resilient cyberspace.
  - Creating a secure cyber ecosystem, generate trust in IT transactions.
  - Creation of a 24 x 7 National Critical Information Infrastructure Protection Center (NCIIPC).
  - Indigenous technological solutions.
  - Testing of ICT products and certifying them.
- **National Technical Research Organization (NTRO):** NTRO is a highly specialized technical intelligence gathering agency. It develops technology capabilities in aviation and remote sensing, data gathering and processing, cyber security, cryptology systems, strategic hardware and software development, and strategic monitoring.
- **National Critical Information Infrastructure Protection Centre (NCIIPC):** Creation of National Critical Information Infrastructure Protection Centre, the national nodal agency in respect of the protection of critical information infrastructure.
  - It is placed under the National Technical Research Organization.
- **CERT-In:** CERT-In has been designated to serve as the national agency to perform the following functions:
  - Collection, analysis, and dissemination of information on cyber incidents.
  - Forecast and alerts of cybersecurity incidents
  - Emergency measures for handling cybersecurity incidents
  - Coordination of cyber incident response activities
  - Issue guidelines, advisories, vulnerability notes, and white papers relating to information security practices, procedures, prevention, response, and reporting of cyber incidents
- **National Cyber Coordination Centre (NCCC):** It is a critical component of India's cyber security against hackers and espionage as well as to track terrorist activity online.

8 Cyber attacks are on rise: INTERPOL

Context: An inter-governmental law enforcement organization, INTERPOL, the International Criminal Police Organization, has cautioned that it has detected a significant increase in cyber-attacks against hospitals around the world that are engaged in the COVID-19 response. Attacks that could "directly lead to deaths."

Types of Cybercrimes:

- **Cyberextortion:** A crime involving an attack or threat of an attack coupled with a demand for money to stop the attack.
- **Cryptojacking:** An attack that uses scripts to mine cryptocurrencies within browsers without the user's consent. Cryptojacking attacks may involve loading cryptocurrency mining software to the victim's system.

- **Identity theft:** An attack that occurs when an individual accesses a computer to glean a user's personal information, which they then use to steal that person's identity or access their valuable accounts, such as banking and credit cards.
- **Cyberespionage:** A crime involving a cybercriminal who hacks into systems or networks to gain access to confidential information held by a government or other organization.
- **Software piracy:** An attack that involves the unlawful copying, distribution, and use of software programs with the intention of commercial or personal use. Trademark violations, copyright infringements, and patent violations are often associated with this type of cybercrime.
- **Dark web:** The deep web refers to all parts of the internet (sites, e-shops, forums, etc.) that are not accessible by a regular search engine like Google or Bing.

About INTERPOL:

- Founded in 1923, Interpol is an international police organization made up of 194 member countries.
- The International Criminal Police Organization or the ¬Interpol is an international police agency that helps other law-enforcement agencies track criminals who operate across national borders.
- In each country, an INTERPOL National Central Bureau (NCB) provides the central point of contact for the General Secretariat and other NCBs.
- An NCB is run by national police officials and usually sits in the government ministry responsible for policing.

Cyber Laws and Legislation in India and Abroad:

Global Level	
Budapest Convention on Cyber Security	• It is the first international treaty seeking to address Internet and computer crime by harmonizing national laws, improving investigative techniques, and increasing cooperation among nations. • Its objective is to pursue a common criminal policy aimed at the protection of society against cybercrime, especially by adopting appropriate legislation and fostering international cooperation.
International Telecommunication Union (ITU):	• ITU is the specialized agency of the United Nations which deals with adopting international standards to: ▸ ensure seamless global communications and interoperability for next-generation networks ▸ building confidence and security in the use of ICTs ▸ emergency communications to develop early warning systems and to provide access to communications during and after disasters, etc.
International Governance Forum (IGF):	• Internet Governance Forum (IGF) is a multi-stakeholder forum for policy dialogue on issues of Internet governance which brings together all stakeholders in the Internet governance debate.

	◎ It facilitates a common understanding of how to maximize Internet opportunities and address risks and challenges. ◎ It is convened under the auspices of the Secretary-General of the United Nations.
National Level	
National Technical Research Organization (NTRO):	◎ NTRO is a highly specialized technical intelligence gathering agency. ◎ It develops technology capabilities in aviation and remote sensing, data gathering and processing, cyber security, cryptology systems, strategic hardware and software develo
National Critical Information Infrastructure Protection Centre (NCIIPC):	◎ National Critical Information Infrastructure Protection Centre is envisaged to act as a 24x7 center to battle cybersecurity threats in strategic areas such as air control, nuclear, and space. ◎ It is placed under the National Technical Research Organization.
CERT-In	◎ The Computer Emergency Response Team (CERT-In) has been designated to serve as the national agency to perform the following functions: ► To collect and analyze information on cyber incidents ► To forecast and give alerts of cybersecurity incidents ► To provide emergency measures for handling cybersecurity incidents ► To coordinate cyber incident response activities ► To issue guidelines, advisories, vulnerability notes, and white papers relating to information security practices, procedures, prevention, response, and reporting of cyber incidents
National Cyber Coordination Centre (NCCC):	◎ NCCC is a critical component of India's cyber security against hackers and espionage as well as to track terrorist activity online.
Crime and Criminal Tracking Network System (CCTNS)	◎ CCTNS is a nationwide network infrastructure for the evolution of IT-enabled state-of-the-art tracking system around "investigation of crime and detection of criminals".
Information Technology Act, 2000	◎ It is the most significant piece of legislation addressing conduct in cyberspace in India. ◎ It provides legal recognition to e-commerce and e-governance and facilitates its development as an alternative to paper-based traditional methods.
National Cyber Security Policy, 2013	◎ The policy provides for developing effective Public-Private Partnerships and collaborative engagements through technical and operational cooperation and contribution for enhancing the security of cyberspace.

	⊙ Key-features: ► Creating a secure and resilient cyberspace ► Creating a secure cyber ecosystem, generate trust in IT transactions ► Creation of a 24 x 7 National Critical Information Infrastructure Protection Center (NCIIPC) ► Testing of ICT products and certifying them

8 EventBot

Context: Indian Computer Emergency Response Team (CERT-In) has issued a detailed warning to people against the trojan called EventBot.

About:

- EventBot is a mobile-banking Trojan and info-stealer that abuses Android's in-built accessibility features to steal user data from financial applications, read user SMS messages and intercept SMS messages, allowing malware to bypass two-factor authentication.
- The EventBot trojan has over 200 different financial applications under its target, including banking applications, money-transfer services, and cryptocurrency wallets, or financial applications based in the US and European region.
- The tricky part about a trojan such as EventBot is that it seems to be a trusted application, as per India's federal cyber-security agency.

What is Trojan?

- A Trojan horse, or Trojan, is a type of malicious code or software that looks legitimate but can take control of your computer.
- A Trojan is designed to damage, disrupt, steal, or in general, inflict some other harmful action on your data or network.
- A Trojan acts as a bona fide application or file to trick you. It seeks to deceive you into loading and executing the malware on your device. Once installed, a Trojan can perform the action it was designed for.

Important terms

- **Malware:** Malware covers all sorts of software with nasty intent. Not buggy software, not programs you don't like, but the software that is specifically written with the intent to harm.
- **Virus:** This is a specific type of malware that spreads itself once it's initial run. It's different from other types of malware because it can either be like a parasite that attaches to good files on your machine, or it can be self-contained and search out other machines to infect.
- **Worm:** In the malware sense, they are viruses that are self-contained (they don't attach themselves like a parasite) and go around searching out other machines to infect.
- **Exploit:** The strange behavior that can be used to create a hole for hackers or malware to get through generally requires someone to use a particular sequence of actions or text to cause the right (or is that wrong?) conditions. To be usable by malware (or on a larger scale by hackers), it needs to be put into code form, which is also called exploit code.

9 RPF busts Real Mango

Context: Railway Protection Force (RPF) has busted an illegal software operation called "Real Mango" — used for cornering confirmed train reservations during the coronavirus pandemic.

What is 'Real Mango'?

- "Real Mango" is illegal software used for cornering confirmed Railway reservations.
- The software was earlier with the name 'Rare Mango'.
- The operation of an illegal software called "Rare Mango" (later changed its name to "Real Mango") was revealed during action against touts by the field units of RPF.
- The software has now been fully decimated

What made it 'illegal' software?

- In course of the systematic unraveling of the working of the illegal software, it has been found that-
  - Real mango software bypasses V3 and V2 captcha
  - It synchronizes bank OTP with help of a mobile app and feeds it to the requisite form automatically
  - The software auto-fills the passenger details and payment details in the forms
  - The software logs in to the IRCTC website through multiple IRCTC Ids
  - The illegal software is sold through a five-tiered structure: System Admin & his team, Mavens, Super sellers, Sellers, and Agents
  - System admin is receiving payment in bitcoins.

13 A Web 3.0 revolution that could relieve social dilemmas

Context: Web 3.0 is the next step in the evolution of the Internet and Web applications.

A brief history of the evolution of the Internet

- Websites and web applications have changed dramatically over the last decades. They have evolved from static sites to data-driven sites that users can interact with and change.

Web 1.0

- The original Internet was based on what is now known as Web 1.0.
- Back in the early 1990s, websites were built using static HTML pages that only had the ability to display information.

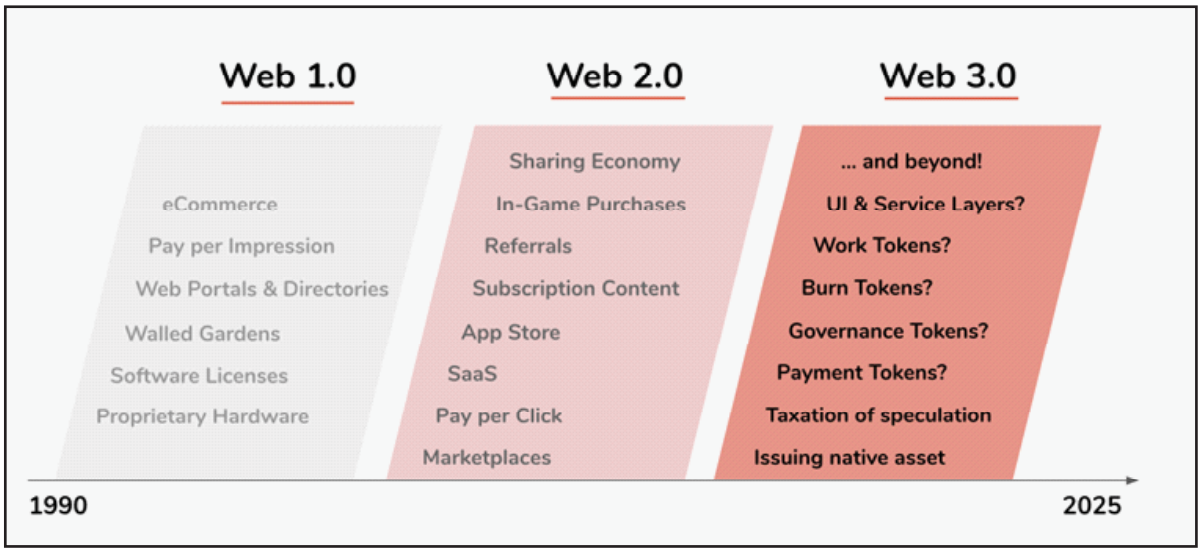
Web 2.0

- With Web 2.0, users were able to interact with websites through the use of databases, server-side processing, forms, and social media.
- This brought forth a change from a static to a more dynamic web.

Web 3.0

- Web 3.0 is the next generation of Internet technology that heavily relies on the use of machine learning and artificial intelligence (AI).

- It aims to create more open, connected, and intelligent websites and web applications, which focus on using a machine-based understanding of data.
- Through the use of AI and advanced machine learning techniques, Web 3.0 aims to provide more personalized and relevant information at a faster rate.



The 4 Properties of Web 3.0

- To understand the nuances and subtleties of Web 3.0, let's look at the four properties of Web 3.0:
  - Semantic Web
  - Artificial Intelligence
  - 3D Graphics
  - Ubiquitous

14 Digital Media Content Regulatory Council (DMCRC)

Context: The 'Indian Broadcasting and Digital Foundation' (IBDF) announced the appointment of Justice (retired) Vikramjit Sen as the Chairman, along with six other eminent industry members for the newly formed **'Digital Media Content Regulatory Council' (DMCRC).**

What is DMCRC?

- It is a self-regulatory body (SRB), according to the **Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021.**
- The industry-led SRB, called as **Digital Media Content Regulatory Council (DMCRC)** for digital OTT platforms.

> OTT, or over-the-top platforms, are audio and video hosting and streaming services.

- This is a second-tier mechanism at the appellate level and similar to **Broadcast Content Complaint Council (BCCC).**
- **Composition:** The council constitutes prominent personalities from the media and entertainment industry and 'Online Curated Content Providers' (OCCPs), with experience in IPR, programming and content creation.

Significance

- Council's mandate is to ensure freedom of expression of the Indian creative industry and to help the discerning audience of the OTT platforms to have unhindered access to world-class and differentiated content.
- DMCRC is expected to create a credible, robust and practical code for content, with an inclusive and fair governance structure.

Indian Broadcasting and Digital Foundation (IBDF)

- The Indian Broadcasting Foundation (IBF) is the apex body of broadcasters and OTT operators.
- It was earlier known as 'Indian Broadcasting Foundation' (IBF).
- To expand its purview to cover digital streaming platforms, it has been renamed as the Indian Broadcasting and Digital Foundation (IBDF).

15 Nano Sniffer, a Microsensor based Explosive Trace Detector

Context: Union Education Ministry launched NanoSniffer, a Microsensor based Explosive Trace Detector (ETD) which is developed by NanoSniff Technologies, an IIT Bombay incubated startup.

What is Nanosniffer?

- **Microsensor technology**: Nanosniffer is the world's first Explosive Trace Detector by using microsensor technology.
- **Indigenous**: Nanosniffer is a 100% Made in India product in every terms starting from research and development to its manufacturing.
- **Detected material:** It detects all classes of military, conventional and homemade explosives.
- **Functioning**: NanoSniffer gives visible & audible alerts with sunlight-readable color display.

Key features

- **Minute detection**: NanoSniffer provides trace detection of a nano-gram quantity of explosives & delivers result in seconds.
- **Reduce import dependency:** The newly developed device would help in reducing our dependency on imported explosive trace detector devices.
- **Rapid detection**: This Home-grown Explosive trace detector device (ETD), NanoSniffer can detect explosives in less than 10 seconds.
- **Patent**: The core technology of NanoSniffer is patented in the U.S. & Europe.
- **Research promotion:** It will also encourage indigenous institutions, startups and medium-scale industries to research & develop products.
- It's a perfect example of lab to market product.

16 Development of the Electrically configured Nano-Channels

Context: Scientists have developed electrically configured nano-channels that can eliminate unwanted energy waste and promise wave-based computing.

It was developed by **S. N. Bose National Centre for Basic Sciences**, an autonomous institute under the **Department of Science and Technology (DST)**, Government of India.

What are Electrically configured Nano-channels?

- These channels are electrically reconfigured parallel nano-channels.
- **Principal:** They tune the behaviour of spin waves in nano-structure elements.
  - It is done through the anisotropy using the electric field. This is technically called the principles of voltage-controlled magnetic anisotropy**.**
  - The spin-waves were efficiently transferred through these nanochannels, and this could be switched 'ON' and 'OFF' and its magnitude altered by a meagre voltage of few volts.

What is Spintronics?

- It is also known as spin electronics, or the study of the intrinsic spin of the electron and its associated magnetic moment.
- In solid-state devices offer to harness electron spins.
- Their collective precession can carry information encoded in its amplitude, phase, wavelength, and frequency without any physical motion of particles, eliminating unwanted energy waste and promising wave-based computing.

Spin Wave

- A spin wave is a collective motion of a magnetic moment in magnetically ordered materials.
- It is a propagating disturbance in the ordering of a magnetic material.
- These low-lying collective excitations occur in magnetic lattices with continuous symmetry.
- The spin wave plays an important role in spintronics as a carrier of spin current, that is, a flow of spin angular momentum.

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2 SPACE TECHNOLOGY & EVENTS

1 NASA's Artemis Project

Context: NASA is forging ahead with its 'Artemis program' to land humans on the moon by 2024.

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.
- The astronauts going for the Artemis program will wear newly designed spacesuits, called Exploration Extravehicular Mobility Unit, or xEMU.
  - These spacesuits feature advanced mobility and communications and interchangeable parts that can be configured for spacewalks in microgravity or on a planetary surface.

Artemis Base Camp

- 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.
- 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.

2 NASA's SunRISE Mission

Context: NASA has announced a 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.

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 flare 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 the 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.
  - 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.

3 Asteroid 465824 (2010 FR) to cross Earth's orbit soon: NASA

Context: NASA has been tracking asteroid 465824 2010 FR, which is twice as big as the Pyramid of Giza and is expected to cross the Earth's orbit.

About:

- It is classified as a Near-Earth Object (NEO) and a potentially hazardous asteroid (PHA).
  - NEOs occasionally move close to the Earth as they orbit the Sun.
    - NASA defines NEOs as comets and asteroids nudged by the gravitational attraction of nearby planets into orbits that allow them to enter the Earth's neighborhood.
    - These objects are composed mostly of water ice with embedded dust particles.
- It is categorized as an Apollo-class Asteroid
- 2010 FR orbits the sun every 440 days (1.20 years), coming as close as 0.72 AU and reaching as far as 1.55 AU from the sun.

What are Asteroids?

- Asteroids are rocky objects that orbit the Sun, much smaller than planets. They are also called minor planets.

- Asteroids are named by the International Astronomical Union (IAU).
- Most such objects can be found in the asteroid belt between Mars and Jupiter, which is estimated to contain somewhere between 1.1-1.9 million asteroids.
  - The explanation for the concentration of asteroids in this belt comes from the formation of Jupiter, whose gravity brought an end to the formation of any planetary bodies in this region, as a result of which the smaller bodies kept colliding with each other, fragmenting into asteroids.
- **Trojans:** Other than those found in the main asteroid belt, asteroids can be classified into trojans, which are asteroids that share an orbit with a larger planet.

4 Mars Opposition

Context: An event referred to as "opposition", which takes place every two years and two months, Mars outshined Jupiter, becoming the third brightest object in the night sky during October.

What is the opposition?

- The opposition is the event when the sun, Earth, and an outer planet are lined up, with the Earth in the middle.
- The time of opposition is the point when the outer planet is typically at its closest distance to the Earth for a given year, and the planet appears brighter in the sky.
- An opposition can occur anywhere along Mars' orbit, but it happens when the planet is also closest to the sun, it is also particularly close to the Earth.
- Like all the planets in our solar system, Earth and Mars orbit the sun. But Earth is closer to the sun and therefore races along its orbit more quickly.
- According to NASA, from an individual's perspective on the Earth, Mars rises in the east and after staying up all night, it sets in the west just as the sun rises in the east and sets in the west.

Mars Oppositions

- Mars oppositions happen about every 26 months.
- Every 15 or 17 years, opposition occurs within a few weeks of Mars' perihelion (the point in its orbit when it is closest to the sun).
- In 2020, Mars opposition occured on October 13, 2020.

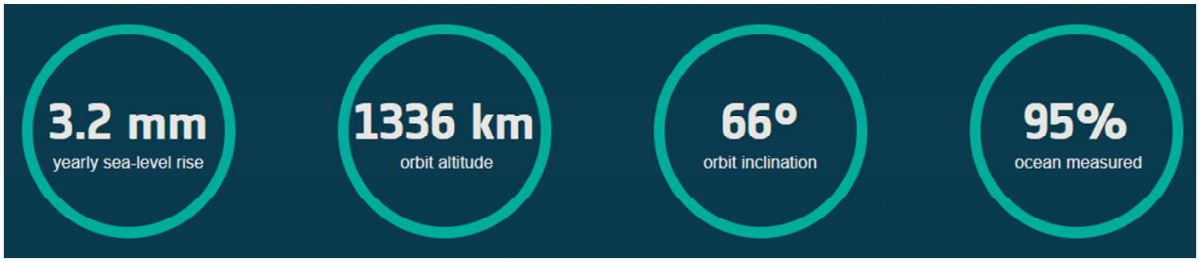
5 Copernicus Sentinel-6 Michael Freilich satellite

Context: The Copernicus Sentinel-6 Michael Freilich satellite, designed to monitor oceans, has been launched from the Vandenberg Air Force base in California aboard a SpaceX Falcon 9 rocket.

About:

- The major objectives of the Satellite:

- To ensure the continuity of sea-level observations
- To provide measurements of global sea-level rise.



Key-highlights

- This is a part of the next mission dedicated to measuring changes in the global sea level.
- The satellite carries a Poseidon-4 radar altimeter and a microwave radiometer.
- Other satellites that have been launched since 1992 to track changes in the oceans on a global scale include the TOPEX/Poseidon, Jason-1, and OSTN/Jason-2, among others.

Significance of the mission

- Data from satellites such as Sentinel-6 help scientists foresee the effects of the changing oceans on the climate.
- Further, in order to measure and track changes in the oceanic heat budget, scientists need to know the ocean currents and heat storage of the oceans, which can be determined from the height of the sea surface.

6 China Launches Chang'e-5 Moon Probe to Bring Back Lunar Rocks

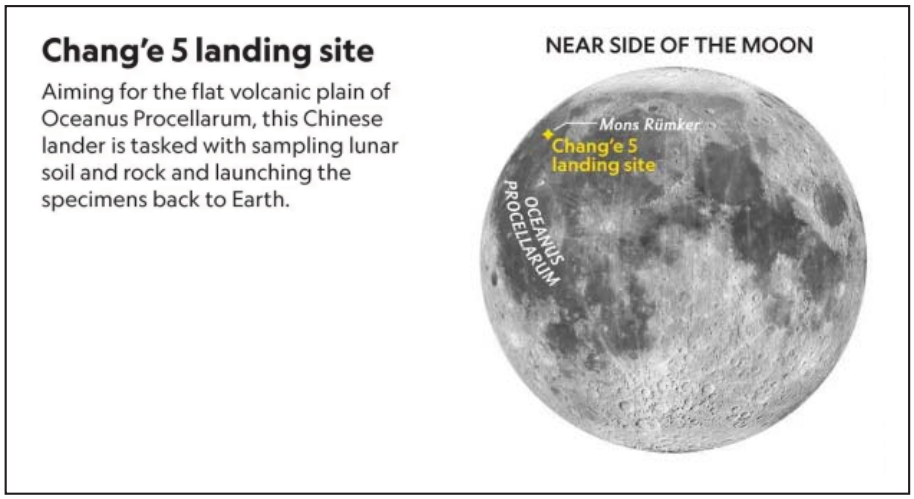
Context: China successfully launched its Chang'e-5 lunar mission to collect rocks from the moon - the first attempt by any country since the 1970s.

About:

- The Chang'e-5 probe will collect 2 kilograms (4.5 pounds) of samples in Oceanus Procellarum.
- Composition: The spacecraft is made up of an orbiter, a lander, an ascender, and a returner.
- Once in the moon's orbit, the probe will deploy a pair of vehicles to the surface to drill into the ground and collect soil and rock samples.
- If successful, the mission will make China only the third country to have retrieved lunar samples, following the United States and the Soviet Union decades ago.

Where will it land?

- The mission will land in the Mons Rumker area of the huge volcanic plain Oceanus Procellarum ("Ocean of Storms"), portions of which have been explored by several other surface missions, including NASA's Apollo 12 in 1969.
- It is a massive lava plain.
- This large dark spot, stretching about 2,900 kilometers (1,800 miles) wide, could be a scar from a giant cosmic impact that created an ancient sea of magma.



The previous attempts

- US astronauts brought back 382 kilograms (842 pounds) of rocks and soil during the Apollo program, between 1969 and 1972.
- The Soviet Union collected 170.1 grams (6 ounces) of samples in 1976.

7 United Arab Emirates celebrates its first mission at Mars

Context: The United Arab Emirates has put a probe called Hope in orbit around the planet, making it only the fifth spacefaring entity to do so after the US, the Soviet Union, Europe, and India.

What is HOPE?

- The unmanned probe — named "Al-Amal", Arabic for "Hope" — is a United Arab Emirates mission to Mars.
- Hope launched from the Tanegashima Space Center near Minamitane, Japan last year (July 2020).
- Hope is the Arab world's first mission to another planet.

