Drishti IAS Presents...

# PT SPRINT 2023

# SCIENCE & TECHNOLOGY

(March 2022 – March 2023)


Drishti IAS, 641, Mukherjee Nagar, Opp. Signature View Apartment, New Delhi

Drishti IAS, 21 Pusa Road, Karol Bagh New Delhi - 05

Drishti IAS, Tashkent Marg, Civil Lines, Prayagraj, Uttar Pradesh

Drishti IAS, Tonk Road, Vasundhra Colony, Jaipur, Rajasthan

e-mail: englishsupport@groupdrishti.com, Website: www.drishtiias.com

Contact: Inquiry (English): 8010440440, Inquiry (Hindi): 8750187501

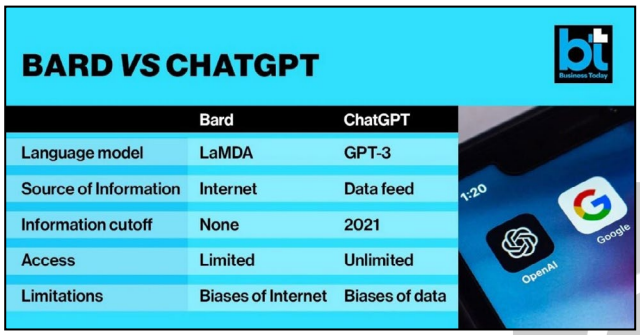
# Contents

# ChatGPT- Powered WhatsApp Chatbot

## Why in News?

The Ministry of Electronics and IT's (MeitY) **BHASHINI** is working on a **ChatGPT-Powered WhatsApp Chatbot** to help Indian farmers learn about various government schemes.

- Google will soon unveil its new **AI chatbot Bard** in response to Microsoft's **ChatGPT**.




## What is Bard?

- **About:**
  - Bard is based on the Language **Model for Dialogue Application (LaMDA)**, Google's own conversational AI chatbot.
  - It will give in-depth, conversational and essay-style answers just like ChatGPT does right now.
  - However, the model is currently a "lightweight" version of LaMDA, and the one being "requires significantly less computing power, enabling it to scale to **more users**

## What is ChatGPT?

- **About:**
  - ChatGPT is a **variant of GPT (Generative Pre-trained Transformer)** which is a large-scale **neural network-based language model developed by OpenAI.**
  - GPT models are **trained on vast amounts of text data** to generate human-like text.
  - It can generate **responses to a wide range of topics,** such as answering questions, providing explanations, and engaging in conversations.
  - In addition to being able to "admit its mistakes, challenge false premises, and refuse unsuitable requests," the ChatGPT can also "answer follow-up questions."
  - The chatbot was also trained using **Reinforcement Learning from Human Feedback (RLHF).**

# Generative Artificial Intelligence

## Why in News?

The use of **Generative Artificial Intelligence (GAI)** is still in its early stages but its impact is likely to grow as technology continues to evolve and improve.

## What is Generative Artificial Intelligence?

- **About:**
  - GAI is a rapidly growing branch of AI that focuses on generating new content (such as images, audio, text, etc.) based on patterns and rules learned from data.
  - The rise of GAI can be attributed **to the development of advanced generative models,** such as **Generative Adversarial Networks (GANs)** and **Variational Autoencoders (VAEs).**
  - These models are trained on large amounts of data and are able to generate new outputs that are similar to the training data. For example, a GAN trained on images of faces can generate new, synthetic images of faces that look realistic.
  - While GAI is often associated with **ChatGPT** and **deep fakes**, the technology was initially used to automate the repetitive processes used in digital image correction and digital audio correction.
  - Arguably, because **machine learning** and deep learning are inherently focused on generative processes, they can be considered types of GAI, too.
- **Applications:**
  - **Art and Creativity:**
    - It can be used to generate new works of art that are unique and innovative, **helping artists and creatives explore new ideas** and push the boundaries of traditional art forms.
    - **DeepDream Generator** - An open-source platform that uses deep learning algorithms to create surrealistic, dream-like images.

Note:

- **DALL·E2** - This AI model from OpenAI generates new images from text descriptions.

❍ **Music**:

- It can help musicians and music producers explore new sounds and styles, leading to more diverse and interesting music.
- **Amper Music** - creates musical tracks from pre-recorded samples.
- **AIVA** - uses AI algorithms to compose original music in various genres and styles.
- **Computer Graphics:**
- It can generate new 3D models, animations, and special effects, helping movie studios and **game developers create more realistic and engaging experiences.**

❍ Healthcare:

- By generating new medical images and simulations, improving the **accuracy and efficiency of medical diagnoses** and treatments.

❍ **Manufacturing and Robotics:**

- It can help optimize manufacturing processes, improving the efficiency and quality of these processes.

## Critical and Emerging Technologies Dialogue

### *Why in News?*

India's **National Security Advisor** hold talks with the US counterpart on the first dialogue on **Initiative for Critical and Emerging Technologies (iCET) in the US.**

➢ Completing the work on the long-awaited **NASA-ISRO Synthetic Aperture Radar (NISAR)** earth observation satellite is an excellent example of how the US-India partnership in space can benefit the world.

### *What is the iCET Initiative?*

➢ **About:**

❍ The iCET initiative was launched by India and the US in May 2022, and is **being run by the National Security Councils** of both countries.

❍ Under iCET, both countries have identified **six areas of cooperation which would include co-development and co-production**, that would gradually be expanded to **QUAD**, then to **NATO,** followed by Europe and the rest of the world.

❍ Under iCET, India is ready to share its core technologies with the US and expects Washington to do the same.

➢ **Six Areas of Cooperation:**

❍ The six areas for cooperation are scientific research and development; **quantum** and **artificial intelligence**, defense innovation, space, advanced telecom which would include things like 6G and semiconductors.

**Who is a National Security Advisor (NSA) in India?**

➢ The NSA is the **primary advisor to the Prime Minister of India.** He also presides over the **National Security Council (NSC)**.

➢ The current NSA is Ajit Doval.

➢ The NSC of India is a **three-tiered organisation that oversees political,** economic, energy and security issues of strategic concern.

➢ It was **formed in 1998**, where all aspects of national security are deliberated upon.

➢ NSC operates within the executive office of the PM, liaising between the government's executive branch and the intelligence services.

## Muons Penetrate Ancient Xi'an Fortress Wall

### *Why in News?*

As per a new study, researchers are **examining the fortress wall of Xi'an, an ancient city in China**, by using tiny outer space particles Muons that can penetrate hundreds of metres of stone surfaces.

➢ Scientists have used a muon detector, called **CORMIS (Cosmic Ray Muon Imaging System)**, to examine the **wall of Xi'an city.**

### *What are Muons?*

➢ **About:**

❍ Muons are subatomic particles raining from space. They are **created when the particles in Earth's atmosphere collide with cosmic rays**.

❍ **Cosmic rays** are the **clusters of high-energy particles** that move through space at almost the **speed of light.**

Note:

- According to Scientific American magazine, **"about 10,000 muons reach every square metre of the Earth's surface a minute"**.
- **Properties:**
- These particles **resemble electrons but are 207 times as massive**. Therefore, they are sometimes called **"fat electrons".**
- Because muons are so heavy, **they can travel through hundreds of metres of rock or other matter before getting absorbed** or decayed.
- In comparison**, electrons can penetrate through only a few centimetres.**
- Also, muons are highly unstable and **exist for just 2.2 microseconds.**

### *What is Muography?*

- **About:**
  - The method of scanning large structures owing to the penetration power of muons is called **Muography.**
- **Applications of Muography:**
  - **Archaeology:**
    - With unique advantages, **muography has gained increasing attention from archaeologists** as a novel and innovative tool to **investigate large-scale archaeological sites.**
    - Example: The first use of muography was in the late 1960s when a **Nobel Prize-winning physicist named Luis Alvarez** teamed up with **Egyptologists** to look for **hidden rooms in the Pyramid of Khafre in Giza**.
- **Other Applications:**
  - Muography has also found use in **customs security, internal imaging of volcanoes and others**.

## H5N1- Avian Influenza

### *Why in News?*

Recent reports of **H5N1 (subtype of avian influenza)** being transmitted between **mammals** have raised concerns about its **potential to cause a human pandemic.**

### *What is H5N1 Avian Influenza?*

- **About:**
  - **Avian influenza** or bird flu refers to the disease caused by **infection with avian influenza Type A viruses.**
  - Infrequently, the **virus can infect mammals from birds**, a phenomenon called **spillover**, and rarely can spread between mammals.
  - **H5N1, a subtype of avian influenza**, has the potential to infect other mammals such as **minks, ferrets, seals, domestic cats,** and others through contact with infected **birds, their faeces, or infected bird carcasses.**
- **Symptoms in Humans:**
  - Range from mild to severe influenza-like illnesses such as **fever, cough, sore throat, muscle aches, nausea, abdominal pain, diarrhea,** vomiting.
  - People can also develop severe respiratory illness (e.g., **difficulty breathing, pneumonia, acute respiratory distress, viral pneumonia**) and altered mental status, seizures etc.
- **Avian Influenza in India:**
  - In 2019, India has been declared free from **Avian Influenza (H5N1)**, which has also been notified to the **World Organization for Animal Health (OIE).**
  - **However,** in December 2020 and early 2021**, outbreaks of avian influenza H5N1 and H5N8** were reported in **poultry in 15 states in India.**
- **Treatment:**
  - Evidence suggests that some **antiviral drugs** can reduce the duration of viral replication and improve prospects of survival, however ongoing clinical studies are needed.

**Types of Influenza Virus**

- There are four types of influenza viruses**: influenza A, B, C, and D**
- Influenza A and B are the two types of influenza that **cause epidemic seasonal infections nearly every year.**
- Influenza C mainly occurs in humans, but has been known to also occur in dogs and pigs.
- Influenza D is found mainly in cattle. It's not known to infect or cause illness in humans yet.

**Avian influenza Type A Viruses**

- Type A viruses are classified based on two proteins on their surfaces – **Hemagglutinin (HA) and Neuraminidase (NA).** There are about 18 HA subtypes and 11 NA subtypes.
- Several combinations of these two proteins are possible e.g., **H5N1, H7N2, H9N6, H17N10, H18N11 etc.**
- All known subtypes of influenza A viruses can infect birds, **except subtypes H17N10** and H18N11, which have only been found in bats.

Note:

| Types | A Subtypes | HPAI vs LPAI |
|---|---|---|
| Influenza A (Infects a wide range of animals including birds) | Avian (Can infect humans) H5N1 H7N3 H7N7 H7N9 H9N2 H10N8<br>Swine (Can infect humans) H1N1 H1N2 H3N2<br>Most common human H1N1 H3N2 | HPAI H5N1<br>LPAI H5N1<br>HPAI H5N8<br>LPAI H5N8<br>Subtypes can be classified as high path or low path based on the ability of the specific virus strain to kill chickens in the lab setting. |
| Influenza B (Mainly infects humans) | | |
| Influenza C (Infects humans and pigs but more rare than types A and B) | | |
| Influenza D (Infects cattle) | | |

# Combating Filariasis

## *Why in News?*

The Ministry of Health and Family Welfare has launched a nationwide **Mass Drug Administration (MDA) campaign** aimed at ending filariasis disease.

- India aims **to eliminate filariasis by 2027**, three years ahead of the global target.

## *What is Filariasis?*

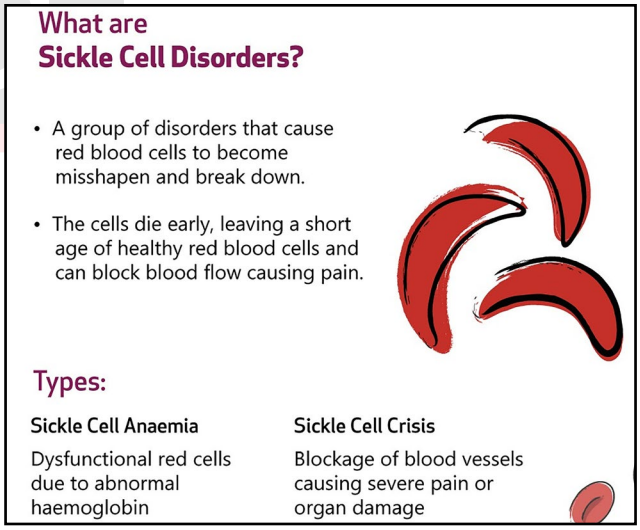
- About:
  - Filariasis is a parasitic infection caused by microscopic, **thread-like worms known as filariae.** It is spread by the bite of infected mosquitoes, and it affects millions of people in tropical and subtropical regions worldwide.
- **Causes and Transmission:**
  - **Lymphatic filariasis** is caused by **infection with parasites classified as nematodes (roundworms)** of the family Filariodidea.
  - There are 3 types of these thread-like filarial worms:
  - Wuchereria bancrofti, which is responsible for 90% of the cases,
  - Brugia malayi, which causes most of the remainder of the cases,
  - Brugia timori, which also causes the disease.
- **Symptoms:**
  - Lymphatic filariasis infection involves asymptomatic, acute, and chronic conditions.
  - In chronic conditions, it leads to **lymphoedema (tissue swelling) or elephantiasis (skin/tissue thickening) of limbs** and hydrocele (scrotal swelling).
- **Treatment:**
  - The **World Health Organization (WHO)** recommends three drug treatments to accelerate the global elimination of lymphatic filariasis. The treatment, known as **IDA, involves a combination of ivermectin, diethylcarbamazine citrate and albendazole.**
  - The plan is to administer these drugs for two consecutive years. The life of th**e adult worm is hardly four years, so it would die a natural death without causing any harm to the person.**

# Sickle Cell Disease

## *Why in News?*

The **Government of India,** through the **National Health Mission**, is supporting the states in their **efforts to prevent and manage sickle cell disease.**

- In **Union Budget 2023-24**, the government has **announced a mission to eliminate Sickle cell Anaemia by 2047.**




## *What is Sickle Cell Disease (SCD)?*

- **About:**
  - **SCD** is a **chronic single gene disorder** causing a debilitating systemic syndrome characterized by **chronic anaemia, acute painful episodes, organ infarction and chronic organ damage** and by a significant reduction in life expectancy.
- **Symptoms:**
  - Symptoms of sickle cell disease can vary, but some common symptoms include:

Note:

- **Chronic Anaemia:** leading to fatigue, weakness, and paleness.
- **Painful episodes** (also known as sickle cell crisis): these can cause sudden and intense pain in the bones, chest, back, arms, and legs.

### *Delayed growth and puberty*

- **Treatment:**
  - **Blood Transfusions:** These can help relieve anaemia and reduce the **risk of pain crises.**
  - **Hydroxyurea:** This is a medication that can help **reduce the frequency of painful episodes** and prevent some of the long-term complications of the disease.
  - It can also be treated by **bone marrow** or **stem cell transplantation**
  - **Government Initiatives to Tackle SCD:**
  - Government has released **technical operational guidelines** for **prevention and control of hemoglobinopathies in 2016** including sickle cell **anaemia** .
  - Integrated centers have also been established in **22 tribal districts for treatment and diagnosis.**
  - The **State Haemoglobinopathy Mission** has been established in **Madhya Pradesh** to address the challenges in screening and management of the disease.

## India's Nuclear Power Capacity

### *Why in News?*

**India's nuclear power capacity** experienced a significant increase. By **2021-22**, it had risen to **47,112 Million Units.**

- In 2022, Japan has adopted a new policy **promoting greater use of Nuclear Energy to ensure a stable power supply** amid global fuel shortages and to reduce carbon emissions.

### *What is the Status of India's Nuclear Energy?*

- **About:**
  - Nuclear energy is the **fifth-largest source of electricity for India** which contributes about 3% of the total electricity generation in the country.
  - India has over **22 nuclear reactors in 7 power plants** across the country which produces **6780 MW of nuclear power**. In addition, one reactor, **Kakrapar Atomic Power Project (KAPP-3)** has also been connected to the grid in January- 2021.
  - **18 reactors** are **Pressurised Heavy Water Reactors (PHWRs)** and 4 are **Light Water Reactors (LWRs).**
  - **KAPP-3** is the India's first 700 MWe unit, and the biggest indigenously developed variant of the PHWR.
- **Recent Developments:**
  - **Joint Ventures with Public Sector Undertakings (PSUs):**
  - Government has also allowed Joint Ventures with PSUs to **enhance India's nuclear program**.
  - As a result, the **Nuclear Power Corporation of India Limited (NPCIL)** is now in two joint ventures with the **National Thermal Power Corporation Limited (NTPC)** and the **Indian Oil Corporation Limited (IOCL).**
- **Expansion of Nuclear Installations:**
  - In the past, **India's nuclear installations were mostly located in South India** or in Maharashtra and Gujarat in the west.
  - However, the government is now **promoting its expansion to other parts of the country.** As an example, the upcoming **nuclear power plant in Gorakhpur town of Haryana**, which will become operational in the near future.
- **India's Indigenous Move:**
  - The world's first thorium-based nuclear plant, **"Bhavni,"** using **Uranium-233**, is being set up at **Kalpakkam in Tamil Nadu**.
  - This plant will be **entirely indigenous and will be the first of its kind.** The experimental thorium plant **"Kamini" already exists in Kalpakkam.**

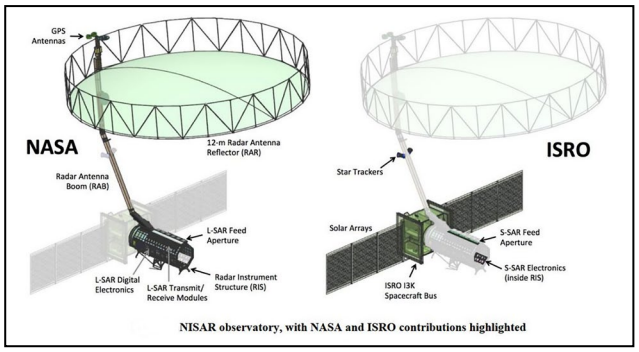
## NISAR Mission

### *Why in News?*

Recently, **NISAR (NASA-ISRO Synthetic Aperture Radar)** has received a send-off ceremony at the **NASA's (National Aeronautics and Space Administration) Jet Propulsion Laboratory (JPL)** in California, USA.

- NISAR will be the **first radar of its kind in space to systematically map Earth**, using two different radar frequencies (L-band and S-band) **to measure changes in our planet's surface less than a centimeter across**.

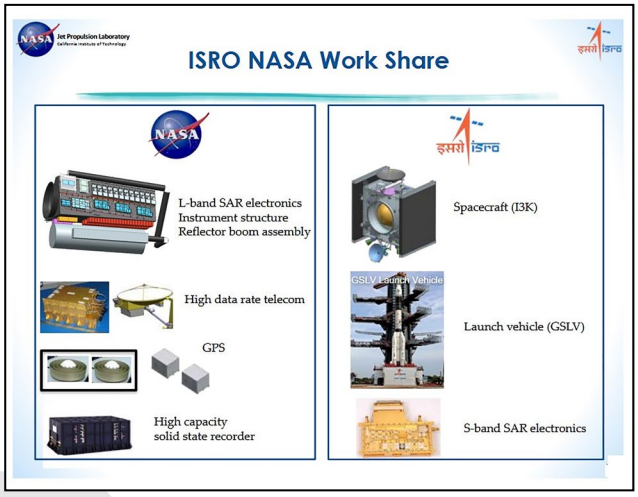
Note:



NISAR observatory, with NASA and ISRO contributions highlighted

## What is the NISAR Mission?

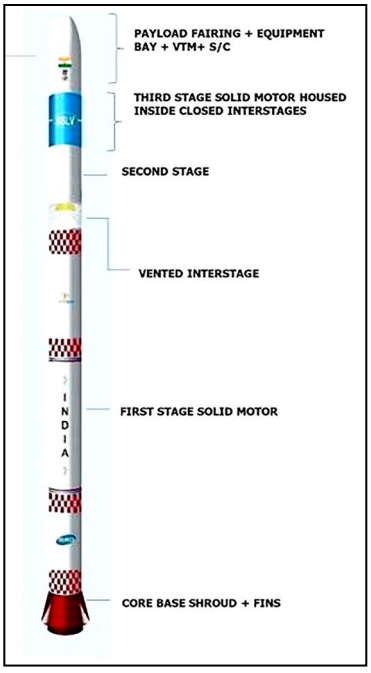
- **About:**
  - NISAR has been built by space agencies of the US and India under a partnership agreement signed in 2014.
  - It is expected to be launched in January 2024 from Satish Dhawan Space Centre into a **near-polar orbit.**
  - The satellite will operate **for a minimum of three years.**
  - It is a **Low Earth Orbit (LEO)** observatory.
  - NISAR will **map the entire globe in 12 days.**
- Features
  - It is a 2,800 kilograms satellite consisting of both **L-band and S-band Synthetic Aperture Radar (SAR)** instruments, which makes it a **dual-frequency imaging radar satellite.**
  - While **NASA has provided the L-band radar, GPS**, a high-capacity solid-state recorder to store data, and a payload data subsystem, **ISRO (Indian Space Research Organisation) has provided the S-band radar,** the **Geosynchronous Satellite Launch Vehicle (GSLV)** launch system and spacecraft.
  - S band radars operate on a wavelength of 8-15 cm and a frequency of 2-4 GHz. Because of the wavelength and frequency, they are **not easily attenuated.** This makes them useful for near and far range weather observation.
  - It has a **39-foot stationary antenna reflector,** made of a gold-plated wire mesh; the **reflector will be used to focus "the radar signals emitted and received by the upward-facing feed** on the instrument structure.
  - By using SAR, NISAR will produce **high-resolution images.** SAR is **capable of penetrating clouds** and can collect data day and night regardless of the weather conditions.
  - NASA requires the L-band radar for **its global science operations** for at least three years. Meanwhile, ISRO will utilise the S-band radar for a minimum of five years.




# ISRO's SSLV-D2

## Why in News?

In its second attempt, the **Indian Space Research Organisation (ISRO)'s** smallest vehicle, **Small Satellite Launch Vehicle (SSLV-D2)**, was launched from the Satish Dhawan Space Centre, Sriharikota, Andhra Pradesh.




## What's Onboard in SSLV-D2?

- SSLV-D2 will place the ISRO's **earth observation satellite EOS-07 and two co-passenger satellites - Janus-1 and AzaadiSat2.**
- **Janus-1:**
  - It is a technology demonstrator satellite built by US-based Antaris and its Indian partners XDLinks and Ananth Technologies.

Note:

- It is a **six-unit cube satellite** with five payloads on board — two from Singapore, and one each from Kenya, Australia, and Indonesia.

- **AzaadiSat2:**
  - It is a **Cubesat** weighing around 8 kg and carries 75 different payloads.
  - Girl students from rural regions across the country were provided guidance to build these payloads.
  - The payloads are integrated by the student team of "Space Kidz India".
- **EOS-07:**
  - EOS-07 is a **156.3 kg satellite designed and** developed by ISRO.
  - Its mission objective is to design and develop payload instruments compatible with microsatellite buses and new technologies for future operational satellites.

### *What is a Small Satellite Launch Vehicle?*

- **About:**
  - SSLV is a 3 **stage Launch Vehicle** configured with three Solid Propulsion Stages and Liquid propulsion-based Velocity Trimming Module (VTM) as a terminal.
  - It is **2 m in diameter and 34m in length with** a lift off weight of 120 tonnes and is capable of launching a 10 to 500 **kg satellite in 500 km planar orbit.**
  - The rocket **can be assembled by a small team in only a few days**, compared to the 6 months and around 600 people it takes for ISRO's workhorse **PSLV**.
- **Objective:**
  - It has been developed to **capture the emerging small (nano-micro-mini) satellite** commercial market, with launches offered on demand.
- **Significance:**
  - It provides **low-cost access to Space**, offers **low turn-around time**, facilitates **flexibility** in accommodating multiple satellites and demands minimal launch infrastructure.

## Lumpy Skin Disease

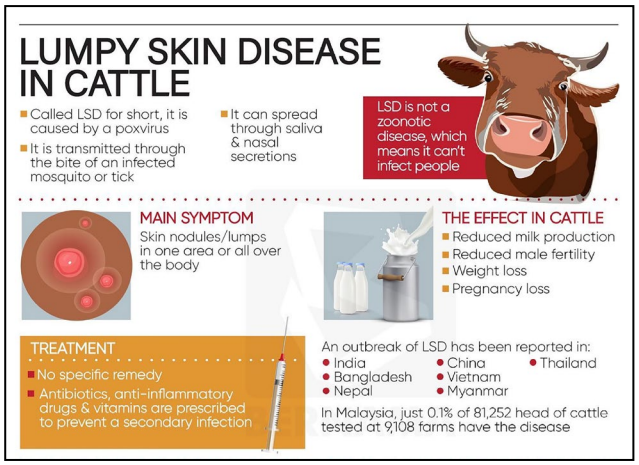
### *Why in News?*

Recently, the Punjab State government has **airlifted 25 lakh doses of goat pox vaccine** to carry out a **free vaccination campaign** for early prevention of cattle from **lumpy skin disease.**

### *What is Lumpy Skin Disease?*

- **Causes:**
  - **LSD** is caused by infection with the **Lumpy Skin Disease Virus (LSDV)** in cattle or water buffalo.
  - The **Food and Agriculture Organization (FAO)** estimates that **its mortality rate is less than 10%.**
  - The **first reported outbreak of LSD occurred in Zambia in 1929**, and it was initially believed to be caused by poisoning or an allergic reaction to insect bites.
- **Transmission:**
  - LSD is primarily **spread between animals through the bite of vectors**, such as mosquitoes and flies.
- **Symptoms:**
  - The primary symptoms of LSD include **fever, discharge from the eyes and nose, drooling, and blisters** on the skin.
  - Also, affected animals may also **lose their appetite** and have difficulty in eating, leading to **reduced milk production.**
- **Prevention and Treatment:**
  - Currently, India is administering the **goat pox vaccine and sheep pox virus vaccines for LSD**.
  - It's a **heterologous vaccine that offers cross-protection** for cattle against the disease.
  - **Goat pox, sheep pox and LSD** belong to the same **capripoxvirus genus.**
  - **Lumpi-ProVacInd** is a live attenuated vaccine developed jointly by **ICAR's National Research Centre on Equines and the Indian Veterinary Research Institute**, which is targeted to protect cattle against the LSD virus, and **provides 100% protection.**
  - It is **expected to be commercially launched in a few months.**
  - There are **no specific antiviral drugs for treating LSD,** and treatment primarily involves supportive care for the affected animals.
  - This may include **treating skin lesions with wound care sprays,**
  - using antibiotics to prevent secondary infections,
  - administering anti-inflammatory painkillers to increase appetite.

Note:




# Antimicrobial-Resistant Gonorrhea

## *Why in News?*

Recently, a strand of **antimicrobial-resistant gonorrhea** outbreak has hit Kenya.

**What is Gonorrhea?**

- **Gonorrhea** is a **sexually transmitted infection (STI)** caused by the bacterium **Neisseria gonorrhoeae.**
- It can infect both men and women and can occur in the **genitals, rectum, and throat.**
- If left untreated, gonorrhea can cause serious health problems, including infertility and an **increased risk of Human Immunodeficiency Virus (HIV) infection.**
- **According to the World Health Organization (WHO),** it is the **second-most common disease to be sexually transmitted** across the world after **chlamydia**.
- Gonorrhea is typically treated with **antibiotics,** but the bacteria have become **increasingly resistant** to many of the drugs that were once effective.

## *What is Anti-Microbial Resistance (AMR)?*

- **About:**
  - **Antimicrobial resistance (AMR)** is the ability of microorganisms (such as bacteria, viruses, fungi, and parasites) to resist the **effects of antimicrobial drugs** (such as antibiotics, antivirals, antifungals, and antiparasitics).
  - Also, Microorganisms that develop antimicrobial resistance are sometimes referred to as **"superbugs"**.
- **Causes:**
  - Poor infection control and **inadequate sanitation and hygiene.**
  - **Overuse of antibiotics** and repeated use of poor-quality drugs.
  - Genetic mutations of the bacteria.
  - Lack of investment in research and development of new antimicrobial drugs.
- **Impacts:**
  - AMR **increases the risk of infections** spreading and becoming harder to treat, leading to **prolonged illness, disability and death.**
  - It also **increases healthcare costs** and threatens the sustainability of healthcare systems.
- **Recognition in India:**
  - The **National Health Policy 2017** highlights the problem of **antimicrobial resistance and calls** for effective action to address it.
  - The **Ministry of Health & Family Welfare (MoHFW)** identified AMR as one of the top 10 priorities for the ministry's collaborative work with the **World Health Organization (WHO).**
  - India has instituted **surveillance of the emergence of drug resistance** in disease causing microbes in programmes on **Tuberculosis, Vector Borne diseases, Acquired immunodeficiency syndrome (AIDS), etc.**
- **Governement Initiatives :**
  - **National Programme on AMR containment:** Launched in 2012. Under this programme, **AMR Surveillance Network** has been strengthened by establishing labs in State Medical College.
  - **National Action Plan on AMR:** It focuses on **One Health approach** and was launched in April 2017 with the aim of involving various stakeholder ministries/departments**.**
  - **AMR Surveillance and Research Network (AMRSN):** It was launched in 2013, to generate evidence and capture trends and patterns of drug resistant infections in the country.
  - **Antibiotic Stewardship Program: Indian Council of Medical Research (ICMR**) Has initiated Antibiotic Stewardship Program (AMSP) on a pilot project across India to control misuse and overuse of antibiotics in hospital wards and ICUs.

Note:

# WHO Report on Global Trans Fat Elimination

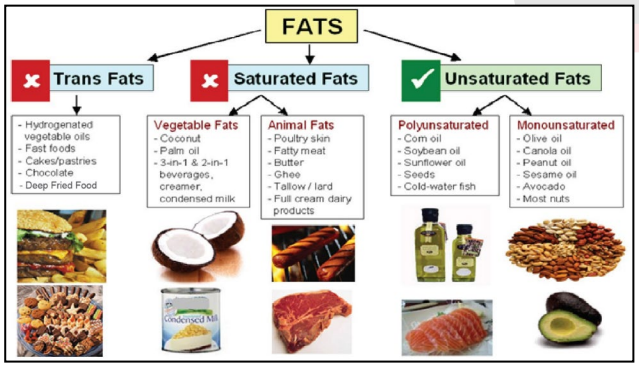
## *Why in News?*

A new report from the **World Health Organization (WHO)** has found that **5 billion people globally remain unprotected from harmful trans fats**, increasing their risk of heart disease and death.

- WHO first called for the global elimination of industrially produced trans fats in 2018, with an **elimination target set for 2023.**

## *What are Trans Fats?*

- **About:**
  - Trans fat, or trans-fatty acids, **are unsaturated fatty acids** that come from either natural or industrial sources.
  - Naturally-occurring trans-fat come from ruminants (cows and sheep).
  - Industrially-produced trans-fat is formed in an industrial process that adds **hydrogen to vegetable oil converting the liquid into a solid**, resulting in **"partially hydrogenated" oil (PHO)**.




- **Impacts:**
  - Trans fats have been linked to an **increased risk of heart disease**, as they can raise **bad cholesterol (LDL)** levels in the blood and lower good cholesterol (HDL) levels.
  - They can also contribute to the development of other health conditions such as **diabetes and obesity.**
- **Initiatives to Eliminate Trans Fat:**
  - **India:**
    - **Eat Right Movement**: Launched in 2018, the programme is built on two broad pillars of 'Eat Healthy' and 'Eat Safe'.
    - **Swachh Bharat Yatra**: A Pan-India cyclothon, was launched under the movement to educate **citizens on issues of food safety, combating food adulteration and healthy diets.**
    - **Heart Attack Rewind**: It is a 30-second public service announcement which was broadcasted in **17 languages on social media platforms**.
    - The objective of the campaign was to **warn citizens about the health hazards of consuming trans fats** and offer strategies to avoid them through healthier alternatives.
    - The **Food Safety and Standards Authority of India (FSSAI)** has stated that all food items should contain less than **2% of trans fat from Jan 2022**.
  - **Global:**
    - WHO released **REPLACE,** a step-by-step guide for the elimination of **industrially-produced trans-fatty acids** from the global food supply.
    - **REPLACE** provides six strategic actions to ensure the prompt, complete, and sustained elimination of industrially-produced trans fats from the food supply:
    - **RE**view dietary sources of industrially-produced trans fats and the landscape for required policy change.
    - **P**romote the replacement of industrially-produced trans fats with healthier fats and oils.
    - **L**egislate or enact regulatory actions to eliminate industrially-produced trans fats.
    - **A**ssess and monitor trans fats content in the food supply and changes in trans-fat consumption in the population.
    - **C**reate awareness of the negative health impact of trans fats among policymakers, producers, suppliers, and the public.
    - **E**nforce compliance of policies and regulations.

# Hyderabad: Center for the Fourth Industrial Revolution

## *Why in News?*

Recently, the **World Economic Forum (WEF)** has chosen Hyderabad, Telangana for establishing its **Center for the Fourth Industrial Revolution** (C4IR).

Note:

- The **C4IR Telangana** will be an **autonomous, non-profit organisation** with a thematic focus on healthcare and life sciences.

### What is the Fourth Industrial Revolution?

- **About:**
  - It is **characterised by the use of technology to blur the boundaries** between the **digital, physical, and biological worlds**, and is **driven by data.**
  - Key technologies include cloud computing, **big data, autonomous robots, cybersecurity,** simulation, additive manufacturing, and the **internet of things (IoT).**
  - The term **4IR** was coined by Klaus Schwab, executive chairperson of the WEF, in 2016.
- **Major Examples of its Application:**
  - **Pacemaker:** The **pacemaker** is a near-perfect example of the ongoing **fourth industrial revolution (4IR).**
  - The **four wireless sensors of the pacemaker** monitor vitals such as **temperature, oxygen levels and the heart's electrical activity.**
  - The device then analyses the vitals and decides when to pace the heart and at what rate. **Doctors can wirelessly access the information** on a tablet or smartphone.
  - **Xenobots: Xenobots,** which are less than a millimetre long, are known to be the first **living robot**, were created in 2020 from the stem cells of the **African clawed frog** and can be programmed using **artificial intelligence.**
  - It has a reproductive ability demonstrated in October 2021 by a team of US scientists.
  - When the researchers put the xenobots into a **petri dish**, they were able to gather hundreds of tiny stem cells inside their mouths and **create new xenobots a few days later.**
  - Once perfected, **xenobots could be useful for tasks like cleaning up microplastics** and regrowing or replacing dead cells and tissues inside human bodies.
  - **Smart Railway Coaches:** In **November 2020**, the **Modern Coach Factory (MCF)** at Raebareli, Uttar Pradesh, rolled out **smart railway coaches** that are fitted with a **battery of sensors** to provide a comfortable experience to passengers.
  - The **sensors monitor odour levels in toilets,** check if the doors are safely closed, avoid fire outbreaks and stop **unauthorised travel using CCTV cameras** with face recognition capabilities, among other technologies.

### What are the Other Industrial Revolutions?

- **First Industrial Revolution (1800s):** It used water and steam power to mechanise production. Example: **Steam engine.**
- **Second Industrial Revolution (early 1900s):** It used **electric power to create mass** production. Example: **Electricity.**
- **Third Industrial Revolution (late 1900s):** It used electronics and information technology to automate production. Example: **Computer and Internet.**

## Superconductivity

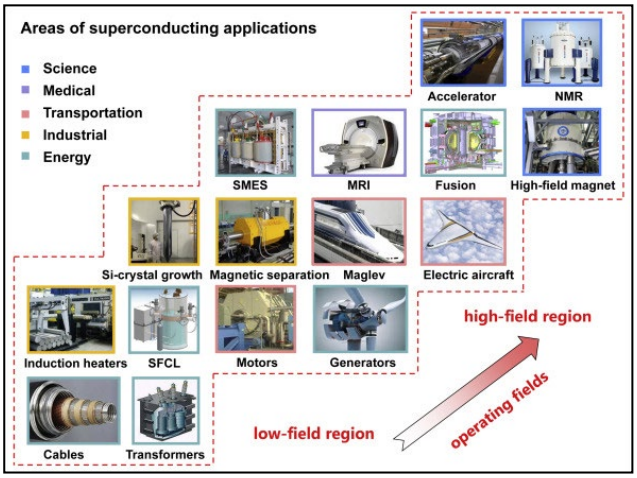
### Why in News?