Other recent Mars Missions

- **China's Tianwen-1** dual orbiter-rover and
- **Perseverance** from NASA,

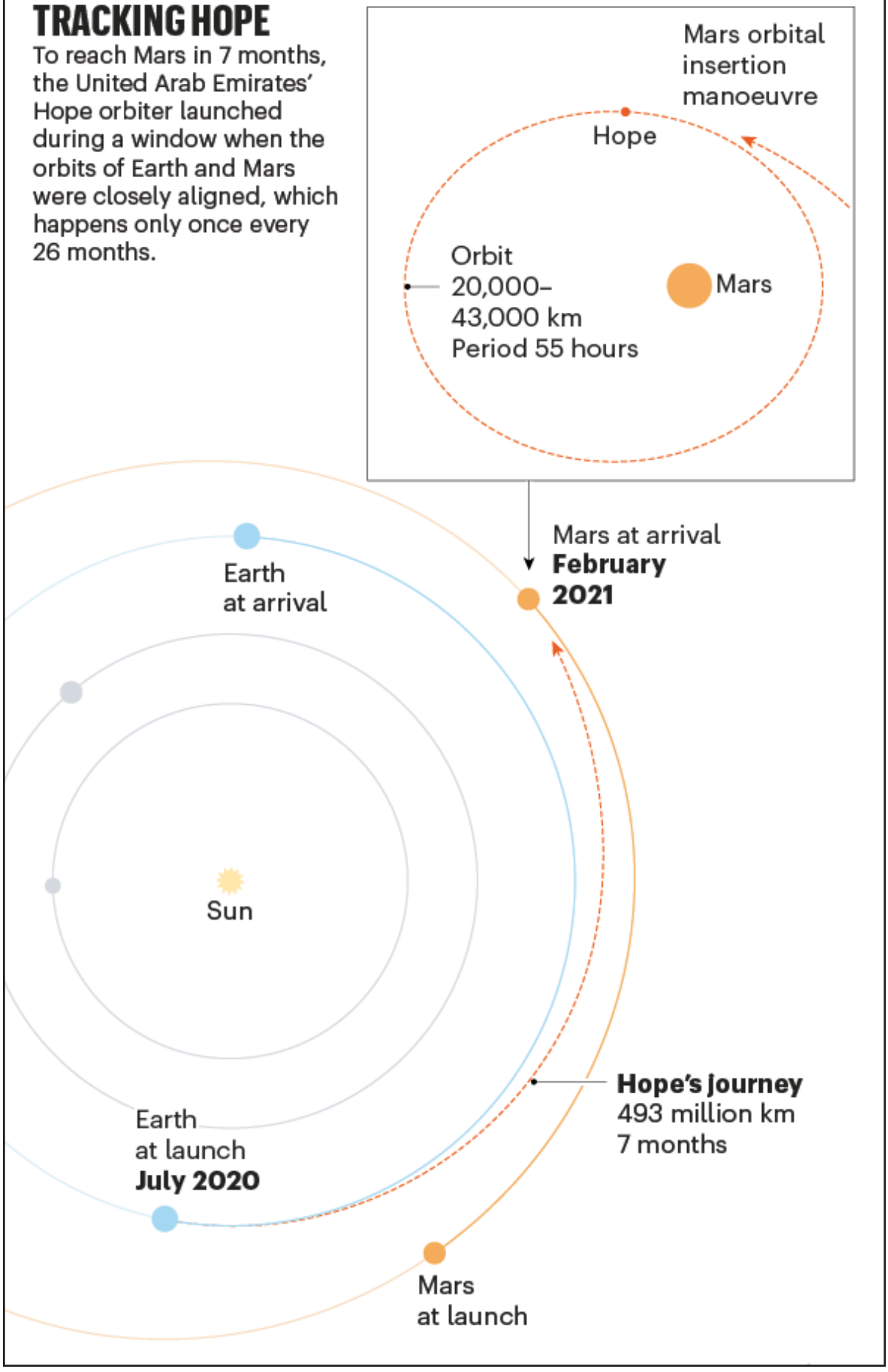
Mangalyaan

- India became the first Asian country to have successfully launched its Mars orbiter mission Mangalyaan which has entered the orbit of the red planet in 2014.
- India also became the first country to have entered the Martian orbit in its first attempt.

- India's MOM (Mars Orbiter Mission) successfully achieved orbit in 2014 to image the entire planet, providing a unique perspective on its weather and surface features.

TRACKING HOPE

To reach Mars in 7 months, the United Arab Emirates' Hope orbiter launched during a window when the orbits of Earth and Mars were closely aligned, which happens only once every 26 months.



8 IRNSS now part of World Wide Radio Navigation System

Context: The Indian Regional Navigation Satellite System (IRNSS) has been accepted as a component of the World Wide Radio Navigation System (WWRNS) for operation in the Indian Ocean Region by the International Maritime Organization (IMO).

What is IRNSS?

- IRNSS is an independent regional navigation satellite system developed by India.
- It is designed to provide accurate position information service to assist in the navigation of ships in Indian Ocean waters.
- It could replace the US-owned Global Positioning System (GPS) in the Indian Ocean extending up to approximately 1500 km from the Indian boundary.
- IRNSS will provide two types of services, namely, Standard Positioning Service (SPS) which is provided to all the users, and Restricted Service (RS), which is an encrypted service provided only to the authorized users

Some applications of IRNSS are:

- Terrestrial, Aerial, and Marine Navigation
- Disaster Management
- Vehicle tracking and fleet management
- Integration with mobile phones
- Precise Timing
- Mapping and Geodetic data capture
- Terrestrial navigation aid for hikers and travelers
- Visual and voice navigation for drivers

Which other countries have their navigation systems?

- After the US, Russia, and China have their navigation systems, India has become the fourth country to have its independent regional navigation system.

9 Ariel Space Mission

Context: The European Space Agency (ESA) has formally adopted Ariel, the explorer that will study the nature, formation, and evolution of exoplanets.

What is the Ariel Space Mission?

- Ariel(Atmospheric Remote-sensing Infrared Exoplanet Large-survey) is the first mission of its kind dedicated to measuring the chemical composition and thermal structures of hundreds of exoplanets.
- These exoplanets will range from gas giants to rocky planets, which will help them to compile a list of their compositions and properties thereby providing insights into how planetary systems form and evolve.
- The mission is expected to be launched in 2029.

What are Exoplanets?

- Planets that lie outside of the Solar System and orbit around stars other than the Sun are called exoplanets or extrasolar planets.
- Exoplanets are not easy to detect since they are much less bright than the stars they orbit and hence it is difficult to see them directly using telescopes.

How to track exoplanets?

- One of these methods involves tracking the dimming of a star that happens when a planet passes in front of it. NASA's Kepler Space telescope uses this method to spot thousands of planets.
- Other methods to track exoplanets include gravitational lensing and the "wobbling method", which is based on the idea that an orbiting planet will cause its parent star to orbit slightly off-center.

10 Fast radio bursts detected in the Milky Way for the first time

Context: Intense pulses of radio waves known as fast radio bursts (FRB) that have been frequently detected in other galaxies have now been found in the Milky Way.

About Fast radio bursts (FRB)

- FRBs were first discovered in 2007.
- The latest studies have now confirmed that FRBs are generated by a rare type of neutron star known as a 'magnetar'.
  - Magnetars are the most powerful magnets in the cosmos.
  - Their magnetic fields are 5,000 trillion times more powerful than that of the Earth.

Source of FRB

- The source of the FRB was traced to a magnetar known as SGR 1935+2154, located about 30,000 light-years from the earth.
  - It lies in the center of the Milky Way, in the constellation Vulpecula.
- The FRB generated by this magnetar was so powerful that it emitted as much energy in one millisecond as the sun does in 30 seconds, according to scientists.
- The scientists also concluded that most FRBs in other galaxies also were generated by magnetars.

Significance of the Study

- Until now, astronomers have been struggling to explain why some FRBs aren't one-off events like supernova explosions but seem to repeat themselves instead. Magnetars could provide the answer, since they spin slowly and flare periodically, like a lighthouse beacon.

11 EOS-01, India's latest earth observation satellite

Context: India launched EOS-01 along with nine satellites from foreign countries, by a PSLV rocket.

What is EOS-01?

- EOS-01 is another Radar Imaging Satellite (RISAT) that will work together with RISAT-2B and RISAT-2BR1.

- EOS-01 was initially named RISAT-2BR2, and was supposed to be the third of the three-spacecraft constellation aimed at providing all-weather round-the-clock service for high-resolution images.
- With EOS-01, ISRO is moving to a new naming system for its earth observation satellites which till now have been named thematically, according to the purpose they are meant for.
  - For example, the Cartosat series of satellites were meant to provide data for land topography and mapping, while the Oceansat satellites were meant for observations over the sea.
  - Some INSAT-series, Resourcesat series, GISAT, Scatsat, and some more are all earth observation satellites, named differently for the specific jobs they are assigned to do, or the different instruments that they use to do their jobs.

Radar imaging

- EOS-01 uses synthetic aperture radars to produce high-resolution images of the land.
  - The edge radar imaging has over optical instruments is that it is unaffected by weather, cloud or fog, or the lack of sunlight.
  - It can produce high-quality images in all conditions and at all times.
- Depending on the wavelength of the electromagnetic radiation used by the radar, different properties on land can be captured in the image.
- EOS-01, and its sister RISATs, use X-band radars that operate at low wavelengths and are considered best for monitoring of urban landscape, and imaging of agricultural or forest land.
- EOS-01 is intended for applications in agriculture, forestry, and disaster management support.
- The radar images are also considered to be immensely useful for military requirements.

What is an Earth Observation Satellite?

- An Earth observation satellite is a satellite used or designed for Earth observation (EO) from orbit, including spy satellites and similar ones intended for non-military uses such as environmental monitoring, meteorology, cartography, and others.

12 Indian astronomers collaborated with Nobel laureate on Thirty Meter Telescope project

Context: Indian astronomers had worked closely with Nobel Laureate Andrea Ghez on the design of back-end instruments and possible science prospects of the Thirty Meter Telescope (TMT) project being installed at Mauna Kea in Hawaii.

What is TMT?

- The saga of the TMT began in 2003 when a nonprofit partnership formed between universities in California and counterparts in Japan, China, India, and Canada.
- The Thirty Meter Telescope is a new class of extremely large telescopes that will allow to see deeper into space and observe cosmic objects with unprecedented sensitivity.
- With its 30 m prime mirror diameter, TMT will be three times as wide, with nine times more area, than the largest currently existing visible-light telescope in the world.
- This will provide unparalleled resolution with TMT images more than 12 times sharper than those from the Hubble Space Telescope.
- It will observe wavelengths ranging from the ultraviolet to the mid-infrared

Who is building TMT?

- The Thirty Meter Telescope is being designed and developed by the TMT International Observatory LLC (TIO).
- The TIO is a non-profit international partnership between:
  - the California Institute of Technology
  - the University of California
  - the National Institutes of Natural Sciences of Japan
  - the National Astronomical Observatories of the Chinese Academy of Sciences
  - the Department of Science and Technology of India
  - the National Research Council (Canada)

13 Moon May Be Rusting Along Poles, Suggest Chandrayaan-1 Images

Context: Recent images sent by Chandrayaan-1, India's first lunar mission, suggest that the Moon may be rusting along the poles.

Chandrayaan-1

- Chandrayaan-1 was the first Indian lunar probe under the Chandrayaan program. It was launched by the Indian Space Research Organisation in October 2008.
- Chandrayaan-1 orbiter, which discovered water ice and mapped out a variety of minerals while surveying the Moon's surface in 2008.
- Among its suite of instruments, it carried NASA's Moon Mineralogy Mapper (M3), an imaging spectrometer that helped confirm the discovery of water locked in minerals on the Moon.

More about the discovery

- The new research suggests that the moon is turning slightly red, indicating the formation of a reddish-black mineral form of iron named hematite on its surface, particularly at the poles.
- The formation of rust or iron oxide can be attributed to the presence of two key elements—water and oxygen—when they come in contact with iron.
- The lunar surface is littered with iron-rich rocks, which may facilitate this chemical reaction when combined with the other two elements.

The rusting chemistry

- Rust is the common name for iron oxide. The most familiar form of rust is the reddish coating that forms flakes on iron and steel (Fe2O3), but rust also comes in other colors including yellow, brown, orange, and even green
- For iron to become iron oxide, three things are required:
  - Iron
  - Water
  - Oxygen

- Rust forms when iron or its alloys are exposed to moist air. The oxygen and water in the air react with the metal to form the hydrated oxide.

14 Stardust 1.0

Context: Stardust 1.0, a rocket powered by bio-derived fuel took off from former military base in Maine. It flew one mile into the sky before parachuting back to Earth

What is Stardust 1.0?

- Stardust 1.0 is a first biofuel-powered launch vehicle suited for student and budget payloads.
- The rocket is 20 feet tall and has a mass of roughly 250 kg.
- **Payloads:** The rocket can carry a maximum payload mass of 8 kg and during its first launch carried three payloads. The payloads included:
  - a CubeSat prototype
  - a metal alloy designed to lessen vibrations called nitinol
  - a CubeSat from software company Rocket Insights
- **Manufactured by:** The rocket is manufactured by bluShift, an aerospace company based in Maine that is developing rockets that are powered by bio-derived fuels.

Significance of the biofuel-powered rocket

- **Cheaper and environment-friendly:** These rockets will help to launch small satellites called **CubeSats** into space in a way that is relatively cheaper than using traditional rocket fuel and is less toxic for the environment.

15 NASA approved EUVST and EZIE missions

Context: NASA has approved two heliophysics missions to explore the Sun and the system that drives space weather near Earth.

About:

- **The Extreme Ultraviolet High-Throughput Spectroscopic Telescope Epsilon**
  - **Led by:** The EUVST Mission is led by the Japan Aerospace Exploration Agency (JAXA), in partnership with other international organizations.
  - **Launching:** The EUVST is targeting a launch date in 2026.
  - It is a solar telescope that will study how the sun's atmosphere releases solar wind and drives eruptions of solar material.
  - NASA's hardware contributions to the mission include an intensified UV detector and support electronics, spectrograph components, a guide telescope, software, and a slip-jaw imaging system to provide Context: for the spectrographic measurement.
- **The Electrojet Zeeman Imaging Explorer**
  - **Launched by:** NASA in June 2024.
  - The EZIE mission is made up of three Cubesats which will study electric currents in Earth's atmosphere linking aurora to the Earth's magnetosphere.

Magnetosphere

- The magnetosphere is the region of space surrounding Earth where the dominant magnetic field is the magnetic field of Earth, rather than the magnetic field of interplanetary space.
- The magnetosphere is formed by the interaction of the solar wind with Earth's magnetic field.

16 GW190412: 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 is the first time researchers have been able to confidently measure the spin of a black hole about to merge.

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 the 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.

17 First-ever digital geological map of the 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.
- 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.

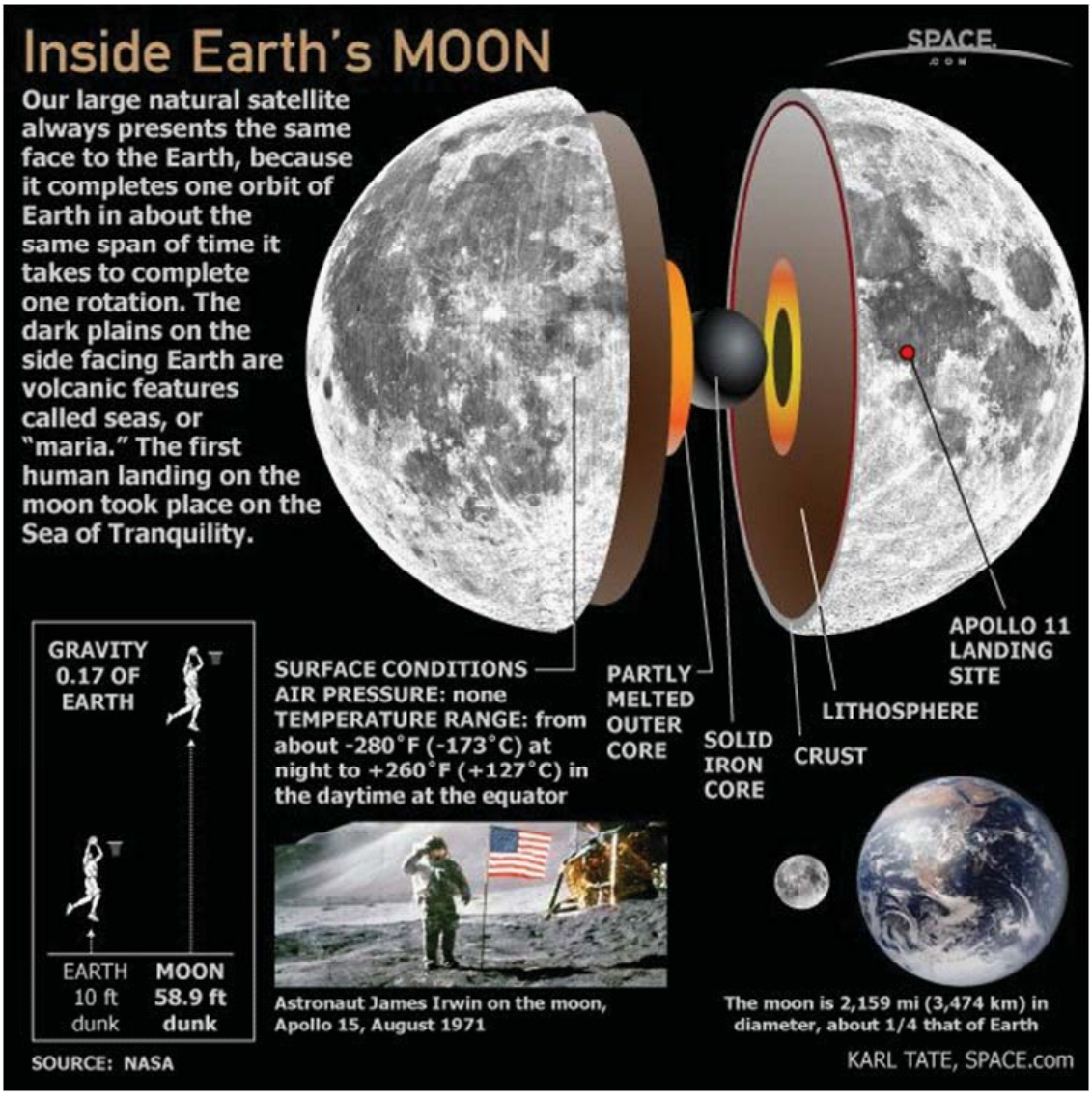
- Data from recent satellite missions to the moon and resources data from NASA's Apollo Missions were used to come up with the map.
- This version of the map is a digital release only. The map can be downloaded from the Unified Geologic Map of the Moon website.

The mapping process:

- 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 the possibility of the presence of water in these permanently shadowed areas.
- Further, the South Pole region also contains the fossil record of the early Solar System.

18 Artificial Neural Networks based global Ionospheric Model

Context: Researchers from the Indian Institute of Geomagnetism (IIG), Navi Mumbai, under the Department of Science & Technology, have developed a global model to predict the ionospheric electron density with larger data coverage.

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 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 a high-performance computer at IIG to develop the ANNIM.

What is the ionosphere?

- A dense layer of molecules and electrically charged particles, called the ionosphere, at about 35 miles (60 kilometers) above the planet's surface and stretching out beyond 620 miles (1,000 km).
- The 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.

19 Discovery of Li-rich giant stars

Context: Researchers at the Indian Institute of Astrophysics (IIA) have discovered hundreds of Li-rich giant stars indicating that Li is being produced in the stars and accounts for its abundance in the interstellar medium.

About:

- Lithium (Li), is one of the three primordial elements, apart from Hydrogen and Helium (He), produced in the Big Bang Nucleosynthesis (BBN) whose models predict primordial Li abundance.

Big Bang Nucleosynthesis:

- The theory predicts rather successfully the primordial abundances of light elements.
- It gives a detailed mathematical description of the production of the light "elements" like deuterium, helium-3, helium-4, and lithium-7.
- Specifically, the theory yields precise quantitative predictions for the mixture of these elements, that is, the primordial abundances at the end of the big-bang.
- It predicts that roughly 25% of the mass of the Universe consists of Helium. It also predicts about 0.01% deuterium and even smaller quantities of lithium.

- Natural lithium is a mixture of two stable isotopes, lithium-6 and lithium-7. Lithium-7 accounts for over 92% of the natural abundance of the element.
- Lithium is an alkali metal. It's silver-white in pure form and is so soft it can be cut with a butter knife. It has one of the lowest melting points and a high boiling point for a metal.

Significance of the finding:

- This is an important discovery that will help to eliminate many proposed theories such as planet engulfment or nucleosynthesis during the red giant evolution in which helium at the center is not burning.
- Moreover, the identification of sources of Li enrichment in our Galaxy has been of great interest to researchers to validate Big Bang Nucleosynthesis as well as a stellar mixing process.

20 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 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.

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.

21 Space Security

Context: Britain recently moved a UN Resolution to prevent arms race in outer space

What are the current space regulations?

- Several legally binding international instruments (treaties) governing the use of outer space for peaceful purposes have been adopted within the framework of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), with the 1967 Outer Space Treaty (OST) at its core.

´ UNCOPUOS (1958):

- The UNCOPUOS was established in 1958 as an ad hoc committee of the UN (later made permanent in 1959) with the UN Office for Outer Space Affairs (UNOOSA) as its secretariat.
- UNCOPUOS oversees the implementation of five UN treaties related to outer space activities, namely,

- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967 (Outer Space Treaty)
- Agreement on the Rescue of Astronauts
- the Return of Astronauts and the Return of Objects Launched into Outer Space of 1968 (Rescue Agreement),
- Convention on International Liability for Damage Caused by Space Objects of 1972 (Liability Convention),
- Convention on Registration of Objects Launched into Outer Space of 1976 (Registration Convention)
- the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 (Moon Treaty)

- It also oversees other related international agreements like the
  - Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water (NTB) of 1963
  - the Brussels Convention Relating to the Distribution of Programme–Carrying Signals Transmitted by Satellite (BRS) of 1979

Outer Space Treaty

- The Treaty declares outer space "the province of mankind".
- It bars states party to the treaty from placing weapons of mass destruction in Earth orbit, installing them on the Moon or any other celestial body, or otherwise stationing them in outer space
- It specifically limits the use of the Moon and other celestial bodies for peaceful purposes, and expressly prohibits their use for testing weapons of any kind, conducting military maneuvers, or establishing military bases, installations, and fortifications.
- Treaty does not prohibit the placement of conventional weapons in orbit, and thus some highly destructive attack tactics, such as kinetic bombardment, are still potentially allowed.
- The exploration of outer space shall be done to benefit all countries and that space shall be free for exploration and use by all the states.

22 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), 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 utilize 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.

23 Detection of fluorine in hot Extreme Helium Stars

Context: A recent study by the Indian Institute of Astrophysics (IIA) detected the presence of singly ionized 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.

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.

Fluorine

- Fluorine is a 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.

24 Sun reportedly entering '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 Solar Minimu

- 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 flares 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 flares. This gradually changes as the Sun ramps up to solar maximum.
- The magnetic field grows stronger, and sunspot and flare 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.
- It also led to the so-called Year Without a Summer in 1816

Impacts:

- **Affecting Earth's upper atmosphere:** Excess cosmic rays pose a health hazard to astronauts and polar air travelers, 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 a 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.

25 Solar Cycle 25 Is Here: NASA & NOAA

Context: NASA and the National Oceanic and Atmospheric Administration (NOAA) discussed their analysis and predictions about the new solar cycle – and how the coming upswing in space weather will impact our lives and technology on Earth, as well as astronauts in space.

About:

- The new solar cycle, called Solar Cycle 25 is believed to have begun.
  - **Solar Cycle 25** officially began in December 2019, when solar minimum occurred, marking the end of Solar Cycle 24. Because the sun is so variable, it can take months to calculate when the new cycle starts.
  - **Solar Cycle 24** had the fourth-smallest intensity since regular record-keeping began with Solar Cycle 1 in 1755. It was also the weakest cycle in 100 years. Scientists forecast that Solar Cycle 25 will be a fairly weak one, similar to Solar Cycle 24.
- The Sun is a huge ball of electrically-charged hot gas. This charged gas moves, generating a powerful magnetic field.
- The Sun's magnetic field goes through a cycle, called the solar cycle.
- Every 11 years or so, the Sun's magnetic field completely flips. This means that the Sun's north and south poles switch places.
- Then it takes about another 11 years for the Sun's north and south poles to flip back again.
- As the magnetic fields change, so does the amount of activity on the Sun's surface.

Tracking solar activity

- Scientists track a solar cycle by using sunspots, which are the dark blotches on the Sun that are associated with solar activity.
- Sunspots are associated with the origins of giant explosions such as solar flares that can spew light, energy, and solar material into space.

What is Sunspot?

- A Sunspot is an area on the Sun that appears dark on the surface and is relatively cooler than the surrounding parts.
- These spots, some as large as 50,000 km in diameter, are the visible markers of the Sun's magnetic field, which forms a blanket that protects the solar system from harmful cosmic radiation.
- When a Sunspot reaches up to 50,000 km in diameter, it may release a huge amount of energy that can lead to solar flares.

26 Algorithm for Aditya L1 Mission

Context: A group of researchers under the lead of Aryabhatta Research Institute of Observational Sciences (ARIES), has developed a novel algorithm for tracking the very fast accelerating **Coronal Mass Ejections (CMEs)** which emerge from the interiors of the Sun.

What is the novel algorithm CIISCO?

- The newly developed algorithm is named **CME Identification in Inner Solar Corona (CIISCO).**
- It was jointly developed along with scientists from the Royal Observatory of Belgium.

- **Significance**: It would help as a foundation in planning research of the lesser-known lower corona region of the Sun using **Aditya L1.**
- It can track bubbles of gaseous matter associated with magnetic field lines ejected from the Sun's inside.

Coronal Mass Ejection (CME)

- It is a significant release of plasma and accompanying magnetic field from the **solar corona**.
- These ejections follow **solar** flares and are normally present during a **solar** prominence eruption.
- The plasma is released into the **solar** wind.

- **Need:** Due to limited technology of satellite and ground-based observatories in acquiring observations of CMEs from within the Sun's interiors was difficult.
- Space environment, Weather, and climate around Earth are governed by the Sun.

Aditya - L1 India's first mission to study the Sun

- The Aditya-1 mission is a 400-kg class satellite carrying one payload, the Visible Emission Line Coronagraph (VELC).
- It was planned to launch in 800 km low earth orbit and now will be inserted in a halo orbit around the L1, which is around 1.5 million km from the Earth
  - A Satellite that is placed in the halo orbit around the **Lagrangian point 1 (L1)** of the Sun-Earth system will have the major advantage of continuously viewing the Sun without any occultation/ eclipses.
- Aditya-1 was meant to observe only the solar corona.
- The outer layer of the Sun which extends to thousands of km above the disc (photosphere) is termed the corona (6000K).

27 New Zealand signs the Artemis accords

Context: As India is heading towards lunar missions, it becomes necessary to think over its cooperation at international level and to go for **Artemis Accord.**

What is Artemis Accord?

- The Artemis Accords are a mechanism by which countries can participate in NASA's Artemis Programme.
- The programme envisages landing the first woman and the next man on the Moon in 2024, which require international cooperation.
- NASA likely sees this as a natural next step after the collaboration at the **International Space Station.**
- The Artemis Accords will describe a shared vision for principles, grounded in the Outer Space Treaty of 1967, to create a safe and transparent environment which facilitates exploration, science, and commercial activities for all of humanity to enjoy.

India's stand

- India's lunar programme has had limited success.
- It has two missions in orbit.
  - The US has collaborated with India on **Chandrayaan 1**, the first lunar mission.
  - India is also collaborating with Japan on a future lunar mission, called **LUPEX**, to the Moon's surface. Japan is also a signatory to the **Artemis Accords.**
  - The US, France, Germany and Italy in Europe, and Japan have also offered help to India with human spaceflight training.
  - India also depends on Ukraine for **semi-cryogenic engines** and Ukraine is a signatory to the accords.
- These various dependencies in advanced space technologies make up an important background to understand the context in which India is operating. They may play a role in India's decision on whether to join the Artemis Accords.
- The Artemis Accords provides a similar opportunity to learn about interplanetary missions and human spaceflight. India must take advantage of this opportunity.

28 Green Propulsion for India's Human Space Mission 'Gaganyaan'

Context: India's human space mission **Gaganyaan is likely to use a green propellant** to avoid all toxic and hazardous materials as a propellant.

What is Green Propulsion?

- **Green Propulsion** is **a green alternative for the conventional chemical propulsion** systems for future spacecraft.
- This is called a "green" fuel because when **combusted it transforms into nontoxic gasses.**
- **Example: Hydroxylammonium nitrate (NH3OHNO3)** fuel/oxidizer blend which is also known as AF-M315E is one example of green propellant.

Significance

- **Efficient:** The green propulsion system seeks to improve **overall propellant efficiency.**
- It delivers **a higher specific thrust** delivered to per given quantity of fuel.
- It strives to **optimize the performance** of the hardware, systems, and power solutions.
- This is **easier and safer** for storage and handling.
- **Less toxic:** It will reduce the handling concerns which are associated with the toxic fuel hydrazine.
- **Lower cost**: It requires a potentially shorter launch processing period and results in lowering costs.

Gaganyaan

- This is an **Indian crewed orbital spacecraft** for the formative spacecraft of the Indian Human Spaceflight Programme under ISRO.
  - The spacecraft is designed to carry three people.

- The mission will have two unmanned flights and one human spaceflight.
- It will **encircle Earth in a low-earth-orbit with an altitude of 300-400 km from earth**.
- **GSLV Mk III** (**LVM-3 (Launch Vehicle Mark-3))** the three-stage heavy-lift launch vehicle, will be used for the launch of Gaganyaan.

29 NASA's InSight lander

Context: NASA's InSight lander has recorded over 500 quakes to date on Mars since its touchdown.

What is InSight lander?

- NASA's InSight lander opens a window into the "inner space" of Mars.
- Its instruments peer deeper than ever into the Martian subsurface, seeking the signatures of the processes that shaped the rocky planets of the inner Solar System, more than four billion years ago.
- InSight's findings are expected to shed light on the formation of Mars, Earth, and even rocky exoplanets.
- The lander builds on the proven design of NASA's Mars Phoenix lander.
- NASA's InSight lander has detected two strong, clear quakes originating in a location of Mars called Cerberus Fossae the same place where two strong quakes were seen earlier in the mission.
- The planet doesn't have tectonic plates like Earth, but it does have volcanically active regions that can cause rumbles.
- These findings support the idea that the planet is seismically active.

InSight Mission

- The Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission is a robotic Lander designed to study the deep interior of the planet Mars.
- It was manufactured by Lockheed Martin Space Systems, is managed by NASA's Jet Propulsion Laboratory, and most of its scientific instruments were built by European agencies.
- Insight's objectives are to place a seismometer, called SEIS, on the surface of Mars to measure seismic activity and provide accurate 3D models of the planet's interior; and measure internal heat flow using a heat probe called HP3 to study Mars' early geological evolution.
- InSight was initially known as GEMS (Geophysical Monitoring Station).

India's Mars Orbiter Mission

- It is also called Mangalyaan.
- It is India's first interplanetary mission and it made it the fourth space agency to achieve Mars orbit, after Roscosmos, NASA, and the European Space Agency.
- It made India the first Asian nation to reach Martian orbit and the first nation in the world to do so on its maiden attempt.
- The Mars Orbiter Mission probe lifted-off from the First Launch Pad at SatishDhawan Space Centre.
- It used a Polar Satellite Launch Vehicle (PSLV) rocket.

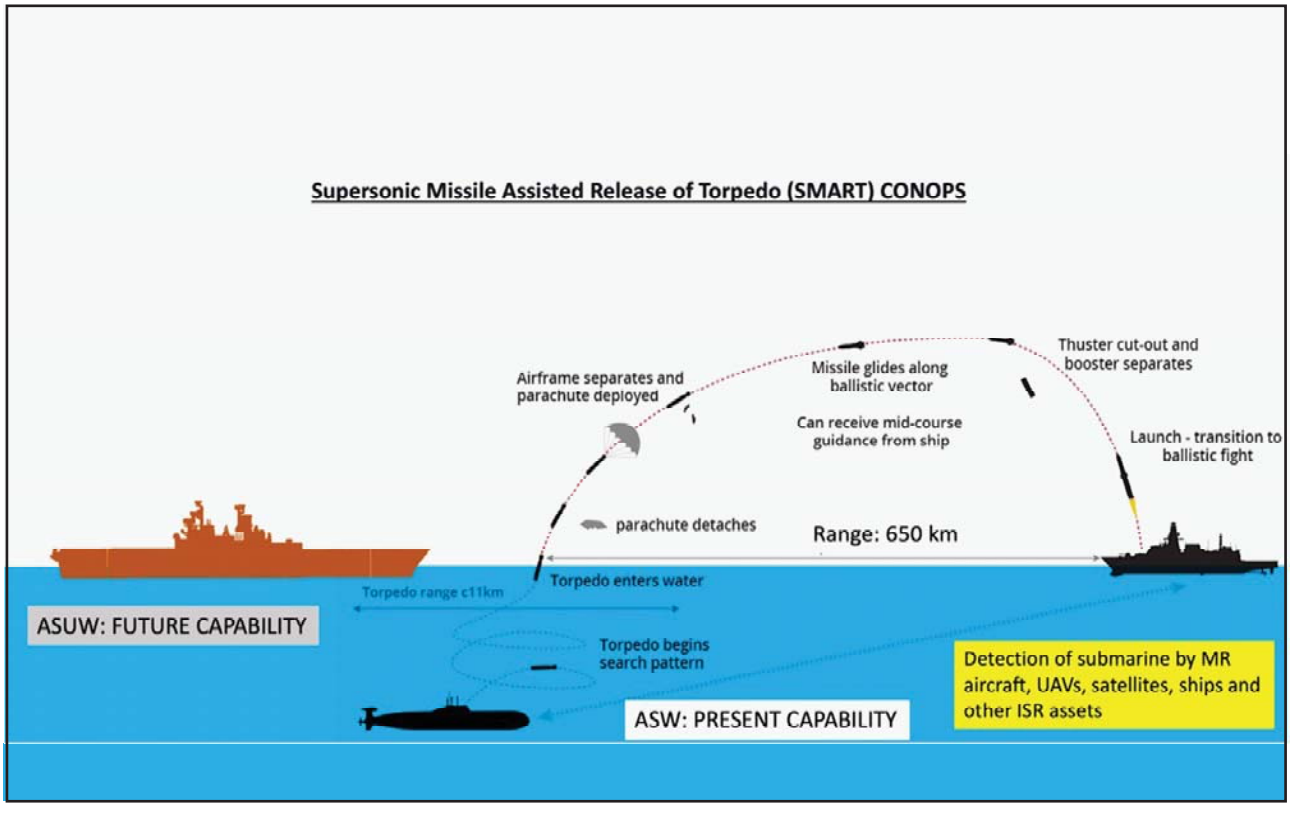
3 DEFENCE TECHNOLOGY

1 Supersonic Missile Assisted Release of Torpedo (SMART) system

Context: A successful flight test of the Supersonic Missile Assisted Release of Torpedo (SMART) system was conducted from Wheeler Island, off the coast of Odisha.

About:

- SMART is a missile-assisted release of lightweight anti-submarine torpedo system for anti-submarine warfare (ASW) operations far beyond torpedo range.
- SMART is a hybrid missile
- While the long-range torpedo available in the world is around 50 km and rocket-assisted torpedoes can strike at a range of 150 km, the SMART will have a range of over 600 km.



2 India test-fires new version of nuclear-capable Shaurya missile

Context:

- India successfully test-fired indigenously developed **hypersonic nuclear-capable Shaurya missile**

About:

- 'Shaurya', has a strike range of 700 km to 1000 km and is capable of carrying payloads of 200 kg to 1000 kg.
- The missile can be stored in a composite canister.
- The missile is less vulnerable to anti-ballistic missile defense systems due to its high maneuverability.
- This surface-to-surface tactical missile is 10 meters long, 74 cm in diameter, and weighs 6.2 tonnes.
- Its two stages use solid propellants.
- **Launching platform:** The missile can be launched from silos and canisters mounted on a truck and fixed on the ground, they said adding that it can be easily moved around. A truck itself can become a launching platform.
- Shaurya missile is considered as a land version of the Sagarika missile of the K Family.

The K Family of missiles

- The K family of missiles are primarily **Submarine Launched Ballistic Missiles (SLBMs)**
- The development of these naval platforms launched missiles helped to complete **India's nuclear triad** — the capability of launching nuclear weapons from land, sea, and air-based assets.
- Because these missiles are to be launched from submarines, they are lighter, smaller, and stealthier than their land-based counterparts.

3 S-400 Triumf Air Defense Systems

Context: The US has yet again warned India that it could face sanctions over acquiring five Russian S-400 Triumf air defense systems.

What is S-400?

- The S-400 is a mobile, surface-to-air missile defense system (SAM) designed by Russia.
- It integrates the 91N6E multi-function panoramic radar with a 600 km range, autonomous detection, and targeting systems and launchers.
- It can fire four missile types with strike ranges of between 400 km and 40 km to provide multi-layered defense against incoming fixed-wing and rotary aircraft, unmanned aerial vehicles (UAVs), and ballistic missiles at altitudes of up to 30 km.
- The S-400 is organized around the 30K6E administration system, with protection against jamming.

- It can simultaneously locate 72 targets and track another 160 alongside, compared with PAC-3s 36 and 125 respectively.

Which countries have sanctions imposed on them?

- So far, the US has imposed sanctions on Turkey and China for taking delivery of S-400 systems.
- US removed Turkey, a NATO ally, from the F-35 joint strike fighter (JSF) program.
- A White House statement declared that the F-35 cannot coexist with a Russian intelligence-collection platform, as that can be used to learn about its advanced capabilities.

India's other air defense system

- **Long Range interception:** Indian Ballistic Missile Defence Programme
  - It is a double-tiered system consisting of two land and sea-based interceptor missiles, namely the Prithvi Air Defence (PAD) missile for high altitude interception, and the Advanced Air Defence (AAD) Missile for lower altitude interception.
- **Intermediate Interception:** S-400 Triumph
- **Short Range interception:** Akash Air Defense System and Similar Systems
- **Very Short-range interception:** MANPADS and Anti- Aircraft Guns.

4 Successful test-firing of Hypersonic Technology Demonstrator Vehicle (HSTDV)

Context: DRDO successfully test-fired the Hypersonic Technology Demonstrator Vehicle (HSTDV), making India the fourth country in the world.

What is HSTDV?

- The HSTDV is an unmanned scramjet demonstration aircraft for hypersonic speed flight.
- Hypersonic flight means a speed greater than five times the speed of sound (Mach 5).
- Apart from being used as a vehicle for hypersonic and long-range cruise missiles, the HSTDV is a dual-use technology that will have multiple civilian applications, including the launch of small satellites at low cost.

What are Hypersonic nuclear missiles?

- Hypersonic missiles travel at speeds faster than 3,800 miles per hour or 6,115 km per hour, much faster than other ballistic and cruise missiles.
- They can deliver conventional or nuclear payloads within minutes.
- They are highly maneuverable and do not follow a predictable arc as they travel.
- They are said to combine the speed of ballistic missiles with the maneuvering capabilities of cruise missiles.
- The speed makes them hard to track compared to traditional missiles.

Different types of missiles

- **Cruise and ballistic missiles**
  - **Cruise missiles:** A cruise missile either locates its target or has a preset target.
    - It navigates using a guidance system — such as inertial or beyond visual range satellite GPS guidance — and comprises a payload and aircraft propulsion system.

- Cruise missiles can be launched from land, sea, or air for land attacks and anti-shipping purposes, and can travel at subsonic, supersonic, and hypersonic speeds.
- Since they stay relatively close to the surface of the earth, they cannot be detected easily by anti-missile systems, and are designed to carry large payloads with high precision.

➤ **Ballistic missiles:** Ballistic missiles, meanwhile, are launched directly into the upper layers of the earth's atmosphere.

- They travel outside the atmosphere, where the warhead detaches from the missile and falls towards a predetermined target.
- They are rocket-propelled self-guided weapons systems that can carry conventional or nuclear munitions.
- They can be launched from aircraft, ships and submarines, and land.

- **ICBMs**
  - ➤ Intercontinental ballistic missiles (ICBMs) are guided missiles that can deliver nuclear and other payloads.
  - ➤ ICBMs have a minimum range of 5,500 km, with maximum ranges varying from 7,000 to 16,000 km.
  - ➤ Only a handful of countries, including Russia, the United States, China, France, India, and North Korea, have ICBM capabilities.
- **Anti-satellite missiles**
  - ➤ ASAT can incapacitate or destroy satellites for strategic military purposes.
  - ➤ Other anti-satellite weapons include ground-based jammers to disrupt the signal from navigation and communications satellites.
  - ➤ The United States, Russia, and China are among countries pursuing anti-satellite weapons.

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 defense 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 defense 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 Hellfire 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 been equipped with anti-submarine Mark 54 torpedoes and Hellfire 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 and Hellfire Longbow air-to-ground missiles.
- Among the Apache's modern capabilities are the ability to shoot fire-and-forget anti-tank missiles, air-to-air missiles, rockets, and other munitions.
- It also has modern electronic warfare capabilities to provide versatility in network-centric aerial warfare.
- The choppers are all-weather capable and have high agility and survivability against battle damage.
- They can be easily maintained in field conditions as well as during operations in the tropical and desert regions.

6 5 Rafales Joins Indian Air Force

Context: The first batch of five **Rafale multirole fighter jets** are formally inducted into the Indian Air Force at **Ambala air base in Haryana**, at a time when India is engaged in an escalating border row with China in eastern Ladakh.

About:

- The Rafale jets, built by French aerospace major Dassault Aviation, are known for air-superiority and precision strikes on ground targets, making them truly multirole jets.
- **Speed:** The state-of-the-art **4.5 Generation Rafale jet** can reach almost double the speed of sound, with a top speed of 1.8 Mach.
- The Rafales (literally meaning "gust of wind", and "burst of fire" in a more military sense) are capable of carrying a range of potent weapons.
- European missile maker MBDA's Meteor beyond visual range (BVR) air-to-air missile and Scalp cruise missile will be the mainstay of the weapons package of the Rafale jets.
  - **MBDA developed** the Meteor to combat common threats facing the UK, Germany, Italy, France, Spain, and Sweden.

- The multirole French-made fighter jets will become a part of the IAF's 17 Squadron **"Golden Arrows".**
- **SCALP missile:** The Rafale jets also come with SCALP, the air-to-ground cruise missile with a range over 300 km. It is a long-range deep strike missile.
- The MICA air-to-air missile on Rafale is for both, close-quarter dogfights, and for BVR.
- **HAMMER:** At the last-minute, India has also asked for **HAMMER (Highly Agile and Manoeuvrable Munition Extended Range)**, which is an air-to-ground precision guided missile produced by French conglomerate Safran, and can be used against bunker-type hardened targets within the range of 70 km.
- India will only be the fourth country, after France, Egypt and Qatar, to fly the Rafale.

Rafale Specifications	
Maximum take-off weight	24.5 Tonnes
Height	5.30 m
Length	15.30 m
Fuel (internal)	4.7 Tonnes
Fuel (external)	Up to 6.7 Tonnes
Top Speed	1.8 Mach at High Altitude
Lending ground run	450 m (1,500 ft)

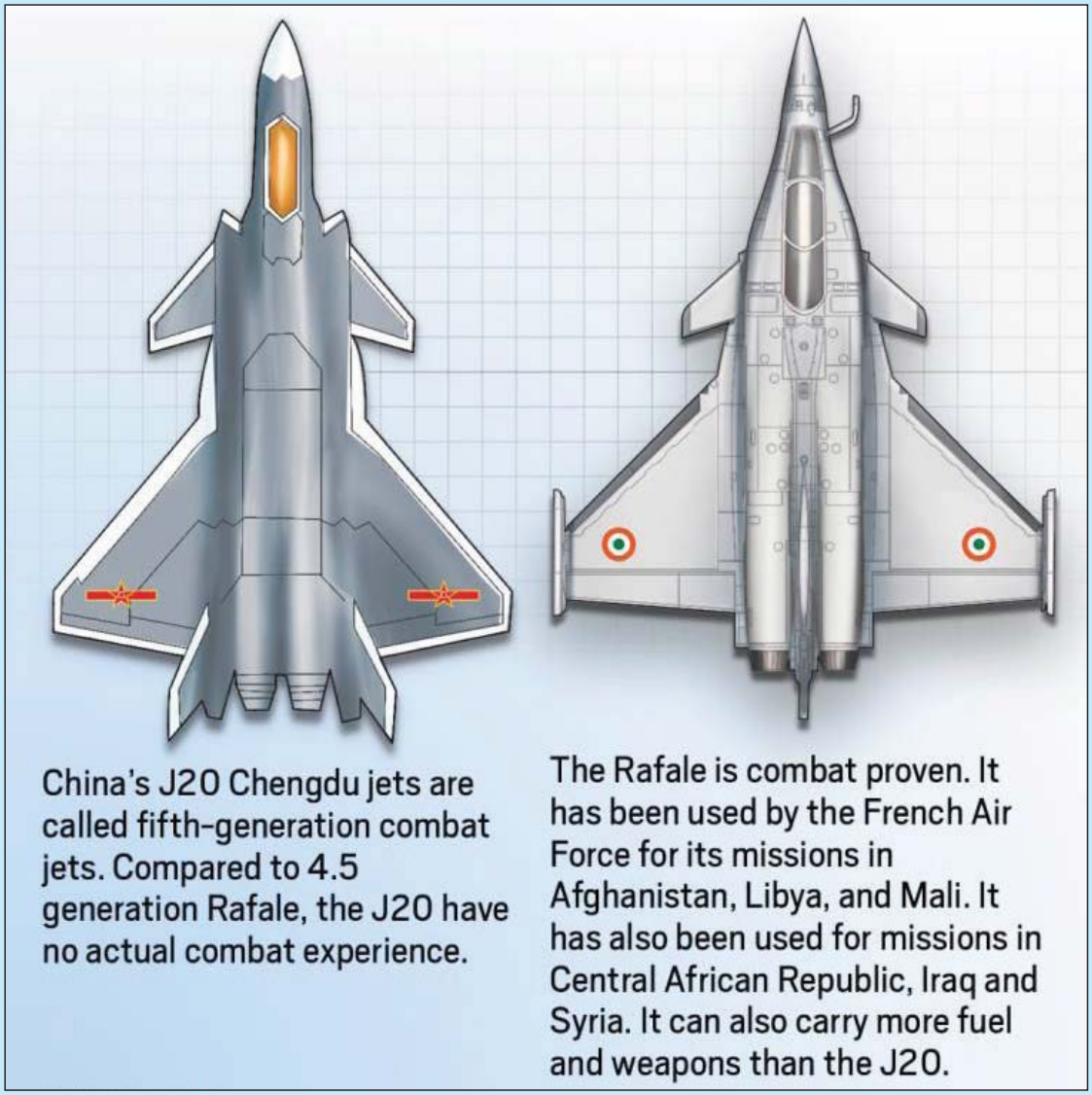
Sukhoi Su-30 MKI fighter jet

- The Sukhoi Su-30MKI is the most advanced fighter jet in operation with the Indian Air Force and is the primary air to air and air to ground strike machine.
- Su-30 MKI is built in India by HAL under license agreement with Russia's Sukhoi.
- The Sukhoi Su-30MKI has a top speed of Mach 2 (2120 kmph) and has a maximum takeoff weight of 38,800 kg.
- The jet can carry a wide range of equipment from radars to missiles, bombs and event rockets.
- **Weapon carrying capacity**: It is capable of carrying a variety of medium-range guided air to air missiles with active or semi-active radar or Infrared homing close range missiles.
- It can be used in carrying out nuclear strikes.
- The Su-30 MKI aircraft is capable of being refuelled by an Air to Air refuelling aircraft or by another Su-30 MKI aircraft carrying a buddy refuelling strap on pod.
- India's Su-30MKI multi-role fighter-bomber is one of the best 4 generation aircraft currently available.

RAFALE vs China's J20

- While China's J20 Chengdu jets are called fifth generation combat jets, compared to 4.5 generation Rafale, the J20 have no actual combat experience.
- Whereas the Rafale is combat proven, having been used by the French Air Force for its missions in Afghanistan, Libya and Mali.

- It has also been used for missions in Central African Republic, Iraq and Syria.
- Rafale can also carry more fuel and weapons than the J20.



7 Abhyas High-speed Expendable Aerial Target (HEAT)

Context: The Defence Research and Development Organisation (DRDO) conducted successful flight-tests of the indigenously-designed **Abhyas High-speed Expendable Aerial Target (HEAT)** in Balasore.

About:

- Abhyas High-speed Expendable Aerial Target (HEAT) is a autonomous flying machine that will be used as a target for various missile systems.
- Abhyas is capable of fully-autonomous flight and runs on a gas turbine engine.

- Its inertial navigation system is based on **micro-electromechanical systems (MEMS)** and it uses a flight control computer for guidance and control.
- MEMS is a process technology used to create tiny integrated devices or systems that combine mechanical and electrical components.
- Abhyas has RCS, Visual and IR augmentation systems required for weapon practice.
- The air vehicle is launched using twin underslung boosters.
- It is powered by a small gas turbine engine and has an **Inertial Navigation System (INS)** along with a **Flight Control Computer (FCC)** for guidance and control.
- The vehicle has been programmed for fully autonomous flight. The check out of the vehicle is done using laptop- based Ground Control Station (GCS).
- It is designed and developed by the Aeronautical Development Establishment (ADE) of DRDO.

What are drones (UAV)?

- Unmanned aerial vehicle technology covers everything from the aerodynamics of the drone, materials in the manufacture of the physical UAV, to the circuit boards, chipset and software, which are the brains of the drone.
- UAV drones are equipped with different state of the art technology such as infrared cameras, GPS and laser (consumer, commercial and military UAV).
- Drones are controlled by remote ground control systems (GSC) and also referred to as a ground cockpit.

8 Agni P Ballistic Missile successfully tested

Context: Defence Research and Development Organisation (DRDO) successfully flight tested a New Generation Nuclear Capable Ballistic Missile 'Agni P' from Dr APJ Abdul Kalam island off the coast of Odisha.

What is Agni P Ballistic Missile?

- Agni P is a new generation advanced variant of Agni class of missiles.
- It is a canisterised missile.
- It is transported by a truck and launched via a canister.
- Its range capability lies between 1,000 and 2,000 kms.
- It is a strategic and conventional.
- It is thermobaric and uses oxygen from the surrounding air to generate a high-temperature explosion.
- With two stage solid fuel system, Agni P is a new generation nuclear capable ballistic missile.
- It is developed under the project Agni I Prime.

Agni-missiles

- Agni-missiles are designed & developed by DRDO and inducted into Services to act as deterrence & meet the country's security requirements.

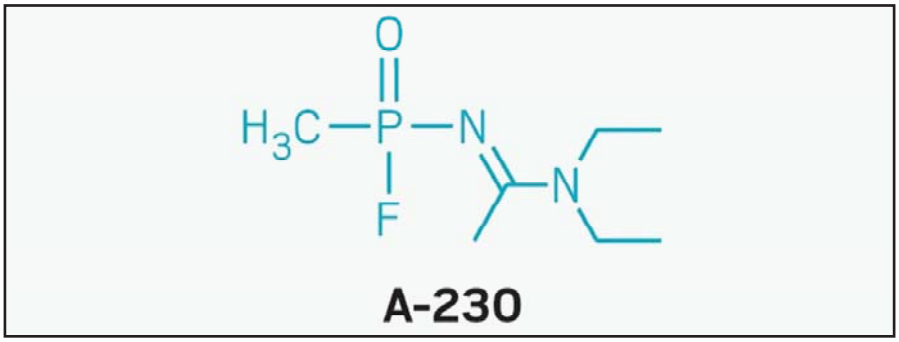
4 ALTERNATIVE TECHNOLOGIES

1 Novichok nerve agent

Context: The German government says Russia's opposition leader, Alexei Navalny, has been poisoned with a Novichok nerve agent.

What are Novichok agents

- The name Novichok (A-230) means "newcomer" in Russian and applies to a group of **advanced nerve agents** developed by the Soviet Union in the 1970s and 1980s.
- They were known as **fourth-generation chemical weapons** and were developed under a **Soviet program codenamed Foliant.**



A-230

How is it used?

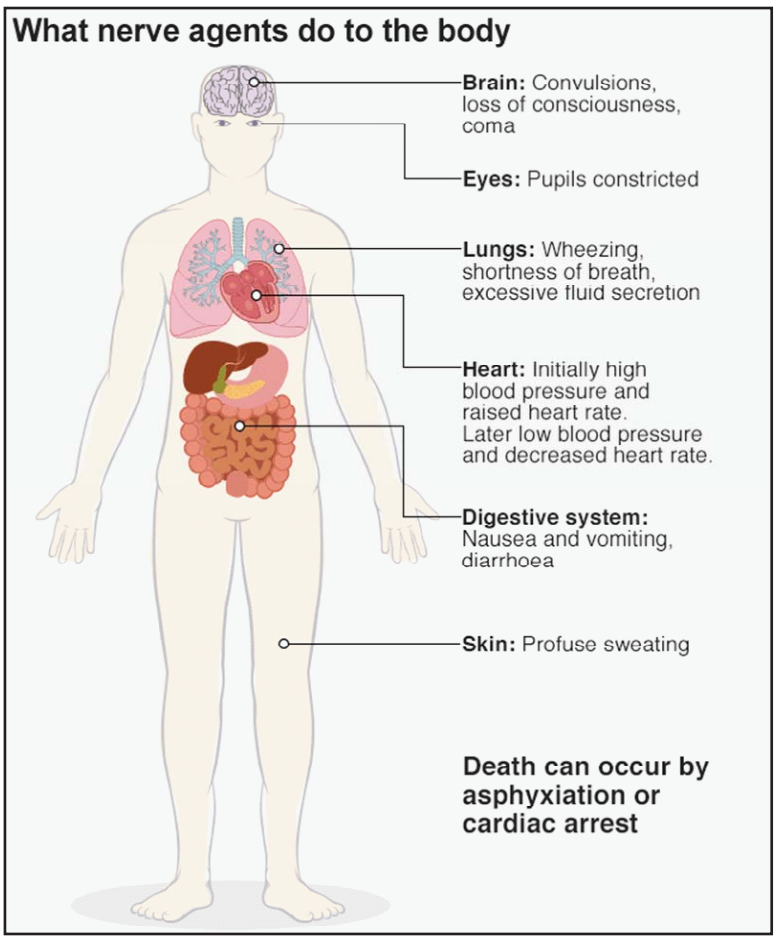
- Novichok agents are dispersed as ultra-fine powder rather than a gas or vapor.
- They can be inhaled, ingested, or absorbed through the skin.