Recently, physicists at the University of L'Aquila in Italy have recently made a breakthrough by achieving **a full microscopic understanding of the superconductivity of Mercury** for the first time.

- Superconductivity was first discovered in mercury, **yet scientists required 111 years to explain how it becomes superconducting.**

### What is Superconductivity?

- **Superconductivity:**
  - **Superconductivity** refers to a state when a material can conduct electricity without any resistance. It is observed in many materials when they are cooled below a **critical temperature.**




Note:

- **Superconductivity of Mercury:**
  - **About:**
    - In 1911, Heike Kamerlingh Onnes discover superconductivity in mercury.
    - Onnes had invented a way **to cool materials to absolute zero** – the lowest temperature possible.
    - Using his technique, he found that at a very low temperature, called the threshold temperature, **solid mercury offers no resistance to the flow of electric current.** It was a watershed moment in the history of physics.
    - **Various Methodologies:** Superconductivity of mercury is explained by various methodologies:
  - **The BCS Theory:**
    - In BCS **(Bardeen-Cooper-Schrieffer)** superconductors, **vibrational energy released by the grid of atoms encourages electrons to pair up**, forming so-called Cooper pairs.
    - These Copper pairs can move like **water in a stream, facing no resistance to their flow, below a threshold temperature**.
    - These could explain why mercury has such a low threshold temperature (around –270°C).
  - **Spin-Orbit Coupling:**
    - Spin-orbit coupling (SOC) is the way an **electron's energy is affected by the relationship between its spin and its momentum**.
    - SOC gave a better view of the phonons' energies and explain why mercury has such a **low threshold temperature (approx. –270º C).**
  - **Coulomb Repulsion:**
    - Another factor was the Coulomb repulsion (a.k.a. 'like charges repel') between two **electrons in each pair**.
    - The superconducting state is determined by a balance between an attractive interaction between electrons, mediated by phonons, and the repulsive Coulomb interaction (electrostatic repulsion between negative charges).

**What is Mercury?**

- Mercury is a **naturally occurring element that is found in air, water and soil.**
- Released into the atmosphere through natural processes such as weathering of rocks, volcanic eruptions, geothermal activities, forest fires, etc.
- Mercury is also **released through human activities.**
- It is the only metal which **remains liquid at room temperature.**

# Doppler Weather Radar Network

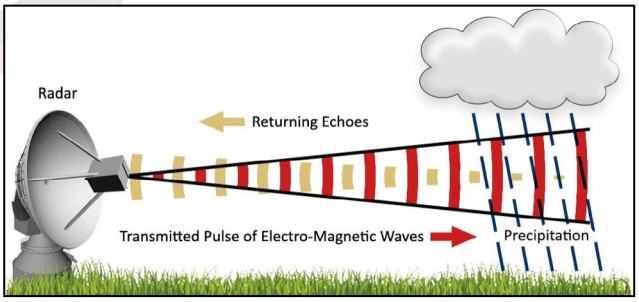
## *Why in News?*

On the Occasion of **148th Foundation Day of India Meteorological Department (IMD),** the Ministry of Earth Science inaugurated the **Doppler Weather Radar (DWR) Systems** in Jammu & Kashmir, Uttarakhand, and Himachal Pradesh.

- The Ministry of Earth Science.is also preparing to cover the entire Country with the **Doppler weather radar network** by 2025 for more accurate forecasts related to extreme weather events.

## *What are Doppler Weather Radars?*

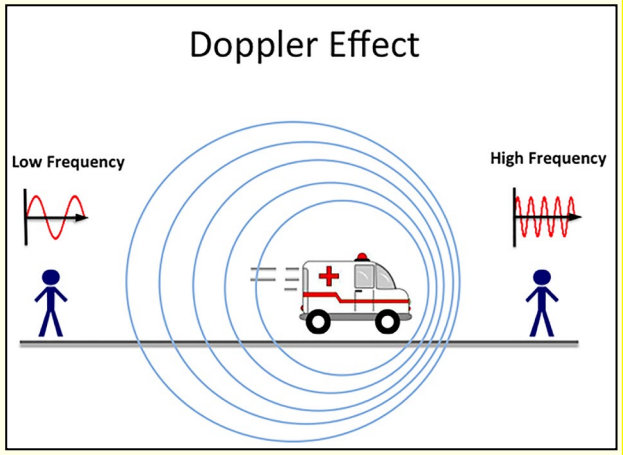
- Based on Doppler principle, the **radar is designed to improve precision in long-range weather forecasting** and surveillance using a parabolic dish antenna and a foam sandwich spherical radome.
- DWR has the **equipment to measure rainfall intensity, wind shear and velocity and locate a storm centre** and the direction of a tornado or gust front.




**What is Radar?**

- **Radar (Radio Detection and Ranging):**
- It is a device which **uses electromagnetic waves in the microwaves region** to detect location (range & direction), altitude, intensity and movement of moving and non-moving objects.
- **Doppler Radar:**
- It is a specialized radar that uses the Doppler effect to produce velocity data about objects at a distance
- Doppler effect: When the source and the signal are in relative motion to each other there is a change in the frequency observed by the observer. If they are moving closer, frequency increases and vice versa.

Note:




- It does this by bouncing a microwave signal off a desired target and analyzing how the object's motion has altered the frequency of the returned signal.
- This variation gives direct and highly accurate measurements of the radial component of a target's velocity relative to the radar.

# Neuromorphic Computing

### *Why in News?*

Recently, a team of scientists from **Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)** has developed Artificial Synapse for Brain-Like Computing or Neuromorphic Computing.

- They have used **scandium nitride (ScN), a semiconducting material with supreme stability** and Complementary Metal-Oxide-Semiconductor (CMOS) compatibility, to develop **brain-like computing.**

### *What is Neuromorphic Computing?*

- **About:**
  - Inspired by the human brain and the functioning of the nervous system, **Neuromorphic Computing was a concept introduced in the 1980s.**
  - Neuromorphic Computing refers to the **designing of computers that are based on the systems found in the human brain** and the nervous system.
  - Neuromorphic computing devices can work as efficiently as the human brain **without acquiring large room for the placement of software.**
  - One of the technological advancements that has rekindled the interest of scientists in neuromorphic computing is the development of the **Artificial Neural Network model (ANN).**
- **Working Mechanism:**
  - The working mechanism of neuromorphic computing involves the use of Artificial Neural Networks (ANN) made up of **millions of artificial neurons, similar to those in the human brain.**
  - These neurons pass signals to each other in layers, converting input into output through electric spikes or signals, **based on the architecture of Spiking Neural Networks (SNN).**
  - This allows the **machine to mimic the neuro-biological networks in the human brain and perform tasks efficiently** and effectively, such as visual recognition and data interpretation.
- **Significance:**
  - Neuromorphic computing has opened the **doors to better technology and rapid growth** in computer engineering.
  - Neuromorphic computing has been a **revolutionary concept in the realm of Artificial Intelligence.**
  - With the help of one of the techniques of AI, (machine learning), neuromorphic computing has advanced the process of information processing and enabled computers to work with better and bigger technology.

# Solitary Wave in Martian Magnetosphere

### *Why in News?*

Recently, **Indian Institute of Geomagnetism (IIG), an autonomous institute of the Department of Science and Technology (DST)** has found evidence of **"solitary waves"** in the **weak magnetic field** around **Mars** for the first time.

- Scientists used **high-resolution electric field data** from **NASA's MAVEN spacecraft** to make the discovery of solitary waves.

### *What are Solitary Waves?*

- **About:**
  - Solitary waves are the **distinct electric field fluctuations** (bipolar or monopolar) that follow constant amplitude-phase relations.
  - Their **shape and size are less affected** during their propagation.

Note:

- **Significance:**
  - Solitary waves have been found to play a significant role in the dynamics of various **physical systems**, such as in the **Earth's magnetosphere and in the Martian magnetosphere.**
  - In the **Earth's magnetosphere**, they are known to be responsible for the **energization and transport of plasma particles,** which can affect the behaviour of satellites and other space-borne equipment.
  - In the **Martian magnetosphere**, their significance is not fully understood yet, but it has been suggested that **they may play a role in the loss of atmospheric ions on Mars.**

**What are the Key Points Related to Mars?**

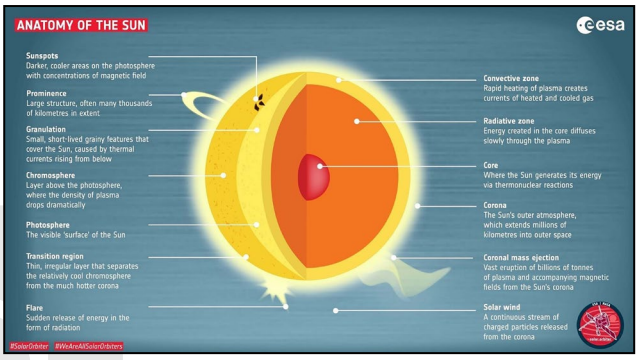
- **Size and Distance:**
  - It is the **fourth planet from the Sun** and the second-smallest planet in the Solar System.
  - Mars is about **half** the size of Earth.
- **Similarity to the Earth (Orbit and Rotation):**
  - As Mars orbits the Sun, it completes one rotation every **24.6 hours**, which is very similar to one day on Earth (23.9 hours).
  - Mars' axis of rotation is tilted **25 degrees** with respect to the plane of its orbit around the Sun.
  - This is similar to Earth, which has an axial tilt of **23.4 degrees.**
  - Mars has **distinct seasons like Earth**, but they last longer than seasons on Earth.
- **Various Mars Missions:**
  - ExoMars rover (2021) (European Space Agency)
  - Tianwen-1: China's Mars Mission (2021)
  - UAE's Hope Mars Mission (UAE's first-ever interplanetary mission) (2021)
  - India's Mars Orbiter Mission (MOM) or Mangalyaan (2013)
  - **Note: 28th November is marked as Red Planet Day** commemorating the day when **National Aeronautics and Space Administration (NASA)** mission Mariner 4 was launched in 1964.
- Mariner 4 captured significant information on, **and photographs of, Mars for the first time**.

# India's First Solar Mission

## *Why in News?*

Recently, the **Visible Line Emission Coronagraph (VLEC)**, the primary payload on board **Aditya-L1**, **was handed over to Indian Space Research Organisation (ISRO)** by the **Indian Institute of Astrophysics (IIA)**.

- ISRO is **planning to launch the Aditya-L1 mission**, **first Indian space mission to observe the Sun** by June or July 2023 to observe the Sun and the **solar corona**.



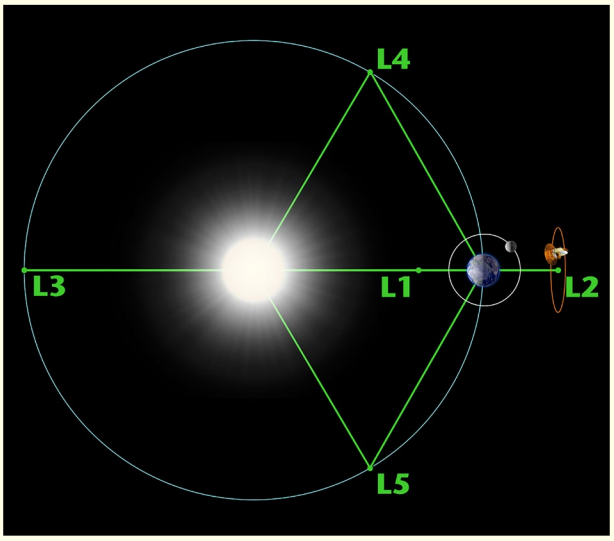

## *What is Aditya-L1 Mission?*

- **Launch Vehicle:**
  - Aditya L1 will be launched **using the Polar Satellite Launch Vehicle (PSLV)** with 7 payloads (instruments) on board.
- **The 7 payloads include:**
  - **VELC**
    - Solar Ultraviolet Imaging Telescope (SUIT)
    - Solar Low Energy X-ray Spectrometer (SoLEXS)
    - Aditya Solar wind Particle Experiment (ASPEX)
    - High Energy L1 Orbiting X-ray Spectrometer (HEL1OS)
    - Plasma Analyser Package for Aditya (PAPA)
    - Advanced Tri-axial High Resolution Digital Magnetometers
  - **Objective:**
    - Aditya L1 will study the **Sun's corona**, **Sun's photosphere**, **chromosphere**, **solar emissions**, **solar winds** and **flares**, and **Coronal Mass Ejections (CMEs)**, and will **carry out round-the-clock imaging of the Sun**.
    - The mission **will be launched by ISRO to the L1 orbit** which is about 1.5 million km from the Earth. The orbit **allows Aditya-L1 to look at the Sun continuously.**

Note:

**What is L1?**

- L1 refers to **Lagrangian/Lagrange Point 1, one of 5 points in the orbital plane of the Earth-Sun system**.
- Lagrange Points **are positions in space** where the gravitational forces of a two-**body system like the Sun and Earth produce enhanced regions of attraction and repulsion**.
- These **can be used by spacecraft to reduce fuel consumption** needed to remain in position.
- A Satellite placed in the halo orbit around the L1 **has the major advantage of continuously viewing the Sun** without any occultation/ eclipses.
- The L1 point is **home to the Solar and Heliospheric Observatory Satellite (SOHO)**, an international collaboration project of **National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA)**.




### What are the Other Missions to the Sun?

- **NASA's Parker Solar Probe:** Aims to trace how energy and heat move through the Sun's corona and to study the source of the solar wind's acceleration.
- It is **part of NASA's 'Living With a Star' programme** that explores different aspects of the Sun-Earth system.
- **Helios 2 Solar Probe:** The earlier Helios 2 solar probe, a joint venture between NASA and space agency of erstwhile West Germany, went within 43 million km of the Sun's surface in 1976.
- **Solar Orbiter:** A joint mission between the ESA and NASA to collect data that will help answer a **central question of heliophysics** like how the Sun creates and controls the constantly changing space environment throughout the solar system.
- **Other Active Spacecraft Monitoring the Sun:** Advanced Composition Explorer (ACE), Interface Region Imaging Spectrograph (IRIS), WIND, Hinode, the Solar Dynamics Observatory, and Solar Terrestrial Relations Observatory (STEREO).

## Exoplanet

### Why in News?

Recently, the **National Aeronautics and Space Administration's (NASA) James Webb Space Telescope** has discovered its first new exoplanet named- LHS 475 b.

- Owing to the Webb telescope's advanced capabilities, researchers may detect more Earth-sized planets in future.

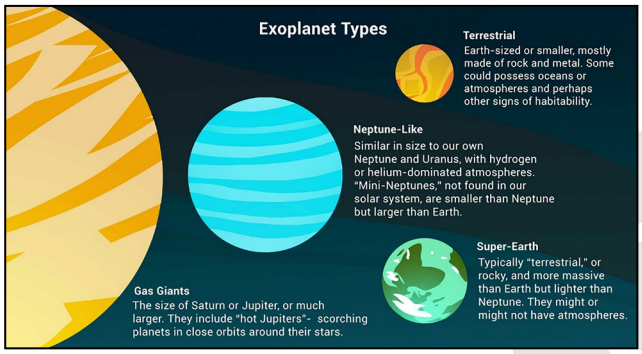
### What are the Key points of LHS 475 b?

- Findings:
  - It is roughly the **same size as Earth, its** diameter is 99% the same as Earth.
  - It is a terrestrial, rocky planet about **41 light-years away** from Earth in the **constellation Octans.**
  - It differs from Earth in **that it completes an orbit in just two days and is hundreds of degrees hotter than Earth.**
  - It is also closer to its star than **any planet in our solar system is to the sun**, although its star is less than half the temperature of the sun.
  - It orbits very close to a **red dwarf star** and completes a full orbit in just two days.
  - So far, most of the discovered exoplanets are similar to Jupiter as Earth-sized planets are much smaller in size and harder to discover with older telescopes.
- **Significance:**
  - These first observational results from an Earth-size rocky planet **open the door to many future possibilities for studying rocky planet atmospheres**.
  - Its red dwarf star is less than half the temperature of the Sun, so the researchers are expecting that it still could have an atmosphere.

Note:

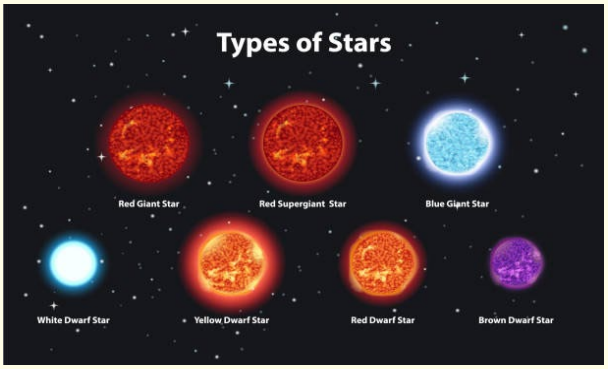
### What are Exoplanets?

- **About:**
  - Exoplanets are planets **that orbit other stars and are beyond our solar system.** The first confirmation of detection of **exoplanets occurred in 1992.**
  - According to NASA, to date, **more than 5,000 exoplanets have been discovered.**
  - Scientists believe that there are more planets than stars as each star have at least one planet orbiting it.
  - Exoplanets come in a host of different sizes. They can be **gas giants bigger than Jupiter or as small and rocky as Earth.** They are also known to have **different kinds of temperatures** — boiling hot to freezing cold.




**What are Red Dwarf Stars?**

- Red dwarf stars are small, low-mass, dim, and cool stars, they are the most common and **smallest in the universe**.
- As they don't radiate much light, **it's very tough to detect them with the naked eye from Earth.**
- However, as red dwarfs are dimmer than other stars, it is easier to find exoplanets that surround them. Therefore, **red dwarfs are a popular target for planet hunting.**
- The habitable zone of red dwarf stars is closer to the star than stars like our sun, making it easier to observe potentially habitable planets.




## Shukrayaan I

### Why in News?

**Indian Space Research Organisation's (ISRO)** Venus mission, Shukrayaan I may be postponed to 2031. ISRO's Venus mission was expected to be launched in December 2024.

- Both the U.S. and the European space agencies have **Venus missions planned for 2031 — VERITAS and EnVision, respectively** — while China may launch around 2026 or 2027.

### What is Shukrayaan I Mission?

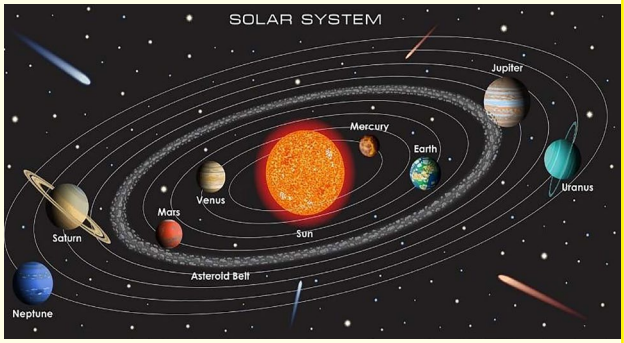
- **About:**
  - Shukrayaan I will be **an Orbiter Mission.** Its scientific payloads **currently include a high-resolution Synthetic Aperture Radar** (SAR) and a ground-penetrating radar.
  - **SAR** would examine Venus' surface, despite the clouds around the planet, which lowers visibility.
  - It refers to **a technique for producing high-resolution images**. Because of the precision, the radar can penetrate clouds and darkness, which means that it can collect data day and night in any weather.
  - The mission is expected to **study Venus's geological and volcanic activity,** emissions on the ground, wind speed, cloud cover, and other planetary characteristics from an elliptical orbit.
  - Shukrayaan-I will be launched on either GSLV Mk II or **GSLV Mk III**, the latter allows more instruments or fuel to be carried, according to ISRO.
- **Objectives:**
  - Investigation of surface process and **shallow subsurface stratigraphy.** Until now, no prior observation of the sub-surface of Venus has been done.
  - Stratigraphy is a branch of geology in which rock layers and layering are studied.
  - Study of the structure, composition and dynamics of the atmosphere.
  - Investigation of **Solar wind interaction with Venusian ionosphere.**
- **Significance:**
  - It will help to learn how Earth-like planets evolve and what conditions exist on **Earth-sized exoplanets** (Planets that orbit a star other than our sun).
  - It will help in modelling Earth's climate and serves as a cautionary tale on how dramatically a planet's climate can change.

Note:

| Previous Missions Sent on Venus | | | |
|---|---|---|---|
| US | Russia | Japan | Europe |
| ➢ Mariner series 1962-1974,<br>➢ Pioneer Venus 1 and Pioneer Venus 2 in 1978,<br>➢ Magellan in 1989. | ➢ Venera series of space crafts 1967-1983,<br>➢ Vegas 1 and 2 in 1985. | ➢ Akatsuki in 2015. | ➢ Venus Express in 2005. |

**What is Venus?**

- It is named after the **Roman goddess of love and beauty.** It is the second planet from the Sun and sixth in the solar system in size and mass.
- It is the **second brightest natural object in the night sky after the Moon**.
- Unlike the other planets in our solar system, **Venus and Uranus spin clockwise on their axis.**
- It is the hottest planet in the solar system because of the high concentration of carbon dioxide which works to produce **an intense greenhouse effect.**
- A day on Venus is longer than a year. It takes Venus longer to rotate once on its axis than to complete one orbit of the Sun.
- That's 243 Earth days to rotate once - the longest rotation of any planet in the Solar System - and only 224.7 Earth days to complete one orbit of the Sun.
- Venus has been called **Earth's twin because of the similarities in their masses,** sizes, and densities and their similar relative locations in the solar system.
- No planet approaches closer to Earth than Venus; at its nearest it is the closest large body to Earth other than the Moon.
- Venus has 90 times the atmospheric pressure of Earth.




# Age Determination Techniques

## *Why in News?*

In November 2022, over four years after the gang rape and murder of an eight-year-old girl in Kathua, the **Supreme Court held that one of the accused persons, who claimed to be a juvenile at the time of the commission of the offence, be tried as an adult.**

## *What are the Different Age Determination Techniques?*

- **Ossification Test:**
  - The most popular test for **determining age is the ossification test.**
  - The **extent of ossification (i.e., calcification) and the union of epiphysis (rounded end of a long bone) in bones,** particularly long bones such as radius and ulna, humerus, tibia and fibula, and femur, are helpful in estimating age.
  - Though the **variations in climatic, dietetic, hereditary and other factors affect the extent of ossification** in different regions, a fairly close estimate within a margin of two years (for example, 16-18 years), allowing a margin of error of six months on either side (15.5 years or 18.5 years) may be made from puberty to the consolidation of the skeleton.
- **Wisdom Teeth:**
  - The **presence, absence, and eruption of wisdom teeth** can be used as a method of estimating the age of an individual.
  - Wisdom teeth, **also known as third molars, are the last teeth to emerge in the mouth** and they usually appear in the late teenage years or early adulthood.

Note:

- This method is **based on the fact that the eruption of wisdom teeth follows a predictable pattern** and can be used to determine the age of an individual within a range of a few years.
- However, it is i**mportant to note that this method is not completely accurate and should not be used as the sole basis** for determining age.
- Factors such as genetics, oral hygiene, and overall health can all influence the eruption of wisdom teeth and may cause variations in the expected pattern.

➢ **Epigenetic Clock Technique:**

- It measures **DNA methylation levels to estimate the chronological age of the subject.**
- DNA methylation is a **process by which methyl groups are added to the DNA molecule**, typically to the promoter region of a gene, resulting in the repression of gene transcription.
- This primarily occurs on **cytosine that precedes guanine nucleotide** (CpG sites).
- Cytosine is a **chemical compound that is used to make one of the building blocks of DNA and RNA.**
- However, the use of this technique is yet to be explored by Indian forensic scientists.

➢ **Radiographic Techniques:**

- X-ray and CT scans can be used to assess the maturity of bones, as well as to look for signs of degeneration or disease.

### *What is the Status of Birth Registration in India?*

➢ **About:**

- According to the **United Nations Children's Fund** report (2016), **only 72% of births of children below five years were registered in India.**
- And **out of 26 million children born every year, around 10 million went unregistered.**
- Under **Sustainable Development Goal 16**, providing legal identity for all, including birth registration, is a specific target.
- According to the **National Family Health Survey (NFHS),** the share of India's institutional deliveries has increased to 88.6% in 2019-21 (NFHS-5) from 40.8% in 2005-06 (NFHS-3).
- It is surprising that even with the increase in institutional deliveries, proving age remains a contested issue in criminal trials.

➢ **Punishment due to Non-Compliance:**

- Non-registration of birth by the **'head of the house' or hospital is punishable with a fine of up to Rs.50** under the **Registration of Births and Deaths Act, 1969.**
- The draft amendment to this Act inter alia proposes to **increase the fine up to Rs. 250 and Rs. 1,000 for an individual and institution, respectively.**
- The objective is to obviously to persuade people to register births and deaths, and not severely punish those who do not do so.

## Virovore

### *Why in News?*

Researchers have found the first known **"Virovore," or organism that eats viruses.**

➢ The new findings may change our **understanding of the role viruses play in the food chain** at a microscopic level.

### *What is Virovore?*

➢ It has been identified as an **actual species of protist that feasts on viruses**.

➢ These virus-eating species of protists — which are their own kingdom on the tree of life and are not an animal, plant, or fungi — are now classified as **Virovores.**

➢ It is a species of **Halteria - microscopic ciliates** that populate freshwater worldwide.

➢ The microbe Halteria is a common genus of protist known to flit about as its hair-like cilia propel it through the water.

➢ They're made up of nucleic acids, nitrogen, and phosphorus. It can eat **huge numbers of infectious chloroviruses that share their aquatic habitat.**

➢ Chloroviruses are known to infect microscopic green algae.

➢ These organisms can sustain themselves **with viruses, consuming many and growing in size.**

➢ A virus-only diet, termed "virovory," is enough to fuel **the physiological growth and even population growth of an organism.**

Note:

# Stem Cell-derived Mitochondrial Transplant

## *Why in News?*

Recently, **six children with rare disorders** caused by deletion in the genomes of their **mitochondria** were **successfully treated for the first time by Stem-cell derived Mitochondria Transplantation.**

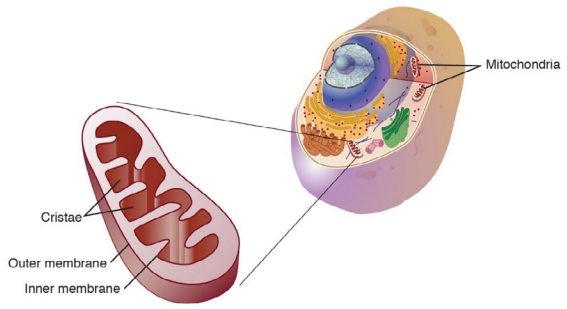
- The process involved the **mitochondrial transplant from donor mothers into children's haematopoietic stem cells**, which give rise to all types of blood cells.

## *What is Stem Cell-derived Mitochondria Transplantation?*

- It involves the **spontaneous mitochondrial transfer of the stem cell to rescue the injured cells** or the injection of stem cell isolated mitochondria into the injured area to repair the damage.
- Stem cells are the **most primitive cells at the top of the origin of cell lines**, and they have a **high capacity for differentiation and self-renewal.**
- In addition, stem cells **can differentiate into various tissues, organs, or functional cells of the human body;** therefore, stem cells hold **great promise for therapeutic tissue engineering and regenerative medicine.**

**What are Mitochondria?**

- Mitochondria are **membrane-bound semi-autonomous cell organelles** and are often referred to as **the powerhouses of the cell.**
- They **generate most of the chemical energy needed** to power the cell's biochemical reactions.
- Chemical energy produced by the mitochondria is stored **in the form of Adenosine Triphosphate (ATP).**
- Mitochondria contain their own **Deoxyribonucleic Acid (DNA). Generally, mitochondria, and therefore mitochondrial DNA, are inherited only from the mother in almost all multicellular organisms.**
- Mitochondria in mammalian sperm are usually **destroyed by the egg cell after fertilization.**
- **The mitochondria are present at the base of the sperm's tail,** which is used for propelling the sperm cells; sometimes the tail is **lost during fertilization.**

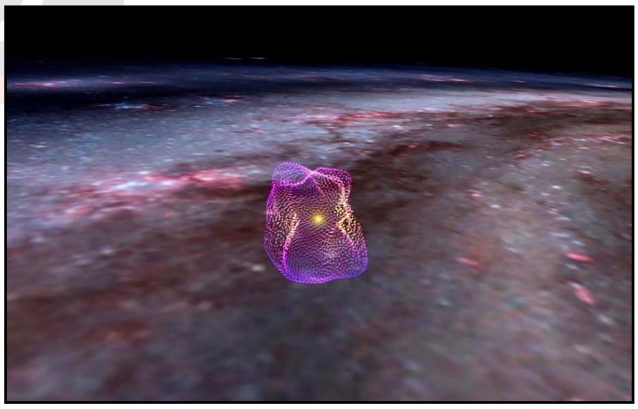



# Local Bubbles

## *Why in News?*

Recently, new research on a **giant cosmic cavity** that surrounds the **solar system** could reveal the **universe's secrets**, including questions about the **origins of stars**.

- Researchers from the **Center for Astrophysics (CfA) | Harvard & Smithsonian** have generated a **3D magnetic map** of the cavity called **Local Bubble**.



## *What are Local Bubbles?*

- The **Local Bubble** is a **1,000-light-year-wide cavity** or a **superbubble**. Other **superbubbles** also exist in the **Milky Way**.
- The **Local Bubble** is a **large, low-density region** in the **interstellar medium (ISM)** of our galaxy, the **Milky Way.**
  - The interstellar medium is the material which fills the space between the stars.
- It's a cavity that is thought to have been created by a series of **supernovae explosions** that occurred about **30 to 50 million years ago**.

Note:

### What is a Supernova?

- A **supernova** is a **powerful and luminous explosion** that occurs at the end of the life of a massive star.
- It is caused by the **collapse of the core of the star**, which can trigger a **massive release of energy.**
- **Supernovae** are also important for the **enrichment of the interstellar medium** with heavy elements and for the propagation of **cosmic rays.**
- There are **two main types of supernovae**:
  - **Type I:**
    - It is a supernova caused by thermonuclear explosion of a white dwarf star that is part of a binary system.
    - The white dwarf accretes material from its companion star, and when its mass exceeds a certain limit, it becomes unstable and detonates.
  - **Type II:**
    - It is caused by the gravitational collapse of the core of a massive star.
    - When a star has exhausted the nuclear fuel in its core, its outer layers collapse inward, and the core becomes incredibly hot and dense.
    - This causes a huge release of energy, which causes the star to explode.
    - The explosion is so powerful that it can outshine an entire galaxy for a brief period of time, and the explosion debris can cause the formation of nebulae, dust and heavy elements.

## Innovation in Agriculture

### Why in News?

Recently, the government of India has taken various initiatives related to Agriculture by using **Internet of Things (IoT)** and **Artificial Intelligence (AI).**

- **IoT** is a **computing concept** that describes the idea of everyday physical objects being connected to the internet and being **able to identify themselves to other devices**.

### What is the Usage of AI in Agriculture?

- **Analyzing Farm Data:**
  - Farms produce hundreds of thousands of data points on the ground daily. With the help of AI**, farmers can now analyze a variety of things in real-time such as weather conditions**, temperature, water usage or soil conditions collected from their farm to better inform their decisions.
  - Farmers are also using AI to create seasonal forecasting models to improve agricultural accuracy and increase productivity.
- **Precision Agriculture:**
  - Precision agriculture uses AI technology to aid i**n detecting diseases in plants, pests, and poor plant nutrition on farms.**
  - AI sensors can detect and target weeds and then decide which herbicides to apply within the right buffer zone.
  - This helps to **prevent over-application of herbicides and excessive toxins** that find their way in our food.
  - It would **increase productivity by introducing precision agriculture.**
- **Tackling the Labour Challenge:**
  - With fewer people entering the farming profession, **most farms are facing the challenge of a workforce shortage.**
  - One solution to help with this shortage of workers is AI agriculture bots. These **bots augment the human labour workforce and are used in various forms**. For example:
    - These bots can harvest crops at a higher volume and faster pace than human labourers, more accurately identify and eliminate weeds, and reduce costs for farms by having around the clock labour force.
    - Additionally, farmers are beginning to turn to chatbots for assistance. Chatbots help answer a variety of questions and provide advice and recommendations on specific farm problems.

### What are the Related Initiatives taken?

- **National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS):**
  - It was launched in **2018 by the Ministry of Science and Technology** with an outlay of Rs. 3,660.00 crore for a period of five years to encourage innovation in new age technologies.
  - Under the Mission, 25 Technology Innovation Hubs (TIHs) have been set up in premier institutes of **national importance across the country in advanced technology verticals.**

Note:

- The Mission can act as an engine of growth that would benefit national initiatives in health, education, energy, environment, agriculture, strategic cum security, and industrial sectors, **Industry 4.0**, **SMART Cities**, **Sustainable Development Goals (SDGs)** **etc.**

- **Digital India initiatives:**
  - Under the Digital India initiatives government has set up Centres of Excellence on Internet of Things with the objective to enable **India to emerge as an innovation hub in IoT through democratization of innovation and realization of prototypes**.
  - One of the focus areas of Centres of Excellence on IoT is on **Agri-tech and it connects various entities** such as startups, enterprises, venture capitalists, government and academia.
- **National e-Governance Plan in Agriculture:**
  - Funding is given to **State Governments for Digital Agriculture projects** using emerging technologies like Artificial Intelligence and Machine Learning (AI/ML), IoT, Block chain etc.
- **Innovation and Agri-Entrepreneurship Development:**
  - This programme is operational under **Rashtriya Krishi Vikas Yojana (RKVY)** from 2018-19 with the objective to **promote innovation and entrepreneurship** by providing financial support and nurturing the incubation ecosystem.
  - In this connection, **five Knowledge Partners (KPs)** and 24 Agribusiness Incubators (R-ABIs) have been appointed across the country. The **five KPs are**:
    - National Institute of Agricultural Extension Management (MANAGE), Hyderabad.
    - National Institute of Agricultural Marketing (NIAM) Jaipur.
    - Indian Agricultural Research Institute (IARI) Pusa, New Delhi.
    - University of Agriculture Science, Dharwad, Karnataka.
    - Assam Agriculture University, Jorhat, Assam.

# GM Mustard

## Why in News?

Recently, the **Genetically Modified (GM) mustard Dhara Mustard Hybrid (DMH-11)** was tested in the field and shown to be **more productive**.

- Production of the **DMH-11** variety is not interfering with **honey bees' natural pollination practices.**

## What are Genetically Modified (GM) Crops?

- **GM crops** are derived from plants whose **genes are artificially modified,** usually by inserting **genetic material** from another organism, in order to give it new properties, such as **increased yield, tolerance** to a **herbicide, resistance** to **disease** or **drought,** or **improved nutritional value.**
  - Earlier, India approved the commercial cultivation of only one GM crop, **Bt cotton,** but **Genetic Engineering Appraisal Committee (GEAC)** has recommended GM Mustard for commercial use.