Variants of Novichok

- Some variants of Novichok are thought to be five to eight times more toxic than the VX nerve agent.
- While some Novichok agents are liquids, others are thought to exist in solid form. This means they could be dispersed as an ultra-fine powder.
- Some of the agents are also reported to be "binary weapons", meaning the nerve agent is typically stored as two less toxic chemical ingredients that are easier to transport, handle and store.
- When these are mixed, they react to produce the active toxic agent.

Is there an antidote?

- All nerve agents have an antidote in atropine, but it needs to be administered as soon as possible.
- A common problem is that it can take time to diagnose that a nerve agent has been used.



Who controls the world's most toxic chemicals?

- The work of the **Organisation for the Prohibition of Chemical Weapons (OPCW)** is carried out as part of an international control regime that governs what is, or is not, permissible as far as very toxic chemicals are concerned.
- This was established by the 1997 Chemical Weapons Convention (CWC), to which 192 countries are signed up members.
- Only four countries are outside the CWC - **North Korea, Israel, Egypt, and South Sudan**. They are still bound by the treaty's provisions, under international law.
- Novichoks were added to the **Chemical Weapons Convention**'s list of **controlled substances.**

2 World's largest solar tree

Context: Scientists at the Central Mechanical Engineering Research Institute (CMERI) in West Bengal have installed a 'solar tree' that is likely to be the largest of its kind in the world.

What is the solar tree?

- A solar tree is a structure resembling a tree that has solar panels fitted on the branches.
- The solar panels connected through branches produce solar power.
- The working of a solar tree is much like that of a real one—leaf-like solar panels connected through metal branches using sunlight to make energy.
- The Solar tree panels charge batteries during the day. At dusk, the tree automatically switches on LED lights. It is programmed to regulate the amount of light it produces.
- Solar trees are flexible and **rotate to face the sun** and produce the maximum possible amount of energy using a technique called **"spiraling phyllataxy".**

Key-details of CMERI solar tree

- This is producing up to 11,500 watts (11.5kw).

- The CMERI solar tree has 35 panels each with a capacity of 330 watts.
- The solar tree has capabilities to adapt a group of Internet of Things (IoT)-based features, such as
  - round-the-clock CCTV surveillance in agricultural fields
  - real-time humidity, wind speed, rainfall prediction
  - soil analytics sensors

- The solar tree can also be connected to CSIR-CMERI's solar-powered e-suvidha kiosks for real-time access to the massive agricultural database, as well as to the eNAM (National Agricultural Marketplace) for instant and real-time access to a unified online market.

3 Transparent wood is coming

Context: As per a new study, researchers have found a way to make wood transparent without using huge amounts of energy in the process.

AboutL

- Wood is an ancient material used for the construction of housing, ships and as a source of fuel for burning.
- Wood is essentially composed of two basic ingredients **cellulose** and **lignin**:
  - Cellulose is tiny fibers and lignin is the bonds that keep these fibers together and resists compression.
  - Lignin is a glue-like material that bonds the fibers together, a little like the plastic resin in fiberglass or carbon fiber. The lignin also contains molecules called chromophores, which give the wood its brown color and prevent light from passing through.
- It's also a renewable source, and one way to capture excess carbon dioxide from the Earth's atmosphere.

Wood's lack of transparency

- Wood's lack of transparency comes from the combination of its two main components- cellulose and lignin.
- The lignin absorbs light, and the presence of chromophores – light-activated compounds – in the material makes the wood look brown.
- The fibers in the wood, which mainly comprise cellulose, are **hollow tube-like** structures.
- The air in these hollow tubes scatters light, further reducing the material's transparency.

The new method

- The new study demonstrates how to make wood transparent using a simple chemical – **hydrogen peroxide** – commonly used to bleach hair.
- This chemical modifies the **chromophores**, changing their structure so they no longer act to absorb light and color the wood.
- The chemical can be brushed onto the wood, and then activated using light to produce a brilliant **white material**
- The other reason paper is white is because pores or holes in its structure scatter light, just like the hollow cellulose fibers in wood.

- Filling these fibers with resin reduces that scattering, allowing light to pass through the wood and making it transparent while retaining its original mechanical properties.

Usage of transparent wood

- Transparent wood would be much more resistant to accidental breakage
- It could become an alternative to glass in energy-efficient buildings, or perhaps coverings for solar panels in harsh environments.

4 Desalination Plants

Context: In the latest development, Maharashtra announced the setting up of a desalination plant in Mumbai, becoming the fourth state in the country to experiment with the idea.

What is a desalination plant?

- A desalination plant turns salt water into water that is fit to drink.
- These plants are mostly set up in areas that have access to sea water.

Which technology is preferred?

- The most commonly used technology for the process is **reverse osmosis** where external pressure is applied to push solvents from an area of high-solute concentration to an area of low-solute concentration through a membrane.
- The **microscopic pores** in the membranes allow water molecules through but leave salt and most other impurities behind, releasing clean water from the other side.

How widely is this technology used in India?

- The following states are using the technology:
- **Tamil Nadu:** Tamil Nadu has been the pioneer in using this technology, setting up two desalination plants near Chennai in 2010 and then 2013.
- **Gujarat:** The other states that have proposed these plants are Gujarat, which has announced to set up a 100 MLD RO plant at the Jodiya coast in Jamnagar district.
  - There are also proposals to set up desalination plants in Dwarka, Kutch, Dahej, Somnath, Bhavnagar, and Pipavav, which are all coastal areas in Gujarat.
- **Andhra Pradesh:** Andhra Pradesh, too, has plans of setting up a plant.

5 Hydrogen Fuel Cell

Context: NTPC Ltd has invited Global Expression of Interest to provide 10 Hydrogen Fuel Cell-based electric buses and cars.

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 (H_2) and oxygen gas (O_2) 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 O_2 is readily available in the atmosphere, we only need to supply the fuel cell with H_2 which can come from an electrolysis process

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 Earth – it's always combined with other elements.
- Water, for example, is a combination of hydrogen and oxygen (H_2O).
- 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.

6 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.
- This initiative aims to provide a great platform for students of Atal Tinkering Labs (ATLs) across the country to create and modify 3D designs with a 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 the 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 to convey all the required information that will allow a manufacturer to produce that component.

7 L&T Construction 3D prints India's first building with reinforcement

Context: L&T Construction, the construction arm of the $21 billion technology, engineering & construction conglomerate, Larsen & Toubro, has 3D printed a G+1 (Ground plus one) building with reinforcement for the first time in India.

About:

- The 3D printed building has a built-up area of 700 sq. feet and is located at L&T Construction's Kanchipuram facility.
- It has been built with a special, in-house-developed concrete mix using indigenously available regular construction materials.
- The building was printed with both vertical reinforcement bars and horizontal distributors using welded mesh, that satisfy provisions in the Indian Codes and optimize the cost of construction.
- Barring the horizontal slab members, the entire building structure was 3D printed 'Cast in Situ' at the job site in an 'open to sky' environment within 106 printing hours, using a fully automated 3D printer.

8 Brain Fingerprinting Technology

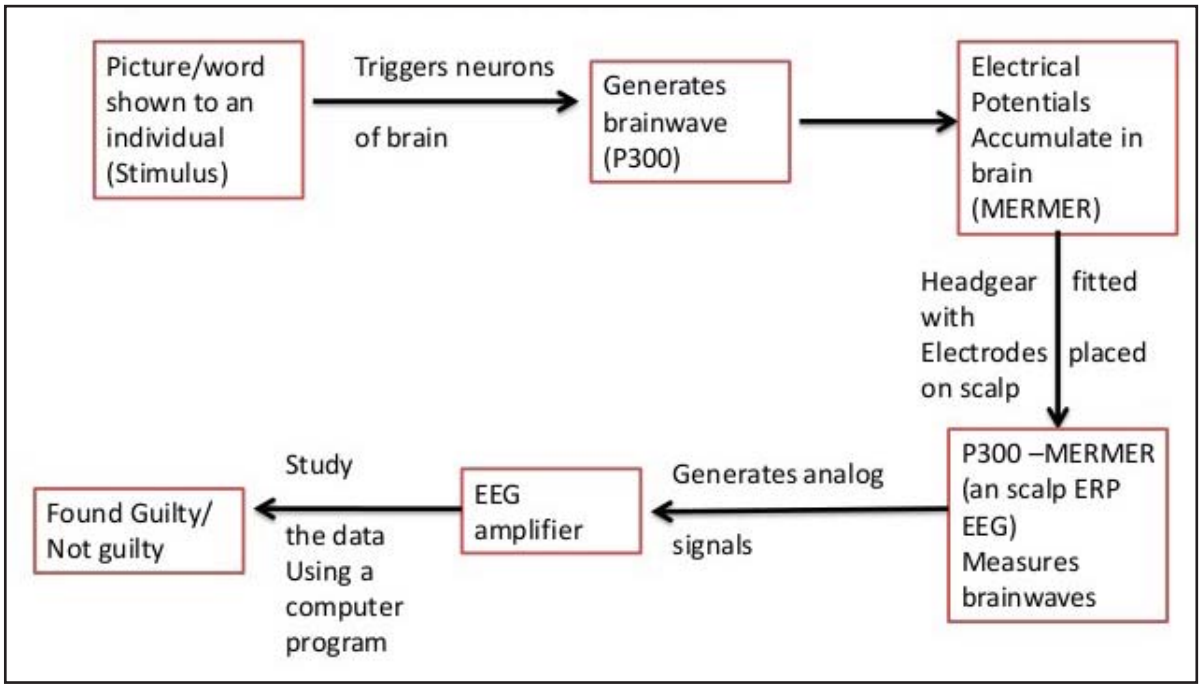
Context: The four accused in the Hathras case were said to undergo brain fingerprinting, the neuropsychological interrogation.

Background:

- The brain fingerprinting technique was first developed and patented in 1995 by Lawrence A. Farwell of the U.S.A. Police in India has used brain fingerprinting since 2003.

What is Brain Fingerprinting?

- In brain fingerprinting, a headset with two electrodes is put on the head of the suspect. One electrode is placed on the forehead between the eyebrows while the other is put on the back of the head where the brain stores experiential memory.
- The electrodes are connected to a laptop with brain fingerprinting software.
- Details and photographs of the crime scene which are not in the public domain are projected on the screen in front of the suspect.
- If the suspect is involved in the crime the moment he sees the details, his brain recognizes the picture and sends a specific, measurable brain response to the software.
- In 1997, Indian neuroscientist Champadi Raman Mukundan developed a different technique called the Brain Electrical Oscillatory Signature (BEOS) Profiling.



What is the BEOSP test?

- BEOS is an electroencephalogram (EEG) technique by which a suspect's participation in a crime is detected by eliciting electrophysiological impulses.
- The technique also referred to as a type of 'brain fingerprinting', has been categorized as "non-invasive" and a legitimate neuro-psychological method of interrogation.

Other important tests

These tests, which are often used as an aid during investigations by probe agencies, are different from each other but are all aimed at collecting vital information.

- **Narco-analysis** is a controlled administration of intravenous hypnotic medications called truth drugs on a suspect to procure vital information.

- **A polygraph,** popularly referred to as a lie detector, is an instrument that measures and records several physiological indices such as blood pressure, pulse, respiration and breathing rhythms, and skin conductivity while a suspect is asked a series of questions.
  - Deceptive answers are said to produce physiological responses that can be differentiated from those associated with non-deceptive answers.

9 Ultraviolet Germicidal Irradiation (UVGI)

Context: Scientists are studying the use of ultraviolet germicidal irradiation (UVGI) to kill 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 sufficiently 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 cause DNA 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.
- 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 is 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 are blocked by our planet's ozone.

How does UV Light Kill Viruses and Bacteria?

- Ultraviolet light kills cells by damaging their DNA.
- Exposure to electromagnetic radiation (light) at certain UV wavelengths modifies the genetic material of microorganisms and destroys their ability to reproduce.
- The UV energy triggers the formation of specific thymine or cytosine 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.

10 Facial-Recognition Research

Context: Although facial recognition software proves to be useful in certain scenarios, what happens if this technology falls into the wrong hands. Researchers must recognize that unethical facial recognition practice is fundamentally dangerous.

What is facial recognition, and how does it work?

- Facial recognition is a biometric technology that uses distinguishable facial features to identify a person.
- Facial recognition is a subcategory of biometrics. It's made possible by advanced computing components, such as processors and memory, and Artificial Intelligence tools, such as machine learning.
- Facial recognition is when a device uses a camera to identify a face for security or other purposes.
- Today, it's used in a variety of ways from allowing people to unlock their phones, go through security at the airport, purchase products at stores, etc.
- Today, the world is inundated with data of all kinds, but the plethora of photo and video data available provides the dataset required to make facial recognition technology work.
- Facial recognition systems analyze the visual data and millions of images and videos created by high-quality Closed-Circuit Television (CCTV) cameras, smartphones, social media, and other online activities.
- Machine learning and artificial intelligence capabilities in the software map distinguishable facial features mathematically, look for patterns in the visual data and compare new images and videos to other data stored in facial recognition databases to determine identity.

History of facial recognition

- Facial Recognition research started in 1964 in the USA for an intelligence agency by a team led by Woodrow Wilson Bledsoe, mathematician and computer scientist.
- Initially it involved manual matching of the facial characteristics assisted by computers.
- The difficulties then encountered in the 1960s over head rotation, tilt, angle, facial expression, skin, and slight variation continue to be problematic even in the 21st century.
- It becomes more difficult in case of unruly crowds with fast and unpredictable movements.
- The first time Facial Recognition Technology (FRT) was used in the USA in a crowd was in January 2001 in Tampa, Florida.

What's the Law on Facial Recognition?

- The direct implementation of such technologies has not been recognized by law.
- As such, there is a need for having in place detailed legal frameworks passed by the Parliament of India which authorize the implementation and maintenance of such automated facial recognition technologies.
- Currently, in India, there is no specific law that authorizes the deployment of these technologies.
- The Indian Information Technology Act, 2000 being India's mother legislation on the electronic format is completely silent on facial recognition. Also even under the rules passed under the Information Technology Act, 2000, there has no reference to facial recognition.
- As such, for long-term deployment of these technologies, it will be imperative, that the Parliament should pass strong laws to not just enable legal implementation of such technologies but also the law should establish the various instances where such technologies can be so implemented.

11 First CAR-T cell therapy in India

Context: Tata Memorial Hospital (TMH) recently conducted the first CAR-T cell therapy (a type of gene therapy) at the Bone Marrow Transplant unit at ACTREC in Mumbai. The CAR-T cells were designed and manufactured at Bioscience and Bioengineering (BSBE) department of IIT Bombay.

The study was funded under the National Bio-pharma Mission.

What is CAR-T therapy?

- The Chimeric Antigen Receptor T-cell (CAR-T) therapy has emerged as a breakthrough in cancer treatment.
- Each patient's CAR-T cell therapy costs 3-4 crore (INR). The challenge therefore is to develop this technology in cost-effective manner.
- The development of CAR-T cell technology for diseases including acute lymphocytic leukemia, multiple myeloma, glioblastoma, hepatocellular carcinoma and type-2 diabetes is supported through DBT.

National Biopharma Mission

- The National Biopharma Mission (NBM) is an industry-academia collaborative mission for accelerating biopharmaceutical development in India, co funded by the World Bank.
- Launched in 2017, it is being implemented by the **Biotechnology Industry Research Assistance Council (BIRAC).**
- Under this Mission the Government has launched Innovate in **India (i3) programme** to create an enabling ecosystem to promote entrepreneurship and indigenous manufacturing in the sector.

DBT

- The Department of Biotechnology (DBT), under the Ministry of Science & Technology, promotes and accelerates the development of biotechnology in India.

BIRAC

- Biotechnology Industry Research Assistance Council (BIRAC) is a not-for-profit Section 8, Schedule B, Public Sector Enterprise, set up by Department of Biotechnology (DBT), Government of India.
- It has been set up as an Interface Agency to strengthen and empower the emerging Biotech enterprise to undertake strategic research and innovation, addressing nationally relevant product development needs.

12 Detailed Project reports of LIDAR survey of forest areas released

Context: Ministry of Environment, Forest, and Climate Change released the Detailed Project Reports (DPRs) of LiDAR-based survey of forest areas in ten states namely Assam, Bihar, Chhatisgarh, Goa, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Nagaland, and Tripura.

What is LiDAR technology?

- Lidar stands for **Light Detection and Ranging.**
- It is a remote sensing method.
- It uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.
- These light pulses generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.

Key facts about the LIDAR survey of forest areas

- The projectstudy is awarded by WAPCOS, a PSU under the aegis of the Ministry of Jal Shakti.
- The Detailed Project Reports (DPRs) were formed using the LiDAR technology.
- The DPR's were produced using LiDAR technology in which the 3-D (three-dimensional) DEM (Digital Elevation Model), imagery, and layers of the project areas are used.

Significance of study:

- The project will help augment water and fodder in jungles areas. It will -
  - reduce human-animal conflict
  - help in groundwater recharge
  - help local communities
  - state forest departments to use CAMPA funds
  - The project reports will help recommend the micro soil and water conservation structures consistent with site-specific geography, topography, and soil characteristics.
  - It will recommend different types of Soil & Water conservation structures such as Anicut, Gabion, Gully Plug, Mini percolation tank, Percolation Tank, Field bund, Sunken pond, Farm pond, etc.
  - These structures will help in catching the rainwater and prevent stream runoff, which will help in recharging Groundwater.

13 LIGO detects new source of gravitational waves from Neutron Star- Black Hole (NSBH) Collision

Context: A team of international scientists, including those from India, confirms detecting collisions between black holes and neutron stars by analyzing gravitational waves created in January 2020.

The gravitational waves were detected by the **Laser Interferometer Gravitational-Wave Observatory (LIGO)** in the United States and by the Virgo detector in Italy.

What are Gravitational waves?

- Gravitational waves are ripples in the space-time fabric.
- These are created by extreme events, such as the collision of two blackholes or two neutron stars.
- They were first discovered in 2015 and since then observed in the collision between similar cosmic bodies.

Key-findings

- Scientists detected the gravitational waves, earlier in 2020, as a result of the two mergers of celestial bodies.
- Now, it is found that these waves were generated by the process of swallowing neutron stars by the black hole.
- The first merger involved a black hole about nine times the mass of our sun and a neutron star about 1.9 times the mass of our sun.

Black Hole

- A black hole is a region of space-time, where gravity is extremely strong that no object can escape from it.

Neutron Stars

- Neutron stars are formed when a massive star runs out of fuel and collapses.

- The location of the first merger in space remains uncertain, with the researchers estimating that it happened somewhere in an area that is 34,000 times the size of a full moon.
- The second merger involved a 6-solar-mass black hole and a 1.5-solar-mass neutron star.
- The second event, designated **GW200115**, originated from the merger of a black hole with a 1.5-solar mass neutron star that took place roughly 1 billion light-years from Earth.
- It is a new set of binary that merged that was missing.
- Earlier, it was thought that only the two similar types of bodies could merge such as a black hole and black hole or neutron star with a neutron star.

Significance of the discovery

- It will be helpful to answer some of the significant questions such as how many of these systems exist, how often they merge, and why we have not yet seen examples in the **Milky Way.**

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5 GENERAL SCIENCE

1 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:

- There are four states of matter common in everyday life-
  - Gases
  - Liquids
  - Solids
  - Plasmas
- However, there is also the fifth state of matter — **Bose-Einstein condensates (BECs)**, which scientists first created in the lab 25 years ago.

The 5th state of matter

- This chilly substance was initially theorised by **Albert Einstein** and **Satyendra Nath Bose** in theearly 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 anentity in a single quantum state.

Cold Atom Laboratory (CAL)

- The Cold Atom Laboratory (CAL) was launched to the ISS in 2018 to investigate a strangekind 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.

How is it made?

- 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.

2 Fortification of edible oil with Vitamins A and D

Context: FSSAI is considering making it mandatory to fortify edible oil with vitamins A and D so that people of India can enjoy better immunity with good health.

What is Oil fortification?

- Oil fortification is the process of adding micronutrients to edible oil to increase its nutritional value.
- It expected to achieve almost 99% penetration of the Indian population due to the widespread use of cooking oil.
- All kinds of edible oils (soybean, palmolein, groundnut, cotton seed, mustard, etc.) can be fortified.

Health benefits

Vitamin A

- Good for healthy vision, bones, skin, and tissues
- Fights cell damage
- Works as antioxidant
- Helps skin growth and repair
- Formation and maintenance of teeth

Vitamin D

- Regulates the amount of phosphate and calcium in the body
- Keeps bones, teeth, and muscles healthy
- Facilitates normal immune system function
- Regulates mood and prevents depression

About FSSAI

- **Food Safety and Standards Authority of India (FSSAI)** is an autonomous body established under the Ministry of Health & Family Welfare, Government of India.
- The FSSAI has been established under the Food Safety and Standards Act, 2006, which is a consolidating statute related to food safety and regulation in India.
- FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safety.

3 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.

About:

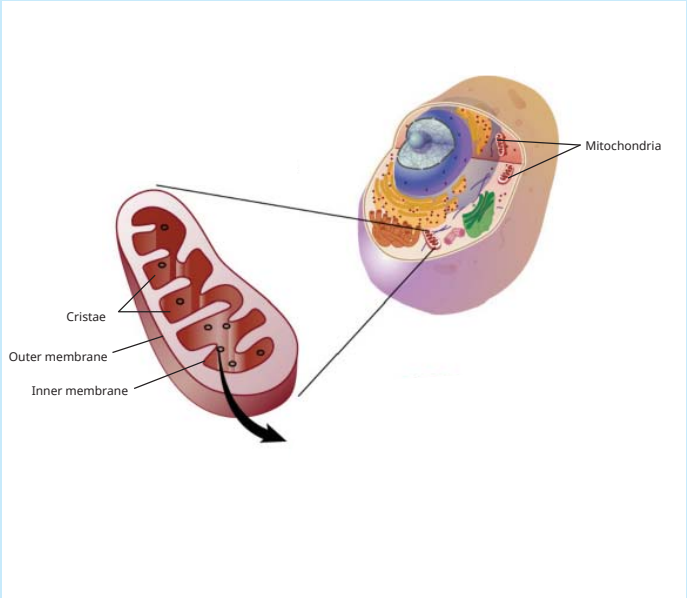
- The discovery was made by accident as the team was sequencing the genome of a common salmon parasite called Henneguyasalminicola.
- When they searched for a mitochondrial genome, they didn't find anything.

The parasite

- Henneguyasalminicola is a myxozoan cnidarian — a type of animal-related to jellyfish and coral.
- It consists of less than 10 cells in its being. It lives inside salmon's muscles and leeches energy off its host. But it is not a harmful parasite, it can live the fish's entire life inside it.
- The environment inside its host is almost entirely free of oxygen. This meant that it didn't need the mitochondria anymore once it found another way to adapt. So it dropped its mitochondrial genome entirely, so as to save energy and not copy genes for multiplication. It gave up breathing.

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.



4 Scientists have synthesized a new high temperature superconductor

Context: A team of scientists performed theoretical and experimental research on a new high-temperature superconductor, yttrium hydride (YH6)

About:

- Yttrium hydrides rank among the three highest-temperature superconductors known to date.
- The leader among the three is a material with an unknown S-C-H composition and superconductivity at 288 K, which is followed by lanthanum hydride, LaH10, superconducting at temperatures up to 259 K),
- Finally, yttrium hydrides, YH6 and YH9, with maximum superconductivity temperatures of 224 K and 243 K, respectively.

Superconductivity

- Superconductivity is a phenomenon whereby a charge moves through a material without resistance.
- In theory this allows electrical energy to be transferred between two points with perfect efficiency, losing nothing to heat.
- The main advantages of devices made from superconductors are low power dissipation, high-speed operation, and high sensitivity.
- Suggested uses for super conducting materials include medical magnetic-imaging devices, magnetic energy-storage systems, motors, generators, transformers, computer parts, and very sensitive devices for measuring magnetic fields, voltages, or currents.

5 Particle Physicist confirms presence of Odderon

Context: Physicists at CERN's Large Hadron Collider (LHC) and the DØ Collaboration at Fermilab have found strong new evidence for the odderon, an elusive three-gluon state predicted almost five decades ago.

About

- In 1973, two French particle physicists found that, according to their calculations, there was a previously unknown quasi-particle.
- The Odderon particle is what briefly forms when protons collide in high-energy collisions, and in some cases do not shatter, but bounce off one another and scatter.
- Protons are made up of quarks and gluons, that briefly form Odderon and Pomeron particles.

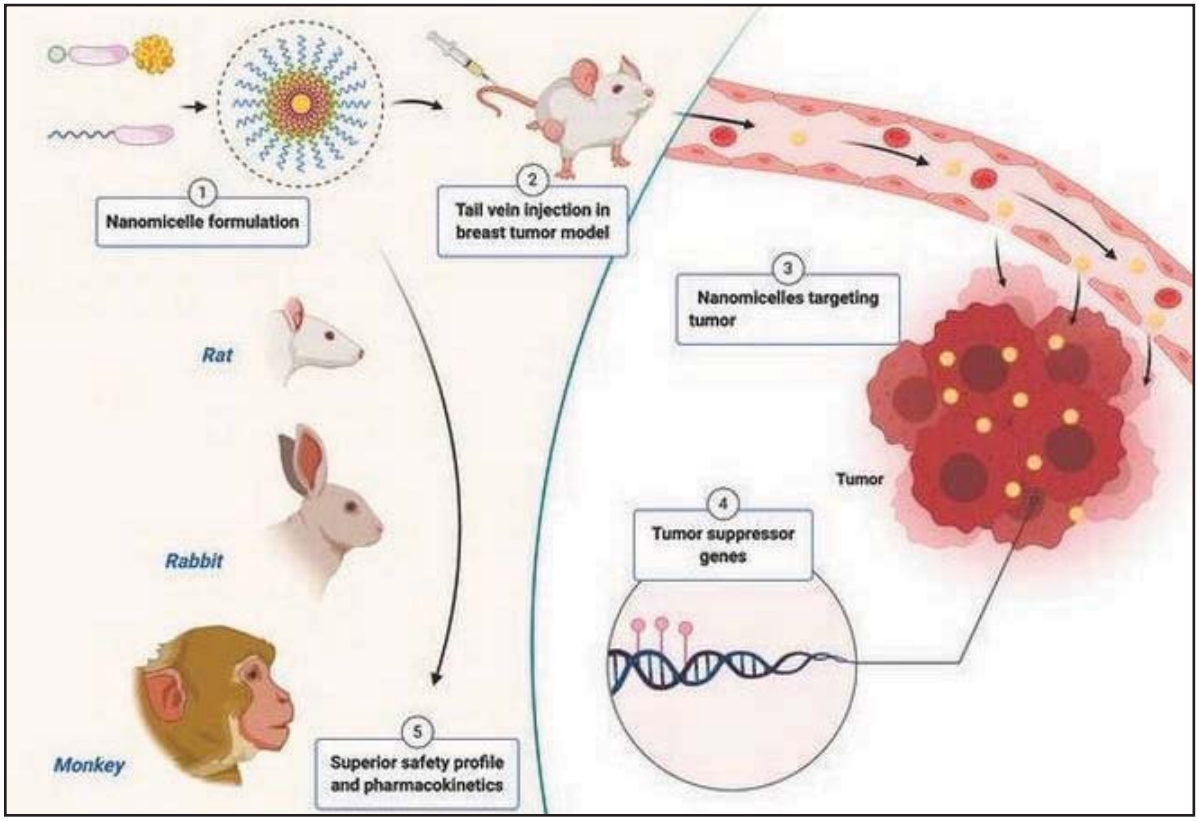
What is the LHC?

- The Large Hadron Collider (LHC) is the world's largest and most powerful particle accelerator.
- It first started up on 10 September 2008, and remains the latest addition to CERN's accelerator complex.
- The LHC consists of a 27-kilometre ring of super conducting magnets with a number of accelerating structures to boost the energy of the particles along the way.
- The beams inside the LHC are made to collide at four locations around the accelerator ring, corresponding to the positions of four particle detectors – ATLAS, CMS, ALICE and LHCb.

6 Genome Editing

Context: Gene editing is a rapidly developing area of biotechnology, it allow the precisely change the nucleotide sequence of the genome of living cells.

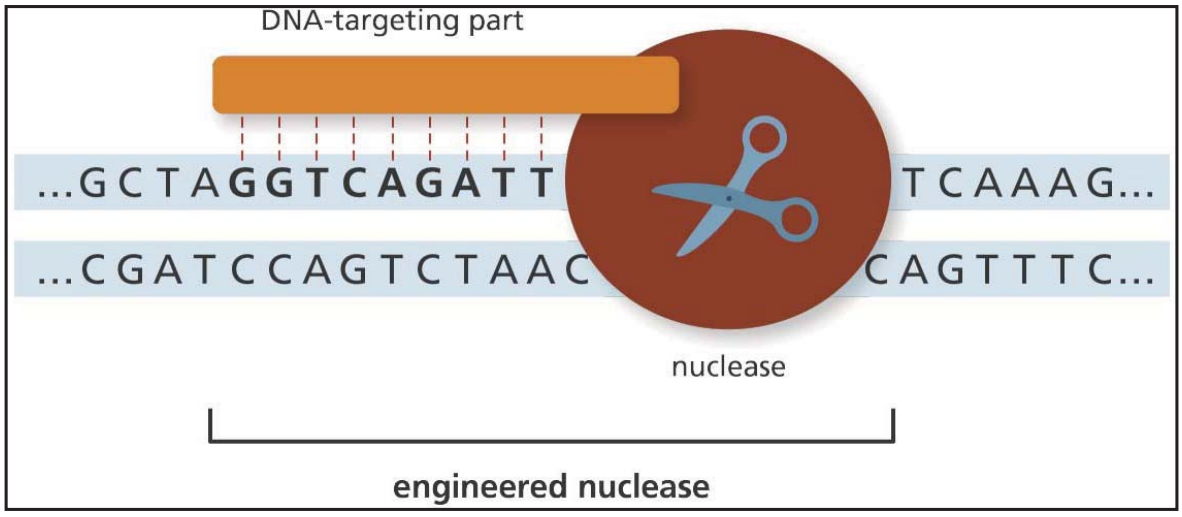
What is Genome editing?



- Genome editing is a technique used to precisely and efficiently modify DNA within a cell leading to changes in physical traits, like eye colour, or disease risk.
- The technique involves making cuts at specific DNA sequences with enzymes known as 'engineered nucleases'.
- The technology can be used to add, remove, or even alter DNA in the genome.
- By editing the genome, the characteristics of a cell or an organism can be changed easily.

How is it done?

- Genome editing uses a type of enzyme called an 'engineered nuclease' which cuts the genome in a specific place.
- Engineered nucleases are made up of two parts:
  - **Nuclease part:** A nuclease part that cuts the DNA.
  - **DNA-targeting part:** A DNA-targeting part that is designed to guide the nuclease to a specific sequence of DNA.
- After cutting the DNA in a specific place, the cell will naturally repair the cut.
- Scientists can manipulate this repair process to make changes (or 'edits') to the DNA in that location in the genome.

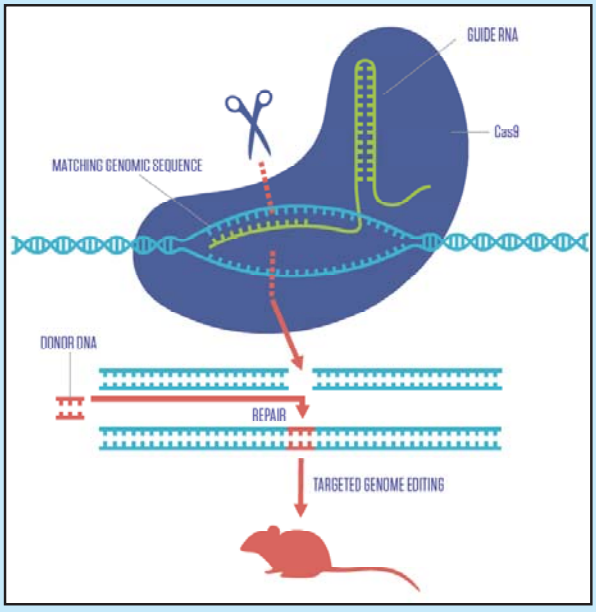


Which genome editing technologies are currently in use?

- Current genome editing technologies include zinc-finger nucleases (ZFNs), transcription activator-like effector-based nucleases (TALENs) and clustered regularly inter spaced short palindromic repeats (CRISPR), with CRISPR-associated nucleases (Cas).
- CRISPR-based genome editing is considered more precise (it is possible to target specific sequences of DNA), more efficient (it has relatively few off-target effects) and cheaper to use than other genome editing technologies.

CRISPR-Cas9

- CRISPR-Cas9 is the most common, cheap and efficient system used for genome editing.
- CRISPR stands for 'clustered regularly inter spaced short palindromic repeats'.
- CRISPR is the DNA-targeting part of the system which consists of an RNA molecule, or 'guide', designed to bind to specific DNA bases through complementary base- pairing.
- Cas9standsforCRISPR-associated protein 9 and is the nuclease part that cuts the DNA.
- The CRISPR-Cas9 system was originally discovered in bacteria that use this system to destroy invading viruses.



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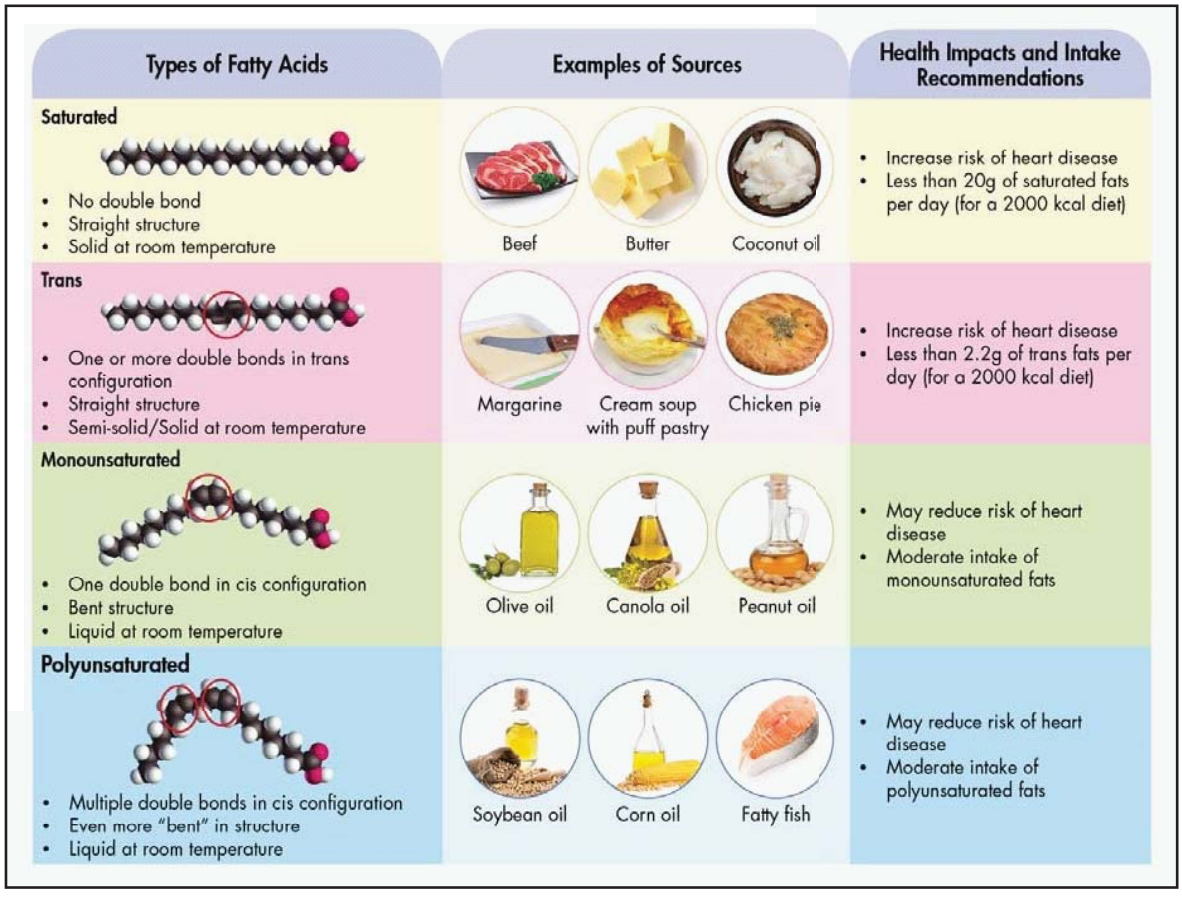
6 HEALTH

1 Trans fat intake: WHO warning to India

Context: WHO, in its report, underlined the need to strengthen regulations on Trans Fat in India.

What are trans fats?

- Trans fats, or trans-fatty acids, are a form of unsaturated fat. They come in both natural and artificial forms.
- Natural, or ruminant, trans fats occur in the meat and dairy from ruminant animals, such as cattle, sheep, and goats.
- They form naturally when bacteria in these animals' stomachs digest grass.



The Report

- Fifteen countries, including India, account for approximately two-thirds of the worldwide deaths linked to trans-fat intake.
- Of these, four countries -- Canada, Latvia, Slovenia, United States of America -- have implemented WHO-recommended best-practice policies since 2017, either by setting mandatory limits for industrially produced trans fats to 2% of oils and fats in all foods or banning partially hydrogenated oils (PHO).
- But the remaining 11 countries- Azerbaijan, Bangladesh, Bhutan, Ecuador, Egypt, India, Iran, Mexico, Nepal, Pakistan, Republic of Korea, still need to take urgent action.

WHO Recommendations:

- WHO recommends that trans fat intake be limited to less than 1% of total energy intake, which translates to less than 2.2 g/day with a 2,000-calorie diet.
- To achieve a world free of industrially produced trans fats by 2023, WHO has launched its **REPLACE** strategy

FSSAI's Recent Regulation

- The Food Safety and Standards Authority of India (FSSAI) has capped the number of trans fatty acids (TFA) in oils and fats to 3% for 2021 and 2% by 2022 from the current permissible limit of 5% through an amendment to the Food Safety and Standards (Prohibition and Restriction on Sales) Regulations.

2 Health in India: MoSPI

Context: The Ministry of Statistics and Programme Implementation has released the report of a survey titled 'Health in India', whose main objective was to gather basic quantitative information on India's health sector.

About:

- The report is released by the Ministry of Statistics and Programme Implementation.
- It contains health information for separate religious communities, including estimates of their susceptibility to ailments.
- The report is based on information collected through NSS Schedule 25.0 (Household Social Consumption: Health) spread over the entire Indian Union.
- Data were collected through a sample survey of 1.13 lakh households covering 5.55 lakh persons.

How 'healthy' is India?

- Around 7.5 percent of Indians reported that they were suffering from ailments.
- The difference in people suffering from ailments in rural and urban India was stark.
  - **rural India**- 6.8 per cent
  - **urban India**- 9.1 per cent

Which religious group is the most prone to illness?

- The **Zoroastrian community** remains the most susceptible to ailments.

- This number for other communities is:
  - **Jains**- 11.2 per cent
  - **Sikhs**- 11 per cent
  - **Christians**- 10.5 per cent
  - **Muslims-** 8.1 per cent D
  - **Buddhists**- 8 per centD
  - **Hindus**- 7.2 per cent

Division in terms of sex

Religion	Male	Female	Person
Hindu	65	79	72
Muslim	70	93	81
Christian	89	122	105
Sikh	94	127	110
Jain	109	115	112
Buddhist	45	113	80
Zoroastrain	257	359	311
Other	83	54	69
All	67	83	75

- Women remain more susceptible to suffering from ailments than men.
  - In rural India, 6.1 per cent of males said that they were suffering from ailments, while 7.6 per cent of rural women said the same.
  - While 8.2 per cent of urban males said that they were sick, 10 per cent of urban females said the same.

3 World Health Day

Context: World Health Day is celebrated every year on April 7 to spread awareness around maintaining good health and a balanced lifestyle.

About:

- April 7 of each year marks the celebration of World Health Day.
- From its inception at the First Health Assembly in 1948 and since taking effect in 1950, the celebration has aimed to create awareness of a specific health theme to highlight a priority area of concern for the World Health Organization.
- Over 1 million people have been infected by the deadly contagion while more than 60,000 havelost their lives to Covid-19 infection.

World Health Organization:

- On April 7, 1948, the United Nations established WHO by the constitution, putting it in charge of classifying diseases.
- WHO acts as the branch of the United Nations responsible for global public health.
- The organization's team, headquartered in Geneva, Switzerland
- Some highlights of WHO's long list of impacts on the world include:
  - Smallpox was eradicated in 1979 after WHO's 12-year vaccination campaign.
  - WHO developed a treatment plan for tuberculosis in 1995 that has saved more than 37 million lives.
  - The WHO Framework Convention on Tobacco Control was adopted in 2005, which prompted countries to establish smoke-free public spaces and print pictorial warnings on cigarette packages.
  - In 2014, WHO sponsored thousands of health care workers to research and treat the Ebola virus. West Africa was officially Ebola-free by 2016.
  - The WHO declared the coronavirus outbreak a pandemic on March 11, 2020.

4 Global Nutrition Report

Context: Malnutrition remains one of India's biggest challenges, according to the 2020 Global Nutrition Report released worldwide.

Key-highlights of the Report

- Most people across the world cannot access or afford healthy food, due to agricultural systems that favor calories over nutrition as well as the ubiquity and low cost of highly processed foods.
- Inequalities exist across and within countries.
- Not one country is on course to meet all 10 of the 2025 global nutrition targets and just eight of 194 countries are on track to meet four targets.

Global Nutrition Targets:

- In 2012, the World Health Assembly identified 6 nutrition targets for maternal, infant, and young child nutrition to be met by 2025.
- These require governments to:
  - reduce stunting by 40% in children under 5 and prevalence of anaemia by 50% among women in the age group of 19-49 years.
  - ensure 30% reduction in low-birth-weight and no increase in childhood overweight. D increase the rate of exclusive breast feeding in the first six months up to at least 50%. D reduce and maintain childhood wasting to less than 5%.

India's Nutritional Story

- Against global targets for 10 specific parameters set for 2019, three had no data, one showed "some progress", while six were marked "no progress or worsening.''
- India is among 88 countries that are likely to miss global nutrition targets by 2025. India is also the country with the highest rates of domestic inequalities in malnutrition.

- The country is identified as among the three worst countries, along with Nigeria and Indonesia, for steep within-country disparities on stunting, where the levels varied four-fold across communities.
- However, the under-five mortality (per 1000 births) rate showed a clear decline from 43.6 per cent in 2015 to 36.6 per cent in 2018.
- Other statistics for India (2016 figures) show that it has 0.76 physicians, 2.09 nurses and midwives, and 0.58 community health workers per 1000 people.

5 Nanomicelles: using nanoparticles for cancer treatment

Context: Researchers have created a nanomicelle that can be used to deliver a drug named docetaxel, which is commonly used to treat various cancers including breast, colon and lung cancer.

About:

- Similar to nanoshells and nanovesicles, nanomicelles are extremely small structures and have been noted as an emerging platform in targeted therapy.
- Nanomicelles are globe-like structures with a hydrophilic outer shell and a hydrophobic interior.
  - The hydrophobic core interacts with hydrophobic drugs/agents, whereas the hydrophilic tail helps surrounding with water and enhances solubility.
- This dual property makes them a perfect carrier for delivering drug molecules.
- The nanomicelles are less than 100nm in size and are stable at room temperature.
- Once injected intravenously these nanomicelles can easily escape the circulation and enter the solid tumours where the blood vessels are found to be leaky.

6 NIBEC, a DBT-supported facility for viral immunogenicity testing inaugurated

Context: The National Immunogenicity and Biologics Evaluation Centre (NIBEC) for assessing clinical immunogenicity of viral vaccines, especially the ones in the pipeline for Covid-19, has been inaugurated.

About:

- Established jointly by Bharati Vidyapeeth University through its constituent unit Interactive Research School for Health Affairs (IRSHA) and BIRAC-DBT, Government of India through "Innovatein India (i3) program under **National Biopharma Mission**.

Immunogenicity refers to the ability of a drug to induce an immune response and is a concern for peptide and protein therapeutics. Preclinical immunogenicity is not predictive of immunogenicity in humans, but it helps to understand the findings in a toxicology study and therefore is an important factor in vaccine development

What is National Biopharma Mission?

- This mission would aid in enhancing India's innovation research and product development capabilities, especially by focusing on development of vaccines, biologics and medical devices for combating public health concerns.

- It is an Industry-Academia Collaborative Mission of Department of Biotechnology (DBT) for Accelerating Early Development for Biopharmaceuticals.
- The mission is implemented by Biotechnology Research Assistance Council (BIRAC).

Innovate in India (I3)

- The program named Innovate in India (I3) is an industry- academia collaborative mission ofDepartment of Biotechnology (DBT) in collaboration with World Bank for accelerating discovery research to early development of Biopharmaceuticals and to be implemented by BiotechnologyIndustry Research Assistance Council (BIRAC).

Biotechnology Industry Research Assistance Council (BIRAC)

- Biotechnology Industry Research Assistance Council (BIRAC) is a not-for-profit Section 8, Schedule B, Public Sector Enterprise.
- It is set up by **Department of Biotechnology (DBT)** as an **Interface Agency** to strengthen and empower the emerging Biotech enterprise to undertake strategic research and innovation, addressing nationally relevant product development needs.

7 Convalescent-Plasma Therapy

Context: The Convalescent-plasma Therapy was in spotlight to help in development of a new coronavirus drug derived from the blood plasma of people who have recovered from Covid-19.

About:

- In the early 20th century, convalescent plasma treatment was used during outbreaks of diseases such as measles, mumps and influenza, H1N1 influenza pandemic, and again in 2013 during the Ebola outbreak in West Africa.

How is blood plasma turned into an infection-fighting drug?

- Patients who have recovered from a disease have permanent antibodies generated by the immune system floating in their blood plasma.
- Plasma is harvested, tested for safety, and purified to isolate those protective antibodies.
- When injected into a new patient, the "plasma-derived therapy" — also known as convalescent plasma — provides "passive immunity" until the patient's immune system can generate its own antibodies.

What is Convalescent plasma?

- Convalescent plasma refers to plasma obtained from an individual who has recuperated from an infection.
- During the infectious period, the individual's immune system would have mounted an attack on the foreign virus.
- By the time the virus is vanquished, the body would have developed ammunition specifically to beat the virus, which will be a type of antibody.
- These antibodies are suspended in the circulating blood, and can be separated out from one ofthe components of blood – the plasma.

8 Hydroxychloroquine now a schedule H1 drug

Context: Hydroxychloroquine is now a schedule H1 drug, and can be sold on prescription only. The drug has been deemed 'essential' to meet emergency requirements due to COVID-19.

About:

- Hydroxychloroquine is a antimalarial drug. It treats malaria by killing the parasites that cause the disease
  - It is classified as disease-modifying anti-rheumatic drug (DMARD).
  - The drug is used to treat malaria, lupus erythematosus, and rheumatoid arthritis.
  - Hydroxychloroquine can modify the underlying disease process, rather than simply treating the symptoms.

Disease-Modifying Anti-Rheumatic Drugs (DMARDs):

- DMARDs act by altering the underlying disease rather than treating symptoms.
- They are not painkillers, but they'll reduce pain, swelling and stiffness over a period of weeks or months by slowing down the disease and its effects on the joints.
- There are two types:
  - conventional DMARDs
  - biological therapies

9 Infectious Diseases bigger global threat than climate change: WEF

Context: Infectious diseases topped the global risks chart, displacing climate change, according to the Global Risks Report, 2021.

What are Infectious diseases?

- Infectious diseases are caused by microorganisms such as viruses, bacteria, fungi and parasites.
- Microorganisms that cause disease are collectively called pathogens.
- Infectious diseases can be spread from one person to another
  - For example through contact with bodily fluids, by aerosols (through coughing and sneezing), or via a vector, for example a mosquito

What causes an infectious disease?

Viruses:

- Viruses are tiny infectious agents that replicate only in the living cells of other organisms.
  - Viruses have a very simple structure consisting of genetic material in the form of DNA or RNA within a protein capsule.
  - They can infect all types of life forms, from animals to plants and bacteria to amoebae.

Bacteria:

- Bacteria are single-celled microorganisms. They come in many shapes including ball-, rod- and spiral-shaped.
  - Most bacteria are not harmful and some are actually beneficial. Less than one per cent of bacteria will actually make person ill.

Fungi:

- Fungi are microorganisms characterised by cell walls made from a substance called chitin.
  - Fungi reproduce by releasing spores that can be picked up by direct contact or even inhaled.

Parasites:

- Parasites are organisms that live in or on another organism and benefit by getting nutrients at the expense of their host.
  - Parasites can be found in many different body sites, for example in the blood, liver, digestive system, brain and even the eyes.

Key-highlights of the Report

- Report is published by World Economic Forum
- Five of the top 10 global risks in terms of impact and likelihood remain from the environmental category.
- Extreme weather is the top-most climate-related risk because of the failure of climate change mitigation and adaptation.

- The category was ranked tenth in the previous report, which said extreme weather and failure of climate change mitigation and adaptation would be the most damaging for the planet over the next 10 years.

10 Policy responses to smokeless tobacco (ST) in India during the COVID19 pandemic

Context: Smokeless tobacco products use is increasingly becoming a serious health issue in India.

What is smokeless tobacco?

- **Smokeless tobacco (SLT)** is defined as a product that contains tobacco, is not smoked or burned at the time of use, and commonly consumed orally or nasally.
- Some of the popular products in India include *khaini*, *gutkha*, *zarda*, betel quid with tobacco, tobacco tooth powder, tobacco toothpaste, etc.
- These products can be placed in the mouth, cheek or the lip and are sucked or chewed.

Harmful Chemicals

- Smokeless tobacco contains nicotine, **carcinogens**, including very high levels of **tobacco-specific nitrosamines (TSNAs).**
  - TSNAs are known to be some of the most potent **carcinogens** present in chewing tobacco, snuff and tobacco smoke.
- Other cancer-causing substances in smokeless tobacco are known to include:
  - Formaldehyde
  - Arsenic
  - Cadmium
  - Radioactive polonium-210

WHO Framework Convention on Tobacco Control (WHO FCTC)

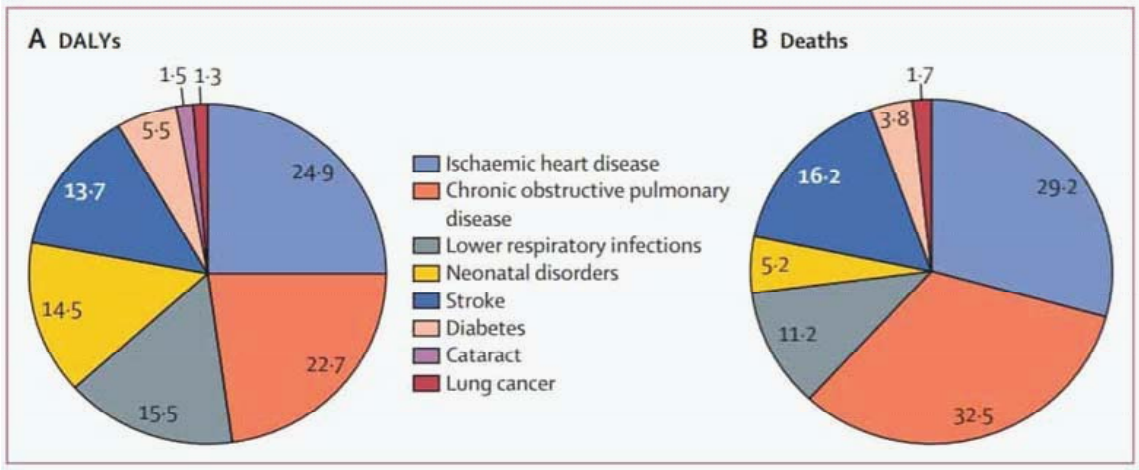
- The WHO Framework Convention on Tobacco Control (WHO FCTC) is the first international treaty negotiated under the auspices of WHO.
- The WHO FCTC represents a paradigm shift in developing a regulatory strategy to address addictive substances; in contrast to previous drug control treaties, the WHO FCTC asserts the importance of demand reduction strategies as well as supply issues.
- India has been a Party to the **WHO Framework Convention on Tobacco Control (WHO FCTC) since 2005.**

11 The India State-Level Disease Burden Initiative

Context: Some 1.7 million Indians died due to air pollution in 2019, according to a report by interdisciplinary journal Lancet Planetary Health.