## What is GM Mustard?

- **DMH-11** is an indigenously developed **transgenic mustard**. It is a **genetically modified variant of Herbicide Tolerant (HT) mustard.**
- **DMH-11** is a result of a cross between **Indian mustard variety 'Varuna'** and **East European 'Early Heera-2'** mustard**.**
- It contains **two alien genes ('barnase' and 'barstar')** isolated from a **soil bacterium** called **Bacillus amyloliquefaciens** that enable breeding of **high-yielding commercial mustard hybrids.**
- **Barnase in Varuna induces a temporary sterility** because of which it can't naturally self-pollinate. Barstar in Heera **blocks the effect of barnase allowing seeds to be produced.**
- **DMH-11** has shown approximately **28% more yield** than the **national check** and **37 %** more than the **zonal checks** and its use has been claimed and approved by the **GEAC.**
  - **"Bar gene"** maintains the **genetic purity** of **hybrid seed.**

## Why is GM Mustard Necessary?

- India's **import of edible oils is on continuous rise** to meet the domestic demand. It ultimately led reduction forex. GM Mustard is **essential to reduce the forex drain on Agri-import.**
- **Productivity of oilseed crops** viz., soybean, rapeseed mustard, groundnut, sesame, sunflower, safflower and linseed in India **is much lower than the global productivity of these crops.**
- Crossing of genetically diverse parents results in hybrids with **increased yield and adaptation**

Note:

# Base Editing

## Why in News?

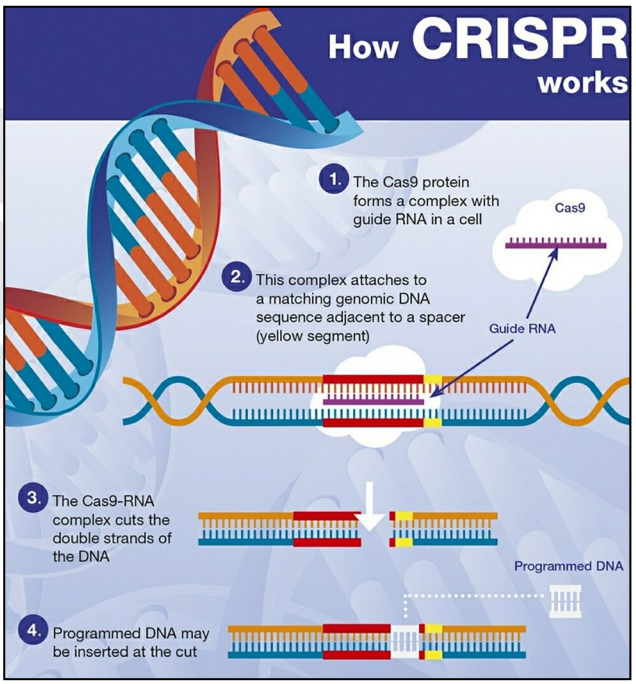
Recently, scientists in the United Kingdom (UK) have **successfully tested a new form of cancer therapy, 'Base Editing' for the time** in a patient with T-cell Acute Lymphoblastic Leukemia (T-ALL).

## What is Base Editing?

- **Bases are the language of life.** Just as letters in the alphabet spell out words that carry meaning, the **billions of bases in our Deoxyribonucleic Acid (DNA) spell out the instruction manual for our body.**
  - A **mis-arrangement in the sequence of bases** may cause cancer.
- Using the technique of **base editing, the molecular structure of just one base in a genetic code can be altered**, effectively changing its genetic instructions.
  - **Genetic code** refers to the **instructions contained in a gene** that tell a cell how to make a specific protein.
  - Each genetic code uses the four nucleotide bases of DNA: **Adenine (A), Cytosine (C), Guanine (G) and Thymine (T)** — in various ways to **spell out three-letter "codons" that specify which amino acid is needed at each position within a protein.**
- **Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)** technology is **one of the most popular approaches** that allows the genes to be altered, thereby, fixing the errors.
  - This method has been **further improvised to be able to directly change certain bases** such as a C can be changed into a G and T into an A.

## What is CRISPR Technology?

- CRISPR is a **gene editing technology,** by which research **scientists selectively modify the DNA of living organisms using a special protein called Cas9.**
- CRISPR/Cas9 edits genes by precisely cutting DNA and then letting natural DNA repair processes to take over. The system consists of two parts: the **Cas9 enzyme and a guide Ribonucleic Acid (RNA).**
  - **Cas9:** a CRISPR-associated (Cas) endonuclease, or enzyme, that acts as "molecular scissors" to cut DNA at a location specified by a guide RNA.
  - **Guide RNA (gRNA):** a type of RNA molecule that binds to Cas9 and specifies, based on the sequence of the gRNA, the location at which Cas9 will cut DNA.
- **CRISPR-Cas9 technology** is often described as **'Genetic Scissors'.**
  - Its mechanism is often compared to the '**cut-copy-paste',** or **'find-replace'** functionalities in common computer programmes.
  - A **bad stretch** in the DNA sequence, which is the cause of disease or disorder, is **located, cut, and removed and then replaced with a 'correct' sequence.**
  - The technology **replicates a natural defence mechanism in some bacteria** that uses a similar method to **protect itself from virus attacks.**




**What is T-ALL?**

- It **affects the stem cells in the bone marrow that produce** a particular **kind of White Blood Cells (WBCs) called T lymphocytes (T-cells).**
  - T-cells **provide a person with immunity** by killing cells carrying infections, activating other immune cells, and regulating the immune response.
- **T-ALL is a rapid and progressive type of blood cancer** in which the **T-cells start destroying healthy cells** instead of helping in immunity (that's T-cells' normal function).
- It is usually **treated by chemotherapy, radiation therapy** and **stem cell/bone marrow transplant.**

Note:

# Whole Genome Sequencing

## Why in News?

Recently, Researchers at the Indian Institute of Science Education and Research (IISER) Bhopal have **carried out Whole Genome Sequencing of banyan (**Ficus benghalensis**) and peepal (**Ficus religiosa**)** from leaf tissue samples.

- The work helped in **identifying 17 genes in the case of banyan and 19 genes of peepal** with **multiple signs of adaptive evolution (MSA)** that play a pivotal role in **long-time survival of these two Ficus species.**

## What is Whole Genome Sequencing?

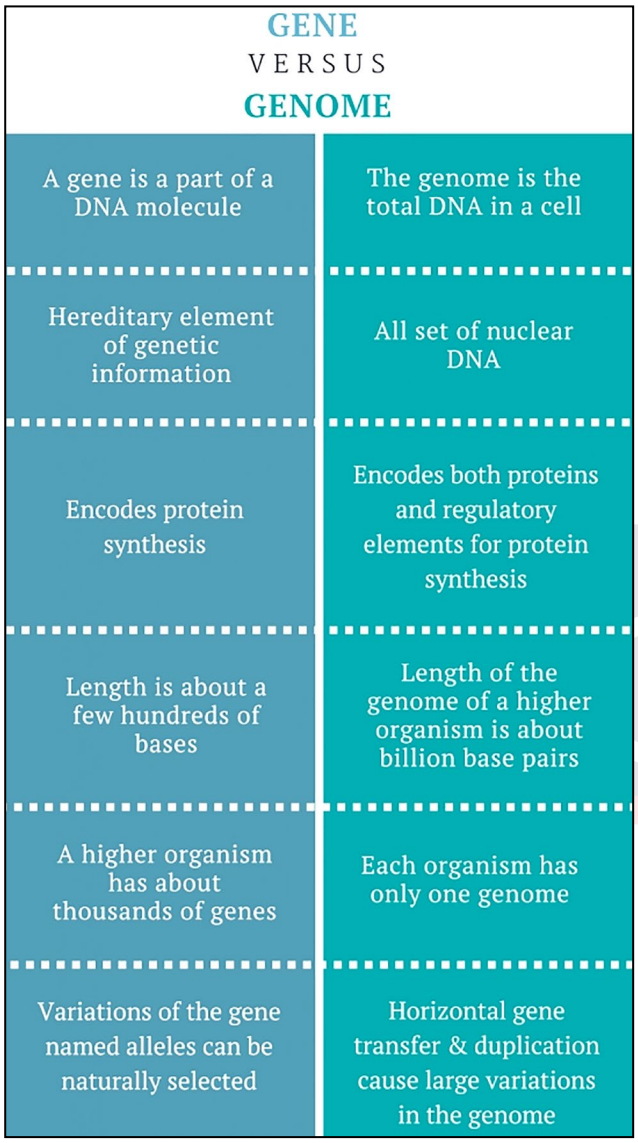
- **About:**
  - All organisms have a unique **genetic code, or genome,** that is composed of **nucleotide bases-Adenine (A), Thymine (T), Cytosine (C) and Guanine (G).**
  - The unique **Deoxyribonucleic Acid (DNA) fingerprint, or pattern can be identified** by **knowing the sequence of the bases** in an organism.
    - Determining the order of bases is called sequencing.
  - **Whole genome sequencing** is a laboratory procedure that **determines the order of bases in the genome of an organism in one process.**
- **Methodology:**
  - **DNA Shearing:**
    - Scientists begin by using molecular scissors to cut the DNA, which is composed of millions of bases (A's, C's, T's and G's), into pieces that are small enough for the sequencing machine to read.
  - **DNA Bar Coding:**
    - Scientists add small pieces of DNA tags, or bar codes, to identify which piece of sheared DNA belongs to which bacteria.
- This is similar to how a bar code identifies a product at a grocery store.
  - **DNA Sequencing:**
    - The bar-coded DNA from multiple bacteria is combined and put in a DNA sequencer.
    - The sequencer identifies the A's, C's, T's, and G's, or bases, that make up each bacterial sequence.
    - The sequencer uses the bar code to keep track of which bases belong to which bacteria.
  - **Data Analysis:**
    - Scientists use computer analysis tools to compare sequences from multiple bacteria and identify differences.
    - The number of differences can tell the scientists how closely related the bacteria are, and how likely it is that they are part of the same outbreak.
- **Advantages:**
  - Provides a **high-resolution, base-by-base view** of the genome
  - Captures both **large and small variants that might be missed** with **targeted approaches**
  - Identifies **potential causative variants for further follow-up studies of gene expression** and regulation mechanisms
  - Delivers **large volumes of data in a short amount of time** to support assembly of novel genomes
  - Genomic information has been instrumental in **identifying inherited disorders,** characterizing the **mutations that drive cancer progression**, and **tracking disease outbreaks.**
  - It is beneficial for **sequencing agriculturally important livestock, plants**, or **disease-related microbes.**

**What is Genome?**

- A **genome** refers to **all of the genetic material in an organism**, and the human genome is mostly the same in all people, but a very small part of the DNA does vary between one individual and another.
- Every organism's **genetic code is contained in its DNA**, the building blocks of life.
- The discovery that DNA is **structured as a "double helix" by James Watson and Francis Crick in 1953**, started the quest for understanding how genes dictate life, its traits, and what causes diseases.
- **Each genome contains all of the information needed** to build and maintain that organism.
- In humans, a copy of the entire genome contains more than 3 billion DNA base pairs.

Note:

### What is the Difference between Genome and Gene?




# Anticancer mRNA Vaccine

### Why in News?

Recently, the results of a trial of **messenger Ribonucleic Acid (mRNA-4157/V940) vaccine** made by Moderna and MSD (Merck & Co.) **when taken along with an immunotherapy drug Keytruda** has shown **promising results against advanced melanoma,** a kind of skin **cancer.**

### What is mRNA Vaccine Therapy for Advanced Melanoma?

- **About:**
  - It is a **personalised cancer vaccine** *i.e.,* tailor-made for every patient.
  - To build the vaccine, researchers **took samples of patients' tumors and healthy tissue.**
    - After analysing the samples to decode their genetic sequence and isolate mutant proteins associated only with the cancer, that information was used to design the vaccine.
  - The personalised cancer vaccine **uses the same m-RNA technology** that was used to **produce the Covid-19 vaccine.**
    - mRNA vaccines use mRNA to teach our cells how to make a protein that triggers an immune response inside our bodies.
- **Mechanism:**
  - It **allows the body's immune system** to seek and **destroy cancerous cells.**
  - The personalised cancer vaccine **works in concert with Keytruda, to disable a protein called Programmed Death 1 (PD-1),** that **helps tumors to evade the immune system.**
  - When injected into a patient, the **patient's cells act as a manufacturing plant, producing perfect copies of the mutations** for the immune system to recognise and destroy.
    - Having been exposed to mutations without the virus, the body learns to fight off the infection.
- **Efficacy:**
  - The vaccine showed a **44% reduction in the risk** of dying of cancer or having the cancer progress.
  - The **combination of mRNA-4157/V940 and Keytruda** was generally **safe and demonstrated the benefit compared with Keytruda alone** after a year of treatment.

**What are Different Types of Vaccines?**

- **Inactivated Vaccines:**
  - Inactivated vaccines use the **killed version of the germ** that causes a disease.
  - Vaccines of this type are created by **inactivating a pathogen, typically using heat or chemicals such as formaldehyde or formalin.** This destroys

Note:

the pathogen's ability to replicate but keeps it **"intact" so that the immune system can still recognize it.** ("Inactivated" is generally used rather than "killed" to refer to viral vaccines of this type, as viruses are generally not considered to be alive.)

- They usually don't provide immunity (protection) **that's as strong as live vaccines.** So, you may need several doses over time (booster shots) in order to get ongoing immunity against diseases.
  - They are Used to protect: Hepatitis A, Flu (shot only), Polio (shot only), Rabies.

➢ **Live-attenuated Vaccines:**

- Live vaccines use **a weakened (or attenuated) form of the germ** that causes a disease.
- Because these vaccines are so similar to the natural infection that they help prevent, they create **a strong and long-lasting immune response.**
- The limitation of this approach is that **these vaccines usually cannot be given to people with weakened immune systems.**
- **Live vaccines are used against**: **Measles**, Mumps, Rubella (MMR combined vaccine), Rotavirus, Smallpox among others.

➢ **Messenger (m) RNA Vaccines:**

- mRNA vaccines **make proteins in order to trigger an immune response.** mRNA vaccines have several benefits compared to other types of vaccines, **including shorter manufacturing times** and, because they do not contain a live virus, no risk of causing disease in the person getting vaccinated.
- The vaccines are used to protect against: Covid-19.

➢ **Subunit, Recombinant, Polysaccharide, and Conjugate Vaccines:**

- They use **specific pieces of the germ** - like its protein, sugar, or capsid (a casing around the germ). They give a very strong immune response.
- They can also be used on people with weakened immune systems and long-term health problems.
- These vaccines are used to protect against: Hib (Haemophilus influenzae type b) disease, **Hepatitis B**, HPV (Human papillomavirus), **Pneumococcal disease** among others.

➢ **Toxoid Vaccines:**

- They use a toxin (harmful product) made by the germ that causes a disease. They **create immunity to the parts of the germ that cause a disease instead of the germ itself.** That means the immune response is targeted to the toxin instead of the whole germ.
- Toxoid vaccines are used to protect against: **Diphtheria, Tetanus.**

➢ **Viral Vector Vaccines:**

- Viral vector vaccines use **a modified version of a different virus as a vector** to deliver protection.
- Several different viruses have been used as vectors, including **influenza, vesicular stomatitis virus (VSV), measles virus, and adenovirus, which causes the common cold.**
  - Adenovirus is one of the viral vectors used in some Covid-19 vaccines being studied in clinical trials.
- The vaccines are used to protect against: **Covid-19**

# Incovacc, Intranasal Covid-19 Vaccine

## *Why in News?*

Bharat Biotech's intranasal vaccine, **BBV154 or Incovacc is the world's first intranasal vaccine to be approved as a booster dose for Covid-19.**

## *What is Incovacc?*

➢ **About:**

- The nasal vaccine is a **recombinant replication-deficient adenovirus vectored vaccine** with a pre-fusion stabilized spike protein.

➢ **Significance:**

- With the vaccine **being delivered through a nasal spray**, it will **do away with the need for needles and syringes** currently required for all the **Covid-19 vaccines** available.
- It will also **reduce dependence on personnel trained to give shots.**
- Incovacc is **effective for Omicron variants** that replicate in the upper respiratory tract before entering the lungs.

➢ **Mechanism:**

Note:

- As the vaccine is given nasally, it **triggers an immune response in the mucosal membrane.**
- BBV154 may **produce local antibodies in the upper respiratory tract** which may provide the potential to reduce infection and transmission.
- Since the nasal vaccine **gives local immunity (in the nose where the virus first enters), it can be said that it is more likely to be effective at preventing transmission** than the current generation of vaccines we have.

➢ **Booster Dose:**

- This is the **second heterologous booster** to be included in the vaccination programme after **Corbevax.**
  - In homologous boosting, a person is injected with the same vaccine that was used for the two previous doses. In heterologous boosting, a person is injected with a different vaccine from that was used for the primary dose.
- It has **previously received the nod** to be used as a **primary dose.**
- Incovacc will be available as a booster dose only for those **above 18 years of age who have got 2 doses of either Covaxin or Covishield.**
  - It will not be administered to any other category, for now, including those who have already taken booster dose.
  - Those who have taken Covishield and Covaxin can now take this nasal vaccine as a heterologous booster dose.

# Deepfake Technology

## *Why in News?*

The **Cyberspace Administration of China**, the country's cyberspace watchdog, is rolling out new regulations to restrict the use of **deep synthesis technology** and curb disinformation.

➢ The policy requires deep synthesis service providers and users to ensure that any doctored content using the technology is explicitly labelled and can be traced back to its source.

## *What is Deep Synthesis?*

➢ **Deep synthesis** is defined as the use of technologies, including **deep learning** and **augmented reality**, **to generate text, images, audio** and **video to create virtual scenes.**

- One of the most notorious applications of the technology is **deepfakes**, where synthetic media is used to **swap the face or voice** of one person for another.
- **Deepfakes** are getting harder to detect with the advancement of technology.

## *What is Deepfake Technology?*

➢ **About:**

- **Deepfake technology** is a method for manipulating **videos, images, audios** utilizing powerful computers and deep learning.
- It is used to generate **fake news** and **commit financial fraud** among other **wrong doings**.
- It overlays a digital composite over an already-existing **video, picture,** or **audio; cybercriminals** use **Artificial Intelligence technology.**

➢ **Origin of the Word:**

- The term **deepfake** originated in **2017,** when an anonymous Reddit user called himself **"Deepfakes."**
- This user manipulated **Google's open-source, deep-learning technology to** create and post **pornographic videos.**

➢ **Misuse:**

- **Deepfake technology** is now being used for **nefarious purposes** like scams and hoaxes, celebrity pornography, **election manipulation,** social engineering, **automated disinformation attacks**, identity theft and financial fraud etc.
- Deepfake technology has been used to impersonate notable personalities like former U.S. Presidents Barack Obama and Donald Trump, India's Prime Minister Narendra Modi, etc.

# iDEX and Defence India Start-Up Challenge

## *Why in News?*

**Innovations for Defence Excellence (iDEX),** the flagship initiative of Department of Defence Production, Ministry of Defence, has **reached a milestone with the signing of its 150th contract.**

Note:

- The contract relates to an Indian Navy project of the **Defence India Start-up Challenge (DISC 7) SPRINT edition.**

### What is iDEX?

- **About:**
  - iDEX, **launched in 2018,** is an ecosystem to foster innovation & technology development in Defence and Aerospace by engaging innovators & entrepreneurs to deliver technologically advanced solutions for modernizing the Indian Military.
  - It **provides funding/grants** to Micro Small and Medium Enterprises (MSMEs), **start-ups,** individual innovators, R&D institutes and academia to carry out research and development.
  - The iDEX-Prime **aims to support projects requiring support beyond Rs 1.5 crore up to Rs 10 crore,** to help ever-growing start-ups in the defence sector.
  - iDEX portal was launched to **provide wider publicity and better visibility of iDEX activities and enable more efficient running of future challenges** through better information management.
- **Core Objectives:**
  - **Indigenization:** Rapid development of new, indigenized and innovative technology.
  - **Innovation:** Creates a culture of engagement with innovative startups to encourage co-creation.
- **Funding:**
  - iDEX is funded and managed by **"Defence Innovation Organisation (DIO)".**
- **Achievement:**
  - iDEX has been awarded the prestigious **Prime Minister Award for Public Policy in Innovation Category** for the year 2021.

**What is DIO?**

- DIO is a **not-for-profit organisation** formed under section 8 of the **Companies Act 2013.**
- It is funded by **Hindustan Aeronautics Limited (HAL)** and **Bharat Electronics Limited (BEL).**
- It provides **high-level policy guidance to iDEX.**

### What is DISC?

- DISC aims at supporting **Startups/MSMEs/Innovators to create prototypes and/or commercialize products/ solutions** in National Defence and Security.
- The **First DISC** was launched in 2018 at Bengaluru.
- It was launched by the **Ministry of Defence in partnership with Atal Innovation Mission (AIM).**
  - **AIM** is Government of India's flagship initiative **to create and promote a culture of innovation and entrepreneurship** across the country.
- Under the program, **the start-ups, Indian companies and individual innovators** (including research & academic institutions) can participate.
- **DISC 7 has been launched with 69 Problem Statements (PS)** from Indian Navy for resolution by startups & innovators.

### What are Government Initiatives Regarding Indigenisation?

- **First Negative Indigenisation**
- **Positive Indigenisation List**
- **New FDI Policy in Defence Sector**
- **Defence Acquisition Procedure 2020**
- **Defence Industrial Corridors**

## Water Worlds

### Why in News?

According to a new study, a team of astronomers have found **water worlds, two exoplanets orbiting a red dwarf star.**

### What are the Key Findings?

- **About the Exoplanets:**
  - These exoplanets **are Kepler-138c and Kepler-138d,** which were observed using **NASA's Hubble** and retired **Spitzer space telescope**.
  - It is the first-time planets are confidently identified as water worlds, a type of planet that was theorized by astronomers to exist for a long time.
  - The exoplanets **are located in a planetary system that is 218 light years away** in the **constellation Lyra** and are unlike any planets in our solar system.
  - The new planet takes **38 days to complete an orbit.**
  - It is in the habitable zone, **meaning it is located in an orbit that receives just the right amount of heat from its star to allow water to exist** in a liquid form.

Note:

- **Findings:**
  - Kepler- 138c and d are made up **of ingredients lighter than rock (rocky planets like Earth)** but heavier than hydrogen or helium (gas-giant planets like **Jupiter**).
  - This **signals the presence of water,** up to half of the mass of the twin worlds should be water.
  - The volume of the two is three times that of Earth and **mass twice as big, they calculated.**
  - They are also **larger-scale versions of Enceladus (Saturn's moon)** and **Europa (Jupiter's moon)**.
  - The density of the twin **exoplanets is lower than Earth** but comparable to Enceladus and Europa.
    - Until now, worlds slightly larger than Earth would likely have rocky features.
  - These twin planets of the same size and mass are **more massive than Earth but lighter than ice giants Uranus and Neptune.**
  - But they are different from the planets in our solar system, which is chiefly composed of **rocky planets like Earth and gas giants like Jupiter.**

## Uncontrolled Re-Entries of Satellites

### *Why in News?*

Outer Space Institute (OSI) has called for both national and multilateral efforts to **restrict uncontrolled re-entries** of Satellites.

- **OSI** is a network of **world-leading space experts united by their commitment to highly innovative, transdisciplinary research** that addresses grand challenges facing the continued use and exploration of space.

### *What are the Stages of a Rocket Launch?*

- **Primary Stage:**
  - The primary stage of a rocket is **the first rocket engine to engage, providing the initial thrust to send the rocket skyward.**
  - This engine will continue to operate until its fuel is exhausted, at which time it separates from the rocket and falls to the ground.
- **Secondary Stage:**
  - After the primary stage has fallen away, **the next rocket engine engages to continue the rocket on its trajectory.**
  - The second stage has considerably **less work to do, since the rocket is already traveling at high speed** and the rocket's weight has significantly decreased due to the separation of the first stage.
  - If the rocket has additional stages, **the process will repeat until the rocket is in space.**
- **Payload:**
  - Once the payload, whether it be a satellite or a spacecraft, is in orbit, the **rocket's final stage falls away, and the craft will be maneuvered** using smaller **rockets whose purpose is to guide the spacecraft.** Unlike the main rocket engines, these maneuvering rockets can be used multiple times.

**Note:**

- The Soviet Union launched the **first artificial satellite in 1957.**
- There are **more than 6,000 satellites in orbit**, most of them in **low-earth** (100-2,000 km) and **geostationary** (35,786 km) orbits, placed there in more than 5,000 launches.
- The number of rocket launches have been surging with the advent of reusable rocket stages.

## World AIDS Day

### *Why in News?*

**World AIDS Day** is observed on **1st December every year** all over the world to spread awareness about the disease and remember all those who lost their lives to it.

### *Why is World AIDS Day Celebrated?*

- **About:**
  - It was founded in 1988 by the **World Health Organization (WHO)** and was the **first ever global health day** with a motto of raising public awareness about **Acquired ImmunoDeficiency Syndrome (AIDS)**.
- **Theme for 2022:**
  - '**Equalize**'.
    - It encourages people to unite globally to eliminate the disparities and inequities that

create barriers to HIV testing, prevention, and access to HIV care.'

- **Significance:**
  - The very day reminds the public and government that HIV has not gone away and there is still a vital need to raise money, increase awareness, fight prejudice and improve education.
  - It is an opportunity to show solidarity with the millions of people living with HIV worldwide.

**What is AIDS Disease?**

- **About:**
  - **AIDS** is a chronic, potentially life-threatening health condition caused by the **human immunodeficiency virus (HIV)** that interferes with the body's ability to fight infections.
  - HIV attacks **CD4, a type of White Blood Cell (T cells)** in the body's immune system.
    - T cells are those cells that move around the body detecting anomalies and infections in cells.
  - After entering the body, HIV multiplies itself and destroys CD4 cells, thus severely damaging the human immune system. Once this virus enters the body, it can never be removed.
  - The CD4 count of a person infected with HIV reduces significantly. In a healthy body, CD4 count is between 500- 1600, but in an infected body, it can go as low as 200.
- **Transmission:**
  - HIV can spread through **multiple sources**, by coming in direct contact with certain **body fluids** from a person infected with HIV, who has a detectable viral load. It can be blood, semen, rectal fluid, vaginal fluid or breast milk.
- **Symptoms:**
  - Once HIV converts into AIDS then it may **present in initial symptoms like unexplained fatigue, fever, sores around genitals or neck, pneumonia etc.**
- **Prevention:**
  - Make sure to use protective techniques.
  - Make sure to avoid using contaminated needles.
  - Prevent mother to child transmission.
  - If someone is aware of the infection in their body, make sure they are on the right treatment path.
  - Opt for the set of pre-marital tests before marriage which includes an HIV test and helps to ensure safety from other **Sexually Transmitted Diseases** as well.

## What is the Global & National Status of AIDS?

- **Global:**
  - According to the Joint **United Nations Programme on HIV/AIDS (UNAIDS)**, as of 2021, 38.4 million people were living with HIV, out of which 1.7 million were children.
    - 54% of all people living with HIV were women and girls.
    - 85% of all people living with HIV knew their HIV status in 2021.
  - In 2021, 6,50,000 people died of AIDS-related diseases.
- **National:**
  - According to UNAIDS, an estimated 2.4 million people were living with HIV in India in 2021 (including 70,000 children).
    - Maharashtra had the maximum numbers followed by Andhra Pradesh and Karnataka.

## What are India's Initiatives to Curb AIDS Disease?

- **HIV and AIDS (Prevention and Control) Act, 2017:** According to this act, the central and state governments shall take measures to prevent the spread of HIV or AIDS.
- **Access to ART:**
  - India has made **Antiretroviral Therapy (ART)** affordable and accessible to over 90 per cent of people living with HIV in the world.
- **Memorandum of Understanding (MoU):**
  - The **Ministry of Health and Family Welfare** signed a MoU with the **Ministry of Social Justice and Empowerment** in 2019 for enhanced HIV/AIDS outreach and to reduce the incidence of social stigma and discrimination against victims of drug abuse and Children and People Living with HIV/AIDS.
- **Project Sunrise:**
  - **Project Sunrise** was launched by the Ministry of Health and Family Welfare in 2016, to tackle the rising HIV prevalence in north-eastern states in India, especially among people injecting drugs.

Note:

# Near-Earth Asteroid Ryugu

## Why in News?

A sample of a space rock called Ryugu that was carried to Earth in 2020 by the Japanese space agency's asteroid sample-return mission, Hayabusa 2 may hold the answers to the **origin of the Earth.**

- It is the first time several grams of **asteroid** samples have been brought back to Earth.

## What is Asteroid Ryugu?

- Asteroid Ryugu is **a diamond-shaped space rock**. The asteroid's name means "dragon palace" in Japanese and refers to a magical underwater castle in a Japanese folktale.
- Ryugu was discovered in 1999 by the **Lincoln Near-Earth Asteroid Research (LINEAR) project**, a collaborative, U.S.-based project to catalogue and track space rocks.
- The asteroid is about 2,952 feet (900 meters) in diameter.
- Ryugu is orbiting the sun between Earth and Mars and **occasionally crosses Earth's orbit, which means the space rock is classified as "potentially hazardous,"** though the body poses no imminent danger to our world.

**What are Asteroids?**

- **About**
  - Asteroids are **also known as minor planets.**
  - They are **rocky remnants left over from the early formation** of our solar system about 4.6 billion years ago.
  - Most asteroids are **irregularly shaped**, though a few are nearly spherical.
  - Many asteroids are known to have a small companion moon (some have two moons).
  - There are **also binary (double) asteroids, in which two rocky bodies of roughly equal size orbit each other**, as well as triple asteroid systems.
- **Classification of Asteroids:**
  - **Main Asteroid Belt:** The majority of known asteroids orbit within the **asteroid belt** between Mars and Jupiter.
  - **Trojans:** These asteroids share an orbit with a larger planet, but do not collide with it because they gather around two special places in the orbit (called the L4 and L5 Lagrangian points). There, the gravitational pull from the sun and the planet are balanced.
    - Lagrange Points are positions in space where the gravitational forces of a two-body system like the Sun and the Earth produce enhanced regions of attraction and repulsion. These can be used by spacecraft to reduce fuel consumption needed to remain in position.
  - **Near-Earth Asteroids:** These objects have orbits that pass close by that of Earth. Asteroids that actually cross Earth's orbital path are known as Earth-crossers.

# Zombie Virus

## Why in News?

European researchers have raised concerns of yet another pandemic after resurrecting a **48,500-year-old 'Zombie Virus' from a frozen lake in Russia.**

- The researchers warned that Climate change-induced thawing of the **permanently frozen land (permafrost)** in the **Arctic** could pose a new public health threat.

## What is a Zombie Virus?

- **About:**
  - 13 new pathogens have been characterized, what are termed **'Zombie Viruses',** which remained **infectious despite spending many millennia trapped in the frozen ground.**
  - The virus emerged due to the **thawing of permafrost as the global temperature is rising.**
  - The new strain is **one of 13 viruses**, each of which possesses its own genome.
    - The oldest, dubbed Pandoravirus yedoma after the mythological character Pandora, was 48,500 years old, a record age for a frozen virus returning to a state where it has the potential to infect other organisms.
  - This has broken the previous record held by a 30,000-year-old virus discovered by the same team in Siberia in 2013.

Note:

# End-to-End Encryption

## Why in News?

Recently, Apple has announced it will be increasing the number of data points protected by **End-to-End Encryption (E2EE)** on iCloud from 14 to 23 categories.

## What is End-to-End Encryption?

- **About:**
  - End-to-end encryption is a **communication process that encrypts data being shared between two devices**.
  - It prevents third parties **like cloud service providers, internet service providers (ISPs) and cybercriminals from accessing data** while it is being transferred.
- **Mechanism:**
  - The cryptographic keys **used to encrypt and decrypt the messages** are stored on the endpoints.
  - The process of end-to-end encryption uses **an algorithm that transforms standard text into an unreadable format.**
  - This format can only be unscrambled and read by those **with the decryption keys, which are only stored on endpoints and not with any third parties** including companies providing the service.
- **Usage:**
  - E2EE has long been used when **transferring business documents**, financial details, legal proceedings, and personal conversations.
  - It can also be used to control **users' authorisation when accessing stored data.**
  - End-to-end encryption is used to **secure communications.**
  - It is also used **to secure passwords, protect stored data and safeguard data on cloud storage.**

## What are the Advantages of E2EE?

- **Security in Transit:**
  - End-to-end encryption uses public key cryptography, which stores private keys on the endpoint devices. Messages can only be decrypted using these keys, so **only people with access to the endpoint devices are able to read the message.**
- **Safety from Third Parties:**
  - E2EE ensures that user **data is protected from unwarranted parties** including service providers, cloud storage providers, and companies that handle encrypted data.
- **Tamper-Proof:**
  - With E2EE, the decryption key does not have to be transmitted; the recipient will already have it.
  - If a message encrypted with **a public key gets altered or tampered within transit**, the recipient will not be able to decrypt it, so the **tampered contents will not be viewable.**
- **Compliance:**
  - Many industries are bound by regulatory compliance laws that require **encryption-level data security.**
  - E2EE can help **organizations protect that data** by making it unreadable.

## What are the Disadvantages of E2EE?

- **Complexity in Defining the Endpoints:**
  - Some E2EE implementations **allow the encrypted data to be encrypted and re-encrypted at certain points** during transmission.
  - This makes it important to clearly **define and distinguish the endpoints** of the communication circuit. **If endpoints are compromised, encrypted data may be revealed.**
- **Too Much Privacy:**
  - Government and law enforcement agencies **express concern that E2EE can protect people sharing illicit content** because service providers are unable to provide law enforcement with access to the content.
- **No Protection to Metadata:**
  - Although messages in transit are encrypted and impossible to read, information about the message - **date of sending message and recipient, for instance - is still visible**, which may provide useful information to an interloper.

**What is the Legal Framework for Encryption in India?**

- **Minimum Encryption Standards:**
  - **India does not have a specific encryption law.** Although, a number of industry rules, such as those governing the banking**, finance, and telecommunications industries, include requirements for minimum encryption standards** to be utilised in protecting transactions.

Note:

- **Prohibition on Encryption Technologies:**
  - Users are not **authorised to employ encryption standards larger than 40 bits** using symmetric key algorithms or similar methods without prior clearance and deposition of decryption keys, according to the licencing agreement between the ISP and the DoT.
  - There are a variety of additional rules and recommendations **that use a greater encryption level than 40 bits for particular sectors.**
- **The Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules 2021:**
  - It superseded the earlier Information Technology (Intermediary Guidelines) Rules 2011.
  - The new set of rules have the potential to impact the end-to-end encryption techniques of social messaging applications like WhatsApp, Telegram, Signal, etc.
- **Information Technology Act of 2000:**
  - It regulates electronic and wireless modes of communication, is devoid of any substantive provision or policy on encryption.

# India's First Private Space Vehicle Launchpad

## *Why in News?*

Recently, Chennai-based space tech startup **Agnikul Cosmos inaugurated India's first private space vehicle launchpad** at the **Satish Dhawan Space Centre (SDSC) in Sriharikota.**

- It was executed in support of the **Indian Space Research Organisation (ISRO)** and IN-SPACe (Indian National Space Promotion and Authorization Center).

## *What is Agnikul's Launchpad Facility?*

- **About:**
  - The facility has two parts: **the Agnikul launchpad and the Agnikul mission control centre**, which are four kilometres apart.
  - The launchpad has been designed to **accommodate and support liquid stage-controlled launches.**
  - Agnikul Cosmos is **planning to launch its Agnibaan rocket from this launchpad.**
- **Significance:**
  - The launchpad is specifically built to **address the need for ISRO's range operations team** to monitor key flight safety parameters during launches.
  - Additionally, it has the ability to share data and other critical information with ISRO's Mission Control Center.

## *What is Agnibaan?*

- Agnibaan is a **two-stage launch vehicle that is capable of taking payloads of up to 100 kilograms to a low-earth orbit around 700 kilometres** from the surface of the Earth.
- It will be powered by the company's **3D-printed Agnilet engines.**
  - Agnilet is the **world's first single-piece 3-D printed engine** fully designed and manufactured in India and was successfully test-fired in early 2021, making Agnikul the first company in the country to test its engines at ISRO.
  - The Agnilet rocket is a **"semi-cryogenic" engine that uses a mixture of liquid kerosene and supercold liquid oxygen to propel itself.**
  - The engine is very complex and it **functions at very high temperatures.**

# SpaceTech Innovation Network: ISRO

## *Why in News?*

The **Indian Space Research Organisation (ISRO)** has signed an MoU with Social Alpha, a multistage innovation curation and venture development platform to launch **SpaceTech Innovation Network (SpIN).**

## *What is SpIN?*

- **About:**
  - SpIN is India's **first dedicated platform for innovation, curation, and venture development** for the burgeoning **space entrepreneurial ecosystem.**
  - The SPIN platform would create a **level playing field for various stakeholders to collaborate and contribute to the space ecosystem** in the country.
  - SpIN will **primarily focus on facilitating space tech entrepreneurs in three distinct innovation categories:**

Note:

- Geospatial Technologies and Downstream Applications
- Enabling Technologies for Space & Mobility
- Aerospace Materials, Sensors, and Avionics.

➢ **Significance:**

- Innovative technologies are expected **to bring a paradigm shift in utilising the space applications to maximise the economic, social, and environmental benefits** for the larger society.

➢ **Innovation Challenge:**

- SpIN has launched its first innovation challenge **for developing solutions in areas of maritime and land transportation,** urbanization, mapping, and surveying.
- The selected start-ups and innovators **will be able to access both Social Alpha's and ISRO's infrastructure** and resources as per the prevailing guidelines.
- They will be provided active hand-holding in critical areas, including access to product design, testing and validation infrastructure, **and intellectual property management.**

## Air Breathing Engines

### *Why in News?*

Recently, the **Indian Space Research Organisation (ISRO) has successfully conducted** the **hot test of Scramjet Engine**, a type of **Air Breathing Engine.**

➢ India is the fourth country to demonstrate the flight testing of a Scramjet Engine.

### *What are Air Breathing Engines?*

➢ **About:**

- An air-breathing engine is an **engine that takes in air from its surroundings in order to burn fuel.**
- All practical air breathing engines are **internal combustion engines that directly heat the air by burning fuel,** with the **resultant hot gases used for propulsion** *via* a propulsive nozzle.
- A continuous stream of air flows through the air-breathing engine. The air is compressed, mixed with fuel, ignited and expelled as the exhaust gas.
- **Thrust produced** by a typical air-breathing engine is about **eight times greater than its weight.**
- The thrust results from the expulsion of the working gases from the exhaust nozzle.

➢ **Types:**

- **Ramjet:** A ramjet is a form of air-breathing jet engine that **uses the vehicle's forward motion to compress incoming air for combustion** without a rotating compressor.
  - Ramjets work most efficiently at supersonic speeds but they are not efficient at hypersonic speeds.
- **Scramjet:** A scramjet engine is an **improvement over the ramjet engine** as it **efficiently operates at hypersonic speeds** and allows **supersonic combustion.**
- **Dual Mode Ramjet (DMRJ):** A dual mode ramjet (DMRJ) is a type of jet engine where a **ramjet transforms into a scramjet over Mach 4-8 range,** which means it can **efficiently operate both in subsonic and supersonic combustion modes.**

| Speed Range | Mach Number | Velocity in m/s |
|---|---|---|
| Subsonic | < 0.8 | < 274 |
| Transonic | 0.8–1.2 | 274–412 |
| Supersonic | 1.2–5 | 412–1715 |
| Hypersonic | 5–10 | 1715–3430 |
| High-hypersonic | 10–25 | 3430–8507 |

## HAKUTO-R Moon Mission: Japan

### *Why in News?*

Recently, a **Japanese space startup ispace Inc** has launched its own private **lander M1** to the Moon under its **HAKUTO-R mission,** from the **SpaceX** Falcon 9 rocket.

➢ It is Japan's **first-ever lunar mission** and the first of its kind by a private company.

### *What are the Key Points of the Mission?*

➢ **About:**

Note:

- The name HAKUTO-R refers to the **white rabbit that Japanese folklore suggests lives on the Moon**.
- The M1 lander will deploy **two robotic rovers, two-wheeled, orange-sized devices from Japan's JAXA space agency** and a four-wheeled Rover made by the **UAE known as the Explorer Rashid**, after the Dubai royal family patriarch.
  - If the rover Rashid lands successfully, it will be the Arab world's first Moon mission.
  - So far only the Us, Russia and China have managed to put a robot on the lunar surface.
- It will also be carrying an **experimental solid-state battery** made by NGK Spark Plug Co, a Japanese-based spark plug company

➢ **Features:**

- It is designed in such a way that it will use **minimal fuel to save money and leave more room** for cargo.
- It is taking a **slow, low-energy path to the Moon**, flying 1.6 million km (one million miles) from Earth before looping back and making a planned landing by the end of April.

➢ **Objective:**

- It is aimed to search for **water deposits before touching down in the Atlas Crater,** which lies in the northeastern section of the Moon's near side and measures more than 87km (54 miles) across and just over 2km (1.2 miles) deep.
- Mission success would also represent a milestone in space cooperation between **Japan and the US at a time when China is becoming increasingly competitive** and rides on Russian rockets are no longer available in the wake of **Russia's invasion of Ukraine.**
- Japan has a contract with NASA to ferry payloads to the Moon from 2025 and is aiming to build **a permanently staffed lunar colony by 2040.**

**What are other Lunar Missions?**

➢ **Indian:**

- **Chandrayaan 1**
- **Chandrayaan-2**
- **Chandrayaan-3**

➢ **Other Countries:**

- **UAE's Moon Mission**
- **NASA's Artemis Mission (USA)**
- **Lunar Evacuation System Assembly (USA)**
- **Chang'e-5 Mission (China)**

# Fusion Energy Breakthrough

## *Why in News?*

Recently a few scientists at the Lawrence Livermore facility, the US have achieved a **net gain in energy from a nuclear fusion reaction**, which is seen as a big breakthrough.

➢ **China's Artificial Sun,** the Experimental Advanced Superconducting Tokamak (EAST) device replicates the nuclear fusion process carried out by the sun.

## *What is Fusion?*

➢ Fusion is a different, but more powerful, way of harnessing the immense energy trapped in the nucleus of an atom.

➢ In fusion, **nuclei of two lighter elements are made to fuse together** to form the nucleus of a heavier atom.

➢ A large amount of energy is released in both these processes, but substantially **more in fusion than fission.**

- This is the process that makes the **Sun and all other stars shine and radiate energy.**

## *What are the Advantages of Nuclear Fusion?*

➢ **Abundant Energy:**

- Fusing atoms together in **a controlled way releases nearly four million times more energy** than a chemical reaction such as the burning of coal, oil or gas and four times as much as nuclear fission reactions (at equal mass).
- Fusion has the **potential to provide the kind of baseload energy** needed to provide electricity to the cities and the industries.

➢ **Sustainability:**

- Fusion fuels are **widely available and nearly inexhaustible.** Deuterium can be distilled from all forms of water, while tritium will be produced during the fusion reaction as fusion neutrons interact with lithium.

➢ **No $CO_2$:**

- Fusion doesn't emit **harmful toxins like carbon dioxide or other greenhouse gases** into the atmosphere. Its major by-product is helium: an inert, non-toxic gas.

➢ **No long-lived Radioactive Waste:**

- Nuclear fusion reactors produce no high activity, long-lived nuclear waste.

Note:

- **Limited Risk of Proliferation:**
  - Fusion doesn't employ fissile materials like uranium and plutonium (Radioactive tritium is neither a fissile nor a fissionable material).
- **No Risk of Meltdown:**
  - It is difficult enough to **reach and maintain the precise conditions necessary for fusion**—if any disturbance occurs, the plasma cools within seconds and the reaction stops.

**What is the difference between Nuclear Fusion & Nuclear Fission?**

| | Fission | Fusion |
|---|---|---|
| Definition | Fission is the splitting of a large atom into two or more smaller ones. | Fusion is the fusing of two or more lighter atoms into a larger one. |
| Occurrence | Fission reaction does not normally occur in nature. | Fusion occurs in stars, such as the sun. |
| Energy Requirement | Takes little energy to split two atoms in a fission reaction. | Extremely high energy is required to bring two or more protons. |
| Energy Released | The energy released by fission is a million times greater than that released in chemical reactions, but lower than the energy released by nuclear fusion. | The Energy released by fusion is three to four times greater than the energy released by fission. |
| Energy production | Fission is used in nuclear power plants. | Fusion is an experimental technology for producing power. |

# Binary Merger of Gamma Ray Burst with Kilonova

## *Why in News?*

Recently, a **rare astronomical event** involving a **compact binary merger emitting long Gamma Ray Burst (GRB) twinned with a kilonova emissions** was reported. This **never before scientifically accepted or proven combination** was also confirmed by **India's largest optical telescope, Devasthal Optical Telescope (DOT).**

- The GRB lasted for over 50 seconds and **identified as GRB211211A.**
- Kilonovae occur when two compact objects, like **binary neutron stars or a neutron star and a black hole, collide.**

## *What are Gamma-Ray Bursts?*

- **About:**
  - GRBs are **massive but extremely bright, high-energy short gamma radiations** which get released **when massive stars collapse or die in the Universe.**
  - They are the **most powerful events** in the universe, detectable across billions of **light-years.**
    - A light-year is the distance a beam of light travels in a single Earth year, or 9.5 trillion kilometers.
  - Astronomers classify them as **long or short based on whether the event lasts for more or less than two seconds.**
- **Long GRBs:**
  - They observe long bursts **in association with the demise of massive stars.**
  - When a star much more massive than the Sun **runs out of fuel, its core suddenly collapses and forms a black hole.**
    - Black hole refers to a point in space where matter is so compressed as to create a gravity field from which even light cannot escape.
  - As matter swirls toward the black hole, some of that **escapes in the form of two powerful jets** that rush outward at almost the speed of light in opposite directions.
  - Astronomers only detect a GRB **when one of these jets happens to point almost directly toward Earth.**
  - Each jet drills through the star, producing a pulse of gamma rays – the highest-energy form of light – that can last up to minutes. **Following the burst, the disrupted star then rapidly expands as a supernova.**
    - A supernova is the name given to an exploding star that has reached the end of its life.
- **Short GRB:**
  - Short GRB, on the other hand, forms when pairs of compact objects – such as **neutron stars, which also form during stellar collapse – spiral inward over billions of years and collide.**
    - A neutron star comprises one of the possible evolutionary end-points of high mass stars.

# PSLV-C54

## *Why in News?*

Recently, the **Indian Space Research Organisation (ISRO)** has successfully launched the **Polar Satellite Launch Vehicle (PSLV) C54** from the Satish Dhawan Space Centre in Sriharikota, Andhra Pradesh.

- This was the **56th flight of PSLV**, which marks the **final mission for the year for PSLV-C54 rocket.**

Note:

### What are the Satellites Launched?

- **Nano Satellite-2 for Bhutan (INS-2B):**
  - **About:**
    - INS-2B satellite is a collaborative mission between India and Bhutan with two payloads.
      - **NanoMx,** a multispectral optical imaging payload developed by Space Applications Centre (SAC)
      - **APRS-Digipeater** which is jointly developed by DITT-Bhutan and URSC was successfully deployed.
  - **Significance of INS-2B:**
    - It will provide high-resolution images to Bhutan for the management of the country's natural resources.
    - The launch of the new satellite is part of India's efforts to back Bhutanese King Jigme Khesar Namgyel Wangchuck's plans to use advanced technology, including ICT and space technology, for the development of Bhutan.
    - The collaboration also fits in with India's "neighbourhood first" policy.
- **Anand:**
  - The Anand three axis stabilized Nano satellite is **a technology demonstrator for miniaturized electro-optical payload** and all other sub-systems like TTC, power, onboard computer and ADCS from Pixxel, India was also placed in the orbit successfully.
- **Astrocast:**
  - Astrocast, a 3U spacecraft, is a technology demonstrator satellite for the Internet of Things (IoT) as the payload. There are 4 nos. of Astrocast Satellites in this mission. These spacecrafts are housed within an ISISpace QuadPack dispenser.
  - The dispenser protects the satellite from contamination.
- **Thymbolt Satellites:**
  - The Thybolt is a 0.5U spacecraft bus that includes **a communication payload to enable rapid technology demonstration and constellation development for multiple users** from Dhruva Space using their own Orbital Deployer with a minimum lifetime of 1 year.
- **EOS-6:**
  - Earth Observation Satellite-06 (EOS-06) is the **Oceansat series' 3rd-generation satellite** envisaged to observe ocean colour data, sea surface temperature and wind vector data to use in oceanography, climatic and meteorological applications.
  - The satellite also **supports value added products such as potential fishing zones using chlorophyll**, Sea Surface Temperature (SST) and wind speed and land based geophysical parameters.

## Third Attempt for Artemis I

### Why in News?

**National Aeronautics and Space Administration (NASA)** has successfully launched its **unmanned Moon mission Artemis I** on 16th November 2022.

- After multiple delays caused by technological failures and natural disasters spread across two months, the **Space Launch System (SLS)** rocket has been lifted off from the **Kennedy Space Centre in Cape Canaveral, Florida.**

### What is the Artemis I Mission?

- Artemis I is an **uncrewed mission** of NASA.
  - Named after the sister of Apollo in Greek mythology, it is NASA's successor to the Apollo lunar missions from fifty years ago.
- It will test the agency's **Space Launch System (SLS) rocket** and **Orion crew capsule.**
  - The SLS is the largest new vertical launch system NASA has created since the Saturn V rockets used in the 1960s and 1970s.
- Artemis I is the first in a series of increasingly complex missions to build a **long-term human presence** at the Moon for decades to come.
  - The **primary goals for Artemis I** are to demonstrate Orion's systems in a spaceflight environment and ensure a safe re-entry, descent, splashdown, and recovery prior to the first flight with crew on Artemis II.
- It is only a lunar Orbiter mission even though, unlike most Orbiter missions, it has a return-to-Earth target.

### What is the Importance of Artemis I Mission?

- Artemis I is the **first step into that new space age of achieving the promise of transporting humans** to new worlds, of landing and living on other planets, or maybe meeting aliens.

Note:

- The CubeSats it will carry are equipped with instruments meant for **specific investigations and experiments**, including **searching for water** in all forms and for **hydrogen that can be utilised** as a source of energy.
- **Biology experiments** will be carried out, and the impact of **deep space atmosphere on humans** will be investigated through the effect on **dummy 'passengers'** on-board Orion.

**What are the Upcoming Artemis Missions?**

- **Artemis II:**
  - It will take off in **2024.**
  - Artemis II will have a **crew aboard Orion** and will be a test mission to confirm that all of the **spacecraft's systems will operate as designed** when it has humans on board.
  - But the Artemis II launch will be similar to that of Artemis I. A crew of four astronauts will be aboard Orion as it and ICPS orbit the Earth twice before moving to the direction of the Moon.
- **Artemis III:**
  - It is scheduled for 2025, and is expected to ferry astronauts to the moon for the first time since the apollo missions.

### *What are India's Moon Exploration Efforts?*

- **Chandrayaan 1:**
  - Chandrayaan-1 was India's first mission to Moon under **Chandrayaan project.**
  - It was launched successfully in October 2008 from Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota, Andhra Pradesh.
    - Indian Space Research Organisation (ISRO) lost communication with Chandrayaan-1 on 29th August 2009.
- **Chandrayaan-2:**
  - **Chandrayaan-2** is India's **second mission to the moon** and comprises a fully indigenous Orbiter, **Lander (Vikram)** and **Rover (Pragyan)**.
  - The Rover Pragyan is **housed inside Vikram lander.**
- **Chandrayaan-3:**
  - The ISRO recently announced India's third lunar mission **Chandrayaan-3**, which will comprise a lander and a rover.

## Semi-Automated Offside Technology

### *Why in News?*

**Federation Internationale de Football Association (FIFA)** is using **Semi-Automated Offside Technology (SAOT) for offside decisions** in the ongoing football world cup.

- The point of the offside rule is to prevent attacking players from perpetually camping in front of the opponent's goal.

### *What is Semi-Automated Offside Technology?*

- SAOT is a **support tool for the video match officials and the on-field officials** to help them make faster, more reproducible and more accurate offside decisions.
- There are two parts to the technology — **a sensor inside the match ball that** is held using suspension technology, and existing tracking tools that are part of the Video Assistant Referee (VAR) system.
- **Every time the ball is hit, data is sent in real time** (at a whopping 500 frames per second) to a network of antennae installed around the playing field.
- Additionally, **there are 12 Hawk-Eye cameras set up around the turf that shadow both the ball and the players**, with as many as 29 separate points in the human body tracked.
- The coming together of the ball sensor and the Hawk-Eye cameras is in effect SAOT.
- These **two data sets are run through artificial intelligence software** which generates automated alerts about offsides to the match officials. This replaces the manual effort taken in poring over replays for minutes on end.

## Photonic Crystal

### *Why in News?*

A soft tunable **photonic crystal with enhanced thermal stability and optical purity** developed by researchers that reflects vivid colours in the visible spectrum has **potential applications in making more durable and better reflective displays and laser devices.**

Note:

### What are Photonic Crystals?

- **About:**
  - Photonic crystals are **optical nanostructures in which the refractive index changes periodically.**
    - Refractive index, also called index of refraction is the measure of the bending of a ray of light when passing from one medium into another.
  - This affects the **propagation of light in the same way that the structure of natural crystals gives rise to X-ray diffraction** and that the atomic lattices (crystal structure) of semiconductors affect their conductivity of electrons.
  - Photonic crystals **occur in nature in the form of structural coloration and animal reflectors.**
    - Examples found in nature include opal, butterfly wings, peacock feathers, etc., exhibiting distinct iridescent colors.
- **Uses:**
  - Photonic crystals promise to be **useful in a range of applications ranging from reflection coatings to optical computers** when artificially produced or engineered in laboratories.
  - They **enable the PCs to exhibit structural colours in the visible spectral regime**.
  - Researchers have also been on the **constant lookout for tuning the properties in-situ post-fabrication.**
  - The development of advanced photonic materials and devices using **Liquid Crystals (LC) that exhibit self-organization**, phase transitions, and molecular orientation behaviors in response to external stimuli is attracting significant interest.

## SARAS 3 Telescope and Clues to First Stars

### Why in News?

Recently, by using the **SARAS-3 Radio Telescope**, scientists have determined the properties of a radio luminous galaxy that was formed just 200 million years after the Big Bang, a period known as the Cosmic Dawn.

- Researchers have used **data from SARAS 3 to throw light on the energy output, luminosity, and masses of the first generation of galaxies** that are bright in radio wavelengths.

**What is SARAS-3 Radio Telescope?**

- SARAS is a niche high-risk high-gain experimental effort of RRI (Raman Research Institute).
  - SARAS-3 was deployed over Dandiganahalli Lake and Sharavathi backwaters, located in Karnataka, in early 2020.
- SARAS aims to design, build and deploy in India a precision radio telescope to detect extremely faint radio wave signals from the depths of time, from our "Cosmic Dawn" when the first stars and galaxies formed in the early Universe.

**What are Radio Waves and Radio Telescopes?**

- **Radio Waves:**
  - Radio waves have the longest wavelengths in the electromagnetic spectrum. They range from the **length of a football to larger than our planet.** Heinrich Hertz proved the existence of radio waves in the late 1880s.
  - The range of the radio spectrum is considered to be **3 kilohertz up to 300 gigahertz.**
- **Radio Telescope:**
  - Radio telescopes collect weak radio light waves, bring it to a focus, amplify it and make it available for analysis.
  - They help study naturally occurring radio light from **stars, galaxies, black holes, and other astronomical objects.**
  - These specially-designed **telescopes observe the longest wavelengths of light, ranging from 1 millimetre to over 10 metres long.** For comparison, visible light waves are only a few hundred nanometers long, and a nanometer is only 1/10,000th the thickness of a piece of paper. In fact, we don't usually refer to radio light by its wavelength, but by its frequency.

## Asian Conference on Diarrhoeal Disease and Nutrition

### Why in News?

Recently, Union Minister addressed **16th Asian Conference on Diarrhoeal Disease and Nutrition (ASCODD) at Kolkata.** Delegates from India and other

Note:

South East Asian countries, African countries, US, European countries joined the conference virtually.

## What is Diarrhoeal Disease?

- **About:**
  - Diarrhoea is defined as the **passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual).**
  - The most severe threat posed by diarrhoea is dehydration.
    - During a diarrhoeal episode, water and electrolytes (sodium, chloride, potassium and bicarbonate) are lost through liquid stools, vomit, sweat, urine and breathing.
    - Dehydration occurs when these losses are not replaced.
- **Statistics:**
  - Diarrhoeal disease is the **second leading cause of death in children under five years old.**
    - Each year diarrhoea kills around 525,000 children under five.
  - Globally, there are **nearly 1.7 billion cases of childhood diarrhoeal disease** every year.
- **Clinical Types:**
  - **Acute Watery Diarrhoea** – lasts several hours or days, and includes cholera;
  - **Acute Bloody Diarrhoea** – also called dysentery; and
  - **Persistent Diarrhoea** – lasts 14 days or longer.
- **Causes:**
  - **Infection:** Diarrhoea can be caused by **bacterial infections such as cholera and typhoid, or by viral and parasitic organisms**, most of which are spread by faeces-contaminated water.
  - **Malnutrition:** Children who die from diarrhoea often suffer from underlying malnutrition, which makes them more vulnerable to diarrhoea.
  - **Contaminated Food and Water:** Contamination with human faeces, for example, from sewage, septic tanks and latrines, is of particular concern. Animal faeces also contain microorganisms that can cause diarrhoea.
- **Treatment:**
  - **Rehydration with Oral Rehydration Solution (ORS):** ORS is a mixture of clean water, salt and sugar. It costs a few cents per treatment. ORS is absorbed in the small intestine and replaces the water and electrolytes lost in the faeces.
  - **Zinc Supplements:** Zinc supplements reduce the duration of a diarrhoea episode by 25% and are associated with a 30% reduction in stool volume.
  - **Rehydration with Intravenous Fluids:** This is done in case of severe dehydration or shock.
  - **Nutrient-rich Foods:** The vicious circle of malnutrition and diarrhoea can be broken by continuing to give nutrient-rich foods – including breast milk – during an episode, and by giving a nutritious diet – including exclusive breastfeeding for the first six months of life – to children when they are well.
  - **Consulting a Health Professional:** For management of persistent diarrhoea or when there is blood in stool or if there are signs of dehydration.

## What are the Related Initiatives by India?

- **Intensified Diarrhoea Control Fortnight (IDCF):** To increase **awareness about use of ORS and Zinc in diarrhoea,** ICDF is being observed during pre-monsoon/ monsoon season, with the aim of **'zero child deaths due to childhood diarrhoea' since 2014.**
- **Integrated Action Plan for Prevention and Control of Pneumonia and Diarrhoea (IAPPD):** In **2014,** India launched the **Integrated Action Plan for Prevention and Control of Pneumonia and Diarrhoea (IAPPD)** to undertake collaborative efforts towards prevention of diarrhoea and pneumonia-related under-five deaths.
- **Universal Immunization Programme (UIP):** It was launched by the government in **1985** and **prevents mortality and morbidity in children and pregnant women against 12 vaccine-preventable diseases** including pneumonia and diarrhoea.
- **Social Awareness and Action to Neutralise Pneumonia Successfully (SAANS) Campaign**: It seeks to **reduce child mortality due to pneumonia,** which contributes to around 15% of deaths of children under the age of five annually.
- **Rotavirus Vaccine Drive:** In **2019,** the government of India launched a **rotavirus vaccine drive** across all states and Union Territories, which was an **unprecedented national scale-up of the rotavirus vaccine**.

Note:

# Dengue

## Why in News?

According to a study, the ongoing spread of **Dengue** in India has been attributed to a late withdrawal of monsoon.

- Dengue transmission is closely associated with three key factors — **rainfall, humidity and temperature** — which dictate the geographies in which dengue spreads and the transmission rate.

## What is Dengue?

- **About:**
  - Dengue is a mosquito-borne tropical disease caused by the **dengue virus (Genus Flavivirus)**, transmitted by several species of female mosquito within the genus Aedes, principally Aedes aegypti.
    - This mosquito also transmits chikungunya, yellow fever and Zika infection.
  - There are 4 distinct, but closely related, serotypes (separate groups within a species of microorganisms that all share a similar characteristic) of the virus that cause dengue (DEN-1, DEN-2, DEN-3 and DEN-4).
- **Symptoms:**
  - Sudden high fever, severe headaches, pain behind the eyes, severe bone, joint, and muscle pain, etc.
- **Diagnosis and Treatment:**
  - Diagnosis of dengue infection is done with a blood test.
  - There is no specific medicine to treat dengue infection.
- **Status of Dengue:**
  - **Incidence of dengue has grown dramatically** around the world in recent decades, with a vast majority of cases under-reported, according to the **World Health Organization (WHO).**
  - WHO estimates 39 crore dengue virus infections per year, of which 9.6 crore show symptoms.
  - According to data shared by the **National Center for Vector Borne Diseases Control**, India recorded 63,280 dengue cases as of September, 2022
- **Controlling Dengue Using Bacteria:**
  - Recently researchers from the World Mosquito Program have used mosquitoes infected with Wolbachia bacteria to **successfully control dengue** in Indonesia.
  - **Method:**
    - The scientists infected some mosquitoes with Wolbachia and then released them in the city where they bred with local mosquitoes, until nearly all mosquitoes in the area were carrying Wolbachia bacteria. This is called the Population Replacement Strategy.
    - At the end of 27 months, the researchers found that the incidence of dengue was 77% lower in areas where Wolbachia-infected mosquitoes had been released, as compared to areas without such deployments.
- **Dengue Vaccine:**
  - The dengue vaccine CYD-TDV or **Dengvaxia** was approved by the US Food & Drug Administration in 2019, the first dengue vaccine to get the regulatory nod in the US.
    - Dengvaxia is basically a live, attenuated dengue virus which has to be administered in people of ages 9 to 16 who have laboratory-confirmed previous dengue infection and who live in endemic areas.
  - **Vaccine manufacturer Indian Immunologicals Limited (IIL) is developing India's first Dengue vaccine** and has received permission for a Phase-1 trial.
    - The vaccine is being produced in collaboration with the National Institutes of Health in the US.

# India's First Private Launch Vehicle

## Why in News?

Space technology startup Skyroot Aerospace is set to **make history by sending India's first privately developed rocket Vikram-S** into space between 12th and 16th November, 2022 under the **'Prarambh' Mission.**

- Skyroot Aerospace is an **Indian startup in the aerospace business.**

Note:

**NOV 12-16 LAUNCH**

- **Skyroot Aerospace will launch Vikram-S between Nov 12 & 16** from Sriharikota
- It will carry three sats, including one **made by students of Space Kidz India**
- Rocket has got **technical launch nod** from IN-SPACe

### What is Vikram-S?

- The **Vikram-S rocket is a single-stage sub-orbital launch vehicle** which would carry three customer payloads.
  - Sub-orbital flight are those vehicles which are travelling slower than the orbital velocity – meaning it is fast enough to reach outer space but not fast enough to stay in an orbit around the Earth.
- It would **help test and validate the majority of the technologies in the Vikram series** of space launch vehicles.
  - Skyroot has been **working on three different Vikram rocket versions.**
  - The Vikram-I can launch with 480 kilograms of payload, whereas the Vikram-II is designed to do so with 595 kilos and Vikram-III has a 500 km Low Inclination Orbit launch capability with 815 kg.

### What is the Prarambh Mission?

- The Prarambh mission is **aimed at carrying three payloads into space**, including a 2.5-kilogram payload that has been developed by students from several countries.
- The Prarambh mission and the Vikram-S rocket were developed by the Hyderabad-based startup with extensive support from **Indian Space Research Organisation (ISRO) and IN-SPACe (Indian National Space Promotion and Authorisation Centre)**.

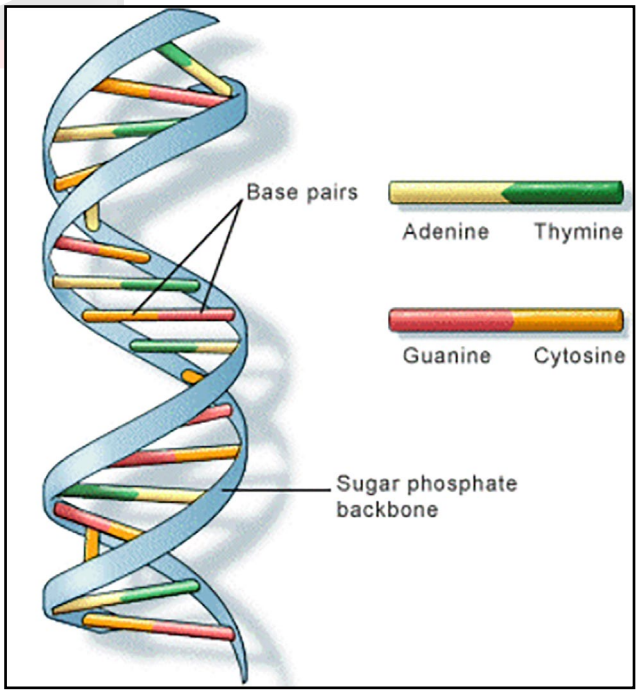
## Growing Demand of DNA Tests

### Why in the News?

Recently, the **Supreme Court** has expressed concern about growing uses of **Deoxyribonucleic Acid (DNA) Tests** in court cases.

### What is Deoxyribonucleic Acid (DNA)?

- **Deoxyribonucleic acid (DNA)** is an organic molecule with a complex molecular structure.
- **DNA** molecule's strands are made up of a long chain of **monomer nucleotides.** It is arranged in **a double helix structure.**
- **James Watson** and **Francis Crick** discovered that **DNA** is a **double-helix polymer** in **1953.**
- It is essential for the transfer of the **genetic characteristic** of the living being from one generation to the other generation.
- The majority of **DNA** is found in the **cell nucleus** so it is called **nuclear DNA.**




  - **DNA** stores data in the form of a code made up of four Nitrogenous bases.
    - Purines:
      - Adenine (A)

Note:

- Guanine (G)
- Pyrimidines
  - Cytosine (C)
  - Thymine (T)

### What is the Use of DNA Testing?

- **DNA testing** is essential for identifying and bringing justice in cases involving abandoned mothers and children.
- It is also a **highly effective technique** in **civil disputes** when the court needs to determine the **issue of maintenance** and **identify the child's parents.**

## Coronal Holes

### Why in News?

Recently, NASA captured an image having **dark patches on the sun's surface resembling eyes and a smile.**

- These patches are called **'Coronal holes',** which **can be seen in ultraviolet light but are typically invisible to our eyes.**

### What are Coronal Holes?

- **About:**
  - These are **regions on the sun's surface from where fast solar wind gushes out into space.**
    - In these regions, the magnetic field is open to interplanetary space, sending solar material What is India Post Payments Bank (IPPB
    - out in a high-speed stream of solar wind i.e. geomagnetic storm.
  - They have **lower temperatures and appear much darker than their surroundings** as they contain little solar material.
  - Coronal holes can **last between a few weeks to months.**
  - The holes are not a unique phenomenon, **appearing throughout the sun's approximately 11-year solar cycle.**
  - They can last much **longer during solar minimum,** a period of time when activity on the Sun is substantially diminished.
- **Significance:**
  - Coronal Holes are **important in understanding the space environment around the earth** through which our technology and astronauts' travel.

**What is a Geomagnetic Storm?**

- Geomagnetic storm is a solar storm that occurs during the **release of magnetic energy** associated with **sunspots ('dark' regions on the Sun that are cooler than the surrounding photosphere - the lowest layer of the solar atmosphere),** and can last for a few minutes or hours.
- It is a **major disturbance of Earth's magnetosphere** that occurs when there is a very **efficient exchange of energy from the solar wind into the space environment** surrounding Earth.
  - The magnetosphere **shields our home planet from harmful solar and cosmic particle radiation,** as well as erosion of the atmosphere by the solar wind – the constant flow of charged particles streaming off the Sun.
- These storms **result from variations in the solar wind** that produce major changes in the currents, plasmas, and fields in Earth's magnetosphere.
  - The solar wind conditions that are effective for creating geomagnetic storms are sustained (for several to many hours) periods of high-speed solar wind, and most importantly, a southward directed solar wind magnetic field (opposite the direction of Earth's field) at the dayside of the magnetosphere.
  - This **condition is effective for transferring energy** from the solar wind into Earth's magnetosphere.
- The largest storms that result from these conditions are associated with solar **Coronal Mass Ejections (CMEs)** where a billion tons or so of plasma from the sun, with its embedded magnetic field, arrives at Earth.
  - CMEs are large ejections of plasma and magnetic fields that **originate from the Sun's corona** (outermost layer).

## RISAT-2

### Why in News?

Recently, the **Indian Space Research Organisation's (ISRO) RISAT (Radar Imaging Satellite)-2 satellite** has made an uncontrolled re-entry into the Earth's atmosphere at the predicted impact point in the **Indian Ocean** near Jakarta.

Note:

- RISAT-2 is India's first **"eye in the sky"** which keep surveillance on the country's borders as **part of anti-infiltration and anti-terrorist operations**.

### *What is RISAT-2?*

- **About:**
  - The principal sensor of Risat-2, considered a 'spy' satellite, was an X-band **synthetic-aperture radar** from Israel Aerospace Industries.
  - Risat-2 was built more quickly following the 2008 Mumbai terror attacks due to delay with the indigenously developed C-band for Risat-1 satellite. The satellite, which was **India's first dedicated reconnaissance satellite**, possessed day-night as well as all-weather monitoring capability.
    - It was also used to track hostile ships at sea that were deemed a military threat.
- **Launch:**
  - Risat-2, weighing about 300 kg was **launched on April 20, 2009**, by the PSLV-C12 launch vehicle.
- **Significance:**
  - Risat-2 **provided beneficial payload data for over 13 years**.
    - Since its injection, Risat-2's radar payload services were provided for various space applications.
  - Risat-2 is a clear example of **ISRO's capability to carry out spacecraft orbital operations in an efficient and optimal way**.
    - As Risat-2 re-entered within 13.5 years, it complied with all necessary international mitigation guidelines for space debris, showing the space agency's commitment towards the long-term sustainability of outer space.

## Xenotransplantation

### *Why in News?*

Genetically modified pig heart took longer than usual to beat for human receiver in the **first-ever transplant of the gene-edited pig heart to human.** The human recipient **lived only for 61 days after the transplant.**

- **Prior attempts** at such transplants have **also failed.**

### *What is Xenotransplantation?*

- **About:**
  - Xenotransplantation involves the **transplantation of nonhuman tissues** or organs **into human recipients**.
    - In the recent heart transplant from pig to human, gene-editing was adopted to remove a sugar in its cells that's responsible for that hyper-fast organ rejection.
      - Genome editing (also called **gene editing**) is a group of technologies that give scientists the ability to change an organism's **Deoxy-Ribonucleic Acid (DNA).**
  - One of the **biggest obstacles** to transplantation is **organ rejection.**
- **Significance:**
  - This development could bring us one step closer to solving the global organ shortage.
    - In India, patients need 25,000-30,000 liver transplants annually. But only about 1,500 end up receiving them.
  - Pigs are increasingly becoming popular candidates for organ transplantation.
    - Pigs offer advantages over primates for organ procurements, because they are easier to raise and achieve adult human size in six months.
      - The pig's anatomical and physiological parameters are similar to that of humans, and the breeding of pigs in farms is widespread and cost-effective.