Key-findings of the Report

- The toll in India was 18 per cent of the total deaths in the country.
- The report has both good and bad news for India:
  - **Indoor, or household, air pollution** caused 64 percent fewer deaths in the last two decades (1990-2019).
  - **Outdoor air pollution, or ambient air pollution**, is not only increasing but also killing more.The death rate from outdoor ambient air pollution has increased during this period by 115 percent.
- **Premature deaths and morbidity:** India has lost 1.4 percent of GDP due to premature deathsand morbidity from air pollution.
- **Lung disease:** Of the total economic loss of $36·8 billion, lung diseases caused by air pollution accounted for the highest share- 36.6 percent.



- 36·6% was from lung diseases, which included chronic obstructive pulmonary disorder (21·1%), lower respiratory infections (14·2%), and lung cancer (1·2%).
- The rest was from ischaemic heart disease (24·9%), stroke (14·1%), diabetes (8·4%), neonatal disorders (13·3%), and cataract (2·7%).
- **Economic Loss:** The economic loss due to air pollution as a percentage of the state GDP washigher in the northern and central India states, with the highest in Uttar Pradesh (2.2 percent of GDP) and Bihar (2 percent of GDP).
- Delhi had the highest per-capita economic loss due to air pollution, followed by Haryana in 2019.

Premature deaths (US$ millions)	28799
Morbidity (US$ millions)	8005
Total (US$ millions)	36804
per capita (US$)	26.5

- **Indoor air pollution:** In term of economic losses attributable to indoor air pollution ranged, Goa had the least loss at $7.6 million and UP the highest at $1829·6 million.

12 Drug-Resistant Infections: The silent pandemic

Context: Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi.

What is antibiotic resistance?

- Antibiotic resistance occurs when bacteria change in response to the use of these medicines.
- Bacteria, not humans or animals, become antibiotic-resistant.
- The misuse and overuse of antibiotics has the potential to contribute to development of AMR globally.

Evolution of Bacteria

- Exposure to antibiotics puts stress on bacteria and, like other living organisms, they defend themselves.

- This allows them to change quickly, readily obtaining the ability to make proteins and other molecules that block the antibiotic's effect.
- However, as we use ever stronger and more diverse antibiotics, new and more powerful bacterial defence options have evolved, rendering some bacteria resistant to almost everything – the ultimate outcome being untreatable **superbugs**.

- Antimicrobial resistant organisms are found in people, animals, food, plants and the environment (in water, soil and air).
- They can spread from person to person or between people and animals, including from food of animal origin.
- The main drivers of antimicrobial resistance include the misuse and overuse of antimicrobials; lack of access to clean water, sanitation and hygiene (WASH) for both humans and animals; poor infection and disease prevention and control in health-care facilities and farms; poor access to quality, affordable medicines, vaccines and diagnostics

13 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 andplacenta 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.

Uses of Cord Blood

- The umbilical cord fluid is loaded with stem cells. They can treat cancer, blood diseases like anemia, and some immune system disorders, which disrupt your body's ability to defend itself.
- As these cells help the body re-generate tissues and systems, cord blood is often referred to as
- regenerative medicine.
- The fluid 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 rejectedas adult stem cells.

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.

14 WHO declares COVID-19, a pandemic

Context: The World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

About:

- A pandemic is a measure of the spread of disease.
- When a new disease spreads over a vast geographical area covering several countries and continents, and most people do not have immunity against it, the outbreak is termed a pandemic.
- There is no fixed number of cases or deaths that determine when an outbreak becomes a pandemic.
- The Ebola virus, which killed thousands in West Africa, is an epidemic as it is yet to mark its presence on other continents.
- Other outbreaks caused by coronaviruses such as MERS (2012) and SARS (2002), which spread to 27 and 26 countries respectively, were not labeled pandemics because they were eventually contained.

Outbreaks that have been declared pandemics in the past

- A major example is the Spanish flu outbreak of 1918, which killed between 20-50 million.
- Cholera pandemics have been declared multiple times between 1817 and 1975.
- In 1968, a pandemic was declared for H3N2 that caused about a million deaths.
- The last pandemic declared by the WHO was in 2009, for H1N1.

The term **Public Health Emergency of International Concern** is defined in the International Health Regulations (2005) of WHO as "an extraordinary event which is determined, as providedin these Regulations:

- to constitute a public health risk to other States through the international spread of disease; and
- to potentially require a coordinated international response".

15 Human Brain Atleas

Context: An 'Indian brain template' for five distinct age groups as well as a 'brain atlas' to help accurate assessment of psychiatric illnesses and conduct neuro-surgical operations have been developed by neuroscientists at the National Institute of Mental Health and Neuro Sciences (NIMHANS).

About:

- The human brain is the largest brain of all vertebrates relative to body size.
- The brain makes up about 2 percent of a human's body weight. It weighs about 3.3 lbs. (1.5 kilograms). Average volume of male's brain is greater than female's brain
- The largest part of the human brain is the cerebrum, which is divided into two hemispheres.
- Underneath lies the brainstem, and behind that sits the cerebellum.
- The outermost layer of the cerebrum is the cerebral cortex, which consists of four lobes:
  - frontal

- parietal D temporal D occipital

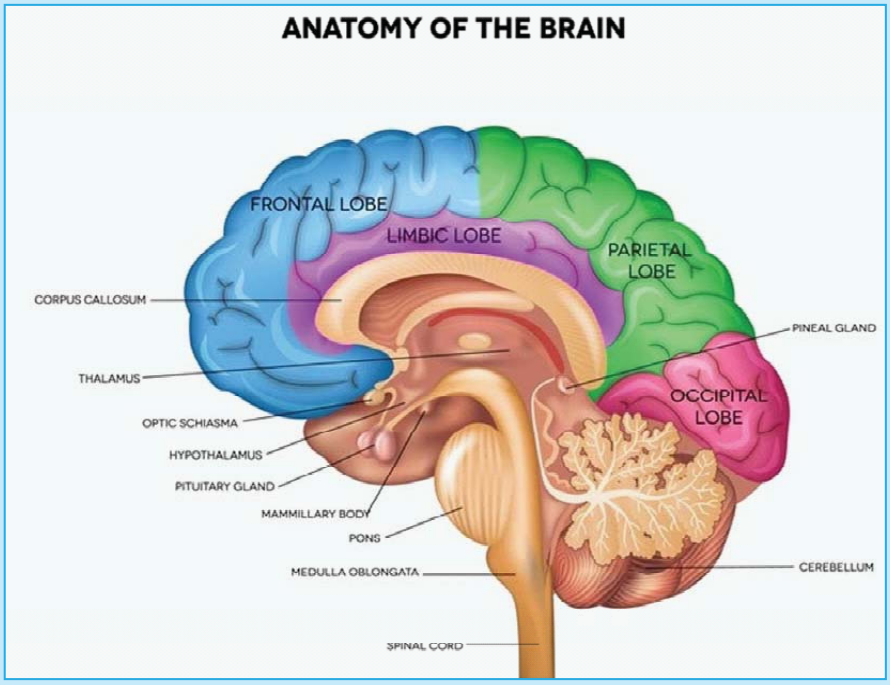
- Like all vertebrate brains, the human brain develops from three sections-
  - the forebrain develops into the cerebrum and underlying structures
  - the midbrain becomes part of the brain stem
  - the hindbrain gives rise to regions of the brain stem and the cerebellum

Brain template

- Brain template is a gross representation from various brain images to understand brain functionality in diseased conditions.

Brain atlas

- A brain atlas is composed of serial sections along different anatomical planes of the healthy or diseased developing or adult animal or human brain where each relevant brain structure is assigned several coordinates to define its outline or volume.



16 AJO-Neo

Context: Recently, the device called "AJO-Neo" is developed by researchers from S.N. Bose National Centre For Basic Sciences (SNBNCBS), Kolkata for non-invasive screening of bilirubin level in new-borns.

About:

- AJO-Neo is 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-basedtechniques** for measurement of neonatal bilirubin level as an alternative of **total serum bilirubin (TSB)**.

- 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 orskin color.
- The device is found to deliver an almost instantaneous report (about 10 seconds) to a concerneddoctor.

Significance of the achievement

- Detection of **neonatal blood bilirubin (Hyperbilirubinemia)** faster is extremely important for therapeutic management to avoid **Kernicterus** leading to **Neuo-psychiatry** problems in neonatalsubjects.
- Careful screening of bilirubin levels in new-borns is mandatory to reduce incidents of a type ofbrain damage called kernicterus that can result from high levels of bilirubin in a baby's blood.
- Although the 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.

Bilirubin

- It is a yellowish substance in the blood. It forms after red blood cells break down, and it travels through liver, gallbladder, and digestive tract before being excreted.
- It is a necessary process in the body's clearance of waste products that arise from the destruction of aged or abnormal red blood cells.

S.N. Bose National Centre For Basic Sciences (SNBNCBS)

- It is an autonomous research Institute under the Department of Science and technology (DST), Government of India.
- The institute is also hosting one of the Technical Research Centres (TRC) funded by DST and in scientific collaboration with Nil-RatanSircar (NRS) Medical College and Hospital, Kolkata.

17 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.

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'.
- These errors are known as **mutations**, which can introduce slight variations in the behaviour of the virus.

18 Immunoglobulin G (IgG) ELISA test

Context: The Indian Council of Medical Research (ICMR) has advised states to conduct a 'sero survey' to measure the coronavirus exposure in a population by using the Immunoglobulin G (IgG) ELISA test.

About:

- **Immunoglobulins**, also known as antibodies, are glycoprotein molecules produced by plasma cells (white blood cells).
- They act as a critical part of the immune response by specifically recognizing and binding to particular antigens, such as bacteria or viruses, and aiding in their destruction.
- Sometimes, the body may even mistakenly make antibodies against itself, treating healthy organsand tissues like foreign invaders. This is called an **autoimmune disease**.

The types of antibodies are:

- **Immunoglobulin A (IgA):** It is found in the linings of the respiratory tract and digestive system, as well as in saliva (spit), tears, and breast milk.
- **Immunoglobulin G (IgG):** This is the most common antibody. It's in blood and other body fluids and protects against bacterial and viral infections. IgG can take time to form after an infectionor immunization.
- **Immunoglobulin M (IgM):** Found mainly in blood and lymph fluid, this is the first antibody the body makes when it fights a new infection.
- **Immunoglobulin E (IgE):** Normally found in small amounts in the blood. There may be higher amounts when the body overreacts to allergens or is fighting an infection from a parasite.
- **Immunoglobulin D (IgD):** This is the least understood antibody, with only small amounts in theblood.

What is an ELISA test?

- ELISAs are designed specifically for screening large numbers of specimens at a time, making them suitable for use in surveillance and centralized blood transfusion services.
- It is an IgG Elisa-based test. This means that the test will be done to detect the Immunoglobulin G (IgG) antibody.
- The body produces Immunoglobulin M (IgM) and IgG antibodies to fight against a pathogen.
  - The **IgM** antibodies are produced in four-seven days after pathogens enter the body
  - The **IgG** antibodies are produced between 10-14 days of the pathogen's appearance.
  - If the IgG antibody is detected, it can be concluded that the person was exposed to SARS-CoV-2.

Why sero-surveys?

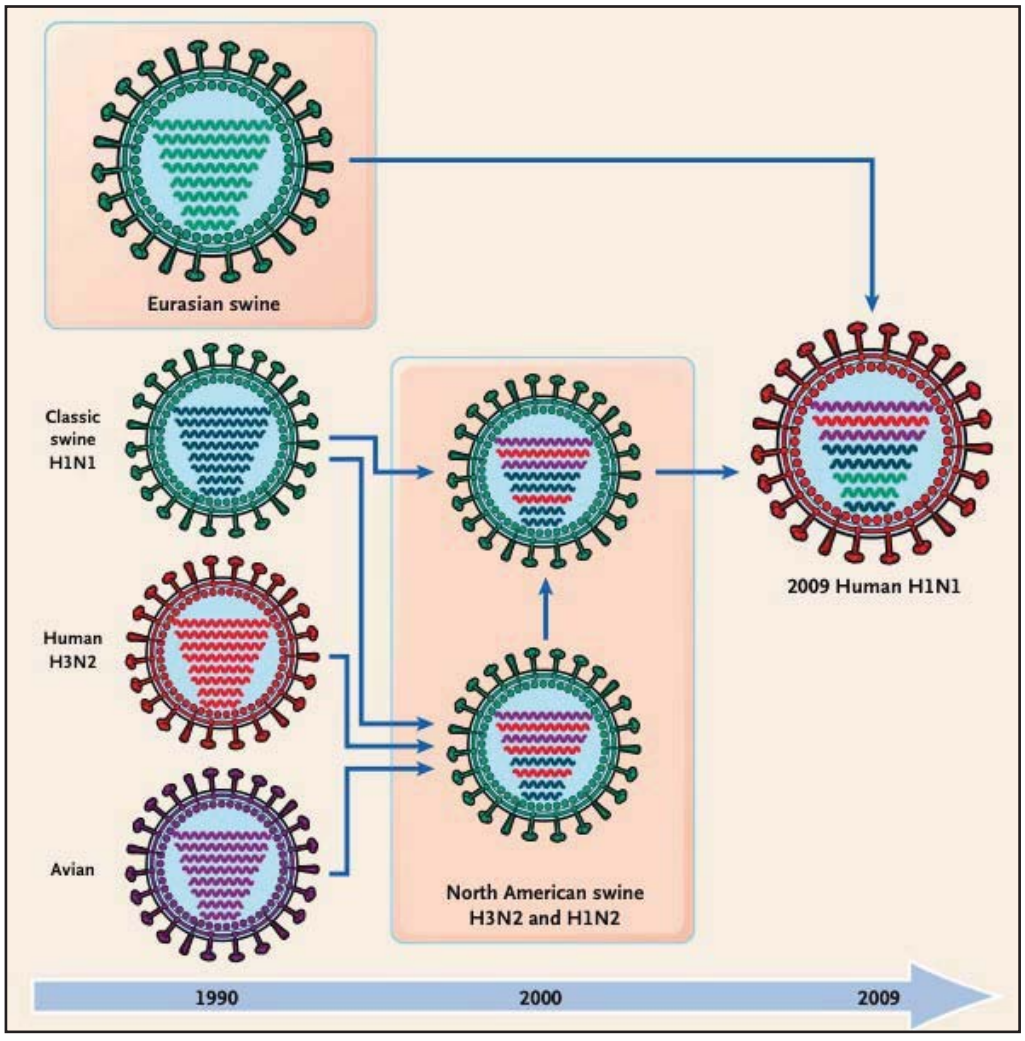
- According to ICMR, sero-surveys help to understand the proportion of population which has been exposed to the SARS-CoV-2 infection including the asymptomatic individuals.

19 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 have pandemic potential. The virus has shown 'increased human infectivity' in swine industry workers.

What is reassortment?

- Reassortment is the process by which influenza viruses swap gene segments.
- This genetic exchange is possible due to the segmented nature of the viral genome and occurs when two different influenza viruses co-infect a cell.
- The viral diversity generated through reassortment is vast and plays an important role in the evolution of influenza viruses.
- 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.



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 protect G4.
- 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 the 2009 swine flu, but with some new changes.

20 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 at the Council of Scientific & Industrial Research's Institute of Genomics and Integrative Biology (CSIR-IGIB).
- 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, but the 'Feluda' test could cost as little as Rs 500.

How does it work?

- The strip will just change color and can be used in a simple pathological lab. The most important part is it will be 100 per cent accurate.

CRISPR Technology:

- Feluda uses cutting-edge gene-editing CRISPR-CAS-9 technology to target and identifies the genomic sequence of the novel coronavirus in suspected individuals
- CRISPR technology recognizes specific genetic sequences and cuts them in a 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.

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.

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7 DISEASE

1 Depletion of particular brain tissue linked to chronic depression, suicide: Study

Context: In a recent research, a common characteristic has been found in the brain structure of people who died by suicide. There was a sharp fall in the density of 'Astrocytes', a particular nerve cell throughout the brain.

What is Astrocytes?

- It is a type of supportive nerve cells, look like the end of a frayerope.
- Astrocytes are **highly heterogeneous neuroglial cells** with distinct functional and morphological characteristics in different parts of the brain.
- They are responsible for maintaining a number of complex processes needed for a healthy **central nervous system (CNS).**
- The density was five times lower in the **mediodorsal thalamus** and **caudate nucleus** and half in the **prefrontal cortex** in the subjects who had died by suicides.
- Astrocytes can strongly modulate most facets of neuronal activity, including neuronal firing, neurotransmitter synthesis, neurotransmitter reuptake and synaptic transmission.

How reduction in astrocytes have negative effects?

- With fewer astrocytes, the neurons in this circuit (important for decision making and emotional regulation, functions) may not function as well as they otherwise would.
- Abnormalities in the prefrontal cortex also seem to be connected to impulsivity, which may play a role in suicide in some cases.

Three regions of the brain that are considered to be responsible for emotion regulation were studied— **dorsomedial prefrontal cortex, dorsal caudate nucleus and mediodorsal thalamus**

2 India's 1st Indigenously Developed Pneumococcal Vaccine "Pneumosil"

Context: The Government launched the country's first pneumococcal conjugate vaccine ''Pneumosil'' developed by Serum Institute of India in collaboration with partners like the Bill and Melinda Gates Foundation.

About:

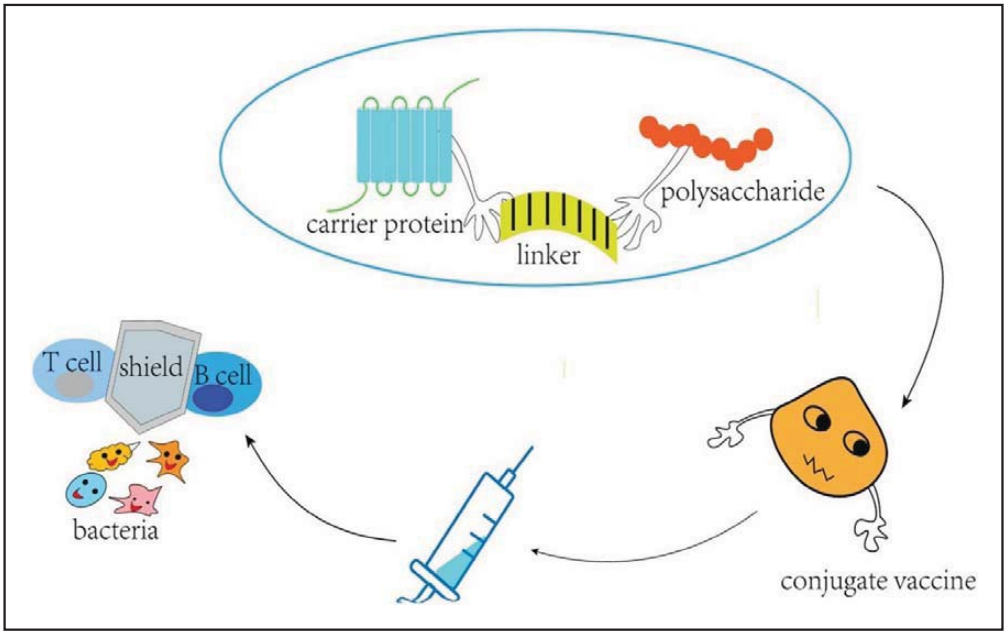
- Pneumococcal disease is a name for any infection caused by bacteria called **Streptococcus pneumoniae, or pneumococcus.**
- Pneumococcal infections can range from ear and sinus infections to pneumonia and bloodstreaminfections.
- There are vaccines to help prevent pneumococcal disease.
- Bacteria called **Streptococcus pneumoniae, or pneumococcus**, can cause many types of infections. Some of these infections can be life threatening.
  - **Pneumonia:** A lung infection
  - **Bacteremia:** A blood infection
  - **Sinusitis:** A sinus infection
  - **Meningitisl:** A infection of the lining of the brain and spinal cord
  - **Otitis Media:** A middle ear infection

About Pneumosil

- PNEUMOSIL is a Polysaccharide Conjugate Vaccine which is sterile suspension of saccharides of the capsular and tigens of Streptococcus pneumoniae serotypes.

Polysaccharide Conjugate Vaccine

- The polysaccharide conjugate vaccine adds the positive characteristics of protein antigens to the polysaccharide antigen, thereby improving the immunogenicity of the polysaccharide antigen, solving the problem that the polysaccharide vaccine cannot be effectively applicable in toddler or children.



3 Tobacco behind more than a quarter of India's cancer cases

Context: As many as 27 per cent of cancer cases were caused due to tobacco consumption, according to a new report released by the National Cancer Registry of India (NCRI).

Cancer

- Cancer is when the cells start to grow out of control.
- The cancer cells keep on growing and making new cells. They crowd out normal cells. This causes problems in the part of the body where the cancer started.
- Cells become cancerous due to the accumulation of defects, or mutations, in their DNA. Certain:
  - Inherited genetic defects (for example, BRCA1 and BRCA2 mutations)
  - Infections
  - Environmental factors (for example, air pollution)
  - Poor lifestyle choices -- such as smoking and heavy alcohol use can also damage DNA and lead to cancer

Tumor

- Most cancers form a lump called a tumor. But not all lumps are cancer.
- Lumps that are not cancer are called benign. Lumps that are cancer are called malignant.
- There are some cancers, like leukemia (cancer of the blood), that don't form tumors. They grow in the blood cells or other cells of the body.

Types of Cancer

- **Carcinoma** is a cancer that starts in the skin or the tissues that line other organs.
  - **Lung cancer:** A cancer that begins in the lungs and most often occurs in people who smoke.
  - **Breast Cancer:** A cancer that forms in the cells of the breasts.
  - **Prostate cancer:** A cancer in a man's prostate, a small walnut sized gland that produce seminal fluid.
  - **Sarcoma** is a cancer of connective tissues such as bones, muscles, cartilage, and blood vessels.
  - **Leukaemia** is a cancer of bone marrow, which creates blood cells.
  - **Lymphoma** an **myeloma** are cancers of the immune system.
  - **Brain and spinal cord cancers** – these are known as central nervous system cancers

National Cancer Registry of India

- The Indian Council of Medical Research set up the National Cancer Registry Programme (NCRP) in 1982.
- The programme is overseen by the ICMR National Centre for Disease Informatics & Research (NCDIR), Bengaluru.
- A network of population and hospital-based cancer registries (PBCR, HBCR) systematicallycollect data related to cancer incidence, mortality and clinical aspects to estimate burden, trends, survival and management.

Is Cancer a notifiable disease?

- Majority of states in India have not declared cancer as a notifiable disease.

- So far, only nine States in India have cancer as a notifiable disease so far either as administrative order or Gazette notification, including Karnataka.
- A notifiable disease is any disease that is required by law to be reported to government authorities. The collation of information allows the authorities to monitor the disease, and provides early warning of possible out breaks.

How Tobacco is killing people?

- Poisons in to bacco smoke can damage or change a cell's DNA.
- Toxic gases damage the cilia, while Tar, the solid particle in tobacco smoke coats lungs like soot in a chimney. Some chemicals in your cigarette are:
  - **Ammonia** – commonly used in toilet cleaners
  - **Cyanide** – used as rat poison
  - **Formaldehyde** – used in laboratories for preservation of dead specimens
  - **Nicotine** – habit forming, addictive drug

4 African Swine Fever

Context: China, the biggest consumer of pork in the world, has banned the import of pigs and wild boars from India to prevent the spread of the African swine fever (ASF).

About:

- African swine fever (ASF) is a severe viral disease affecting domestic and wild pigs.
- This **transboundary animal disease (TAD)** can be spread by live or dead pigs, and pork products; furthermore, transmission can also occur via contaminated feed and fomites (non-living objects) due to the high environmental resistance of ASF virus
- There is **no approved vaccine** against ASF.
- Humans are not susceptible to the disease.
- **Symptoms:** Symptoms include fever, loss of appetite, lack of energy, abortions, internal bleeding, with haemorrhages visible on the ears and flanks. Sudden death may occur.

Outbreaks:

- It was first detected in Africa in the 1920s.
- More recently (since 2007) the disease has been reported in multiple countries across Africa, Asiaan Europe, in both domestic and wild pigs.

Since February 2020, African swine fever (ASF) has killed over 17,000 pigs in Assam and an unknown number in Arunachal Pradesh. This is the first time India has reported the disease, and since ASF hasn't been to India before.

5 Shigella infection

Context: A number of cases of shigella infection have detected in Kozhikode district of Kerala.

What is shigella infection?

- Shigellosis or Shigella infection is a contagious intestinal infection.

- **Caused by:** It is caused by a genus of bacteria known as **Shigella.**
  - The same bacteria is also understood to be the prime reason for the occurrence of diarrhea especially among children in the African and South Asian countries.
  - The lethal bacteria enters the body through ingestion and harms the epithelial lining of thecolon resulting in severe inflammation and subsequent damage to the cells.
  - The bacteria is so lethal that only a minute number of bacteria can cause havoc in a person's body.
- **Transmission:** It gets transmitted from person to person after the bacteria has been ingested bythe person accidentally.

What are the symptoms?

- People with shigellosis may start experiencing symptoms within one or two days of the entry of germs in the body.
- The common symptoms are:
  - diarrhea (often bloody and painful)
  - stomach pain
  - fever
  - nausea
  - vomiting
- There have been cases too where people don't experience any signs of the bacterial infection.

6 Need action to avert Measles and Polio epidemics

Context: The UNICEF and World Health Organization (WHO) called for action to avert measles and polio epidemics as the novel coronavirus disease (COVID-19) continued to disrupt immunisation services across the world.

About:

Measles

- Measles is caused by a virus in the **paramyxovirus family.** It is serious for small children.
- The disease spreads through the air by respiratory droplets produced from coughing orsneezing.
- **Symptoms:** They include cough, runny nose, inflamed eyes, sore throat, fever ana red, blotchy skin rash.
- **Prevention:** It is easily preventable by a **vaccine**.
- **Treatment:** There is **no treatment** to get rid of and established measles infection.