## Indian Biological Data Centre

### *Why in News?*

Recently, government has set up **'Indian Biological Data Bank' at the Regional Centre for Biotechnology (RCB), Faridabad.**

- Indian Biological Data Bank is better known as **'Indian Biological Data Centre (IBDC)'.**

### *What is IBDC?*

- **About:**
  - IBDC is the **first national repository for life science data in India**, where the data will not only be submitted from across India but can be accessed by researchers from across India
  - It is **mandated to archive all life science data in IBDC generated from publicly funded research** in India.

Note:

- The data center is supported by the **Department of Biotechnology (DBT).**
- It is being established at the **RCB in collaboration with the National Informatics Centre (NIC), Bhubaneshwar.**
- It costed around **85 crore rupees to be set up.**

➢ **Key Features:**

- The digitised data will be stored on a **four-petabyte supercomputer called 'Brahm'.**
  - A petabyte equals 10,00,000 gigabytes (gb).
- **Different sections of IBDC** would typically deal with **particular type(s) of life science data.**
  - Each IBDC section would have dedicated data submission and access schema.
- IBDC has a backup data **'Disaster Recovery' site at NIC.**
- Further, IBDC shall also develop **highly curated data sets in order to facilitate knowledge discovery** in various domains of life sciences.
- It would also provide **infrastructure and expertise for biological data analysis.**
- It currently accepts nucleotide sequences — the **digitised genetic makeup of humans, plants, animals, and microbes.**
  - There are now 200 billion base pair data in the bio-bank, including 200 human genomes sequenced under the '1,000 Genome Project', which is an international effort to map the genetic variations in people.
    - The project will also focus on populations that are predisposed to certain diseases.
  - It will also help researchers in studying zoonotic diseases.
- Although the database **currently only accepts such genomic sequences, it is likely to expand later to storage of protein sequences** and **imaging data** such as copies of Ultrasound and Magnetic Resonance Imaging (MRI).

➢ **Objectives:**

- **Provide IT platform** for perpetually archiving biological data in the country.
- **Development of standard operating Procedures (SOPs)** for storing and sharing the data as per FAIR (Findable, Accessible, Interoperable and Reusable) Principle.
- **Perform quality control, curation/annotation of data**, data backup and management of data life cycle.
- Development of **web-based tools/Application Programming Interface (API)** for data sharing/ retrieval.
- Organization of **training programs on 'Big' data analysis** and benefits of data sharing.

➢ **Data Access:**

- IBDC would have majorly two data access types:
  - Open access/time-release access: Data submitted at IBDC would be freely accessible across the globe as per international open-access standards. The submitter, however, may choose to restrict the data access for a defined period of time.
  - Restricted access: The data would not be made accessible freely. It can only be accessed through prior permission through IBDC from the original data submitter.

## NavIC

### *Why in News?*

Indian plans to expand its regional satellite navigation system **NavIC (Navigation in Indian Constellation)**, to increase its use in the civilian sector and ships, aircraft travelling far from the country's borders.

### *What is NavIC?*

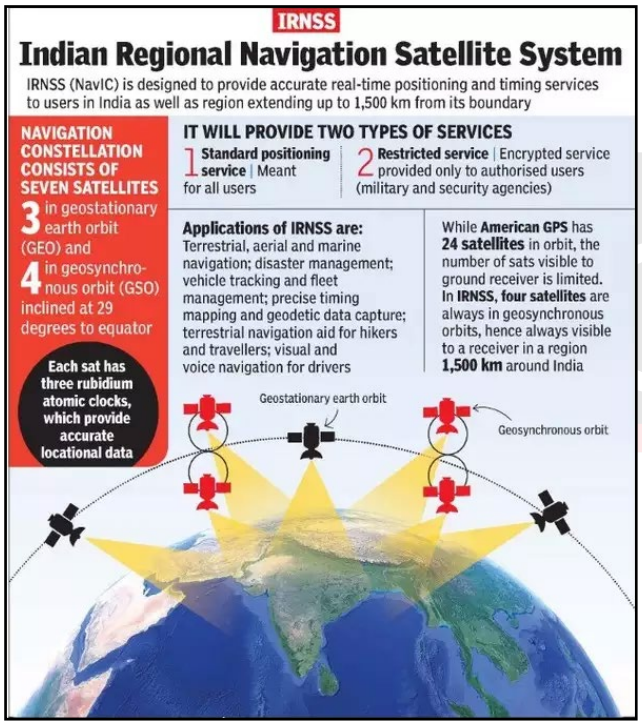
➢ **About:**

- NavIC or the Indian Regional Navigation Satellite System (IRNSS) is designed with a constellation of 7 satellites and a network of ground stations operating 24x7.
  - There are a total of eight satellites however only seven remain active.
  - Three satellites in geostationary orbit and four satellites in geosynchronous orbit.
- The constellations' first satellite (IRNSS-1A) was launched on **1st July 2013 and the eighth satellite IRNSS-1I** was launched in **April 2018.**
  - With the seventh launch of the constellation's satellite (IRNSS-1G), IRNSS was renamed NaVIC by India's Prime Minister in 2016.

Note:

- It was recognised by the **International Maritime Organization (IMO)** as a part of the World-Wide Radio Navigation System (WWRNS) for operation in the Indian Ocean Region in 2020.

➢ **Potential Uses:**
- Terrestrial, aerial and marine navigation;
- Disaster management;
- Vehicle tracking and fleet management (especially for mining and transportation sector);
- Integration with mobile phones;
- Precise timing (as for ATMs and power grids);
- Mapping and geodetic data capture.




### *What is the Significance?*

➢ It gives real time **information for 2 services i.e standard positioning service open for civilian use and Restricted service** which may be encrypted for authorized users like for military.

➢ India became one of the **5 countries having their own navigation system**. So, India's dependence on other countries for navigation purposes reduces.

➢ It will help **scientific & technological advancement in India**. It is important for the country's sovereignty and strategic requirements.

➢ In April 2019, the government made **NavIC-based vehicle trackers mandatory for all commercial vehicles** in the country in accordance with the Nirbhaya case verdict.

➢ Also, Qualcomm Technologies has **unveiled mobile chipsets** supporting NavIC

➢ Further with extensive coverage, one of the stated future uses of the project includes sharing of the project with the **SAARC nations.** This will help in integrating the regional navigation system further and a diplomatic goodwill gesture from India towards countries of the region.

### *Which are the other Navigation Systems operational in the world?*

➢ **Four global systems:**
- GPS from the U.S.
- GLONASS from Russia.
- Galileo from European Union
- BeiDou from China.

➢ **Two regional systems:**
- NavIC from India
- QZSS from Japan.

## Pillars of Creation: James Webb Telescope

### *Why in News?*

A lush, highly detailed landscape- the iconic **"Pillars of Creation"** has been caught by NASA's powerful **James Webb Telescope.**

### *What is Pillars of Creation?*

➢ **About:**
- It is a **vista of three looming towers made of interstellar dust and gas**.
- These iconic Pillars of Creation is located in the centre of the **Eagle Nebula (it is a constellation of stars)**, which is also known as Messier 16.
- The images show vast, towering columns of dense clouds of gas and dust where young stars are forming in a region some **6,500 light-years from Earth.**
- At the ends of several pillars are **bright red, lava-like spots.** These are **ejections from stars that are still forming**, only a few hundred thousand years old.

Note:

- The pillars were made famous by the **Hubble Space Telescope**, which first captured them in **1995 and then again in 2014.**

➢ **Significance:**

- The new image will help researchers revamp their models of star formation by identifying far more precise counts of newly formed stars, along with the quantities of gas and dust in the region.

### *What is the James Webb Space Telescope?*

➢ **About:**

- The telescope is the result of an international collaboration between NASA, the **European Space Agency (ESA)** and the Canadian Space Agency which was launched in December 2021.
- It is currently at a point in space known as the **Sun-Earth L2 Lagrange point**, approximately 1.5 million km beyond Earth's orbit around the Sun.
  - Lagrange Point 2 is one of the five points in the orbital plane of the Earth-Sun system.
  - Named after Italian-French mathematician Josephy-Louis Lagrange, the points are in any revolving two-body system like Earth and Sun, marking where the gravitational forces of the two large bodies cancel each other out.
  - Objects placed at these positions are relatively stable and require minimal external energy or fuel to keep themselves there, and so many instruments are positioned here.
- It's the largest, most powerful infrared space telescope ever built.
- It's the **successor to Hubble Telescope.**
- It can see backwards in time to just after the Big Bang by looking for galaxies that are so far away that the light has taken many billions of years to get from those galaxies to our telescopes

➢ **Objectives:**

- It will **examine every phase of cosmic history:** from the Big Bang to the formation of galaxies, stars, and planets to the evolution of our own Solar System.
- The goals for the Webb can be grouped into four themes.
  - The first is to look back around 13.5 billion years to see the first stars and galaxies forming out of the darkness of the early universe.
  - Second, to compare the faintest, earliest galaxies to today's grand spirals and understand how galaxies assemble over billions of years.
  - Third, to see where stars and planetary systems are being born.
  - Fourth, to observe the atmospheres of extrasolar planets (beyond our solar system), and perhaps find the building blocks of life elsewhere in the universe.

## Mangalyaan Mission Over

### *Why in News?*

The **Indian Space Research Organization (ISRO)** confirmed that the **Mars Orbiter craft** has lost communication and is non-recoverable and the Mangalyaan mission has attained end-of-life.

➢ Despite being designed for a life-span of six months as a technology demonstrator, the **Mars Orbiter Mission (MOM)** has lived for about eight years in the **Martian orbit.**

Note:

### What is MOM?

- **About:**
  - The **Rs 450 crore Mars Orbiter Mission** was launched onboard **PSLV-C25** on 5th November, 2013, and the **MOM spacecraft was successfully inserted into the Martian orbit** in September, 2014 in its first attempt.
  - Mangalyaan was **India's first interplanetary mission.**
  - The mission made India the first Asian country, and the fourth in the world after **Roscosmos**, **NASA (National Aeronautics and Space Administration)**, and the **European Space Agency**, **to get to the planet.**
    - China referred to India's successful Mangalyaan as the "Pride of Asia".
- **Description:**
  - It carried **850 kg of fuel and 5 science payloads** including a **Mars Color Camera (MCC)** which it was using to study the **Martian surface and atmosphere** since entering orbit successfully.
    - The highly elliptical orbit geometry of MOM enabled MCC to take snapshots of the 'Full disc' of Mars at its farthest point and finer details from the closest point.
    - The MCC has produced more than 1000 images and published a Mars Atlas.
  - **Other instruments are:** Thermal Infrared Imaging Spectrometer (TIS), Methane Sensor for Mars (MSM), Mars Exospheric Neutral Composition Analyser (MENCA) and Lyman Alpha Photometer (LAP).
- **Objectives:**
  - It was aimed at studying the Martian atmosphere.
  - To explore Martian surface **features, mineralogy, morphology and atmosphere using indigenous scientific instruments**.
  - A crucial objective of MOM was to **develop technologies required in planning, designing, management and operations** of an interplanetary mission.

### What is the Future Indian Mars Mission?

- ISRO came out with an 'Announcement of Opportunity' (AO) for future **Mars Orbiter Mission (MOM-2)** in 2016 but 'Gaganyaan', 'Chandrayaan-3' and 'Aditya - L1' projects are in the current priority list.
- Mangalyaan-2 will only be an **orbiter mission.**

**What are the Various Mars Missions?**

- **ExoMars rover (2021) (European Space Agency)**
- **Tianwen-1: China's Mars Mission (2021)**
- **UAE's Hope Mars Mission (UAE's first-ever interplanetary mission) (2021)**
- **Mars 2 and Mars 3 (1971) (Soviet Union)**
- **NASA'sPerseverance Rover**

## First-Ever List of Fungal Infections

### Why in News?

Recently, The **World Health Organisation** released the first-ever **list of fungal infections (Priority Pathogens)** that can be a **threat to public health.**

### What is WHO's Fungal Priority Pathogen List?

- **About FPPL:**
  - **Fungal priority pathogens list (FPPL)** includes **19 fungi that represent the greatest threat to human health.**
  - The list takes precedence from the **bacterial priority pathogens list**, first established by **WHO in 2017** with a similar focus to galvanise global attention and action.
- **Aim:**
  - It aims to **focus and drive further research and policy interventions** to strengthen the global response to fungal infections and antifungal resistance.
- **Categories:**
  - The classification is based on the **pathogen's public health impact or emerging antifungal resistance risk.**
    - Critical Priority Group: It includes Candida auris, which is a highly drug-resistant fungi, Cryptococcus neoformans, Aspergillus fumigatus, and Candida albicans.
    - High Priority Group: It includes a number of other fungi from the Candida family as well as others such as Mucorales, a group containing "black fungus", an infection which rose rapidly in seriously ill people, particularly in India, during Covid-19.

Note:

- Medium Priority Group: It includes a number of other fungi, including Coccidioides spp and Cryptococcus gattii.

# Uniform Safety Standards for EVs

## *Why in News?*

To establish **uniform safety standards for electric vehicles (EVs),** India will begin its first ever testing of EVs from April 1, 2023.

- This comes amid concerns over **multiple instances of fires in electric two-wheelers** and four-wheelers in recent months.

## *What are Electric Vehicles?*

- **About:**
  - An EV **operates on an electric motor** instead of an internal combustion engine and **has a battery instead of a fuel tank.**
  - In general, EVs have **low running costs** as they have fewer moving parts and are also environmentally friendly.
    - In India, the fuel cost for an EV is approximately 80 paisa per kilometer.
- **Current Scenario of EVs in India:**
  - The **push for Electric Vehicles (EVs)** is driven by the **global climate agenda** established under the **Paris Agreement** to reduce carbon emissions in order to limit global warming.
  - As of June 2022, India had **over 1.3 million electric vehicles — 50% of which are three-wheelers,** a bulk of the remaining vehicles being two-wheelers, with four-wheelers making up the rest.
- **India's Initiatives to Support EVs:**
  - Localisation of EV manufacturing through **Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles Scheme-II (FAME-II)**
  - **PLI schemes for manufacturers in the automobile, automotive components** and **Advanced Chemistry Cell (ACC)** to develop indigenous supply chains for critical EV components.
  - The government also **revised its guidelines for charging infrastructure** by including a revenue-sharing model for use of public land.
  - To boost sales, there also exist **consumer-centric incentives - tax exemptions, subsidies and interest subvention schemes** to trigger a mass demand for EV mobility options.
  - In April 2022, the **NITI Aayog** released the **draft battery swapping policy for Electric Vehicles (EVs)** in the country.
  - The Ministry of Road Transport and Highways recently extended the rollout of **amendments to EV battery testing standards**- Automotive Industry Standards-156 (or AIS-156) and AIS-038 to a staggered two-phased implementation (first from December 1, 2022 and second from March 31, 2023).
    - The AIS-156 includes motor vehicles in the L category — those with less than four wheels and an electric powertrain.
    - The second amendment — AIS-038 — regulates vehicles with electric power trains for M category (those with four wheels and used to carry passengers) and N category (electric four-wheelers used to carry both goods and passengers).
- **Recent Issues Related to EVs:**
  - There have been **increased instances of electric vehicles catching fire.** The reasons for fire may include:
    - Manufacturing defects
    - External damage
    - Faults in the deployment in the battery management system, and
    - Faulty charging in some cases
- The Covid-19 pandemic and the **US-China trade war** has **disrupted supply chains** thus making the **critical components of EV prohibitively expensive**.
  - Indian manufacturers are also struggling to source **lithium-ion batteries.**
- The **semiconductor shortage** which began at the end of 2021 has still not been resolved completely and has **hindered multiple industries.**
  - A similar challenge can adversely impact India's upcoming EV industry in terms of **high price volatility** and **supply disruptions** of these elements.

Note:

# Alzheimer Disease

## Why in News?

Researchers have discovered a drug named Lecanemab that **reduces cognitive decline in patients with early Alzheimer's**, making it one of the **first neuroprotective treatments for the disease.**

## What is Alzheimer's Disease?

- **About:**
  - It is a neurological disorder which causes brain cells to degenerate and die. This leads to loss of memory, problems with words in speaking or writing, poor judgment, changes in mood and personality, confusion with time or place, etc.
    - At the first stage, these symptoms are mild but they become more severe with time.
  - **Alzheimer's is the most common cause of dementia** among older adults.
  - Alzheimer's disease is thought to be caused by the abnormal build-up of proteins in and around brain cells. One of the proteins involved is called amyloid, deposits of which form plaques around brain cells and the other protein is called tau.
    - Tau is a protein that when it occurs in tangled formations in the brain of Alzheimer patients, disrupts the ability of neurons to communicate with one another in the brain.
  - Alzheimer's is an incurable disease, as the death of brain cells cannot be reversed.
  - Women have a higher risk of having Alzheimer's disease than men.
- **Treatment:**
  - There is **currently no known cure for Alzheimer's disease**. Treatment addresses several areas:
    - Helping people maintain brain health.
    - Managing behavioural symptoms.
    - Slowing or delaying symptoms of the disease.

# Role of Nanomaterials in Solving Environmental Issues

## Why in News?

The use of modern technology like nanomaterials or Carbon Dots (CD) **may offer solutions to environmental issues like water pollution.**

- The urban development of modern society has resulted in the introduction of harmful and toxic pollutants into waterbodies, disturbing the integrity of the aquatic environment.
- Novel technological developments like **nanotechnology** provide innovative solutions for sustainable and efficient environmental cleanup.

## What is Nanotechnology?

- **About:**
  - Nanotechnology is the **use and the development of techniques to study physical phenomena** and develop new material and devices structures in the physical size range from 1 to 100 nanometres (nm).
  - Nanotechnology **influences almost all areas of our lives,** including manufacturing, electronics, computers and information technologies, medicine, the environment and energy storage, chemical and biological technologies and agriculture.
- **Nanotechnology in India:**
  - The emergence of nanotechnology in India has **witnessed the engagement of a diverse set of players**, each with their own agenda and role.
  - Presently nanotechnology in India is mostly a government-led initiative. Industry participation has very recently originated.
  - Nanotechnology R&D barring a few exceptions is largely being ensued at public-funded universities as well as research institutes.

## What are Carbon Dots?

- **About:**
  - CDs are **one of the youngest members of the carbon nanomaterial family.**
  - They were discovered in 2004 and have an average diameter of less than 10 nanometres.
  - CDs possess remarkable optical properties, which differ peculiarly based on the precursor used for synthesis.
  - They are becoming more popular as candidates in applications such as sensing and bioimaging due to their good electron donors and acceptors.
    - Bioimaging relates to methods that non-invasively visualise biological processes in real time.
  - Moreover, **CDs are inexpensive, highly biocompatible**, and environment-friendly.

Note:

# Nobel Prize in Chemistry 2022

### *Why in News?*

**Carolyn R Bertozzi, Morten Meldal and K Barry Sharpless** have been awarded the **Nobel Prize 2022 in Chemistry** "for the development of **Click Chemistry and Bioorthogonal Chemistry"**.

- **Sharpless (**won second time) came up with the term **'click chemistry'** and worked extensively on it.
- **Meldal**, independently of Sharpless, came up with a special chemical structure called **'triazole'** which has many significant applications.
- **Bertozzi** took the next step of developing click reactions that could work inside living organisms — 'bioorthogonal' reactions (a term she coined).
- **The 2021 Nobel Prize in Chemistry** was awarded to **Benjamin List and David MacMillan** for the development of **asymmetric organocatalysis.**

**Note:**

**K Barry Sharpless shared the 2001 Nobel Prize** with William S. Knowles and Noyori Ryōji for **"Developing the First Chiral Catalysts".**

# Nobel Prize in Physics 2022

### *Why in News?*

- The **Nobel Prize in Physics for 2022** was awarded to **John F. Clauser, Alain Aspect and Anton Zeilinger** for their work in **quantum mechanics** by the **Royal Swedish Academy of Sciences.**
  - In 2021, the **Nobel Prize in Physics** was awarded to **Syukuro Manabe and Klaus Hasselmann (jointly)** for their research on climate models and to **Giorgio Parisi** for his work on the interplay of disorder and fluctuations in physical systems.
  - The **Nobel Prize for 2022 in Physiology or Medicine** was awarded to Svante Pääbo for his research in the field of genomes of extinct hominins and human evolution.

**What is Quantum Mechanics and Quantum Entanglement?**

- Mechanics is the branch of physics that **deals with the movement and interaction of various bodies. Mechanics has two parts - classical and quantum.**
  - **Classical or Newtonian mechanics** is the mathematical study of the motion **of macroscopic objects** and the forces that affect them.
  - **Quantum mechanics** is a subfield of physics that describes the **behavior of particles — atoms, electrons, photons** and almost everything in the **molecular and sub molecular realm.**
    - One important difference in the behaviour of quantum systems, when compared to classical rigid bodies, is the concept of entanglement.
- **Quantum entanglement** is a phenomenon by which a pair of subatomic particles are **allowed to exist in a shared state where they have complementary properties,** such that by measuring the properties of one particle, one can automatically know the properties of the other particle.
  - This is true regardless of how far apart the two particles are transported.
  - Quantum entanglement was **first elucidated by Erwin Schrödinger** in 1935, leading to his well-known **cat paradox.**

# Nobel Prize 2022 in Medicine/ Physiology

### *Why in News?*

Recently, the 2022 **Nobel Prize for Physiology or Medicine** has been awarded to **Swedish geneticist Svante Pääbo** for his **research in the field of genomes of extinct hominins and human evolution.**

- **In 2021,** the honour went to two United States-based scientists, **David Julius** and **Ardem Patapoutian** for their **discoveries of receptors for temperature and touch.**

# Lassa Fever

### *Why in News?*

Recently a study has found that Climate change may aid the **spread of Lassa fever, which is endemic to parts**

Note:

**of west Africa**, to the C**entral and Eastern parts** of the **African continent** in the next 50 years.

### *What is Lassa Fever?*

- **About:**
  - The Lassa fever-causing virus is found in West Africa and was **first discovered in 1969 in Lassa, Nigeria.**
  - The virus is a **single-stranded RNA virus** belonging to the virus family **Arenaviridae.**
  - The fever is spread by rats and is primarily found in countries in West Africa including Sierra Leone, Liberia, Guinea, and Nigeria where it is endemic.
    - Mastomys rats have the potential to spread the deadly Lassa virus.
  - The death rate associated with this disease is low, at around 1%. But the death rate is higher for certain individuals, such as pregnant women in their third trimester.
  - According to the **European Centre for Disease Prevention and Control**, about 80% of the cases are asymptomatic and therefore remain undiagnosed.
- **Transmission:**
  - A person can become infected if they come in contact with household items of food that is contaminated with the urine or feces of an **infected rat (zoonotic disease).**
  - It can also be spread, though rarely, if a person comes in contact with a sick person's infected bodily fluids or through mucous membranes such as the eyes, nose or the mouth.
- **Symptoms:**
  - Mild symptoms include **slight fever, fatigue, weakness and headache.**
  - Serious symptoms include bleeding, difficulty breathing, vomiting, facial swelling, pain in the chest, back, and abdomen and shock.
  - Death can occur from two weeks of the onset of symptoms, usually as a result of multi-organ failure.
- **Treatment:**
  - The **antiviral drug ribavirin seems to be an effective treatment** for Lassa fever if given early on in the course of clinical illness.
  - There are no vaccines currently licensed for the prevention of Lassa fever.
  - program electronic computers were developed.
  - **Example:** Millions of algorithms and codes are there around humans to understand their commands and perform human-like tasks. Facebook's list of suggested friends for its users, a pop-up page, telling about an upcoming sale of the favourite brand of shoes and clothes, that comes on screen while browsing the internet, are the work of artificial intelligence.
- **Complex Technology:**
  - AI involves c**omplex things such as feeding a particular data** into the machine and making it react as per the different situations.
  - It is basically about **creating self-learning patterns where the machine can give answers** to the never answered questions like a human would ever do.

## India's Space Ecosystem

### *Why in News?*

Recently, Indian Space Conclave was organized to celebrate the one-year anniversary of the Indian Space Association (ISpA).

- The Indian space economy is set to reach USD 13 billion by 2025, according to a **joint report** prepared by EY (Ernst and Young) and the Indian Space Association (ISpA).

### *What is ISpA?*

- **About ISpA:**
  - It was launched in 2021, and is the premier industry association of space and satellite companies. It is also part of the Government's approach to **space reforms** based **on 4 pillars.**
    - **Allowing the private sector** freedom of innovation.
    - Government **playing the enabler's role.**
    - **Preparing youngsters for the future.**
    - **Treating the space sector as a resource for the progress** of the common man.
  - ISpA aspires to be the **collective voice of the Indian Space industry**. ISpA will be represented by leading domestic and global corporations that have advanced capabilities in space and satellite technologies.
- **Objectives:**

Note:

- ISpA will undertake **Policy Advocacy and engage with all stakeholders** in the Indian Space domain, including the Government and its Agencies, to make **India self-reliant**, technologically advanced and a leading player in the space arena.
- It will work towards b**uilding global linkages for the Indian space industry** to bring in critical technology and investments into the country to create more high skill jobs.

➢ **Significance:**

- One of the main goals of the organization is to supplement the government's efforts towards **making India a global leader** in commercial space-based excursions.
- Of late, ISRO's rockets have been carrying the payload and communication satellites of various countries; now, private players will also look to touch on this space with the new organisation.
- Several private sector companies have shown an interest in India's space domain, with **space-based communication networks** coming to the fore.

**What are the Related Initiatives taken?**

➢ **IN-SPACE:**

- IN-SPACE was launched to provide a level playing field for private companies to use Indian space infrastructure.
- It acts as a single-point interface between Indian Space Research Organisation (ISRO), and everyone who wants to participate in space-related activities or use India's space resources.

➢ **NewSpace India Limited (NSIL):**

- Announced in Budget 2019, its aim is to use research and development carried out by ISRO over the years for commercial purposes through Indian industry partners.

# ISRO's Next-Gen Launch Vehicle

## *Why in News?*

**Indian Space Research Organisation (ISRO)** is developing a **Next-Gen Launch Vehicle (NGLV)** to replace operational systems like the **Polar Satellite Launch Vehicle (PSLV).**

➢ Launch Vehicles are used to carry spacecraft to space. India has two operational launchers, PSLV and Geosynchronous Satellite Launch Vehicle (GSLV).

## *What is NextGen Launch Vehicle?*

➢ **About:**

- In NGLV, ISRO is looking at a cost-efficient, three-stage to orbit, reusable heavy-lift vehicle with a payload capability of ten tonnes to **Geostationary Transfer Orbit (GTO)**.
- Its robust design allows bulk manufacturing, modularity in systems, sub-systems and stages and minimal turnaround time.

➢ **Features:** It will feature **semi-cryogenic propulsion** (refined kerosene as fuel with liquid oxygen (LOX) as oxidiser) for the booster stages.

➢ **Use:** Potential uses will be in launching **communication satellites, deep space missions, future human spaceflight and cargo missions.**

## *What are other Launch Vehicles Developed by ISRO?*

➢ **Satellite Launch Vehicle (SLV):** The first rocket developed by ISRO was simply called SLV, or Satellite Launch Vehicle.

- It was followed by the Augmented Satellite Launch Vehicle or ASLV.

➢ **Augmented Satellite Launch Vehicle (ASLV):** SLV and ASLV both could carry small satellites, weighing up to 150 kg, to lower earth orbits.

- ASLV operated till the early 1990s before PSLV came on the scene.

➢ **Polar Satellite Launch Vehicle (PSLV):** PSLV's first launch was in 1994, and it has been ISRO's main rocket ever since. Today's PSLV, however, is vastly improved and several times more powerful than the ones used in the 1990s.

- It is the **first Indian launch vehicle** to be equipped with liquid stages.
- PSLV is the most reliable rocket used by ISRO to date, with 52 of its 54 flights being successful.
- It successfully launched two spacecraft – **Chandrayaan-1** in 2008 and **Mars Orbiter Spacecraft** in 2013 – that later travelled to Moon and Mars respectively.

Note:

- **Geosynchronous Satellite Launch Vehicle (GSLV):** GSLV is a much more powerful rocket, meant to carry heavier satellites much deeper into space. To date, GSLV rockets have carried out 18 missions, of which four ended in failure.
  - It can take 10,000 kg of satellites to lower the earth's orbits.
  - The indigenously developed Cryogenic Upper Stage (CUS), forms the third stage of GSLV Mk II.
  - Mk-III versions have made ISRO entirely self-sufficient in launching its satellites.
    - Before this, it used to depend on the European Arianne launch vehicle to take its heavier satellites into space.

# Detection of Barium in the Exoplanet Atmospheres

Recently, in a new study, scientists have **detected barium in the upper atmosphere** of two giant exoplanets for the first time.

- Ultra-hot Jupiters are a class of hot gaseous planets that matches the size of Jupiter, but they have short orbital periods, unlike Jupiter.

## *What are the Characteristics of Barium?*

- **About:**
  - Barium, which is slightly harder than lead, has a silvery white luster when freshly cut.
  - It readily **oxidizes when exposed to air** and must be protected from oxygen during storage.
  - In nature it is always found combined with other elements.
  - It is very light and its density is half of that of iron.
- **Uses:**
  - Barium is often **used for spark-plug electrodes** and in vacuum tubes as a drying and oxygen-removing agent. As well as fluorescent lamps: impure barium sulfide phosphorescence after exposure to light.
  - Its **compounds are used by oil and gas industries** to make drilling mud. Drilling mud simplifies drilling through rocks by lubricating the drill.
  - Barium compounds are also used to make paint, bricks, tiles, glass, and rubber.
  - Barium nitrate and chlorate give fireworks a green colour.

# Non-Communicable Diseases

## *Why in News?*

Recently, the **World Health Organisation (WHO)** released its report "Invisible Numbers — The True Extent of Non-communicable Diseases and What To Do About Them", which stated that every two seconds, one person under the age of 70 dies of a **non-communicable disease (NCD)** with 86% of those deaths occurring in low- and middle-income countries.

## *What are Non-Communicable Diseases?*

- **About:**
  - Noncommunicable diseases (NCDs), also known as chronic diseases, **tend to be of long duration** and are the result of a **combination of genetic, physiological, environmental and behavioural factors.**
  - The main types of NCD are **cardiovascular diseases** (such as heart attacks and stroke), **cancers, chronic respiratory diseases** (such as chronic obstructive pulmonary disease and asthma) and **diabetes.**
- **Causes:**
  - Tobacco use, unhealthy diet, harmful use of alcohol, physical inactivity and air pollution are the main risk factors contributing to these conditions.
- **Status of Non-Communicable Diseases in India:**
  - According to WHO, over **60.46 lakh people died due to NCDs in India in 2019**.
  - **Over 25.66 lakh deaths** in 2019 in the country were **due to cardiovascular diseases** while 11.46 lakh deaths were **due to chronic respiratory diseases**.
  - Cancer led to 9.20 lakh deaths while 3.49 lakh deaths in the country were attributed to diabetes.
- **Indian Initiatives:**
  - **National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)** is being implemented under the **National Health Mission (NHM)**.
  - The Central Government is implementing the Strengthening of Tertiary Care Cancer facilities scheme to support the setting up of **State Cancer Institutes (SCI)** and **Tertiary Care Centres (TCCC)** in different parts of the country.

Note:

- Oncology in its various aspects has a focus in case of new AIIMS and many upgraded institutions under **Pradhan Mantri Swasthya Suraksha Yojana (PMSSY).**
- **Affordable Medicines and Reliable Implants for Treatment (AMRIT)** Deendayal outlets have been opened at 159 Institutions/Hospitals with an objective to **make available Cancer and Cardiovascular Diseases drugs and implants at discounted prices to the patients.**
- **Jan Aushadhi stores** are set up by the Department of Pharmaceuticals to provide generic medicines at affordable prices.

➢ **Global:**

- **Agenda for Sustainable Development:** As part of the 2030 Agenda for Sustainable Development, **heads of state and government committed to develop ambitious national responses, by 2030**, to reduce by one third premature mortality from NCDs through prevention and treatment (SDG target 3.4).
  - WHO plays a key leadership role in the coordination and promotion of the global fight against NCDs.
- **Global action Plan:** In 2019, the World Health Assembly extended the WHO Global action plan for the **prevention and control of NCDs 2013–2020 to 2030** and called for the **development of an Implementation Roadmap 2023 to 2030 to accelerate progress on preventing and controlling NCDs**.
  - It supports actions to achieve a set of nine global targets with the greatest impact towards prevention and management of NCDs.

# INSPIRE Awards

## *Why in News?*

Recently, the 9th **National Level Exhibition and Project Competition (NLEPC)** for the **INSPIRE Awards – MANAK** (Million Minds Augmenting National Aspiration and Knowledge), has commenced.

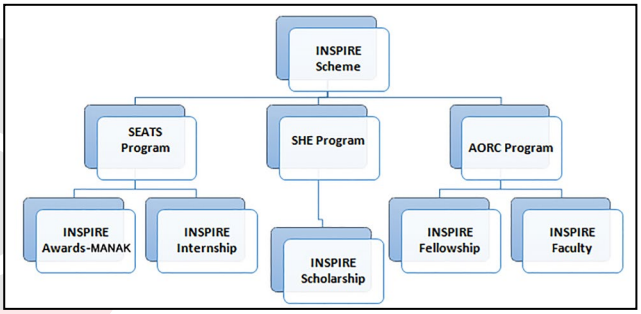
## *What do we Know about INSPIRE Scheme?*

➢ The INSPIRE (Innovation in Science Pursuit for Inspired Research) scheme is **one of the flagship programmes** of the **Ministry of Science and Technology.**

➢ Its **objective is to communicate to the youth population** of the country the creative pursuit of science and attract talent to the **study of science at an early stage** and build the **required critical human resource pool** for strengthening and expanding the Science & Technology system and Research & Development base.

➢ The Government of India has successfully implemented the INSPIRE scheme **since 2010.** The scheme **covers students in the age group of 10-32 years** and has five components.

- The **INSPIRE Awards- MANAK is one of its components.**




## *What are the Other Related Initiatives?*

➢ **Draft National Science Technology and Innovation Policy, 2020:**

- Its aim is to identify and **address strengths and weaknesses of the Indian Science Technology and Innovation (STI)** ecosystem to catalyse socio-economic development of the country and also make the Indian STI ecosystem globally competitive.

➢ **SERB-POWER Scheme:**

- It is a scheme designed **exclusively for women scientists** to mitigate gender disparity in science and engineering research in various science and technology (S&T) programmes in Indian academic institutions and **Research and Development** (R&D) laboratories.

➢ **Swarna Jayanti Fellowship:**

- It provides **special assistance** and support to a selected number of **young scientists** with a proven track record to enable them to pursue basic research in frontier areas of science and technology.

Note:

# First Meeting of the Reconstituted National Medical Device Promotion Council (NMDPC)

## Why in News?

Recently, important **issues of Medical Technology (MedTech) Industry were taken-up** at the first meeting of the reconstituted **National Medical Device Promotion Council (NMDPC).**

**What is NMDPC?**

- **About:**
  - **National Medical Device Promotion Council (NMDPC)** is chaired by the **Secretary, Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers.**
    - It has members from stakeholder departments/ organizations, functions of which have a bearing on the growth of the sector.
    - Also, it has representation from several medical device industry associations, representing the sector in India.
- **Significance:**
  - NMDPC, going forward, is **expected to become a vibrant forum for all issues relating to the medical devices sector**, which is a sunrise sector with **huge potential for social obligations and the economic aspirations of India.**

# Rohini Sounding Rocket

## *Why in News?*

The **Indian Space Research Organisation (ISRO)** is planning the **200th successful launch** of the **Rohini RH-200** sounding rocket in a row.

- RH-200 of the Rohini sounding rocket family has completed **198 consecutive successful** flights.
- The 199th launch will happen in October 2022 during the **World Space Week (4th-10th October) celebrations.** The 200th will take place either towards the end of October or the beginning of November 2022.

## *What are the Sounding Rockets?*

- **About:**
  - Sounding rockets are **one or two stage solid propellant rockets** used for probing the upper atmospheric regions and for space research.
    - Sounding rockets take their name from the nautical term "to sound," which means to take measurements.
  - They also serve as **easily affordable platforms to test or prove prototypes** of new components or subsystems intended for use in launch vehicles and satellites.
- **History:**
  - The Thumba Equatorial Rocket Launching Station (TERLS) was established on 21st November 1963. Its southern tip is close **to earth's magnetic equator.**
  - The launch of the first sounding rocket (American Nike-Apache) from Thumba in 1963, **marked the beginning of the Indian Space Programme** and was the bedrock of all the vehicles built.
  - ISRO began with the launch of **indigenously built sounding rockets from 1965.** The ISRO launched its own version - **Rohini RH-75 - in 1967.**
  - In 1975, all sounding rocket **activities were cluttered under the Rohini Sounding Rocket (RSR) Programme**.
  - The series of sounding rockets are called **Rohini series with RH 200, RH 300 and RH 560 being the most important** among them.
- **RH-200:**
  - RH-200 is **a two-stage rocket capable of climbing to a height of 70 km** bearing scientific payloads.
  - The first and second stages of RH-200 are powered by solid motors.
  - For years, the RH-200 rocket had used a **polyvinyl chloride (PVC)-based propellant**.
  - The first RH-200 to use a new propellant based on hydroxyl-terminated Polybutadiene (HTPB) was successfully flown from the TERLS in September 2020.
    - As compared to PVC based propellants, HTPB based propellant is more energetic, higher mechanical & interface properties and has less defects due to lower processing temperature.
  - The '200' in the name **denotes the diameter of the rocket in mm**. Other operational Rohini variants are **RH-300 Mk-II and RH-560 Mk-III.**

Note:

| Some details of Sounding Rockets: | | | |
|---|---|---|---|
| Vehicle | RH-200 | RH-300-Mk-II | RH-560-MK-II |
| Payload (Kg) | 10 | 60 | 100 |
| Altitude (Kms) | 80 | 160 | 470 |
| Purpose | Meteorology | Aeronomy | Aeronomy |
| Launch Pad | Thumba Balasore | SDSC-SHAR | SDSC-SHAR |

# Double Asteroid Redirection Test (DART) Mission: NASA

## *Why in News?*

The **National Aeronautics and Space Administration (NASA)** is about to launch its Double Asteroid Redirection Test (DART) mission.

## *What is a DART mission?*

- **About:**
  - DART is a **low-cost spacecraft.**
  - It has **two solar arrays and uses hydrazine propellant** for maneuvering the spacecraft.
  - It also carries about **10 kg of xenon** which will be used to demonstrate the agency's new thrusters called **NASA Evolutionary Xenon Thruster**–Commercial (NEXT-C) in space.
    - NEXT-C gridded ion thruster system provides a combination of performance and spacecraft integration capabilities that make it uniquely suited for deep space robotic missions.
  - The spacecraft carries **a high-resolution imager called Didymos Reconnaissance and Asteroid Camera** for Optical Navigation (DRACO).
    - Images from DRACO will be sent to Earth in real-time and will help study the impact site and surface of Dimorphos (the target asteroid).
  - DART will also carry a **small satellite or CubeSat named LICIACube** (Light Italian CubeSat for Imaging of Asteroids).
    - LICIACube is expected to capture images of the impact and the impact crater formed as a result of the collision.
- **Objectives:**
  - The mission is to test **the new technology to be prepared in case an asteroid** heads towards Earth in the future.
  - The aim is to test the newly developed technology that would allow a spacecraft to crash into an asteroid and change its course.
  - The target of the spacecraft is a small moonlet called Dimorphos (Greek for "two forms").
    - Dimorphos orbits a larger asteroid named Didymos (Greek for "twin").
  - It is a suicide mission and the **spacecraft will be completely destroyed.**

# Ebola Virus Disease

## Why in News?

Recently, an **outbreak of Ebola Virus Disease (EVD) has been declared in Uganda** following the confirmation of a **relatively rare Sudan strain case.**

## *What is Ebola Virus Disease (EVD)?*

- **About**:
  - EVD, formerly known as **Ebola haemorrhagic fever** is a deadly disease with occasional outbreaks that occur mostly on the African continent.
  - Ebola virus was **first discovered in 1976 near the Ebola River** in what is now the **Democratic Republic of Congo.**
  - It most commonly **affects people and nonhuman primates (such as monkeys, gorillas, and chimpanzees).**
  - It is caused by an infection with a group of viruses within the genus *Ebolavirus*:
    - Ebola virus (species Zaire ebolavirus)
    - Sudan virus (species Sudan ebolavirus)
    - Taï Forest virus (species Taï Forest ebolavirus, formerly Côte d'Ivoire ebolavirus)
    - Bundibugyo virus (species Bundibugyo ebolavirus)
    - Reston virus (species Reston ebolavirus)
    - Bombali virus (species Bombali ebolavirus)
- **Host:** **Fruit bats of the Pteropodidae family** are natural Ebola virus hosts.
- **Transmission:**

Note:

- **Animal to Human Transmission occurs** through close contact with the blood, secretions, organs or other bodily fluids of infected animals such as fruit bats, chimpanzees, gorillas, monkeys, forest antelope or porcupines found ill or dead or in the rainforest.
- **Human-to-Human Transmission occurs** via direct contact (through broken skin or mucous membranes) with Blood or body fluids of a person who is sick with or has died from Ebola.

➢ **Signs and Symptoms:**
- Symptoms may appear anywhere from **2 to 21 days** after contact with the virus, with an average of 8 to 10 days which include **Fever, Fatigue, Muscle pain,** Body weakness, Headache, Sore throat, Vomiting, Diarrhoea, Symptoms of impaired kidney and liver function, in some cases, both **internal and external bleeding.**

➢ **Diagnosis:**
- It can be **difficult to clinically distinguish** Ebola from other infectious diseases such as **malaria**, typhoid fever, and meningitis but confirmation that symptoms are caused by Ebola virus infection are made using the following diagnostic methods:
  - ELISA (antibody-capture enzyme-linked immunosorbent assay)
  - Reverse transcriptase polymerase chain reaction (RT-PCR) assay, etc.

➢ **Vaccines:**
- The **Ervebo (rVSV-ZEBOV) vaccine** has been highly effective in containing the disease.
  - However, this vaccine has only been approved to protect against the
  - Zaire strain of the virus.

# Floods on Mars

## *Why in News?*

China's Zhurong rover that landed on Mars in 2021 has found evidence of major floods that took place billions of years ago by studying underground layers.

➢ The rover **studied its landing site - Utopia Planitia** - vast plains in Mars's northern hemisphere.

➢ These are the **rover's first results** of the radar imager. Radio waves from the radar bounce off **underground materials to reveal** their **grain size and ability to hold an electric charge**. Stronger signals typically indicate larger objects.

## *What are the Findings?*

➢ The radar did not find any evidence of liquid water down to 80 metres, but it did detect **two horizontal layers with interesting patterns.**
- In a layer between 10 and 30 metres deep, the reflection signals strengthened with increasing depth.
- An older, thicker layer between 30 and 80 metres down showed a similar pattern.

➢ The **older layers** (30 and 80 metres) are probably the result of rapid flooding that carried sediments to the region more than **three billion years ago**, when there was a lot of water activity on Mars.

➢ The **upper layer** (between 10 and 30 metres deep) could have been created by another flood **some 1.6 billion years ago**, when there was lots of glacial activity.

➢ Radar data is not enough to discern if the underground materials were sediments or volcanic remnants.

## *What is Zhurong Rover?*

➢ Zhurong named after a Chinese mythical fire god, is **China's first Mars** rover carried by **China's Tianwen-1 spacecraft** in 2021.

➢ During the mission, Zhurong will explore the colossal basin of **Utopia Planitia** on Mars' northern hemisphere, which was probably formed by an impact early in the planet's history.

➢ Weighing about 240 kilograms, the 'Zhurong' rover is **slightly heavier than NASA's Spirit and Opportunity rovers**, but only one-fourth the weight of **Perseverance and Curiosity (NASA)**.

➢ It is powered by **retractable solar panels and fitted with seven primary** instruments — cameras, ground-penetrating radar, a magnetic field detector and a weather station.

➢ The purpose of the radar is **to look for signs of ancient life as well as subsurface water.**

**What are the Key Points Related to Mars?**

➢ **Size and Distance:**
- It is the **fourth planet from the Sun** and the second-smallest planet in the Solar System.
- Mars is about half the size of Earth.

Note:

- **Similarity to the Earth (Orbit and Rotation):**
  - As Mars orbits the Sun, it completes one rotation every 24.6 hours, which is very similar to one day on Earth (23.9 hours).
  - Mars' axis of **rotation is tilted 25 degrees** with respect to the plane of its orbit around the Sun. This is similar to Earth, which has an axial tilt of 23.4 degrees.
    - Mars has distinct seasons like Earth, but they last longer than seasons on Earth.
      - Martian days are called sols—short for 'solar day'.
- **Other Features:**
  - The reason Mars looks reddish is due to oxidation or rusting of iron in the rocks, and dust of Mars. Hence it is also called the Red Planet.
  - It has the largest volcano in the solar system i.e., Olympus Mons.
  - It has two small moons**, Phobos and Deimos.**

**What are the Various Mars Missions?**

- **ExoMars rover (2021) (European Space Agency)**
- **Tianwen-1: China's Mars Mission (2021)**
- **UAE's Hope Mars Mission (UAE's first-ever interplanetary mission) (2021)**
- **India's Mars Orbiter Mission (MOM) or Mangalyaan (2013)**
- **Mars 2 and Mars 3 (1971) (Soviet Union)**

# Dark Sky Reserve in Ladakh

## *Why in News?*

Recently, in a first-of-its-kind initiative, the **Department of Science & Technology (DST)** has announced the setting up of **India's first Dark Sky Reserve in Hanle, Ladakh .**

## *What is Dark Reserve?*

- A Dark Sky Reserve is a **designation given to a place that** has policies in place to ensure that a tract of land or region **has minimal artificial light interference.**
- The International Dark Sky Association is a U.S.-based non-profit that **designates places as** International Dark Sky Places, Parks, Sanctuaries and Reserves, depending on the criteria they meet.

## *What are the Key Highlights of the Dark Reserve in Ladakh?*

- **MoU for Setting up Dark Reserve:** There was a three-way Memorandum of Understanding was signed among the **Union Territory administration**, **Ladakh Autonomous Hill Development Council (LAHDC), Leh, and the Indian Institute of Astrophysics (IIA), Bengaluru,** which uses and maintains the telescopes, for launching the Dark Space Reserve.
  - It will have activities to help in boosting local tourism and the economy through interventions of science and technology.
- **Promote Tourism:** To promote **Astro-tourism,** villages around Hanle will be encouraged to promote homestays equipped with telescopes that visitors can use to view the night sky.
  - Villagers and residents will also be **trained to help visitors with astronomical observations.**
    - There will be delineators on roads like you do outside observatories. People can come, park, observe the sky and stay in homestays.
- **Wildlife Awareness:** A visitor centre would also be set up to inform people not only about astronomy but also about the **wildlife and plant life in the adjoining Changthang Wildlife Sanctuary.**

# WEST: A New I-STEM Initiative

## *Why in News?*

Recently, a **new Indian Science Technology and Engineering facilities Map (I-STEM) initiative called "Women in Engineering, Science, and Technology (WEST)" was launched.**

## *What is WEST Initiative?*

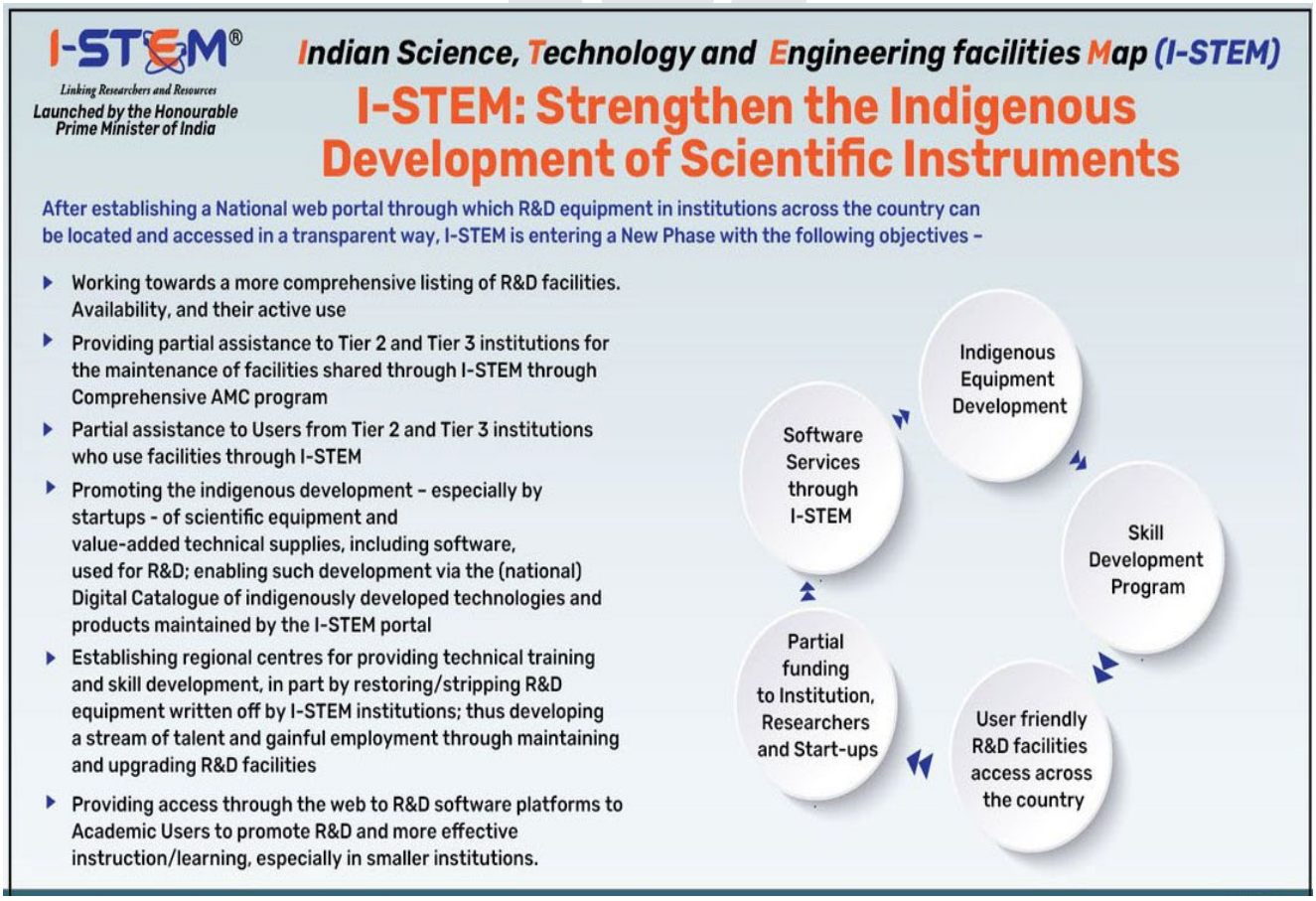
- The WEST programme will cater to **women with a Science, Technology, Engineering, and Mathematics (STEM)** background and empower them **to contribute to the science, technology, and innovation ecosystem.**
- Through the WEST initiative, I-STEM shall provide a **separate platform to scientifically inclined women researchers, scientists, and technologists for pursuing research** in basic or applied sciences in frontier areas of science and engineering.

Note:

- Women may join the WEST program and **explore opportunities to become stakeholders in various domains and pursue careers in R&D** at various levels: technicians, technologists, scientists, and entrepreneurs.
  - Opportunities range from operating scientific equipments and maintaining them, to designing and manufacturing them.
- The **Skill Development programmes** under the WEST initiative **will provide training for women with S&T backgrounds** to brush up on their abilities and become engaged "in the field" as lab technicians and maintenance engineers.
- The access to R&D facilities and R&D software platforms (COMSOL, MATLAB, LABVIEW, AUTOCAD) will be available through the I-STEM portal.
- In addition, a **digital consortium "Connect Quickly"** for online discussion and immediate support has also been established through the I-STEM WhatsApp and Telegram platforms.
- A **dedicated team of women** will ensure the successful implementation of the WEST initiative.

**What is I-STEM?**

- **About:**
  - I-STEM is **a National Web portal for sharing R&D** (Research and Development) facilities.
  - The portal **facilitates researchers to access slots for the use of equipment,** as well as to share the details of the outcomes, such as patents, publications and technologies.
- **Launch:**
  - Launched in January 2020. It is an initiative of the Office of the **Principal Scientific Adviser** to the Government of India under the aegis of **Prime Minister Science, Technology and Innovation Advisory Council (PM-STIAC) mission.**
    - **PM-STIAC:** It is an overarching Council that facilitates the Principal Scientific Adviser's Office **to assess the status in specific science and technology domains,** comprehend challenges in hand, formulate specific interventions, develop a futuristic roadmap and advise the Prime Minister accordingly.




Note:

# National List of Essential Medicines (NLEM)

## Why in News?

Recently, The Union Health Ministry launched the new **National List of Essential Medicines (NLEM)**, where 384 drugs have been included in this list with addition of 34 drugs, while 26 from the previous list have been dropped.

- As per the **World Health Organisation (WHO),** Essential Medicines are those that satisfy the priority health care needs of the population.

## What is the National List of Essential Medicines (NLEM)?

- **About:**
  - The National List of Essential Medicines (NLEM) is a list released by the **Ministry of Health and Family Welfare**.
    - The medicines listed in the NLEM are sold below a price ceiling fixed by the National Pharmaceutical Pricing Authority (NPPA).
  - In India, it was framed on the lines of the **Essential Medicines List (EML)** released by the WHO.
- **History:**
  - The **Ministry of Health and Family Welfare** prepared and released the first National List of Essential Medicines of India in 1996 consisting of 279 medicines. This list was subsequently revised in 2003, 2011, 2015 and 2022.
- **Purpose:**
  - Guide safe and effective treatment of priority disease conditions of a population.
  - Promote the rational use of medicines.
  - Optimize the available health resources of a country. It can also be a guiding document for:
    - State governments to prepare their list of essential medicines
    - Procurement and supply of medicines in the public sector.

## When is a Medicine Deleted from NLEM?

- A drug is deleted from the list if it gets banned in India. Also, it is removed if reports of concerns about drug safety emerge.
- If medicine with better efficacy or favourable safety profile and better cost-effectiveness is now available, then it is removed from NLEM.

**What is an Essential Medicine List (EML)?**

- **About:**
  - The list is made with consideration of disease **prevalence, efficacy, safety and comparative cost-effectiveness** of the medicines.
  - Such medicines should be available in such a way that an individual or community can afford them.
  - The WHO EML is updated every two years by the Expert Committee on Selection and Use of Essential Medicines.
- **History:**
  - The first country in the world to compose its EML was Tanzania in 1970. Then in 1975, the **World Health Assembly (WHA)** requested WHO to assist member states in selecting and procuring essential medicines, assuring good quality at a reasonable cost.
  - Subsequently, the **first WHO model list of essential medicines was published in the year 1977 which contained 186 medicines**.
  - It stated that essential medicines were "of **utmost importance, basic, indispensable and necessary for the health and needs of the population**" and the criteria for selection were based on efficacy, safety, quality and total cost.

Note:

# New branches of the National Centre for Disease Control

## Why in News?

Recently, the Union Health Minister virtually laid the foundation stone for **National Centre for Disease Control (NCDC)** branches in **Andhra Pradesh, Arunachal Pradesh, Kerala, Maharashtra, Tripura, and Uttar Pradesh.**

## What is the National Centre for Disease Control (NCDC)?

- **About:**
  - The National Centre for Disease Control (NCDC), formerly **National Institute of Communicable Diseases (NICD),** had its origin as the Central Malaria Bureau, established at **Kasauli (Himachal Pradesh) in 1909.**
  - NICD was transformed into the **National Centre for Disease Control (NCDC)** with a larger mandate of controlling emerging and re-emerging diseases in 2009.
  - It is under the administrative control of the **Director General of Health Services, Ministry of Health and Family Welfare,** Govt. of India**.**
- **Function:** It functions as the **nodal agency in the country for disease surveillance facilitating the prevention** and control of communicable diseases.
  - In coordination with the State Governments, NCDC has the **capacity and capability for disease surveillance**, outbreak investigation, and rapid response to contain and combat outbreaks.
- **Services:** The Institute provides referral diagnostic services to individuals, communities, medical colleges, research institutions and state health directorates.
- **Headquarters:** The Institute has its headquarters in **Delhi.**
- **Branches: It has eight branches** located at Alwar (Rajasthan), Bengaluru (Karnataka), Kozikode (Kerela), Coonoor (Tamil Nadu), Jagdalpur (Chattisgarh), Patna (Bihar), Rajahmundry (Andhra Pradesh) and Varanasi (Uttar Pradesh).

# Inflatable Aerodynamic Decelerator: ISRO

## Why in News?

Recently, the **Indian Space Research Organisation (ISRO)** has successfully tested the **Inflatable Aerodynamic Decelerator (IAD)** technology that could aid cost-effective recovery of spent rocket stages and safely land payloads on other planets.

## What is IAD?

- **About:**
  - The IAD is designed, developed and successfully test-flown by **ISRO's Vikram Sarabhai Space Centre (VSSC)**.
  - The IAD was successfully test flown in Rohini-300 (RH300 Mk II) sounding rocket from Thumba Equatorial Rocket Launching Station.
    - Rohini sounding rockets are routinely used for flight demonstration of new technologies being developed by ISRO as well as by scientists from India and abroad.
  - The IAD serves to **decelerate an object plunging down** through the atmosphere.
  - The IAD was initially folded and kept inside the payload bay of the rocket. At around 84 km altitude, the IAD was inflated and it descended through the atmosphere with the payload part of a sounding rocket.
  - The IAD has systematically **reduced the velocity of the payload through aerodynamic drag** and followed the predicted trajectory.
    - The force on an object that resists its motion through a fluid is called drag. When the fluid is a gas like air, it is called aerodynamic drag or air resistance.
- **Significance:**
  - The IAD has huge potential in a variety of space applications like **recovery of spent stages of rocket, for landing payloads on to Mars or Venus** and in making space habitat for human space flight missions.

Note:

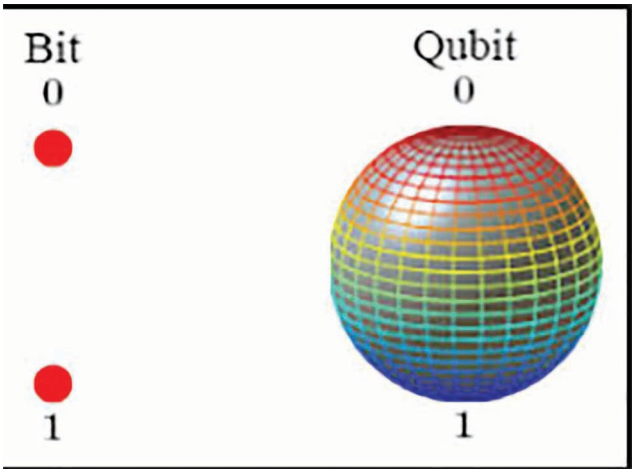
# India & Quantum Computing

## *Why in News?*

According to a study by IBM, **India is witnessing a growing interest in quantum computing,** with students, developers, and academia actively participating. Consequently, the country is **emerging as a talent hub for quantum computing.**

## *What is Quantum Computing?*

- **About:**
  - Quantum computing is a **rapidly-emerging technology that harnesses the laws of quantum mechanics** to solve problems too complex for classical computers.
    - Quantum mechanics is a subfield of physics that describes the behavior of particles — atoms, electrons, photons, and almost everything in the molecular and submolecular realm.
  - It is an exciting **new technology that will shape our world tomorrow** by providing us with an edge and a myriad of possibilities.
  - It is a fundamentally **different way of processing information** compared to today's classical computing systems.
- **Features:**
  - **Different from Traditional Computers:**
    - While today's classical computers store information as binary 0 and 1 states, quantum computers draw on the fundamental laws of nature to carry out calculations using quantum bits.




- Unlike a bit that has to be a 0 or a 1, a qubit can be in a combination of states, which allows for exponentially larger calculations and gives them the potential to solve complex problems which even the most powerful classical supercomputers are not capable of.

## *What are the Key Initiatives taken by the Indian Government?*

- **National Mission on quantum technologies and applications**: The Government in its 2021 budget allocated INR 8000 Crore towards the **National Mission on quantum technologies and applications** to spur developments in quantum computing, cryptography, communications, and material science.
- **Quantum Computing Laboratory**: In December 2021, the Indian Army set up a **quantum computing laboratory** and an AI centre at a military engineering institute at Mhow, Madhya Pradesh. It is also backed by the **National Security Council Secretariat (NSCS).**
- **Quantum Communication Lab:** The **Centre for Development of Telematics (C-DOT)** launched a **quantum communication lab** in October 2021. It can support more than 100 km of standard optical fibre.
- **Collaborations**: The **Defence Institute of Advanced Technology (DIAT)** and the **Centre for Development of Advanced Computing (C-DAC)** agreed to collaborate and develop quantum computers.
- **I-HUB Quantum Technology Foundation**: The Department of Science and Technology and about 13 research groups from IISER Pune launched **I-HUB Quantum Technology Foundation** (I-HUB QTF) to further enhance the development of quantum tech.
- **Startups**: A number of Start-Ups such as **Qunu Labs, Bangalore; BosonQ, Bhilai** have also emerged and as a result, they are making inroads in this area.

# CRISPR-Cas9 for Sickle-Cell Anaemia

## *Why in News?*

India approved a 5-year project to **develop Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) to cure sickle cell anaemia** in 2021.

- Sickle cell anaemia is the **first disease that is being targeted for CRISPR-based therapy in India.**

Note:

- The pre-clinical phase (trials on animal subjects) is about to begin.

### What is CRISPR Technology?

- **About:**
  - **Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)** is a **gene editing technology,** which **replicates natural defence mechanism in bacteria to fight virus attacks, using a special protein called Cas9.**
  - It usually involves the **introduction of a new gene, or suppression of an existing gene,** through a process described as **genetic engineering.**
    - CRISPR technology does not involve the introduction of any new gene from the outside.
  - **CRISPR-Cas9 technology** is often described as **'Genetic Scissors'.**
    - Its mechanism is often compared to the 'cut-copy-paste', or 'find-replace' functionalities in common computer programmes.
    - A bad stretch in the DNA sequence, which is the cause of disease or disorder, is located, cut, and removed and then replaced with a 'correct' sequence.
      - The tools used to achieve this are biochemical i.e., specific protein and RNA molecules.
  - The technology **replicates a natural defence mechanism in some bacteria** that uses a similar method to **protect itself from virus attacks.**

**What is Sickle Cell Anaemia?**

- **About:**
  - It is an **inherited blood disease** which is most common among people of African, Arabian and Indian origin.
  - It is a group of disorders that **affects hemoglobin, the molecule in red blood cells that delivers oxygen to cells throughout the body.**
  - People with this disease have **atypical hemoglobin molecules called hemoglobin S,** which can **distort red blood cells into a sickle, or crescent shape.**
    - This blocks blood flow and oxygen from reaching all parts of the body.
- **Symptoms:**
  - It can cause severe pain, referred to as **sickle cell crises.**
  - Over time, people with sickle cell disorders can experience **damage to organs including the liver, kidney, lungs, heart and spleen. Death can also result** from complications of the disorder.
- **Treatment:**
  - Medication, blood transfusions and rarely a bone-marrow transplant.

## Cyber Threat to Mobile Banking

### Why in News?

According to a recent study, more people are inclining toward **digital payments and there is a rise in the number of people's interactions with their bank or bank accounts** happen through their smartphones.

- Further, this acceleration brings along with it a vulnerability: an increased threat of **cyberattacks** on mobile devices.

**What are Cyber Threats?**

- **About:**
  - A cyber or **cybersecurity threat** is a **malicious act that seeks to damage data, steal data, or disrupt digital life in general.** It **includes computer viruses, data breaches, Denial of Service (DoS) attacks, and other attack vectors.**
- **Different Types:**
  - **Malware: Malware** short for malicious software refers to any kind of software that is designed to cause damage to a single computer, server, or computer network. **Ransomware, Spy ware, Worms, viruses, and Trojans are all varieties of malware.**
  - **Phishing:** It is a method of trying to gather personal information using deceptive e-mails and websites.
  - **Denial of Service attacks:** A Denial-of-Service (DoS) attack is an attack meant to shut down a machine or network, making it inaccessible to its intended users. DoS attacks accomplish this by flooding the target with traffic, or sending it information that triggers a crash.

Note:

- **Man-in-the-middle (MitM) attacks,** also known as eavesdropping attacks, occur when attackers insert themselves into a two-party transaction. Once the attackers interrupt the traffic, they can filter and steal data.
- **Social engineering** is an attack that relies on human interaction to trick users into breaking security procedures in order to gain sensitive information that is typically protected.

# Wind Projects in India

## *Why in News?*

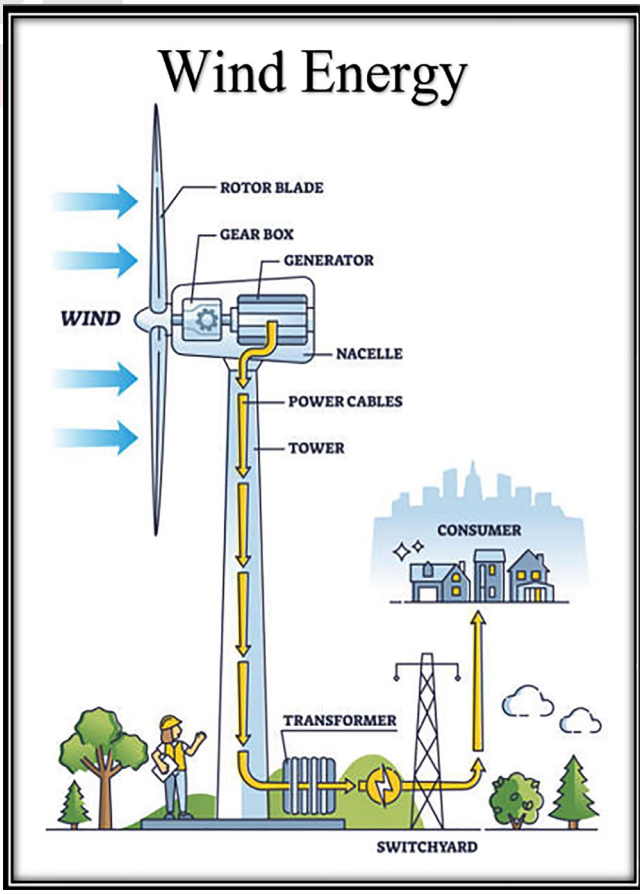
**The Global Wind Energy Council (GWEC) and MEC Intelligence (MEC+),** a consulting firm that specialises in renewable energy has reported that **annual installation of new wind power projects** in India will peak by 2024 and likely decline thereafter.

- After 2024, fresh projects are likely to be **wind-solar hybrids.**

## *What do we need to know about Wind Projects in India?*

- **About:**
  - **Wind energy** today typically comes in two different types:
  - **Onshore wind farms** which are large installations of wind turbines located on land.
  - **Offshore wind farms** which are installations located in bodies of water.
- **Status:**
  - India currently has **13.4 GW of prospective projects in wind energy**, which are expected to **drive installations until 2024 in the market.**
  - India is **expected to add** 3.2 GW in 2022, 4.1 GW in 2023 peaking to 4.6 GW in 2024, **thereafter declining to 4 GW and 3.5 GW in the next two years.**
  - Wind industry installations have been **slowing down in India since 2017.**
    - Only 1.45 GW of wind projects were installed in 2021 with many delayed due to the **second wave of Covid-19** and **supply chain-related disruptions.**
- **Challenges:**
  - The market has **concentrated wind projects around a few substations of Gujarat and Tamil Nadu**, which were home to the strongest resource potential and lowest cost of land.
  - This created **bottlenecks and slowed down project activity** and made it **costlier than solar power.**
  - India's track record has indicated that the **wind installation market is a lumpy market.**
  - Considerable momentum has been built in the pipeline since 2017-2018, **but inordinate delays in project execution** have challenged the assumptions of developers.
  - Due to the COVID-19 pandemic and supply chain constraints, **the overall dues of electricity distribution companies (DISCOM) have ballooned.**
  - The outstanding payments to RE generators increased by 73% to ₹19,400 crores in December 2021, as compared to ₹11,200 crores in December 2020.

## *What do we know about Wind Energy?*




Note:

- **About:**
  - **Wind is used** to produce electricity using the **kinetic energy created by air** in motion. This is transformed into electrical energy u**sing wind turbines or wind energy conversion systems.**
  - Wind first **hits a turbine's blades**, causing them to **rotate** and turn the **turbine** connected to them.
  - That changes the **kinetic energy to rotational energy**, by moving a shaft which is **connected to a generator**, and thereby **producing electrical energy through electromagnetism.**
  - The electricity is **sent through transmission and distribution lines** to homes, businesses, schools, and so on.
  - The amount of power that **can be harvested from wind depends on the size of the turbine and the length of its blades.**
  - The output is proportional to the dimensions of the rotor and to the cube of the wind speed.
  - Theoretically, **when wind speed doubles, wind power potential increases by a factor of eight.**
- **History:**
  - Wind turbines **first emerged more than a century ago.**
  - Following the **invention of the electric generator in the 1830s**, engineers started attempting to harness wind energy to produce electricity.
  - **Wind power generation** took place in the United Kingdom and the United States in 1887 and 1888, but modern wind power is considered to have been **first developed in Denmark.**

# MoU for Cooperation on Satellite- Based Naval Applications

## *Why in News?*

Recently, Memorandum of understanding (MoU) has been signed between the **Space Applications Centre (ISRO)** and the **Indian Navy** on data sharing and cooperation on Satellite-based Naval Applications in **Oceanology** and **Meteorology**.

## *What are the Key Highlights of The MoU?*

- It will **enhance collaboration** and would initiate a **common platform of mutual cooperation**.
- The scientific advancements by Space Applications Centre would be **synergized with the Indian Naval efforts to keep the nation's defence in step with rapid development in the field of Satellite Data retrieval and applications**.
- **Cooperation would include various dimensions**:
  - Sharing of non-confidential observational data.
  - Operational exploitation of Space Applications Centre (SAC)-generated **weather products and provisioning of Subject Matter Experts (SME) for the processing of satellite data towards the development of new tools**.
  - Providing Calibration and validation of ocean models.

## *What is Space Applications Centre?*

- **About:**
  - **Space Applications Centre** is a major **research and development centre of the Indian Space Research Organisation (ISRO).**
  - It is **situated in Ahmedabad** and performs multi-disciplinary activities.
  - The core competence of the Centre lies in the **development of space-borne and air-borne instruments/payloads** and their applications for national development and societal benefits.
  - These applications are in diverse areas and **primarily meet the communication, navigation, and remote sensing needs of the country**.
- **Achievements:**
  - The Centre also contributed significantly to scientific and planetary missions of ISRO like **Chandrayaan-1, Mars Orbiter Mission**, etc.
  - The communication transponders developed at this Centre for **Indian National Satellite (INSAT)** and **Geo Synchronous Satellite (GSAT)** series of satellites are used by the government and private sector for VSAT, DTH, Internet, broadcasting, telephones, etc.