Polio

- Polio, or poliomyelitis, is a disabling and life-threatening disease caused by the poliovirus.
- The virus spreads from person to person and can infect a person's spinal cord, causing paralysis.
- Most people who get infected with poliovirus will not have any visible symptoms.
  - About 25% people with infection will have flue-like symptoms that may include: Sore throat, Fever, Tiredness, Nausea, Headache and Stomach pain
- A smaller proportion of people with poliovirus infection will develop other, more serious symptoms that affect the brain and spinal cord:

- **Paresthesia** (feeling of pins and needles in the legs)
- **Meningitis** (infection of the covering of the spinal cord and/or brain) occurs in about 25%
- **Paralysis** or weakness in the arms, legs, or both, occurs in about 1 out of 200 people with poliovirus infection.

The current situation of the disease

- Poliovirus transmission is expected to increase in Pakistan and Afghanistan and in many under-immunised areas of Africa.
- Pakistan and Afghanistan are among the two countries where polio is still endemic.

7 Eluru Mystery Disease

Context: A 'mystery disease' has left 450 patients in Eluru, Andhra Pradesh with seizures, nausea, dizziness and headaches. Among tentative reasons being blamed are organochlorides.

What are organochlorines?

- Organochlorines (OC) are a group of **chlorinated compounds** that belong to the class of **persistentorganic pollutants (POPs)** with high persistence in the environment.
- OC **insecticides** were earlier used to control malaria and typhus; they were later banned in mostcountries.
- They are widely used as **pesticides**.
- They are relatively cheaper as a result Dichloro diphenyl trichloroethane (DDT), hexachlorocyclohexane (HCH), aldrin andieldrin are among the most widely used pesticides in developing countries of Asia.

How can these pesticides affect human health?

- **Short-term exposure:** Exposure to organochlorine pesticides over a short period may result in convulsions, headache, dizziness, nausea, vomiting, tremors, confusion, muscle weakness, slurred speech, salivation and sweating.
- **Long-term exposure:** Long-term exposure to organochlorine pesticides may damage the liver, kidney, central nervous system, thyroid and bladder

8 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.
- 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.
- Cytokine storms are a common complication not only of covid-19 and flue but of other respiratory diseases caused by coronaviruses such as SARS anMERS.
- 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.
- 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.

Role of inflammation in immunity

- 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 potentially, death.

9 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.

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.

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, introduce BCG mass immunisation in 1948.

10 Acute Encephalitis Syndrome (AES)

Context: Bihar government fearing outbreak of AES again.

About:

- Locally known as **Chamki Bukhar**, it has claimed the lives of more than 500 children in the previous decade.
- It is characterized as acute-onset of fever and a change in mental status (mental confusion, disorientation, delirium, or coma) and/or new-onset of seizures in a person of any age at any time of the year.
- **Symptoms:** AES complications may include memory loss, coma and even death. The signs and symptoms typically include:
  - High Fever
  - Headache
  - Vomiting
  - Confusion
  - Seizures
  - Sensitivity to light Stiff neck and back Memory loss
  - Problems with speech or hearing
  - Drowsiness
  - In some severe cases, paralysis and coma
- **Who is affected?** It mostly affects people below 15 years.
- **Hotspot:** AES has its endemic zones covering the Gangetic plain like states of Bihar, Assam, east UP, West Bengal and some parts of Tamil Nadu.

11 Multi-System Inflammatory State

Context: Doctors have picked up a slight rise in the number of children of all ages needing intensive care treatment for a condition called "multi-system inflammatory state".

About:

- Multi-system inflammatory state is a severe immune response that can affect the body in multiple ways, most importantly by making the blood vessels leaky, similar to the condition called Kawasaki disease.
- This leads to low blood pressure and a build-up of fluid in the lungs and organs. It is extremely serious.
- Patients need urgent intensive care to support the heart, lungs and sometimes other organs such as the kidneys.

Symptoms:

- The children have overlapping symptoms of two diseases:
  - **Toxic Shock Syndrome**: TSS is where bacteria gets into the body and releases harmful toxins that cause a temperature and flue-like symptoms, as well as nausea and vomiting and a loss of consciousness in severe cases.
  - **Unusual Kawasaki Disease:** A rare vascular condition that is the main cause of acquire heart disease in under-18.

12 Hantavirus in China

Context: Reports have emerged of another virus, termed the Hantavirus, surfacing in China, at a time when the country was on a path to recovery from the novel coronavirus disease (COVID-19) outbreak.

About:

- The Hantavirus comes from a family of viruses that spreads mainly from rodents and can cause a range of diseases.
- The term 'hantavirus' refers to a genus covering several tens of species or genotypes globally; differing in their virulence to humans.
- **Symptoms:** The symptoms of the infection are fatigue, muscle ache and fever.
  - The affected person can also experience stomach pain, diarrhoea, vomiting and headache.
  - In more serious cases, it can lead to kidney failure and lung disease.
- But other symptoms have also been observed in children, including gastrointestinal problems and heart inflammation.

13 Classical Swine Fever

Context: Amid Coronavirus outbreak, 1300 pigs died of Classical Swine Fever (CSF) in Assam.

About:

- Classical swine fever (CSF), also known as hog cholera, is a contagious viral disease of domestic and wild swine.
- It is caused by a virus of the genus Pestivirus of the family Flaviviridae, which is closely related to the viruses that cause bovine viral diarrhoea in cattle and border disease in sheep.
- There is only one serotype of CSF virus (CSFV).
- CSF is a disease listed by the OIE World Organisation for Animal Health (OIE) Terrestrial Animal Health Code and must be reported to the OIE (OIE Terrestrial Animal Health Code).

Transmission anspread:

- **Direct contact:** The most common method of transmission is through direct contact between healthy swine and those infected with CSF virus. The virus is shed in saliva, nasal secretions, urine, and feces.
- **Contact with contaminated items:** Contact with contaminated vehicles, pens, feed, or clothingmay spread the disease.

14 Deconstructing SARS-CoV-2 virus

Context: The novel coronavirus disease (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 virus) has affected more than half-a-million people across the globe.

About:

- SARS coronavirus (SARS-CoV) – virus was identified in 2003. SARS-CoV is thought to be an animal virus from an animal reservoir, perhaps bats, that spread to other animals (civet cats).

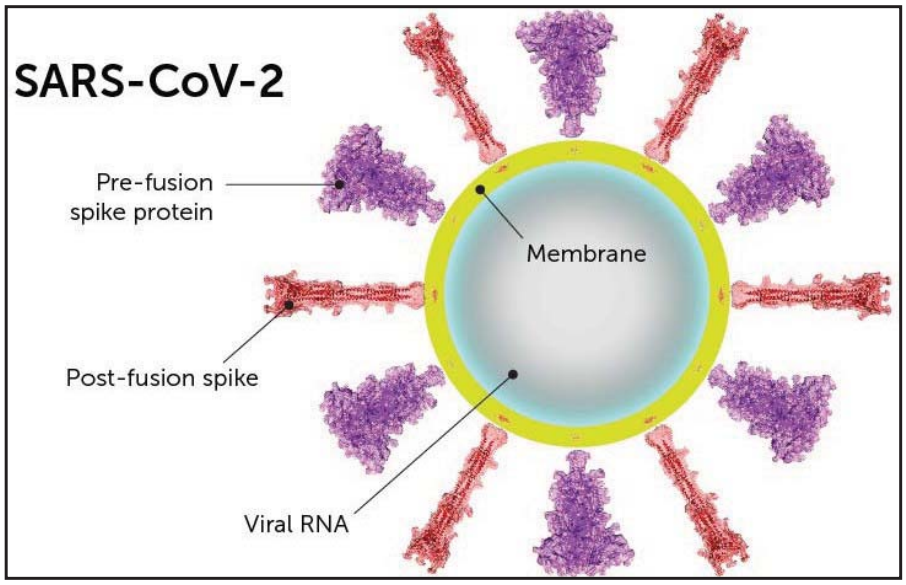
- It first infected humans in the Guangdong province of southern China in 2002.

How RBD facilitates the virus?

- SARS-CoV-2 has **spike proteins** which contain a **receptor-binding domain (RBD).**
- The RBD facilitates the virus' entry into target cells by binding with the **angiotensin-converting enzyme-2** (ACE-2) found in heart, lungs, kidneys and the gastrointestinal tract.
- The mutation (if any) increases the RBD's bonding affinity with the ACE-2 of target cells in humans, ferrets and Malayan Pangolins.
- This bonding is stronger in SARS-CoV-2 virus than it was in SARS-CoV virus, which caused the SARS [Severe Acute Respiratory Syndrome] epidemic in 2002-2003.
- The stronger bonding affinity partly explains CoVID-19's faster spread.

What is spike protein?

- The presence of S proteins on the coronavirus is what gives rise to the **spike-shaped protrusions** found on their surface.
- S proteins of coronavirus can be divided into two important functional subunits, which includethe N-terminal S1 subunit, which forms the globular head of the S protein, and the C-terminal S2 region that forms the stalk of the protein and is directly embedded into the viral envelope.



15 Huntingtin Disease

Context: A team of scientists from National Centre for Cell Science (NCCS) observed that the pathogenic Huntingtin protein causes a decrease in the overall protein production in cells.

About:

- Huntington disease (HD) is a progressive genetic disorder affecting the brain that causes uncontrolled movements, impaired coordination of balance and movement, a decline in cognitive abilities, difficulty in concentrating and memory lapses, mood swings and personality changes.
- It is caused by a mutation in a gene calle **HTT**. The HTT genes are involved in the production of aprotein called huntingtin.

- HTT genes provide the **instruction** for making the protein. When the genes mutate, they provide**faulty instructions** leading to production of **abnormal huntingtin proteins** anthese form intoclumps.
- The clumps disrupt the normal functioning of the brain cells, which eventually leads to the death of neurons in the brain, resulting in Huntington disease.
- While it is known that the clumps formeby the abnormal huntingtin protein disrupt several cellular processes, it is not known whether they also influence the key process in the formation of other proteins in the cell.

16 ICMR warns India of 'Cat Que Virus'

Context: Even as the worlis still grappling with the COVID-19 pandemic, the Indian Council of Medical Research (ICMR) scientists have founanother virus, the 'Cat Que Virus,' reportemainly in China.

What is Cat Que Virus?

- CQV belongs to the **Simbu serogroup** aninfects both **humans** aneconomically important **livestock** species.
- One of the arthropod-borne viruses (arboviruses), the CQV may cause febrile illnesses, meningitis,anpaediatric encephalitis among humans.
- **Natural host:** Its natural host is a mosquito. Domestic pigs are the primary mammalian host of CQV.

Antibodies against the virus

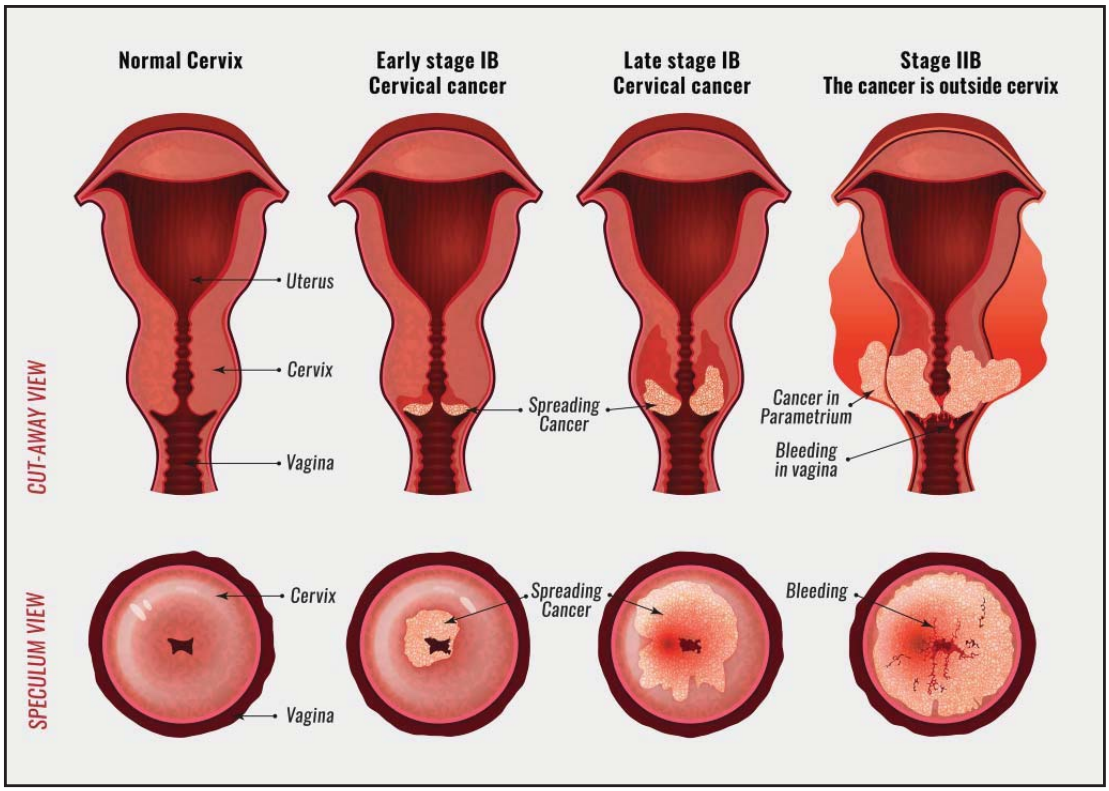
- Antibodies against the virus have been reportein swine rearelocally in China.
- It indicates that the virus has formea "natural cycle" in the local area anhas the ability to spreain pigs another animal populations through mosquitoes.

17 WHO commits to eliminate cervical cancer globally

Context: In a first, the WorlHealth Organisation's (WHO) launchethe Global Strategy to Accelerate the Elimination of Cervical Cancer.

About:

- Cervical cancer develops in a woman's **cervix** (the entrance to the uterus from the vagina).
- Almost all cervical cancercases (99%) are linkedtoinfection with **high-risk human papillomaviruses (HPV)**, an extremely common virus transmittethrough sexual contact.
- Although most infections with HPV resolve spontaneously ancause no symptoms, persistentinfection can cause cervical cancer in women.
- Effective primary **(HPV vaccination)** ansecondary prevention approaches (screening for, antreating precancerous lesions) will prevent most cervical cancer cases.
- When diagnosed, cervical cancer is one of the most successfully treatable forms of cancer, as longas it is detecteearly anmanageeffectively.
- Cancers diagnosein late stages can also be controllewith appropriate treatment anpalliative care.



Key-highlights of the Programme

- The programme aims to complete the following targets by 2030 globally:
  - 90 per cent of girls fully vaccinated with the **Human papillomavirus (HPV) vaccine** by 15 years of age
  - 70 per cent of women screened using a high-performance test by 35 years and again by 45 years
  - 90 per cent of women identified with the cervical disease receive treatment (90 per cent of women with pre-cancer treated and 90 per cent of women with invasive cancer managed).
- Another highlight of the strategy is to stress investing in interventions to meet these targets that can generate substantial economic and societal returns.

18 Kyasanur Forest Disease (KFD)

Context: Karnataka government has allocated Rs. 15 crore for establishing a research center 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 Harticks (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 infecteanimal (a sick or recently deamonkey).
- **Signs and Symptoms:** chills, fever, headache, severe muscle pain, vomiting, gastrointestinal symptoms, and bleeding. Patients may experience abnormally low bloopressure, anlow platelet, red blood cell, and white blood cell count.
- **Diagnosis:** It can be diagnoseind 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.**

19 Rare Diseases Day

Context: World Rare Disease Day is observed every year on the last day of February.

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.
- 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.

What causes rare diseases?

- There are many different causes of rare diseases. The majority are thought to be genetic, directly caused by changes in genes or chromosomes.
- In some cases, genetic changes that cause disease are passed from one generation to the next.
- In other cases, they occur randomly in a person who is the first in a family to be diagnosed.
- Many rare diseases, including infections, some rare cancers, and some autoimmune diseases, are not inherited.
- The most common rare diseases identified in India are **Haemophilia, Thalassemia, Sickle-cell Anaemia, Primary Immuno Deficiency, Lysosomal Storage Disorders such as Gaucher Disease, Fabry Disease, Hunter Syndrome and Pompe's Disease.**

20 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.

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:** Asian tick calle **Haemaphysalis longicornis** is the primary vector, or carrier, ofthe virus.
- **Who are vulnerable?** Farmers, hunters and pet owners 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 animalslike 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 blooof mammals, birds, and sometimes reptiles anamphibians.
- They are mostly found in bushes, grass and shrubs. The eight-legged bugs are arachnids --relateto 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

21 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 causeby 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 milto 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
  - **Acute amoebiasis** can present as diarrhoea or dysentery with frequent, small and often bloodyd stools.
  - **Chronic amoebiasis** can present with gastrointestinal symptoms plus fatigue, weight loss and occasional fever.

What is Entamoeba histolytica?

- According to the World Health Organization (WHO), Entamoeba histolytica is the third-leading cause of morbidity anmortality due to parasitic disease in humans.
- E. histolytic 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 of products.
- Besides the GI tract, E. histolytica can affect many organ systems.

- Extraintestinal amoebiasis can occur if the parasite spreads to other organs, most commonly the liver where it causes an amoebic liver abscess.
- Amoebic liver abscess presents with fever anright upper quadrant abdominal pain.

22 World Tuberculosis (TB) Day

Context: Each year, World Tuberculosis (TB) Day is commemorateon March 24 to raise public awareness about the devastating health, social aneconomic consequences of TB.

Analysis:

World TB Day:

- The date marks the day in 1882 when Dr. Robert Koch announced that he had discovered the bacterium that causes TB, which opened the way towards diagnosing and curing this disease.
- **Theme:** The theme of World TB Day 2020 - 'It's time'

What is Tuberculosis?

- Tuberculosis (TB) is caused by bacteria **(Mycobacterium tuberculosis)** that most often affect the lungs. Tuberculosis is curable and preventable.
- **Transmission:** TB is spread from person to person through the air. When people with lung TB cough, sneeze, or spit, they propel the TB germs into the air.
- **Symptoms:** Common symptoms of active lung TB are cough with sputum and blood at times, chest pains, weakness, weight loss, fever, and night sweats.

Multidrug-resistant tuberculosis (MDR-TB):

- Multidrug-resistant tuberculosis (MDR-TB) is a form of TB caused by bacteria that do not respond to at least isoniazianrifampicin, the 2 most powerful first-line anti-TB drugs.
- MDR-TB is treatable and curable by using second-line drugs. However, second-line treatment options are limited and require extensive chemotherapy (up to 2 years of treatment) with medicines that are expensive antoxic.
- In some cases, more severe drug resistance can develop. Extensively drug-resistant TB (XDR-TB) is a more serious form of MDR-TB caused by bacteria that do not respon to the most effective second-line anti-TB drugs, often leaving patients without any further treatment options.

What is extensively drug-resistant tuberculosis (XDR TB)?

- Extensively drug-resistant TB (XDR TB) is a rare type of MDR TB that is resistant to isoniazianrifampin, plus any fluoroquinolone and at least one of three injectable second-line drugs (i.e., amikacin, kanamycin, or capreomycin).

Government initiatives to enTB

- **Nikshay Poshan Yojana (NPY):** Government of India introduced Nikshay Poshan Yojana (NPY) through Direct Benefit Transfer (DBT) as monthly financial assistance towards nutrition for TB patients in 2018. It aims to-
  - To determine the number (proportion) of TB patients who received the benefits
  - To explore the challenges encountere by the health care providers in delivering the NPYthrough DBT To explore the ways the incentives were utilized by the patients.
- **TB Harega Desh Jeetega:** Launched in 2019, it is a nationwide campaign to spreadisease awareness about TB and encourd age people with TB symptoms to seek medical attention.

- **Saksham Pravah Project:** The project provides home-based counseling to MDR-TB patients and caregivers. Patients are encouraged to share fears and talk about the discrimination, depression, and familial discord they face.

23 World Chagas Disease Day

Context: For the first time, the global community is preparing to celebrate 14 April as the first World Chagas Disease Day.

About:

- Chagas disease, also called American trypanosomiasis, has been termed as a "silent and silence disease", not only because of its slowly progressing and frequently asymptomatic clinical course but also because it affects mainly poor people who have no political voice or access to health care.
- Once endemic in Latin American countries, Chagas disease is now present in many others, making it a global health problem.

Transmission of the disease:

- The disease can be transmitted by vectorial transmission (T. cruzi parasites) are mainly transmitted by contact with faeces/urine of infected blood-sucking triatomine bugs.
- These bugs, vectors that carry the parasites, typically live in the wall or roof cracks of poorly-constructed homes in rural or suburban areas.

24 World Malaria Report 2020

Context: India has made considerable progress in reducing its malaria burden, as per the World Malaria Report 2020.

About:

- **Causeby:** Malaria is caused by Plasmodium parasites. The parasites are spread to people throughthe bites of infected female Anopheles mosquitoes, called" malaria vectors."
  - 5 parasite species cause malaria in humans, and of these species – P. falciparum and P. vivax –pose the greatest threat.
- **Symptoms:** The first symptoms – fever, headache, and chills – may be mild an difficult to recognize as malaria.
- **Transmission:** In most cases, malaria is transmitted through the bites of female Anophelesmosquitoes.

Key-highlights of the Report

- The report is published by World Health Organisation
- India is the only high endemic country that has reported a decline of 17.6 per cent in 2019 as compared to 2018 as far as malaria cases are concerned.
- The **Annual Parasitic Incidence (API)** reduced by 27.6 per cent in 2018 as compared to 2017, and by 18.4 per cent in 2019 as compared to 2018. India has sustained API less than one since year 2012.
- India has also contributed to the largest drop in such cases region-wide, from approximately 20 million to about 6 million.

- The percentage drop in the malaria cases was 71.8 per cent and deaths were 73.9 per cent between 2000 to 2019.
- India achievead reduction of 83.34 per cent in malaria morbidity and 92 per cent in malaria mortality between the year 2000 (20,31,790 cases, 932 deaths) and 2019 (3,38,494 cases, 77deaths), there by achieving Goal 6 of the Millennium Development Goals (50-75 percent decrease in case incidence between 2000 and 2019).

Government's Malaria elimination efforts

- Malaria elimination efforts were initiated in the country in 2015 and intensified after the launch of the **National Framework for Malaria Elimination (NFME)** in 2016 by the Ministry of Health and Family Welfare.
- The **National Strategic Plan for Malaria Elimination (2017-22)** was launched by the health ministry in July 2017

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8 MISCELLANEOUS

1 Engineer's Day in India

Context: The birth anniversary of Sir M Visvesvaraya (September 15) is celebrated every year as Engineer's Day in India.

About Sir MV:

- Popularly called 'Sir MV', he was awarded the Bharat Ratna in 1955 for his immense contribution to India's early infrastructure development, education, and social welfare.
- After completing his undergraduate degree in Arts, M Visvesvaraya changed track and went for a degree in civil engineering from the College of Engineering in Pune.
- As the Diwan of Mysore, M Visvesvaraya founded the Mysore Soap Factory, Bangalore Agricultural University, State Bank of Mysore, and Mysore Iron and Steel Works.
- He also founded the Government Engineering College, now known as University Visvesvaraya College of Engineering.

2 Digital Quality of Life Index

Context: India ranks among the lowest in the world in terms of Internet quality, according to global research released by online privacy solutions provider SurfShark.

About:

- The Digital Quality of Life Index 2020 is prepared by Surfshark, a virtual private network (VPN) provider based in the British Virgin Islands.
- The study sampled the quality of digital wellbeing in 85 countries across the globe over five key pillars:
  - Internet affordability
  - Internet quality
  - electronic infrastructure
  - electronic government
  - electronic security
- All parameters have equal weightage.

Key-highlights of the Index

- As per the "Digital Quality of Life Index 2020", in terms of e-infrastructure, India occupies 79th place, ranking below countries including Guatemala and Sri Lanka.
- India makes it into the top 10 in terms of Internet affordability. With a ranking of nine, it outperforms countries such as the U.K., the U.S., and China.
- Additionally, when it comes to e-government, India occupies 15th place globally, just below countries like New Zealand and Italy.
- However, India's Internet quality is one of the lowest across 85 countries analyzed in the research.
- In position 78, India is at the bottom of the pillar with unstable and slow mobile Internet dragging it down in the overall Internet quality index.
- This year's Digital Quality of Life Index found that seven of the 10 countries with the highest digital quality of life are in Europe, with Denmark leading among 85 countries.
- Canada stands out as a country with the highest digital quality of life in the Americas, while Japan takes the leading position in Asia.
- Among the countries in Africa, people in South Africa enjoy the highest quality of digital lives whereas New Zealand leads in Oceania, outperforming Australia in various digital areas.

3 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

Ammonium nitrate, the substance used

- In its pure form, ammonium nitrate (NH4NO3) is a white, crystalline chemical that is soluble in water.
- It is the main ingredient in the manufacture of commercial explosives used in mining and construction.

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 the storage of ammonium nitrate in large quantities in populated areas illegal in India.
- For the manufacture of ammonium nitrate, an Industrial license 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.