# Forever Chemicals

## *Why in News?*

According to a recent study, scientists have found that rainwater from many places across the globe is contaminated with **Per- and Polyfluoroalkyl Substances (PFAs).**

Note:

- Further, they are called **Forever chemicals** because of their **tendency to stick around in the atmosphere, rainwater, and soil for long periods of time.**
- PFAs are also listed in the **Stockholm Convention.**

**What is Stockholm Convention?**

- **About:** It is a global treaty to protect human health and the environment from **persistent organic pollutants (POPs)**. POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife.
- **Objectives:**
  - Support the transition to safer alternatives.
  - Target additional POPs for action.
  - Clean up old stockpiles and equipment containing POPs.
  - Work together for a POPs-free future.
  - India **ratified the Stockholm Convention in 2006** as per Article 25(4), which enabled it to keep itself in a default "opt-out" position such that amendments in various Annexes of the convention cannot be enforced on it unless an instrument of ratification/ acceptance/ approval or accession is explicitly deposited with UN depositary.

### *What are Per- and Polyfluoroalkyl Substances (PFAs)?*

- **About:**
  - They are **man-made chemicals used to make nonstick cookware, water-repellent clothing, stain-resistant fabrics, cosmetics, firefighting forms**, and many other products that resist grease, water, and oil.
  - They can **migrate to the soil, water, and air** during their production and use.
  - Most PFAs do not break down, they remain in the environment for long periods of time.
  - Further, some of these PFAs can **build up in people and animals if they are repeatedly exposed to the chemicals.**
- **Harmful Effects:**
  - They cause a variety of **health risks** that are attributed to PFA exposure, including **decreased fertility, developmental effects in children, interference with body hormones, increased cholesterol levels, and increased risk of some cancers.**
  - Recent research has also revealed that **long-term low-level exposure** to certain PFAs can make it **difficult for humans to build antibodies after being vaccinated against various diseases.**

## India's First Indigenously Developed HFC Bus

### *Why in News?*

Recently, the Union Minister of State of Science & Technology launched **India's first Hydrogen Fuel Cell (HFC) Bus.**

- **Bisphenol-A pilot plant** in **CSIR**- National Chemical Laboratory (NCL), an **important feedstock for the production of epoxy resins**, polycarbonate and other engineering plastics was also inaugurated.

**What are Hydrogen Fuel Cells (HFC)?**

- **About:**
  - A hydrogen fuel cell is an **electrochemical device** that converts hydrogen into electrical energy.
  - Fuel cells work in a similar manner to conventional batteries found in electric vehicles, but they do not run out of charge and don't need to be recharged with electricity.
  - They continue to produce electricity as long as there is a supply of hydrogen.
  - One of the most successful **fuel cells uses the reaction of hydrogen with oxygen to form water.**
- **Advantages of HFC Powered Vehicles:**
  - They produce **no tailpipe emissions** (emission of gaseous and particulate pollutants) and **only emit water vapour and warm air.**
  - They are **more efficient than internal combustion engine vehicles**.
  - Hydrogen FCEVs have an advantage over battery powered EVs in terms of refuelling time; **hydrogen can be refilled in a fuel cell vehicle in a matter of minutes**, nearly as fast as an internal combustion engine can be refilled with fossil fuels.
- **What is the National Hydrogen Energy Mission?**

Note:

- The **Union Budget for 2021-22** announced a National Hydrogen Energy Mission (NHM) to draw up a **road map for using hydrogen as an energy source.**
- It will **capitalise on one of the most abundant elements on earth (Hydrogen)** for a cleaner alternative fuel option.
- The initiative has the potential of transforming transportation.

➢ It will:

- Focus on generation of hydrogen from green power resources.
- Link India's growing renewable capacity with the **hydrogen economy.**
- The usage of hydrogen will not only help India in achieving its emission goals under the **Paris Agreement**, but will also **reduce import dependency on fossil fuels.**

**What is Green Hydrogen?**

➢ **About:**

- It is **produced by splitting water into hydrogen and oxygen** using an electrolyzer powered by renewable energy sources such as wind and solar.
- The fuel is **considered a game-changer for the energy security of India**, which imports 85% of its oil and 53% of gas requirements.
- In February 2022, the **Ministry of Power has notified Green Hydrogen/Green Ammonia Policy** for production of Green Hydrogen or Green Ammonia using renewable sources of energy.

➢ **Significance:**

- Green hydrogen energy is vital for India to meet its **Nationally Determined Contribution (INDC) Targets** and ensure regional and national energy security, access and availability.
- Green Hydrogen can **act as an energy storage option**, which would be essential to meet intermittencies (of renewable energy) in the future.
- In terms of mobility, for long distance mobilisations for either urban freight movement within cities and states or for passengers, **Green Hydrogen can be used in railways, large ships, buses or trucks, etc.**
- Hydrogen has the potential to be the **key renewable target in supporting infrastructure as well.**

### *In What Other Ways is the Government of India Promoting Clean Fuel Transition?*

- **NTPC's project for hydrogen Fuel Cell Electric Vehicles (FCEV)**
- **FAME India Scheme**
- **Faster Adoption and Manufacturing of Electric Vehicles (FAME II)** scheme.
- **Green Hydrogen Fuel Cell Electric Vehicle (FCEV) Toyota Mirai**
- **EV30@30 campaign**
- **Roadmap for Ethanol Blending in India by 2025**
- **Amendments to the National Policy on Biofuels, 2018**

## India's First Commercial SSA Observatory

### *Why in News?*

India's **first commercial Space Situational Awareness (SSA) Observatory** will be set up in the Garhwal region of **Uttarakhand**.

- The observatory will be set up by **Digantara, a Bengaluru-based space sector start-up.**

**What is Space Debris?**

- Space debris consists of **spent rocket stages, dead satellites, fragments of space objects** resulting from **Anti-satellite (ASAT) System (ASAT).**
- Hurtling at an average speed of 27,000 kmph in **Low Earth Orbit (LEO),** these objects **pose a very real threat** as collisions involving even centimetre-sized fragments can be **lethal to satellites.**
- This free floating space debris is a **potential hazard for operational satellites** and colliding with them can leave the satellites dysfunctional.
- If there is too much space junk in orbit, it could result in a chain reaction where more and more objects will collide and create new space junk in the process, to the point where **Earth's orbit becomes unusable – a Domino Effect.**

### *What about India's Current Scenario regarding SSA?*

➢ **About SSA:**

- **Space Situational Awareness (SSA) refers to keeping track of objects in orbit** and predicting where they will be at any given time.

Note:

- It involves monitoring the movement of all objects — **natural (meteors) and man-made (satellites)** — and **tracking space weather.**
- SSA is generally understood as covering three main areas:
- Space Surveillance and Tracking (SST) of man-made objects.
- Space Weather (SWE) monitoring and forecast.
- Near-Earth Objects (NEO) monitoring (only natural space objects).

➢ **India's SSA Capability:**

- At present, India uses a **Multi Object Tracking Radar at Sriharikota range** (Andhra Pradesh), but it has a limited range.
- Further, for SSA, **India depends on data from NORAD (North American Aerospace Defence Command)** and others available in the public domain.
- However, these platforms don't provide accurate or comprehensive information.

➢ **Nodal Agency:**

- **ISRO**'s efforts towards SSA is coordinated by the **SSA Control Centre in Bengaluru** and managed by the **Directorate of Space Situational Awareness and Management** at the ISRO headquarters.

➢ **Related Initiatives:**

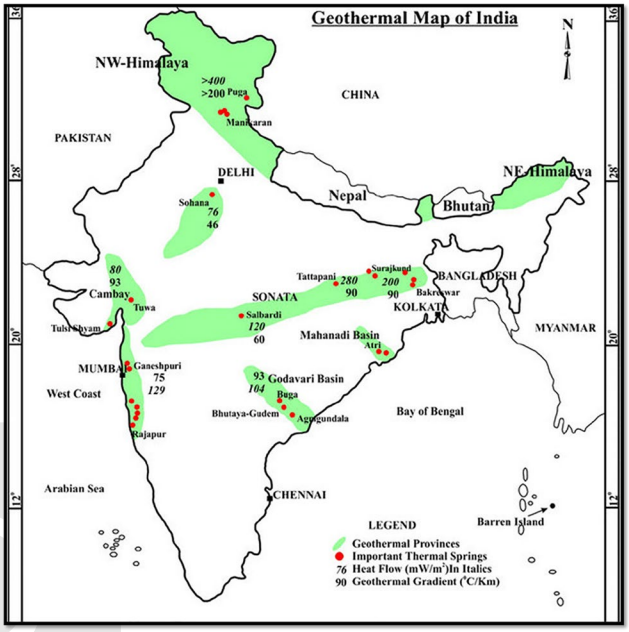
- **Project NETRA: 'Project NETRA'** will be an early warning system in space to detect space debris and other hazards to Indian satellites.
- Once operational, **it will give India its own capability in Space Situational Awareness (SSA)** like the other space powers.
- Under this project, a space debris tracking radar with a range of 1,500 km and an optical telescope will be inducted
- **Clearspace-1:** At global level, this initiative of the **European Space Agency,** scheduled to launch in 2025, will be the **first space mission to eliminate debris** from orbit.

# Geothermal Power in Ladakh

## *Why in News?*

**State-run explorer Oil and Natural Gas Corporation (ONGC)** will be participating to generate electricity through **Geothermal Energy** at Puga, a remote valley located in Ladakh, off the road to Chumar on the de-facto border with China.

## *What do we need to know about the Puga Project?*




➢ **About Puga Valley:**

- Puga Valley is situated in the **Changthang Valley** in the south-eastern part of Ladakh, about 22 km away from the **Salt Lake Valley**.
- It is a region of great significance known for its **natural beauty and geothermal activities.**
- Puga is also visited for its **hot sulphur spring.**

➢ **About Geothermal Project:**

- It will be India's **first geothermal energy project** and also the **world's highest at 14,000ft.**
- **ONGC** has started drilling its first well for the project and encountered **high-pressure steam at 100 degrees Celsius** with a discharge rate of 100 tonne geothermal energy per hour, **considered as a good sign for the project.**

➢ **Phases:**

- In the first phase, the company will drill 1,000-metre-deep wells to run a **one-megawatt power plant as a pilot.**
- The second phase envisages a **deeper exploration of the geothermal reservoir** and a higher capacity demonstration plant.

Note:

- The third phase would involve commercial development of the geothermal plant.

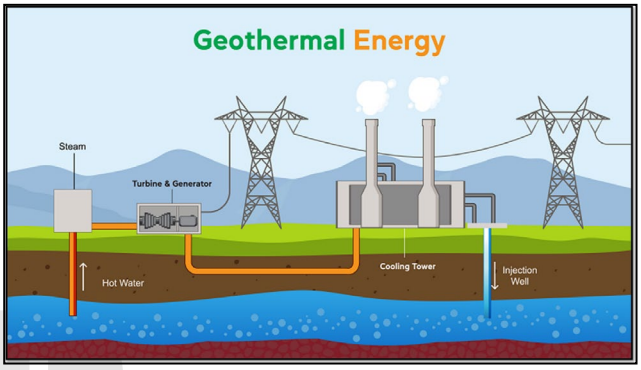
➢ **Benefits:**

- It will **boost Ladakh's potential to emerge as one of the country's clean energy bowl** by expanding the area's horizon beyond **solar** or **wind power**.
- The pilot plant provides **power and heating needs** of the nearby settlements of Tibetan pastoralist refugee settlements at Sumdo and nearby areas.
- A bigger plant will provide **24X7 supply for the far-flung settlements** and the **large defence establishment in the eastern sector**, reducing their dependence on **diesel for running generators.**
- The plant can also play a vital role as a **stabiliser for the 15-gigawatt solar/wind project** being planned in the nearby Morey plains in the southwest.

➢ **Status of Geothermal Energy:**

- **National:**
  - Geological Survey of India has identified about 340 geothermal hot springs in the country. Most of them are in the low surface temperature range from 370C to 900C, which is suitable for direct heat applications.
  - The potential for power generation at these sites is about 10,000 MW.
  - The hot springs in the country are grouped into seven geothermal provinces:
    - Himalayan, Sahara Valley, Cambay Basin, San-Narmada –Topi lineament belt, West Coast, Godavari Basin and Mahanadi Basin.
    - **Some of the prominent places where a power plant can be established based on geothermal energy are:**
    - Manikaran in Himachal Pradesh
    - Jalgaon in Maharashtra
    - Tapovan in Uttarakhand
    - Bakreshwar in West Bengal
    - Tuwa in Gujarat
- **Global:**
  - Gigawatt-Size Geothermal Capacities:
- **The US:**
  - The US leads the world in the amount of geothermal electricity generation.
- **Indonesia:**
  - Indonesia was the second-largest geothermal electricity producer.
  - Philippines
    - Turkey
    - New Zealand
    - Mexico and Italy have 900 megawatt-plus capacity, while Kenya has over 800 mw, followed by Iceland, Japan and others.

## *What is Geothermal Energy?*




➢ **About:**

- Geothermal energy is the **heat from the earth**. This heat is used for bathing, to heat buildings, and to generate electricity.
- The word geothermal comes from the Greek words **geo (earth)** and **therme (heat)**, and geothermal energy is a **renewable energy source** because heat is continuously produced inside the earth.

➢ **Sources:**

- **Hot water or steam reservoirs** deep in the earth are accessed by **drilling.**
- Geothermal **reservoirs located near the earth's surface**, mostly located in the western U.S., Alaska, and Hawaii.
- The **shallow ground near the Earth's surface that maintains a relatively constant temperature** of 50-60°F.

➢ **Uses:**

- Hot water and steam from reservoirs can be used to **drive generators and produce electricity for consumers.**
- Other applications apply the **heat produced from geothermal directly to various uses** in buildings, roads, agriculture, and industrial plants.
- The heat can also be used directly from the ground to provide **heating and cooling in homes and other buildings.**

Note:

**What is ONGC?**

- ONGC is a **public sector petroleum company.**
- **Under the leadership of Pandit Jawaharlal Nehru**, the foundation stone of ONGC was laid in 1955 as the Oil and Gas Division under the **Geological Survey of India**.
- It may be noted that on 14th August 1956, it was renamed as the Oil and Natural Gas Commission and in 1994 the Oil and Natural Gas Commission was converted into a corporation.
- In the year 1997 it was accepted as one of the Navaratnas by the Government of India, while in the year 2010 it was given the status of **Maharatna**.

# Call for Applications for AIC and AICC: NITI Aayog

## *Why in News?*

**Recently, Atal Innovation Mission (AIM), NITI Aayog** launched **Call for Applications for its two leading programs** Atal Incubation Centre (AIC) and Atal Community Innovation Centre (ACIC).

## *What is the Call for Applications?*

- The call for applications is **a step to expand the current ecosystem of incubators** and to provide them with access to global benchmarks and best practices.
- Both the programs envision creating and supporting the innovative ecosystem in the country by establishing world-class institutions which shall help budding entrepreneurs of the country.
- These AICs and ACICs will play a pivotal role in enriching the **start-up** and entrepreneurship ecosystem of India and echo the anthem of **Atmanirbhar Bharat.**

## *What is Atal Incubation Centre?*

- AIC is an initiative of the AIM, NITI Aayog to foster **innovation and entrepreneurial spirit while creating a supportive ecosystem for start-ups** and entrepreneurs in India.
- Each AIC is supported with **a grant of up to INR 10 crores over a period of 5 years.**
  - Since 2016, **AIM has established 68 Atal Incubation Centres across 18 states** and 3 UTs which have supported more than 2700 startups.

## *What is Atal Community Innovation Centre?*

- ACIC is envisaged **to serve the unserved/underserved areas of the country** with respect to the start-up and innovation ecosystem.
- Each ACIC is supported with a grant of up to **INR 2.5 crores over a period of 5 years.**
- AIM has established **14 Atal Community Innovation Centres** across the country.

**What is Atal Innovation Mission?**

- **About:**
  - AIM is Government of **India's flagship initiative to promote a culture of innovation and entrepreneurship** in the country.
  - Its objective is to develop new programmes and policies for fostering innovation in different sectors of the economy, provide platform and collaboration opportunities for different stakeholders, create awareness and create an umbrella structure to oversee the innovation ecosystem of the country.
- **Major Initiatives:**
  - **Atal Tinkering Labs:** Creating problem solving mindset across schools in India.
  - **Atal New India Challenges:** Fostering product innovations and aligning them to the needs of various sectors/ministries.
  - **Mentor India Campaign:** A national mentor network in collaboration with the public sector, corporates and institutions, to support all the initiatives of the mission.
  - **Atal Research and Innovation for Small Enterprises (ARISE):** To stimulate innovation and research in the MSME industry.

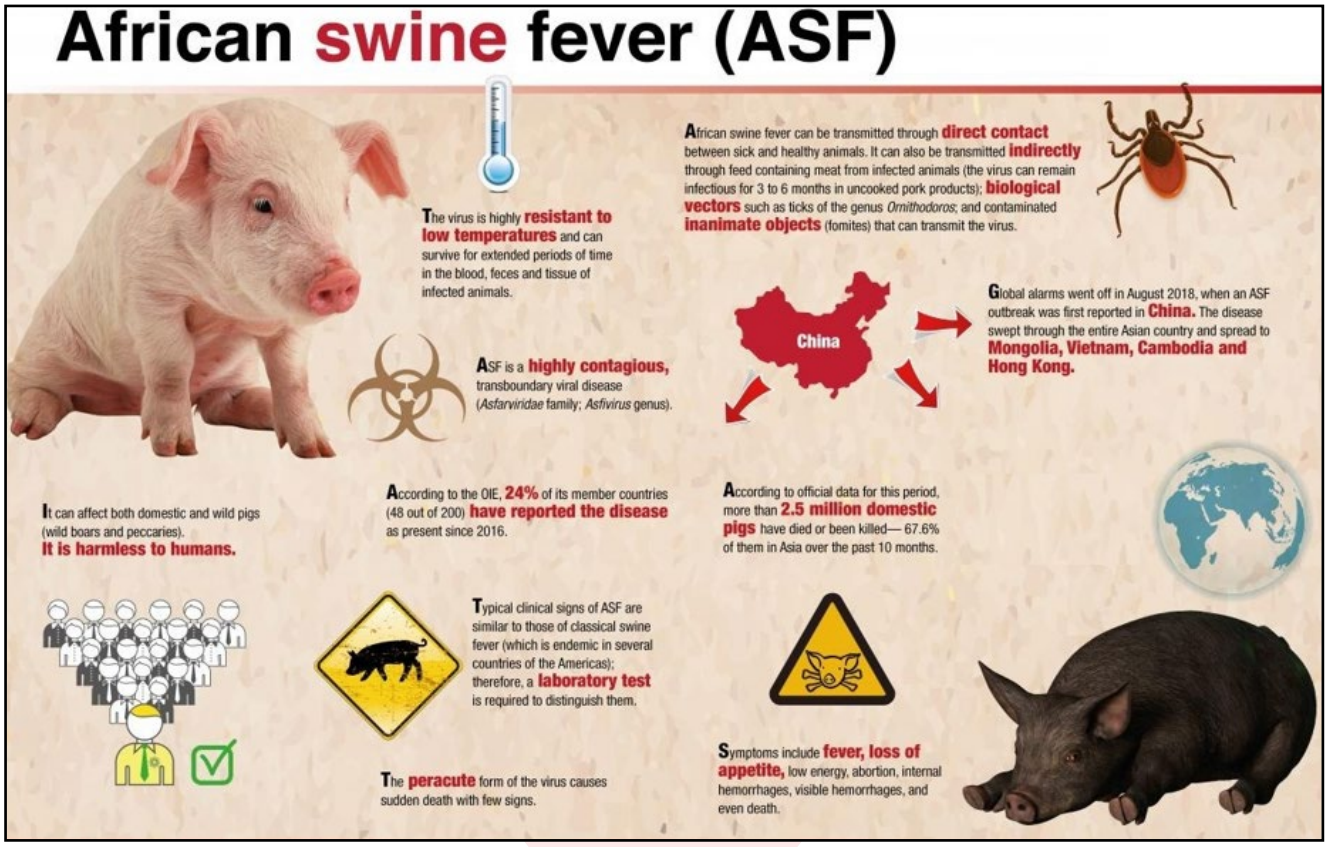
# African Swine Fever in India

## *Why in News?*

Recently, **African Swine Fever** has been confirmed for the first time, at a private pig farm in **in Kerala**, after **more than 15 pigs** on the farm had died due to the **disease in the last ten days.**

Note:

## What is African Swine Fever?




- **About:**
  - It is a **highly contagious and fatal animal disease** that infects and leads to an acute form of **hemorrhagic fever in domestic and wild pigs**.
  - **Other manifestations of the disease include:**
    - High fever
    - Depression
    - Anorexia
    - Loss of appetite
    - Hemorrhages in the skin
    - Vomiting and diarrhoea among others.
  - It was **first detected in Africa** in the 1920s.
    - Historically, outbreaks have been reported in Africa and parts of Europe, South America, and the Caribbean.
      - However, since 2007, the disease has been reported in multiple countries across **Africa, Asia and Europe**, in both **domestic and wild pigs.**
  - The mortality is close to 95% - 100% and since the fever has no cure, **the only way to stop its spread is by culling the animals.**
  - ASF is **not a threat to human beings** since it **only spreads from animals to other animals.**
  - ASF is a disease listed in the **World Organisation for Animal Health (OIE)'s Terrestrial Animal Health Code.**
- **Clinical Signs:**
  - The clinical signs of ASF may occur in **chronic, sub-acute or acute form.**
    - In the acute form pigs develop a high temperature (40.5 degrees C or 105 degrees F), then become dull and go off their food.
    - Other symptoms can vary but will include some or all of the following:
      - Vomiting
      - Diarrhoea (sometimes bloody)
      - Reddening or darkening of the skin, particularly ears and snout
      - Gummed up eyes
      - Laboured breathing and coughing
      - Abortion, still births and weak litters
      - Weakness and unwillingness to stand

Note:

- **Transmission:**
  - **Direct contact** with infected pigs, faeces or body fluids.
  - **Indirect contact** via fomites such as equipment, vehicles or people who work with pigs between pig farms with ineffective biosecurity.
  - **Pigs eating** infected pig meat or meat products.
  - **Biological vectors** - ticks of the species **Ornithodoros.**

### *What is Classical Swine Fever?*

- **CSF**, also known as **Hog Cholera**, is an important disease of pigs.
- It is one of the most **economically-damaging pandemic viral diseases** of pigs in the world.
- 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.**
- Mortality rate of Classical Swine Fever is 100%.
- Recently, the **Indian Council of Agricultural Research ICAR-Indian Veterinary Research Institute IVRI** developed a Cell Culture **CSF Vaccine** (live attenuated) using the **Lapinized Vaccine Virus** from foreign strain.
  - The new vaccine has been found to **induce protective immunity** from day 14 of the Vaccination till 18 Months.

**What is the World Organisation for Animal Health?**

- WOAH was formerly called the **"Office International des Epizooties"**.
- OIE is an **intergovernmental organisation** responsible for **improving animal health worldwide.**
- It has **182 Member Countries**.
  - **India** is one of the member countries.
- OIE develops **normative documents relating to rules that Member Countries can use** to protect themselves from the introduction of diseases and pathogens.
  - One of them is the **Terrestrial Animal Health Code.**
- OIE standards are recognised by the **World Trade Organization** as reference **international sanitary rules.**
- It is headquartered in **Paris, France**.

## Booster Dose: Corbevax

### *Why in News?*

Recently, the government of India announced that those who have received **Covishield** or **Covaxin** as their first or second dose for **Covid-19** can take **Corbevax as the third booster shot.**

- Corbevax is still awaiting **World Health Organisation's Emergency Use Listing (EUL)**.
- Until now, the third dose **had to be the same vaccine** that was used for the first and second doses.
- The decision comes after **India's drug regulator** approved Corbevax as a **heterologous Covid booster dose** for individuals aged 18 years.

**What is WHO's Emergency Use Listing (EUL)?**

- EUL is a **risk-based procedure** for **assessing and listing** unlicensed vaccines, therapeutics and in-vitro diagnostics with the ultimate aim of **expediting the availability of products to people** affected by a **public health emergency**.
- **International travel in many countries** requires people to get a vaccine that's on the **WHO's approved list**.

### *What are other types of Vaccines?*

- **Inactivated vaccines:**
  - **Inactivated vaccines** use the **killed version of the germ that causes a disease**.
  - Vaccines of this type are created by **inactivating a pathogen, typically using heat or chemicals such as formaldehyde or formalin.**
    - This destroys the pathogen's ability to replicate, but keeps it "intact" so that the immune system can still recognize it. ("Inactivated" is generally used rather than "killed" to refer to viral vaccines of this type, as viruses are generally not considered to be alive.)
- **Live-attenuated Vaccines:**
  - Live vaccines use a **weakened (or attenuated) form of the germ that causes a disease.**
  - Because these vaccines are so similar to the natural infection that they help prevent, **they create a strong and long-lasting immune response**.
- **Messenger (m) RNA Vaccines:**

Note:

- mRNA vaccines make proteins in order to **trigger an immune response**. mRNA vaccines have **several benefits compared to other types of vaccines**, including **shorter manufacturing times**, because they do not contain a live virus, **no risk of causing disease in the person getting vaccinated.**
- The vaccines are used to protect against: Covid-19.

➢ **Toxoid Vaccines:**

- They use a **toxin (harmful product) made by the germ that causes a disease.**
  - They create immunity to the parts of the germ that cause a disease instead of the germ itself. That means the immune response is targeted to the toxin instead of the whole germ.

➢ **Viral Vector Vaccines:**

- Viral vector vaccines use a **modified version of a different virus** as a vector to deliver protection.
- Several different viruses have been used as vectors, including **influenza, vesicular stomatitis virus (VSV), measles virus, and adenovirus**, which causes the common cold.

# Small Satellite Launch Vehicle (SSLV)

## *Why in News?*

Recently, **Indian Space Research Organisation(ISRO)** launched the first flight of the **Small Satellite Launch Vehicle( SSLV),** carrying an **Earth observation satellite EOS-02** and co-passenger students' satellite **AzaadiSAT**.

➢ However, the mission failed to place the satellites in their required orbits, and the satellites, as they were already detached from the launch vehicle, were lost.

## *What is a Small Satellite Launch Vehicle?*

➢ **About:**

- **Small Satellite Launch Vehicle (SSLV)** is a **three stage Launch Vehicle** configured with **three Solid Propulsion Stages and a liquid propulsion**-based **Velocity Trimming Module (VTM)** as a terminal stage.
  - SSLV is 2m in diameter and 34m in length with a lift-off weight of around 120 tonnes.
  - SSLV is capable of launching 500kg satellites in 500km planar orbit from Satish Dhawan Space Centre (SDSC).

➢ **Key Features:**

- Low cost,
- Low turn-around time,
- Flexibility in accommodating multiple satellites,
- Launch demand feasibility,
- Minimal launch infrastructure requirements, etc.

## *What is the SSLV-D1/EOS-02 Mission?*

➢ It was aimed at garnering a larger pie in the small launch vehicles market, as it could place the satellites into **Low Earth Orbit**.

➢ It was carrying the two satellites on board the rocket –

- **The primary EOS-2 Earth-observing satellite-** EOS-02 is an earth observation satellite designed and realised by ISRO.
  - This microsat series satellite offers advanced optical remote sensing operating in infra-red band with high spatial resolution.
- **The secondary AzaadiSAT student satellite-** It is an 8U Cubesat weighing around 8 kg.
  - It carries 75 different payloads each weighing around 50 grams and conducts femto-experiments.
    - It carried out tiny experiments which would have measured the **ionising radiation in its orbit** and also a transponder which worked in the **ham radio frequency to enable amateur operators to access it.**
  - Girl students from rural regions across the country were provided guidance to build these payloads.
    - The payloads are integrated by the student team of "**Space Kidz India**".

## *What is the Difference between Circular and Elliptical Orbits?*

➢ **Elliptical Orbits:**

- Mostly objects such as s**atellites and spacecrafts are put in elliptical orbits only temporarily.**
- They are then either pushed up to circular orbits at a greater height or the acceleration is increased until the trajectory changes from an ellipse to a hyperbola and the spacecraft escapes the gravity of the Earth in order to move further into space — for example, to the Moon or Mars or further away.

➢ **Circular Orbits:**

Note:

- **Satellites that orbit the Earth** are mostly placed **in circular orbits.**
- One reason is that if the satellite is used for imaging the Earth, it is easier if it has a fixed distance from the Earth.
- If the distance keeps changing as in an elliptical orbit, keeping the cameras focused can become complicated.

# OTEC Plant in Lakshadweep

## *Why in News?*

Recently, the **National Institute of Ocean Technology,** an autonomous institute under the Union **Ministry of Earth Sciences (MoES)** is establishing an **Ocean Thermal Energy Conversion Plant** with a capacity of 65 kilowatts (kW) in Kavaratti, **Lakshadweep.**

- The plant will power the one lakh liter per day low temperature thermal desalination plant, which converts seawater into potable water.
- The plant is the first of its kind in the world as it will **generate drinking water from sea water using indigenous technology, green energy** and environmentally friendly processes.

## *What is Ocean Thermal Energy Conversion?*

- **About:**
  - Ocean Thermal Energy Conversion (OTEC) is a **process for producing energy by harnessing the temperature differences (thermal gradients) between ocean surface waters and deep ocean waters.**
    - Oceans are huge heat reservoirs as they cover almost 70% of Earth's surface.
  - Researchers focus on **two types of OTEC technologies-**
    - Closed cycle method - where a working fluid (ammonia) is pumped through a heat exchanger for evaporation and the steam runs a turbine.
      - The vapour is turned back to fluid (condensation) by the cold water found at the depths of the ocean where it returns to the heat exchanger.
    - Open cycle method - where the warm surface water is pressurized in a vacuum chamber and converted to steam which runs the turbine. The steam is then condensed using cold ocean water from lower depths.
- **Historical perspective:**
  - India initially had planned to set up an OTEC plant way back in 1980, off the Tamil Nadu coast. However, with the foreign vendor closing down its operation, it had to be abandoned.
- **India's OTEC Potential:**
  - As India is **geographically well-placed to generate ocean thermal energy, with around 2000 kms of coast length along the South Indian coast,** where a temperature difference of above 20°C is available throughout the year.
  - The total OTEC potential around India is estimated as **180,000 MW**, considering 40% of gross power for parasitic losses.

## *What are the Related Recent Initiatives of the Government?*

- **Deep Sea Mining:**
  - The MoES is developing technologies for **mining deep sea** resources like polymetallic nodules from the **Central Indian Ocean** at a water depth of 5,500 meters.
- **Weather Forecasting:**
  - The ministry is also working on introducing **ocean climate change advisory services** for climate risk assessment due to **sea level rise; cyclone intensity and frequency; storm surges and wind waves**; biogeochemistry, and changing **harmful algal blooms** in the coastal waters of India.
- **Deep Ocean Mission:**
  - MoES is trying to design and develop a **prototype crewed submersible rated for 6,000 meters of water depth** under the **Deep Ocean Mission**.
  - It will include technologies for underwater vehicles and underwater robotics.
- **DNA Bank:**
  - There efforts are being made to improve the detection, sampling and **DNA storage** of benthic fauna of the northern Indian Ocean through systematic sampling using a remotely operated vehicle.

Note:

**National Institute of Ocean Technology (NIOT)**

- It was established in **November 1993** as an **autonomous society** under the **Ministry of Earth Sciences,** Government of India.
- It aims to develop reliable indigenous technologies to solve various engineering problems associated with harvesting of non-living and living resources in the **Indian Exclusive Economic Zone.**

# Council of Scientific and Industrial Research

## *Why in News?*

Senior electrochemical scientist Nallathamby Kalaiselvi has become the **first woman director general** of the **Council of Scientific and Industrial Research**.

- Kalaiselvi's research work of more than 25 years is primarily focused on electrochemical power systems and in particular, development of electrode materials, and electrochemical evaluation of in-house prepared electrode materials for their suitability in energy storage device assembly.
- Kalaiselvi also made key contributions to the **National Mission for Electric Mobility.** She has more than 125 research papers and six patents to her credit.

## *What is CSIR?*

- **About:**
  - Council of Scientific and Industrial Research (CSIR) is the **largest research and development (R&D) organisation in India**.
  - CSIR has a pan-India presence and has a dynamic network of **37 national laboratories, 39 outreach centres, 3 Innovation Complexes and 5 units.**
  - CSIR is funded by the Ministry of Science and Technology and it operates as an autonomous body through the Societies Registration Act, 1860.
- **Scope:**
  - CSIR **covers a wide spectrum of streams** – from radio and space physics, oceanography, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology.
    - It provides significant technological intervention in many areas with regard to societal efforts which include the environment, health, drinking water, food, housing, energy, farm and non-farm sectors.
- **Established:** September 1942
- **Headquarters:** New Delhi

## *What is the Structure of the Organisation?*

- **President:** Prime Minister of India (Ex-officio)
- **Vice President:** Union Minister of Science and Technology (Ex-officio)
- **Governing Body:** The Director-General is the head of the governing body.
  - The other ex-officio member is the finance secretary (expenditures).
  - Other members' terms are of three years.

## *What is the Vision & Strategy 2022?*

- **Vision:** Pursue science which strives for global impact, the technology that enables innovation-driven industry and nurtures trans-disciplinary leadership thereby catalyzing inclusive economic development for the people of India.

## *What are the Initiatives taken by CSIR?*

- **Covid-19:**
  - CSIR has set up five technology verticals for addressing the emerging situation due to **pandemic:**
    - Digital and Molecular Surveillance.
    - Rapid and Economical Diagnostics.
    - Repurposing of Drugs, Vaccine and Convalescent Plasma Therapy.
    - Hospital Assistive Devices and PPEs (Personal Protective Equipment).
    - Supply Chain and Logistics Support Systems.
- **Strategic:**
  - Head-Up-Display (HUD): It developed indigenous Head-Up- display (HUD) for Indian Light Combat Aircraft, **Tejas.** HUD aids the pilot in flying the aircraft and in critical flight maneuvers including weapon aiming.
- **Energy & Environment:**
  - **Solar Tree:** It occupies minimum space to produce clean power.

Note:

- **Lithium Ion Battery:** India's first **lithium ion battery** fabrication facility based on indigenous novel materials for making 4.0 V/14 h standard cells has been established.

- **Agriculture:**
  - **Samba Mahsuri Rice Variety:** It developed a Bacterial Blight Resistant Rice.
  - **Rice Cultivar (Muktashree):** A rice variety has been developed which restricts assimilation of Arsenic within permissible limits.
  - **White-fly resistant Cotton variety**: Developed a transgenic cotton line which is resistant to whiteflies.
- **Healthcare:**
  - **Genomics and other omics technologies for Enabling Medical Decision – GOMED:** It has been developed by the CSIR which provides a platform of disease genomics to solve clinical problems.
- **Food & Nutrition:**
  - **Ksheer-scanner:** It detects the level of milk adulteration and adulterants in 45 seconds at the cost of 10 paise.
  - **Double-Fortified Salt:** Salt fortified with iodine and iron having improved properties developed and tested for addressing **anaemia** in people.

# Fungus for Pyrene Remediation

## *Why in News?*

Researchers at the **Council of Scientific & Industrial Research (CSIR)** have identified a fungus capable of removing toxic, recalcitrant (Not easily controlled), and carcinogenic Pyrene or **Polycyclic Aromatic Hydrocarbons (PAHs)** from the environment.