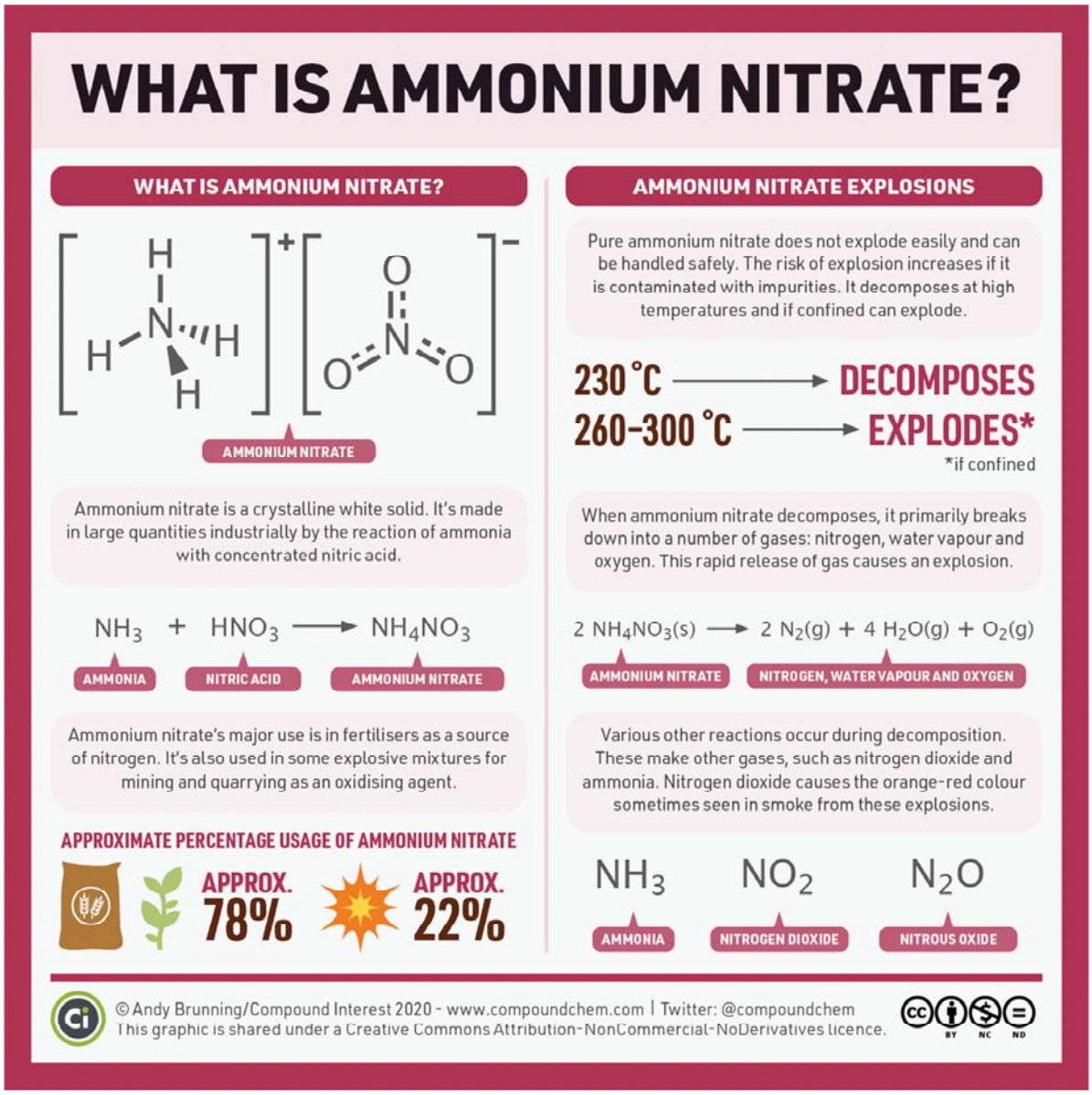
Is it explosive?

- Pure ammonium nitrate is not an explosive on its own. It is classified as an oxidizer 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(ammonium nitrate fuel oil) 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 an explosive mixture:** One is by some type of detonation or initiation because the storage comes in contact with the explosive mixture.
  - **Fire or heat generation:** Second, the blast can result due to a fire that starts in the ammonium nitrate store because of the heat generated due to the oxidation process at a 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 Texas in 1947.



4 ANtarctic Impulsive Transient Antenna

Context: In a significant breakthrough, a team of researchers has succeeded in finding "a fountain of high-energy particles erupting from the ice" in Antarctica which according to the researchers could be proof of a parallel universe. The event was recorded by NASA's ANITA.

What is ANtarctic Impulsive Transient Antenna or ANITA?

- Designed by NASA, the ANITA instrument is a radio telescope that is used to detect ultra-high energy cosmic-ray neutrinos from a scientific balloon flying over Antarctica.
- ANITA, a stratospheric balloon payload flying over the Antarctic, is the first NASA observatory for neutrinos of any kind.

The findings:

- ANITA succeeded in detecting the 'fountain' of high-energy particles in 2006 and 2014 but the researchers initially thought of them as background noise or glitches.
- Low-energy, subatomic neutrinos can pass completely through Earth, but higher-energy objects are stopped by solid matter, which means that the high-energy particles can only be detected coming "down" from space.
- But the team's ANITA detected heavier particles, so-called tau neutrinos, which come "up" out of the Earth, implying that these particles are traveling backward in time, suggesting evidence of a parallel universe.

What are neutrinos?

- Neutrinos are high-energy particles that pose no threat to us and pass through most solid objects without anyone even noticing.
- Neutrinos constantly bombard Earth and as per some estimates emerging from studies, 100 trillion neutrinos pass through your body every second!
- Rarely do they interact with matter. But if they do smash into an atom, they produce a shower of secondary particles we can detect, which allows us to probe where they came from in the universe.
- ANITA detects neutrinos pinging in from space and colliding with the matter in the Antarctic ice sheet.

5 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 "Future of STI: Impacts on Education, Skills, and Work".
- 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 honored him with the Bharat Ratna, its highest civilian award, in 1954.

- CV Raman was appointed to be the first Indian director of the 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 that are energized 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 utilized 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 color.
- 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.

6 World Neglected Tropical Diseases (NTD) Day

Context: The first-ever edition of "World Neglected Tropical Diseases Day"(World NTD Day) is launched on 30 January 2020. This initiative brings together various civil society organisations, community leaders, global health experts and policymakers working in the field of NTDs.

What are Neglected tropical diseases (NTDs)?

- **Neglected tropical diseases** (NTDs) are a diverse group of communicable diseases that prevail in tropical and subtropical conditions in 149 countries.
- NTDs are a diverse set of bacterial, viral, and parasitic pathogens that collectively cause significant illness and debilitation, primarily in impoverished communities of low and middle-income countries.
- Neglected tropical diseases (NTDs) are called "neglected," because they generally afflict the world's poor and historically have not received as much attention as other diseases.
- Effective control can be achieved when selected public health approaches are combined and delivered locally.
- In May 2013, the **66th World Health Assembly** resolved to intensify and integrate measures against neglected tropical diseases and to plan investments to improve the health and social well-being of affected populations.

Types of Neglected Tropical Diseases:

- Dengue, Rabies, Trachoma, Buruli ulcer, Yaws, Leprosy, Chagas disease, Human African trypanosomiasis (sleeping sickness), Leishmaniases, Lymphatic filariasis.

Significance of the Day:

- **Awareness:** World NTD Day will raise awareness and rally the general public behind the urgent need to end NTDs, helping to keep the issue high on the global agenda. Ending NTDs can help alleviate poverty and uplift entire generations.
- **Checking progress:** World NTD Day will serve as a platform to both celebrate progress and galvanize the diverse global community around the goal of ending NTDs.
- **Broadening the conservation programme:** This day will broaden the conversation beyond the traditional global health community, engaging the general public in the effort to ensure people at risk for NTDs no longer remain "neglected".

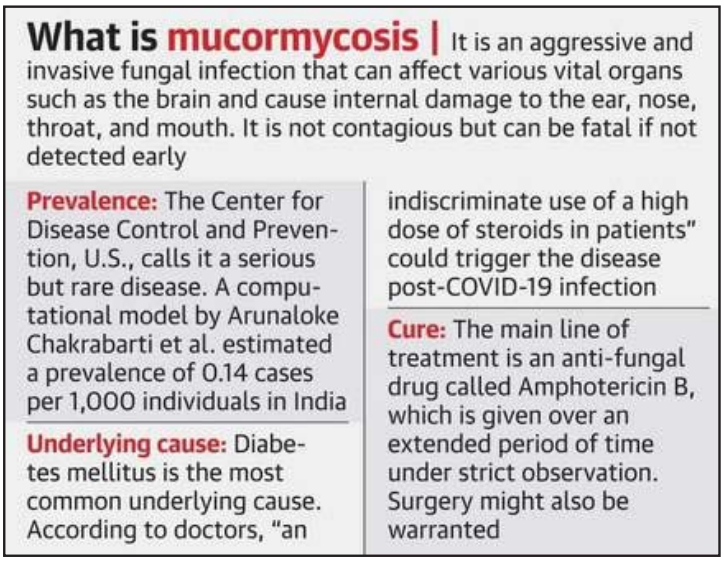
- **Finding new ways:** It is a truly unique collaborative approach with the aim to catalyse innovation and help unlock new ways of reaching a world free of NTDs.
- **Making it a global movement:** Through this day of recognition, the NTD community will align behind a common set of messages and calls to action that drive home the urgent need for political and financial commitments in 2020, while establishing a sustainable annual moment for the NTD community to drive advocacy for the future.

7 Mucormycosis

Context: The **mucormycosis**, the fungal infection being reported in COVID-19 patients, has caused panic among the people as they were struggling to cope with the threat of new pandemic. Even center government had asked states to declare it as epidemic.

What is mucormycosis?

- It is a new challenge in the form of a fungal infection, namely mucormycosis.
- It has emerged and is reported from many States amongst COVID-19 patients, especially in those who are on steroid therapy and deranged sugar control.
- This infection is leading to prolonged morbidity and mortality amongst COVID-19 patients.
- The Union Ministry of health and Family Welfare requested to make mucormycosis a notifiable disease under **Epidemic Diseases Act 1897.**



- **Use:** Declaring the black fungus infection seen in COVID-19 patients an epidemic would lead to health facilities screening for it and reporting all such cases to the government.

Epidemic Diseases Act, 1897

- This was first enacted to tackle bubonic plague in Mumbai in former British India.
- The law is meant for containment of epidemics by providing special powers that are required for the implementation of containment measures to control the spread of the disease.
- A disease can be declared as epidemic by State or Central government.

Earlier use of the Act

- In 2018, the Act was enforced as cholera began to spread in a region of Gujarat.
- In 2015, it was used to deal with dengue and malaria in Chandigarh .
- In 2009 it was invoked in Pune to combat swine flu.
- In 2020, in order to limit the spread of coronavirus disease 2019 during the COVID-19 pandemic in India

8 Deep Fake

Context: AI-generated fake videos (or deep fakes) are becoming more common and convincing. These videos have become one of the key weapons used in propaganda battles for quite some time now.

What is deep fake?

- Deep Fakes are called so because they use deep learning technology, a branch of Artificial intelligence that applies neural network simulation to large data sets, to create fake videos.
- Using this technology, a person's head movements and expressions, etc are transferred onto some other person's video in such a way that it becomes difficult to tell that it is a deep fake unless one closely observes the source media file.
- Here the AI learns what a source face looks like and then transposes it onto another target to perform a face swap seamlessly.

How are deepfakes detected currently?

- Currently, deep fakes are identified manually or by software, using some identifiers like:
- Flicking, blur with bleeding color, etc. in poorly produced deep fake videos
- Unusual eye blinking pattern in deep fake videos
- Using markers known as "soft biometrics" of a person i.e., his/her eyebrow movements, lip movements, etc.

What are the threats posed by deep fakes?

- **Can lead to a new type of Warfare**
- **Can undermine Democracy**
- A high-quality deepfake can create false information.
- Deep fakes can become an effective tool to induce polarization, amplify division in society, and suppress dissent.
- **Can be used for targeting women**
- **Can cause damage to personal reputation**
- **Can be used for financial and other frauds**

How to counter deep fakes?

- **Technological Interventions**
- **Media Authentication**
- **Media provenance**
- **Deep fake detection**
- **Increased public awareness and behavioral change in society**
- **Proper Regulation**

9 Smuggling of Ambergris

Context: In the past few weeks, the Mumbai Police has arrested five persons trying to sell Ambergris or whale vomit.

What is Ambergris?

- Ambergris is generally referred to as whale vomit.
- It is a solid waxy substance that floats around the surface of the water body and at times settles on the coast.
- A sperm whale eats several thousand squid beaks a day.
- Occasionally, a beak makes its way to the whale's stomach and into its looping convoluted intestines where it becomes ambergris through a complex process, and may ultimately be excreted by the whale.

Is it Ambergris valuable?

- This excretion is so valuable it is referred to as floating gold.
- As per the latest estimates, 1 kg of ambergris is worth Rs 1 crore in the international market.
- The reason for its high cost is its use in the perfume market, especially to create fragrances like musk.
- It is also believed to be used in some traditional medicines.

Why are the laws on Ambergris?

- Due to its high value, Ambergris has been a target for smugglers, especially in coastal areas.
- Since the sperm whale is a protected species, hunting the whale is not allowed.
- However, smugglers are known to have illegally targeted the fish to obtain the valuable Ambergris from its stomach.

10 First-ever genetically modified rubber planted

Context: Rubber Research Institute of India had developed a rubber plant tailored for the climatic conditions in the Northeast.

What are Genetically modified organisms (GMOs)?

- A genetically modified organism (GMO) or living modified organism (LMO), is any organism whose genetic material has been modified.
- Mass production of GM technology-based human insulin, vaccines, growth hormones and other drugs has greatly facilitated the availability and access to life-saving pharmaceuticals are the results of Genetic Modification.
- Under this, the gene is incorporated into the DNA of crop plant using laboratory-based gene gun or agrobacterium approaches.
- Bt cotton is the only crop that got permission to be grown as GMO. Other crops such as Bt Brinjal, Potato are waiting for trials and clearance.
- Indian farmers started cultivating Bt cotton in 2002-03.

About the GM rubber

- This is the world's first genetically modified (GM) rubber plant tailored for the climatic conditions in the Northeast.
- The plant was developed at the Kerala-based Rubber Research Institute of India (RRII).
- This is the first time any GM crop has been developed exclusively for a particular region.
- Natural rubber is a native of warm humid Amazon forests and is not naturally suited for the colder conditions in the Northeast, which is one of the largest producers of rubber in India.

- The growth of young rubber plants remains suspended during the winter month.
- The GM rubber would tide over the severe cold conditions during winter, which impacts its growth.
- The GM rubber has additional copies of the gene MnSOD or manganese-containing superoxide dismutase.
- The MnSOD gene can protect plants from the adverse effects of severe environmental stresses such as cold and drought.

11 Hidden 'Goldilocks' black hole exposed by early universe explosion

Context: Analysis of light of a **gamma-ray burst**,which dates back three billion years ago, has revealed the presence of a previously **undetected black hole**.

What is a gamma-ray burst?

- The gamma-ray burst that is known as **GRB 950830** was detected in 1995.
  - GRBs are the most energetic form of electromagnetic events in the universe having short bursts of gamma rays that ejected at the speed of light.
- Gamma-ray bursts are formed when a high-mass star collapses and creates a neutron star or black hole.
- The **gravitational lensing technique** was used to detect the black hole.
  - Under this technique, the gravity around a massive body bends lightwhich comes from a source behind.
  - It is then used to identify the intermediate-mass black hole (IMBH) which lensed the **gamma-ray burst.**

About the finding

- **Intermediate-mass black holes:** The discovered black hole is **Intermediate-mass black holes** which is an elusive category of black holes that was considered non-existing until a few years ago.
  - In 2020, the **Hubble Space Telescope**provided a piece of evidence for an IMBH.

Intermediate-mass black holes (IMBHs)

- **These** are a class of a black hole with a mass approximately 100 to 100,000 times that of the Sun.

What is Gravitational lensing?

- When the light from distant galaxies or events like gamma-ray bursts passes by massive objects in the universe such as stars or black holes then **Gravitational lensing** is expected to occur.
- The gravitational tug of these massive bodies can bend the light and causes the source to look distorted.
  - **Weak:** When gravitational lensing is weak, it distorts the distant object or galaxy to appear magnified or stretched out.
  - **Strong:** When it is strong, it bends light to such a degree that multiple images of the same galaxy are visible.

12 India ranked under Top 10 in Global Cybersecurity Index 2020 Rankings

Context: India showed a significant improvement in the GCI ranking by reaching 37 places upward. It is ranked 10th in the 4th edition of the Global Cybersecurity Index 2020 (GCI).

What is Global Cybersecurity Index 2020?

- The index is released by the **United Nations (UN) agency for information and communication technologies (ITU).**
- It was the 4th edition of the GCI ranking.
- It measures the commitment of countries to cybersecurity at a global level.
- **Pillars**: The GCI index is based on the countries commitment to **5 pillars namely:Legal, Technical, Organizational, Capacity development and Cooperation.**

Key-findings of the index

- **Overall ranking**: USA, UK, Saudi Arabia, and Estonia are ranked at top 3 positions, respectively, in the Index.
- **India's ranking**: India ranked 10th in the Global Cybersecurity Index 2020 (GCI).
- India also ranked 4th in the Asia-Pacific region.
- In the last edition of the GCI in 2018, India was placed at the 47th spot.
- India achieved a consolidated score of 97.5.
- The score is based on 20 indicators under 5 pillars.

United Nations specialized agency for information and communication technologies

- ITU is the United Nations specialized agency for information and communication technologies – ICTs.
- It helps in allocating the global radio spectrum and satellite orbits, develop the technical standards that ensure networks and technologies seamlessly interconnect, and strive to improve access to ICTs to underserved communities worldwide.
- ITU is **committed to connecting all the world's people** wherever they live and whatever their means.
- ITU brings the benefits of modern communication technologies to people everywhere in an efficient, safe, easy, and affordable manner.
- It also released the Global Cybersecurity Agenda.

Global Cybersecurity Agenda (GCA)

- It was launched in 2007 by ITU.
- Global Cybersecurity Agenda (GCA) is a framework for international cooperation aimed at enhancing confidence and security in the information society.
- The GCA is designed for cooperation and efficiency, encouraging collaboration with and between all relevant partner s and building on existing initiatives to avoid duplicating efforts.

13 ZyCov-D vaccine, the world's first DNA vaccine

Context: Ahmedabad-based ZydusCadila has applied to Central Drugs Standard Control Organisation (CDSCO), the national drugs regulator, seeking emergency use authorisation (EUA) for ZyCov-D, its Covid-19 vaccine.

If approved by the regulator, ZyCov-D will be the **world's first DNA vaccine**against infection with SARS-CoV-2.

What is ZyCov-D vaccine or DNA vaccine?

- ZyCov-D is a **"plasmid DNA". These DNA are engineered to show the desired results.**
- The plasmids used in the vaccine are coded with the instructions to make the **spike protein of SARS-CoV-2.**

Plasmid

- A **plasmid** is a small, circular, double-stranded DNA molecule that is distinct from a cell's chromosomal DNA.
- **Plasmids** naturally exist in bacterial cells, and they also occur in some eukaryotes.
- Often, the genes carried in **plasmids** provide bacteria with genetic advantages, such as antibiotic resistance.

- Vaccination gives the code to cells in the recipient's body, so they can begin making the spiky outer layer of the virus.
- The immune system is expected to recognize this as a threat and develop antibodies in response.
- No needle is used to deliver the vaccine, instead, a spring-powered device delivers the shot.
- ZyCov-D has been developed with the support of the central government's **Department of Biotechnology** and the **Indian Council of Medical Research (ICMR).**

Safety concerns

- Safety concerns to integrate into cellular DNA or cause auto-immune diseases.

Emergency Use Authorization

- In the current pandemic situation, it may not be possible to have all the evidence that a drug regulator would normally require for approving a drug, vaccine, device or test.
- When there is a declared emergency, the regulator, in India's case the DCGI, can take a call whether it is worth releasing a drug or vaccine that is not fully tested for efficacy and safety.
- If there is evidence to suggest it may benefit patients, then the regulator is well within its rights to issue an emergency use authorisation to a medical product to make it widely available for use.

Vaccines approved under the EUA

- The process for using the EUA is less clearly spelt out in India, but the DGCI has also been issuing EUAs based on clinical trial data.

- In January, the DCGI approved the first two vaccines
- Covishield, produced by Pune-based Serum Institute of India under licensing agreement from AstraZeneca
- Covaxin, manufactured by Bharat Biotech

14 'The Unicorn', closest known black hole to Earth

Context: Scientists named a newly discovered and the closest to our solar system black hole, in the Milky Way galaxy, as Unicorn. It may be the smallest known black hole.

What is Unicorn?

- **Characteristics:** It is roughly three times the mass of our sun.
- The black hole is located about 1,500 light-years away from Earth.
- A luminous star known as a red giant, orbits with the black hole in a binary star system, named V723 Mon.
- It is nicknamed as the Unicorn' partly because V723 Mon is in the Monoceros constellation that translates to unicorn and partly because it is a unique system.
- The Unicorn is said to be the smallest known black hole.
- It is thought to be formed by the gravitational collapse of a single star.
- 'The Unicorn' falls into a "mass gap", that is between, the largest-known neutron at around 2.2 times the mass of our sun and the smallest black holes at around five times the sun's mass.
- Its strong gravity causes the tidal distortion which alters the shape of its companion star.
- It makes the star elongated rather than spherical and causes its light to change as it moves along its orbital path.

Blackholeand its subtypes

- A **black hole** is a **region of space-timewhere gravity is extremely strong** that no object can escape from it.
- **Types**: There are **two types of black holes which become three with the discovery**:
  - **Stellar-mass black holes:** These are the black holes witha mass of fewer than 100 times that of the Sun.
  - **Supermassive black holes (SMBH):** These are the ones with a mass greater than 100,000 times that of the Sun.
  - **Intermediate-mass black holes (IMBHs)**: These are a class of a black hole with a mass approximately 100 to 100,000 times that of the Sun.
- Both stellar black holes and SMBHs are commonly found.

15 Neutrino Oscillations induced by Space-time

Context: A study conducted by the **National Centre for Basic Sciences (SNBNCBS)** shown that the geometry of space-time can cause neutrinos to oscillate.

The study was supported under the **Department of Science & Technology (DST).**

What are Neutrinos?

- They are mysterious particles, produced copiously in nuclear reactions in the Sun, stars, and elsewhere.
- Neutrinos interact very weakly.
- They oscillate and different types of neutrinos change into one another.
- The phenomenon of neutrino oscillations requires neutrinos to have tiny masses.
- Probing oscillations of neutrinos and their relations with mass are crucial in studying the origin of the universe.

Findings of the study

- The geometry of space-time can cause neutrino oscillations through quantum effects even if neutrinos are massless.
- Einstein's theory of general relativity says that gravitation is the manifestation of space-time curvature.
- The neutrinos, electrons, protons, and other particles which are in the category of fermions show a certain peculiarity when they move in presence of gravity.
- Space-time induces a quantum force in addition to gravity between every two fermions.
- This force can depend on the spin of the particles and causes massless neutrinos to appear massive when they pass through matter, like the Sun's corona or the Earth's atmosphere.
- Something similar happens for electroweak interactions, and together with the geometrically induced mass, it is enough to cause oscillation of neutrinos.

- S**pace-time** is a mathematical model which fuses the three dimensions of **space** and the one dimension of **time** into a single four-dimensional manifold.
- **Spacetime** diagrams can be used to visualize relativistic effects, such as why different observers perceive differently where and when events occur.

5 The genome of a Salt-secreting Mangrove Species Decoded by DBT-ILS

Context: Scientists at the DBT-Institute of Life Sciences, Bhubaneswar have reported for the first time a **reference-grade whole genome sequence** of a **highly salt-tolerant and salt-secreting true-mangrove species, Avicennia marina.**

What are salt secreting Mangroves?

- Mangroves are a unique group of species found in **marshy intertidal estuarine regions** and survive a **high degree of salinity** through several adaptive mechanisms.
- Mangroves are important resources for the coastal region and are of great ecological and economic value.
- They form a link between marine and terrestrial ecosystems, protect shorelines, provide habitat for a diverse array of terrestrial organisms.
- **Avicennia marina** is one of the most prominent mangroves species found in all mangrove formations in India.

- It is a **salt-secreting** and extraordinarily salt-tolerant mangrove species that grows optimally in 75% seawater and tolerates >250% seawater.
- It is among the **rare plant species**, which can excrete 40% of the salt through the salt glands in the leaves, besides its extraordinary capacity to exclude salt entry to the roots.

Significance of study

- This study assumes significance as agriculture productivity globally is affected due to abiotic stress factors such as limited water availability and salinization of soil and water.
- Availability of water is a significant challenge to crop production in dryland areas.
- The genomic resources generated in the study will pave the way for researchers to study the potential of the identified genes for developing drought and salinity tolerant varieties of important crop species of the coastal region that is significant for India with 7,500m of coastline and two major island systems.

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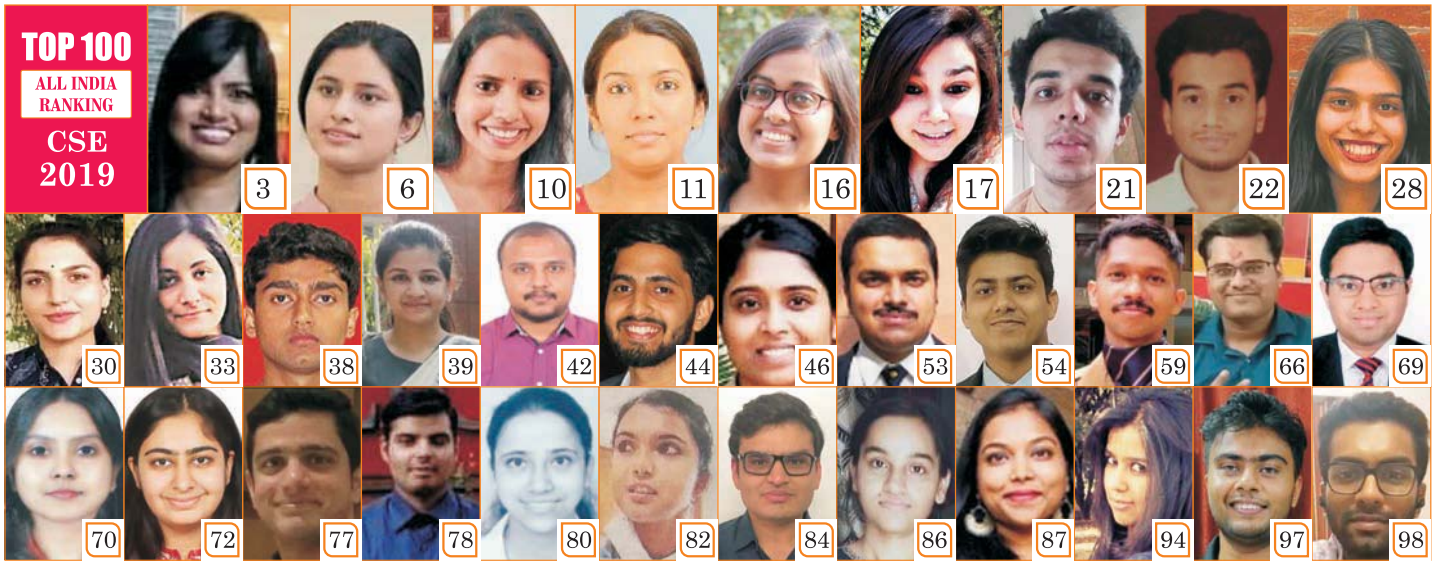

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