- The researchers used **gas chromatographic-mass spectrometer and serotome analysis** for their study.
- Gas chromatographic-mass spectrometric identification of prominent metabolites helped determine the pyrene degradation pathway and **Serotome analysis** in pyrene degradation helped **understand the degradation mechanism of pyrene.**

## *What is Pyrene?*

- **Pyrene,** possessing four benzene rings, **belongs to the highly toxic class of PAHs,** with **carcinogenic and mutagenic properties**.
- It gets **lodged into the environmental matrices** like soil, water and atmosphere, resulting in widespread environmental pollution, necessitating adequate remediation of contaminated environmental matrices.
- The rapid pace of economic development and industrialisation has resulted in the release of several PAHs into the environment.
- **PAHs are a class of chemicals** that occur naturally in coal, crude oil, and gasoline. These are **ubiquitous environmental pollutants** originating from multiple sources, including combustion of petrogenic fossil fuels, and incomplete incineration of municipal wastes and biomass.

## *What is Bioremediation?*

- **Bioremediation** is **a branch of biotechnology that employs the use of living organisms, like microbes and bacteria to decontaminate affected areas.**
- It is used in the **removal of contaminants**, pollutants, and toxins from soil, water, and other environments.
- Bioremediation is **used to clean up oil spills or contaminated groundwater.**
- Bioremediation may be done **"in situ"–at the site of the contamination–or "ex situ"–away from the site.**

# Leprosy

## *Why in News?*

For months there has been an acute shortage of the key drug named Clofazimine which is used in Leprosy treatment in the private market.

- Clofazimine, along with Rifampicin and Dapsone, is **one of the three essential drugs in the Multi-Drug Treatment of Multibacillary Leprosy (MB-MDT)** cases.

## *What do we Know about Leprosy?*

- **About:**
  - Leprosy is a **chronic, progressive bacterial infection caused by the bacterium *Mycobacterium leprae*. It primarily affects the nerves of the extremities, the skin, the lining of the nose, and the upper respiratory tract**. Leprosy is also known as **Hansen's disease.**
  - It produces skin ulcers, nerve damage, and muscle weakness. If it isn't treated, it can cause severe disfigurement and significant disability.

Note:

- It is one of the oldest diseases in recorded history.
- It is common in many countries, especially those with tropical or subtropical climates including India.

➢ **Prevalence of Disease:**

- The **World Health Organization (WHO)** reports that leprosy is **endemic in several Indian states and union territories,** with an **annual case detection rate of 4.56 per 10,000 population**.
- **India reports more than 1,25,000 new patients of leprosy every year**.

### *What are Related Government Initiatives?*

➢ **National Leprosy Eradication Programme (NLEP):**

- It is a **Centrally Sponsored Scheme** under the umbrella of **National Health Mission (NHM).**
- India has achieved the **elimination of leprosy as a public health problem** i.e., defined as less than 1 case per 10,000 populations, at the National level.
- The NLEP aims at **eliminating leprosy in each of the districts by 2030.**

➢ In 2017, **SPARSH Leprosy Awareness Campaign** was launched to promote awareness and address the issues of stigma and discrimination.

## India Stack Knowledge Exchange 2022

### *Why in News?*

As a part of the **Digital India** week celebrations, a three day dedicated event titled '**India Stack Knowledge Exchange'** programme was organised.

➢ India Stack refers to ambitious project of **creating a unified software platform to bring India's population into the digital age.**

### *What is the India Stack Knowledge Exchange Programme (ISKE)?*

➢ **About:**

- The idea behind ISKE 2022 was to get the real practitioners - **the IT champions** - to speak of the **implementation of ground-breaking projects**, the **challenges faced and the road ahead for these projects**.
- ISKE 2022 was also visualised to present to the global community, India Stack solutions and goods, and welcomed any nation to adopt and customize them for their own use.

**What were the areas covered in ISKE?**

➢ **Urban Stack:**

- **Smart Cities Mission:**
  - SCM is a Centrally Sponsored Scheme, launched in June 2015 to transform 100 cities to provide the necessary core infrastructure and clean and sustainable environment to enable a decent quality of life to their citizens through the application of "Smart Solutions".
  - The mission aims to meet the aspirations of India's population living in cities through various urban development projects.
- **Digital Infrastructure for Governance, Impact and Transformation (DIGIT):**
  - DIGIT is a platform which is open source and open API (Application Programming Interface) powered for developers, enterprises and citizens to build new applications and solutions.
  - The ready to use platform helps achieve quicker implementation timeframes and helps local governments achieve process improvements, accountability and transparency at various levels of administration.
  - It is a manifestation of Societal Platform thinking, a systemic method to resolve complex societal challenges with speed, at scale, sustainably.

➢ **Societal Platforms** are manifestations of **Societal Thinking**, a systemic **approach**, a set of **values** and specific **design** principles, to reimagine **social problems**, **redesign core interactions** between key actors of society and induce exponential social change.

- **India urban data exchange:**
  - IUDE has been developed in partnership between the Smart Cities Mission and the Indian Institute of Science (IISc), Bengaluru.
  - It is an open-source software platform which facilitates the secure, authenticated, and managed exchange of data amongst various data platforms, 3rd party authenticated and authorised applications, and other sources.

➢ **Technology Stack for e-Commerce:**

Note:

- **GeM Portal:**
  - The Government e-Marketplace one-stop National Public Procurement Portal to facilitate online procurement of common use Goods & Services required by various Central and State Government Departments/Organizations/Public Sector Undertakings (PSUs).
  - The procurement of goods and services by Ministries and the Central Public Sector Enterprises (CPSEs) is mandatory for goods and services available on GeM.
  - It also provides the tools of e-bidding and reverse e-auction to facilitate the government users achieve the best value for their money.
- **Open Network for Digital Commerce:**
  - ONDC is a freely accessible government-backed platform that aims to democratise e-commerce by moving it from a platform-centric model to an open network for buying and selling of goods and services.
  - It is a not-for-profit organisation that will offer a network to enable local digital commerce stores across industries to be discovered and engaged by any network-enabled applications.
  - Under ONDC, it is envisaged that a buyer registered on one participating e-commerce site (for example, Amazon) may purchase goods from a seller on another participating e-commerce site (for example, Flipkart).

➢ **Space Technology Stack:**

- **NavIC:**
  - Navigation in Indian Constellation (NavIC) is an Indian Regional Navigation Satellite System (IRNSS), developed by the Indian Space Research Organization (ISRO).
  - The main objective is to provide reliable position, navigation and timing services over India and its neighbourhood.
  - It has been certified by the 3rd Generation Partnership Project (3GPP), a global body for coordinating mobile telephony standards.
- **Visualisation of Earth Observation Data and Archival System (VEDAS):**
  - VEDAS provides a platform to motivate young researchers and academia to showcase their spatiotemporal analytical skill using Indian Earth Observation data and build geo-spatial applications.
  - It is a step toward expanding the societal benefits of the nation's investments in ISRO's Earth science research.
  - It is expected that with a handshake between data generators and potential analysts, newer and innovative processing tools and geo-spatial applications will emerge.
  - **It provides:**
    - Platform for Research & training to Academia
    - Data visualization and graphical analysis on web
    - Geo-processing tools for analysis on web
    - Integrate Web Map Service from various sources
- **Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC):**
  - Space Applications Centre (SAC) is an ISRO Centre located at Ahmedabad, dealing with a wide variety of themes from satellite payload development, operational data reception and processing to societal applications.
  - Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC) is a Data Centre of Space Applications Centre (SAC) and has facilities for satellite data reception, processing, analysis and dissemination.
  - MOSDAC is operationally supplying earth observation data from Indian meteorology and oceanography satellites, to cater to national and international research requirements.
- **Bhuvan, Bhoonidhi & Yuktdhara:**
  - **Bhuvan:**
    - **Bhuvan** is a type of **web portal** used to find and access geographic information (geospatial information) and associated geographic services (display, editing, analysis, etc.) via the Internet.
  - **Bhoonidhi:**
    - It enables access to an extensive archive of **Remote Sensing data** from 44 satellites, including Indian and Foreign Remote Sensing sensors acquired over 31 years.
  - **Yuktdhara:**
    - It is a geospatial planning portal meant for facilitating Gram Panchayat level planning of **MGNREGA** activities across India.

Note:

# New Autonomous Flying Wing Technology Demonstrator

## *Why in News?*

Recently, **Defence Research and Development Organisation(DRDO)** carried out the maiden test flight of a new **unmanned Aerial Vehicle**, an **Autonomous Flying Wing Technology Demonstrator**.

- DRDO is in the process of developing **Unmanned Aerial Vehicles (UAVs)** of **different classes** to meet the requirements of the armed forces**.**

## *What is Autonomous Flying Wing Technology?*

- **About:**
  - It's an **Unmanned Combat Aerial Vehicle (UCAV)** or a combat drone that is a flying wing type.
  - It refers to a **tailless fixed-wing aircraft that houses its payload and fuel in its main wings and does not have a defined fuselage-like structure found in conventional aircraft**.
  - The design has the potential to deliver **high fuel efficiency and stability** if executed with precision.
- **Applications:**
  - Mapping of Landslide Affected Area
  - Infested Crop Damage Assessment
  - Large Scale Mapping
  - Traffic Monitoring and Management
  - Logistics support

# New POEM Platform

## *Why in news?*

Recently, the **Indian Space Research Organisation (ISRO)** achieved the feat of successfully launching the **PSLV Orbital Experimental Module or 'POEM'.**

- Besides this achievement, **ISRO also launched three satellites from Singapore on the PSLV-C53.**
  - This was the second **Polar Satellite Launch Vehicle(PSLV) mission of the year.** In February 2022, ISRO launched PSLV-C52 with the **Earth observation satellite EOS-04** and two smaller satellites.
- This was the second **dedicated commercial mission of NewSpace India Limited (NSIL)**, the commercial arm of ISRO.

**Which were the Singaporean Satellites?**

- **DS-EO: It carries an electro-optic, multispectral payload to provide full-color images for land classification and serve humanitarian assistance, and disaster relief** needs.
- **NeuSAR** – It is **Singapore's first small commercial satellite** carrying a SAR (synthetic aperture radar) payload, which is capable of providing images day and night and under all weather conditions.
- **SCOOB-I satellites** – It is the first in the Student Satellite Series (S3-I), a hands-on student training program from the Satellite Research Centre (SaRC) at Singapore's NTU School of Electrical and Electronic Engineering

## *What are the Key Highlights of POEM?*

- **POEM** (**PSLV Orbital Experimental Module**) is an experimental mission by ISRO which performs **in-orbit scientific experiments** during the fourth stage of the Polar Satellite Launch Vehicle (PSLV) launch vehicle as an orbital platform.
  - The PSLV is a **four-stage rocket where the first three spent stages fall back into the ocean**, and the final stage (PS4) — after launching the satellite into orbit — ends up as space junk.
  - However, in PSLV-C53 mission, the spent final stage will be **utilised as a "stabilised platform" to perform experiments.**
- It is the first time that the (fourth stage) PS4 stage would **orbit the earth as a stabilized platform**.
- POEM has a dedicated **Navigation Guidance and Control (NGC)** system for attitude stabilization, which stands for controlling the orientation of any aerospace vehicle within permitted limits. The **NGC will act as the platform's brain to stabilize it with specified accuracy.**

# TiHAN: First Autonomous Navigation Facility

## *Why in News?*

Ministry of Science & Technology has inaugurated **"Technology Innovation Hub on Autonomous Navigation"**

Note:

**or TiHAN,** in IIT- Hyderabad, which is a first **"Autonomous Navigation" facility**.

- It is seen as one of the steps toward India's vision of **'Atmanibhar Bharat'**, **'Skill India'** and **'Digital India'**.

### What is TiHAN?

- It is a **multidisciplinary initiative**, which aims at making India a global player in the futuristic and next-generation **"Smart Mobility" technology.**
- The multi-departmental initiative includes researchers from electrical, computer science, mechanical and aerospace, civil, mathematics.
- At present, **there is no such testbed facility in India to evaluate the autonomous navigation** of vehicles. Therefore, it is envisioned **to address this gap by developing a fully functional and exemplary testbed facility dedicated to Connected Autonomous Vehicles (CAVs).**
  - Connected vehicles use technology to either communicate with each other, connect with traffic signals, signs, and other road items, or obtain data from a cloud. This information exchange helps with safety and improves traffic flow.

## Metaverse Standards Forum

### Why in News?

Recently, various brands gathered for the founding of the **Metaverse Standards Forum for** the **development of interoperability standards** to drive the growth of the metaverse.

**What is Metaverse?**

- The metaverse is not a new idea, science fiction writer Neal Stephenson coined the term in 1992, and the **concept is commonplace among video game companies**.
- Metaverse is the **next version of the Internet** focused on social connection.
  - It can be defined as a simulated digital environment that uses **Augmented Reality (AR), Virtual Reality (VR), and blockchain,** along with concepts from social media, to create spaces for rich user interaction mimicking the real world.
  - It can be imagined as a 3D virtual world, with ever-evolving aspects which are collectively shared by its inhabitants - a virtual world with real-time events and an online infrastructure.
  - In theory, it encapsulates everything that's happening into the real world and will bring real-time events and updates going forward. The user exists in a virtual world without borders.

## GigaMesh Solution

### Why in News?

Recently, Astrome has signed a contract with the Department of Telecommunication to start the pilot project called "GigaMesh Network Solution with 15 villages in India.

- GigaMesh, developed by Astrome, will address congestion issues in rural 4G infrastructure and provide high-tech and affordable internet connectivity.

### What Do We Know about GigaMesh?

- The solution has been developed by **Astrome**.
  - The startup is supported by **AI & Robotics Technology Park (ARTPARK)**, the **Technology Innovation Hub (TIH)** at the **Indian Institute of Science (IISc).**
- It's a **network solution** which will wirelessly provide **fibre-like** backhaul capacity and paves the road for **5G**.
- It is the **world's first multi-beam E-band Radio** that is able to communicate from one tower to multiple towers simultaneously while delivering multi GBPS throughput to each of these towers.
- A **single GigaMesh device can provide up to forty links with 2+ Gbps capacity**, communicating up to a range of ten kilometers.
- Gigamesh features multiple point-to-point communication in E-Band, lowering cost and is driven by software to make it easy to deploy, maintain and repair remotely.

### What Do we Need to Know about ARTPARK?

- **About:**
  - ARTPARK is a not-for-profit foundation promoted by the Indian Institute of Science (IISc), Bengaluru to promote technology innovations in **artificial intelligence (AI)** & **Robotics**.

Note:

- **Initiatives:**
  - AI researchers at ARTPARK, in collaboration with HealthTech startup Niramai Health Analytix and the Indian Institute of Science (IISc), have also developed **XraySetu.**
    - XraySetu is a platform that can interpret chest X-rays with 98.86 % sensitivity toward Covid-19 within few seconds.
  - ARTPARK also organized the **ARTPARK Innovation Summit** that brought industry, academia and the government under one roof to discuss important topics such as:
    - how to create next-generation connectivity in rural areas, health AI for Bharat, connecting Bharat with Drones, inclusive learning for the future and building AI and research ecosystem.
  - Apart from this, they participated in an unmanned ground vehicle (UGV) experiment of the **Indian Army** and showcased India's only Legged Robotic Dog.

# Biomolecular Alterations Post EPV Infection

## *Why in News?*

Scientists have found that **cancer**-causing virus **Epstein Barr Virus (EBV)** can infect the neuronal cells and drive various changes in biomolecules.

- A researchers utilized the **Raman Microspectroscopy Technique**, **under FIST (Fund for Improvement of S&T Infrastructure)** scheme to explore the **possible impacts of a cancer-causing virus on brain cells.**
- **Biomolecules** are an organic molecule that includes carbohydrates, protein, lipids, and nucleic acids.

**What is Raman microspectroscopy?**

- Raman is **a light scattering technique, whereby a molecule scatters incident light from a high intensity laser light source.**
  - Most of the scattered light is at the same wavelength (or color) as the laser source and does not provide useful information – this is called Rayleigh Scatter. However, **a small amount of light (typically 0.0000001%) is scattered at different wavelengths (or colors), which depend on the chemical structure of the analyte – this is called Raman Scatter.**
- Raman microspectroscopy is **a vibrational spectroscopy technique used for investigating molecular fingerprints** of a wide range of liquid or solid samples.
- The technique can be efficiently utilized to understand virus-mediated cellular changes and could **provide valuable insights into specific biomolecular alterations.**

## *What is EBV?*

- EBV is **a virus in the herpesvirus family** that can infect humans.
- EBV virus has been found to be widely present in the human population. It usually does not cause any harm, but the **virus gets reactivated inside the body in some unusual conditions like immunological stress or immunocompetence.**
- This may further lead to various complications like **a type of blood cancer called Burkitt's lymphoma, stomach cancer, multiple sclerosis, and so on.**

**What is FIST Scheme?**

- The "Fund for Improvement of S&T Infrastructure (FIST)" of the Department of Science & Technology (DST) is intended to provide basic infrastructure and enabling facilities for promoting R&D activities in new and emerging areas and attracting fresh talents in universities & other educational institutions.
- It is considered as complimentary support for enabling Departments/ Centres/ Schools/ Colleges to pursue research activities more effectively and efficiently.
- The current emphasis on the immensely successful FIST programme is for orienting it towards the goal of Atmanirbhar Bharat by providing accessibility of the R&D infrastructure facilities not only for research activities in academic organizations but also for use by the start-ups/ manufacturing industries/ MSMEs.
- The duration of support for each FIST Project is for a period not exceeding 5 years.

# Dark Matter

## *Why in News?*

Recently, a highly sensitive experiment named **LUX-ZEPLIN (LZ) has been used to detect dark matter in the universe in the U.S.**

Note:

- Earlier, while investigating how the shape of dark matter affects the motion of stars in the centre of some galaxies (stellar bars), **scientists have found that out-of-plane bending can be explained** through dark matter halos in barred galaxies.

### What is Dark Matter?

- Dark matter is made up of particles that do not have a charge.
  - So, these particles are "dark", namely because they do not emit light, which is an electromagnetic phenomenon, and "matter" because they possess mass like normal matter and interact through gravity.
- The **visible universe** we see is the result of various **interactions among the four Fundamental forces** acting upon the particles, namely-
  - **Strong nuclear force**
  - **Weak nuclear force**
  - **Electromagnetic force**
  - **Gravitation**
- Only 5% of the entire visible universe is made up of all matter and the rest of 95% is dark matter and dark energy.
  - So far gravitational force is less understood as its extremely weak force, and that's why it's not easy to detect any particle which interacts with gravitational force.

### What is Dark Energy?

- Dark Energy is a theorized type of energy that **exerts a negative, repulsive force, acting in the opposite direction of gravity**.
- It has been proposed to explain the observed features of distant types of supernovae, which **reveal the universe expanding at an accelerated rate**.
- Dark Energy, like Dark Matter, is inferred from measurements of gravitational interactions between celestial objects rather than explicitly observed.

### What is the difference between Dark Matter and Dark Energy?

- **Dark matter acts as an attractive force,** a kind of cosmic mortar that holds our world together.
  - This is because dark matter interacts with gravity yet does not reflect, absorb, or emit light. Meanwhile, dark energy is a **repulsive force**, a kind of anti-gravity that **slows down the expansion of the universe**,
- **Dark energy** is by far the most powerful of the two, accounting for **around 68% of the universe's total mass and energy**.
  - Dark matter accounts for 27% of the total. The rest, a meagre 5%, is all the ordinary matter we see and interact with on a daily basis.
  - This also helps in **speeding up the universe's expansion**.

### What are the particles used to observe dark matter?

- **Neutrino** would have been very helpful in detecting dark matter but they are too light and hence would not be useful.
- There are **several other proposed entities** which include the **Z boson's supersymmetric companion**, a particle that **mediates the electro-weak interaction.**
- But still, no proper particle had been found which can interact with gravity and is also detectable using present technology on earth.

## Private Players in Space Sector

### Why in News?

Recently, the Minister of State for the Department of Space (DOS) informed the **Lok Sabha** that the **government was looking at opening the space sector to Foreign Direct Investment.**

### How this Step will be Beneficial for ISRO?

- **Research and Development Activities:**
  - These reforms will allow I**SRO to focus more on new technologies**, exploration missions and **human spaceflight programme.**
    - Some of the planetary exploration missions will also be opened up to the private sector through an 'announcement of opportunity' mechanism.
- **Fruitful Dissemination of Space Technologies:**
  - Allowing industries and others like students, researchers or academic bodies greater access to space assets **would lead to a much better utilisation of India space resources.**
- **Global Technology Powerhouse:**
  - It will **enable Indian Industry to be an important player in the global space** economy.

Note:

- With this, there is an opportunity for large-scale employment in the technology sector and India becoming a Global technology powerhouse.

➢ **Cost-effective:**
- ❍ The operating costs of setting up base and launching space vehicles in India is comparatively much less compared to its counterparts like **National Aeronautics and Space Administration (NASA).**
- ❍ The FDI will also ensure that the newer technology makes it more effective in price as well as efficiency.

➢ **Exceptional Success Rate:**
- ❍ ISRO is the **6th largest space agency in the world** and holds an exceptional success rate.
  - India has made a name for itself by successful launch of about 342 (three hundred and forty-two) foreign satellites from over 34 (thirty-four) countries.

### *What are the Benefits for Foreign Investors?*

➢ **Innovative Equipment:**
- ❍ ISRO holds the **cutting-edge equipment and is also in process of launching SSLV (small satellite launch vehicle)** in partnership with private companies.
- ❍ This will provide a greater benefit to foreign investors to form partnerships with the Indian space sector.

➢ **Liberalised Space Sector:**
- ❍ Over the years, I**SRO has forged strong relationships with numerous industrial ventures** that will be beneficial to foreign players who wish to set up base in India.

### *What is the Need for Reforms of Space Sector?*

➢ **To increase the Scale of the Sector:**
- ❍ ISRO is **centrally funded and its annual budget is between Rs 14-15,000 crore,** which is a drop in the ocean and most of this is used in building rockets and satellites.
- ❍ To increase the scale of the sector, it is i**mperative for private players to enter the market.**
- ❍ ISRO is **planning to share knowledge and technology,** such as manufacturing rockets and satellites, to all the private players.
  - The United States, Europe, Russia — all have space industries with big players like Boeing, SpaceX, Air Bus, Virgin Galactic, etc.

➢ **Reforms in Private Players:**
- ❍ Private players can **bring in the innovation needed for developing space-based applications and services.**
- ❍ Additionally, the demand for these services is soaring worldwide and in India, with satellite data, imageries and space technology being used across most sectors.
  - The Private players can participate in setting up of ground stations for space crafts which constitute 48% of the space sector budget and also in application of space technology which result in 45% of space economy.

### *What are the Related Initiatives taken?*

➢ **IN-SPACE:**
- ❍ IN-SPACe was launched to **provide a level playing field for private companies** to use Indian space infrastructure.
- ❍ It acts **as a single-point interface** between Indian Space Research Organisation (ISRO), and everyone who wants to participate in space-related activities or use India's space resources.

➢ **NewSpace India Limited (NSIL):**
- ❍ Announced in Budget 2019, its aim is to **use research and development carried out by ISRO** over the years for commercial purposes through Indian industry partners.

➢ **Indian Space Association (ISpA):**
- ❍ ISpA **aspires to be the collective voice of the Indian Space industry**. ISpA will be represented by leading domestic and global corporations that have advanced capabilities in space and satellite technologies.

## Endosulfan

### *Why in News?*

The Supreme Court has slammed the Kerala government for doing "virtually nothing" for Endosulfan pesticide exposure victims.

➢ The court said the **State's inaction was "appalling" and amounted to a breach of the apex court's 2017 judgment**, which had ordered the State to pay Rs 5 lakh each to the victims in three months.

➢ Five years since the judgment, the court has realised that **only eight out of 3,704 victims have been paid compensation.**

Note:

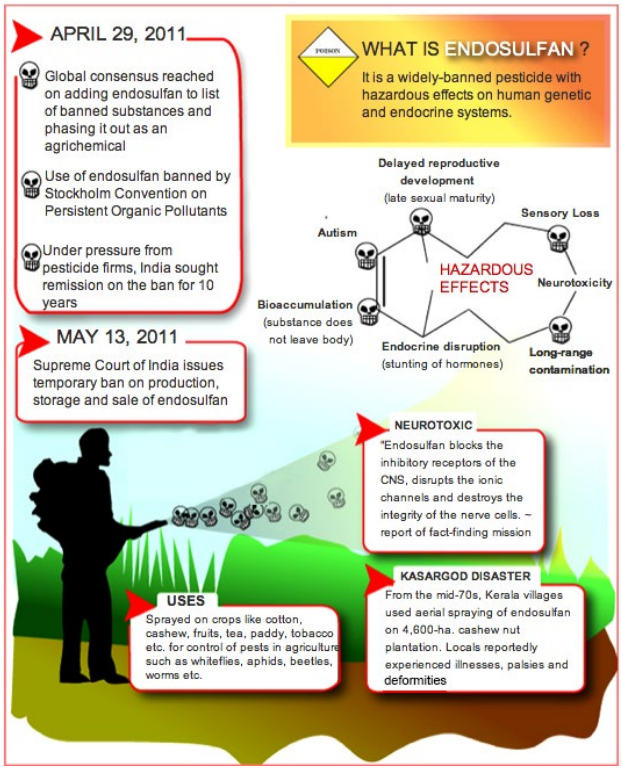
- The SC has banned the **manufacture, sale, use, and export of endosulfan throughout the country**, citing its harmful health effects in 2015.

### What is Endosulfan?

- Endosulfan is an **organochlorine insecticide** which was first introduced in the 1950s and is commonly known by its trade name **Thiodan**.
- It is linked to **a slew of grave medical conditions, such as neurotoxicity, physical deformities, poisoning and more.**
- It is sprayed on crops like **cotton, cashew, fruits, tea, paddy, tobacco etc. for control of pests** such as whiteflies, aphids, beetles, worms etc.
- Endosulfan is listed under both the **Rotterdam Convention on the Prior Informed Consent** and the **Stockholm Convention on Persistent Organic Pollutants.**

### What are the Impacts of Endosulfan?

- **Environment:**
  - Endosulfan in the environment gets accumulated in food chains leading to higher doses causing problems.
  - If Endosulfan is released to water, it is expected to absorb to the sediment and may bioconcentrate in aquatic organisms.
- **Humans And Animals:**
  - The endosulfan ingestion results in diseases ranging from physical deformities, cancer, birth disorders and damage to the brain and nervous system.




**What is the Rotterdam convention 1998?**

- The convention aims to promote cooperation and responsibility sharing measures amongst different countries dealing with trade in hazardous chemicals and pesticides.
- PIC, Prior Informed Consent is the main feature of the convention and is legally binding on the party members.
- PIC facilitates information exchange about nature and trade-related information amongst the party members.
- The Convention creates obligations for the implementation of the Prior Informed Consent (PIC) procedure.

**What is Stockholm convention 2001?**

- The convention aims to reduce the concentration of persistent organic pollutants (POPs) which are chemical substances that not only remain in the atmosphere for longer periods but also possess the ability to bio-accumulate.
- The convention listed 12 POPs as 'dirty dozen'.

## Sudden Infant Death Syndrome

### Why in News?

A team of researchers in Australia has identified a biochemical marker in the blood that could help identify newborn babies at risk for the **Sudden Infant Death Syndrome (SIDS).**

- The researchers **used dried blood spots from newborn infants and screened the samples for BChE (Butyrylcholinesterase) level and total protein content**.

### What is SIDS?

- Sudden infant death syndrome is the **unexpected death of an apparently healthy infant.**
- It usually occurs **while the baby is asleep, although in rare cases**, it can also occur while the child is awake.

Note:

- The condition is also called **"Cot Death".**
- Newborn babies **delivered prematurely or with low weight at birth are believed to be at a greater risk** of SIDS.
- The exact cause of SIDS is unknown, although revelations from the new research look promising.

### What are the Findings?

- Babies who died of SIDS **showed lower levels of the BChE enzyme shortly after birth.**
  - A low level of the BChE enzyme **affects a sleeping infant's ability to wake up or respond to their environment.**
  - The enzyme is **an important part of the autonomic nervous system** of the body and controls unconscious and involuntary functions.
    - The previously conducted studies have found that **low BChE activity is associated with severe systemic inflammation and considerably higher mortality** after sepsis and cardiac events.
  - Prior to this research on SIDS, **inflammation has been thought to be a factor in SIDS cases.**
- The mild inflammatory changes on the walls of air passages of the lungs were observed in SIDS infants as early as 1889.
- **Prematurely-delivered babies have been considered to be at a higher risk** for SIDS, although a 1957 study that evaluated BChE in infancy found that there was no difference in the levels of the enzyme in premature and mature newborn infants.
- Smoking during pregnancy is **associated with a significant increase in SIDS events**.

### What are the Limitations of the study?

- Even though BChE levels can be a possible cause of SIDS, the research points out that **the samples were over two years old and hence would not accurately reflect BChE specific activity** in fresh dried blood samples.
- The researchers also added that d**espite analysing over 600 control samples, they are unaware of how common abnormality is in the wider population.**
- Furthermore, the study did not use autopsy details of the subjects of the study but used **Coroners' Diagnosis (when a death is reported to the coroner, the coroner investigates who has died, where, when and how the death occurred. If the cause of death is unclear, the coroner will order a post-mortem)** where possible.

## National AI Portal

### Why in News?

Recently, the second-year anniversary of **National AI Portal** was celebrated on 30th May, 2022.

### What is the National AI Portal?

- **About:**
  - Launched in 2020, it is a **joint initiative by the Ministry of Electronics and IT (MeitY)**, National e-Governance Division (NeGD) and **NASSCOM (National Association of Software and Services Companies).**
- **Objectives:**
  - The portal **focuses on creating and nurturing a unified AI ecosystem in the country to drive excellence and leadership in knowledge creation to develop an AI-ready robust workforce** for the future and use AI to foster economic growth.
- **Significance:**
  - Over the past two years, the portal has played a crucial role in evangelising and nurturing the AI ecosystem through numerous impactful initiatives such as the lab2market, Women in AI Roundtable, AI patent report, Responsible AI handbook for startups, Responsible AI Startups survey, podcasts, and the AI Standards.

### What is Artificial Intelligence?

- **About:**
  - It describes the **action of machines accomplishing tasks** that have historically required human intelligence.
  - It includes technologies like **machine learning, pattern recognition, big data, neural networks, self algorithms etc.**
  - AI involves complex things such as **feeding a particular data into the machine and making it react as per the different situations.**
  - AI is being **used across different industries** including finance and healthcare.
  - As per a report by PwC, India reported **a 45% increase in the use of AI**, the highest among all countries, following the outbreak of the virus.
- **Barriers to Adoption of AI:**
  - **Limited understanding of AI**: Many Indian companies may have not yet understood the full

Note:

benefits of leveraging AI in their companies.

- **Low Investments and Less Evolved Startup Ecosystem:** Startup/investment funding ecosystem in India is yet to scale up in terms of AI startups and service providers.
- **Limited Availability of AI Trained Talent:** There is limited infrastructure to 'democratise' and scale-up important AI skills such as deep learning and neural networks.

➢ **Recent Examples of Use of AI in India:**

- **For the Covid-19 Response:** An **AI-enabled Chatbot** was used by **MyGov** for ensuring communications.
- **In Judicial System:** An AI based **portal 'SUPACE'** is aimed at assisting judges with legal research.
- **In Agriculture:** ICRISAT has developed an **AI-power sowing app**, which utilises weather models and data on local crop yield and rainfall to more accurately predict and advise local farmers on when they should plant their seeds.
- **In Disaster Management**: An **AI-based flood forecasting model** that has been **implemented in Bihar** is now being expanded to cover the whole of India to ensure that around 200 million people get alerts and warnings 48 hours earlier about impending floods.
- **In Banking & Financial Services Industry:** Few banks in India have adopted AI **to increase digitisation to improve customer experience and use algorithms in risk** management (for example, fraud detection).

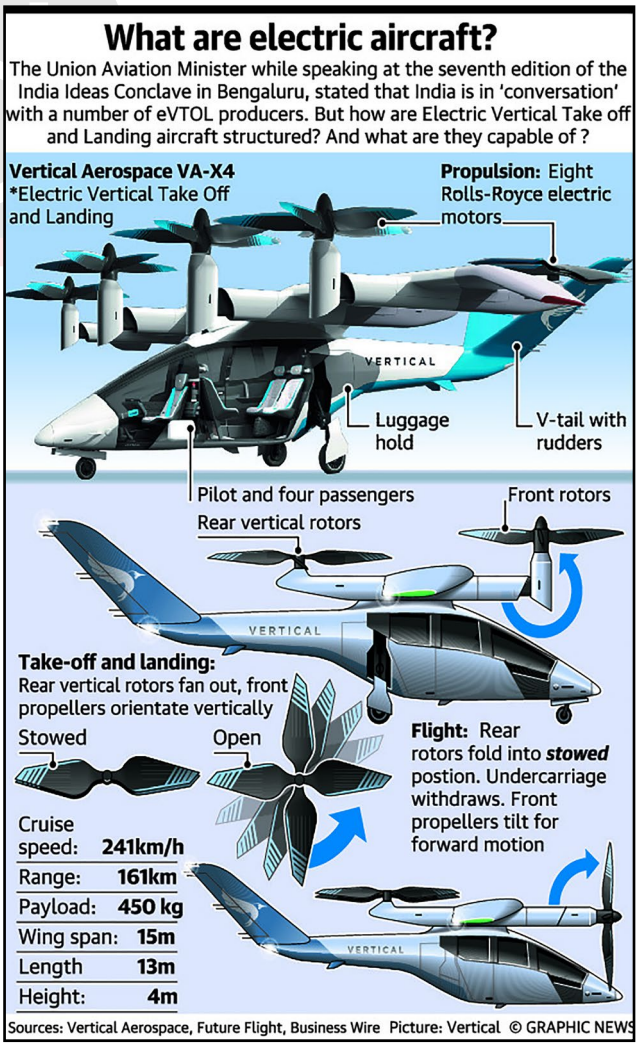
➢ **Initiatives Taken to Boost Use of AI:**

- The **National Strategy for Artificial Intelligence** (NITI Aayog, June 2018) which is focused on inclusive AI (AI for all), and the **New Education Policy** (NEP, 2020) which addresses the need to inculcate AI in the curriculum are the right strategic steps to encourage core and applied research.
- The **Ministry of Tribal Affairs (MTA)** has inked a **MoU with Microsoft** to support the **digital transformation of schools such as Eklavya Model Residential Schools (EMRS)** and Ashram Schools, among others under the Ministry.
- **US India Artificial Intelligence (USIAI) initiative** has been launched to scale up the science and technology relationship between India and the United States.
- In 2020, India joined the **'Global Partnership on Artificial Intelligence (GPAI)'** as a founding member to support the responsible and human-centric development and use of AI.
- **'RAISE 2020 - Responsible AI for Social Empowerment 2020'**, a mega virtual summit, was jointly organised by the NITI Aayog and the MeitY.
- The larger aim of the program **"Responsible AI for Youth"** is to provide an equal opportunity to all Indian youths - in urban, rural and remote corners of India - to become human-centric designers who can create real AI solutions to solve economic and social impact issues of India.

# Electric Vertical Take off and Landing (eVTOL) Aircraft

## *Why in News?*

The Government of India is exploring the possibility of inviting manufacturers of **Electric Vertical Take off and Landing (eVTOL) aircraft to set up base in India.**




Note:

## What is eVTOL Aircraft?

- **About:**
  - An eVTOL aircraft is one **that uses electric power to hover, take off, and land vertically.**
  - Most eVTOLs also use what is called as **distributed electric propulsion technology** which means integrating a complex propulsion system with the airframe.
- **Features:**
  - In order to maximize efficiency, and to also ensure safety, there are **multiple motors.**
  - This is technology that has **grown on account of successes in electric propulsion** based on progress in motor, battery, fuel cell and electronic controller technologies and also fuelled by the need for new vehicle technology that ensures **Urban Air Mobility (UAM).**
    - Thus, eVTOL is one of the newer technologies and developments in the aerospace industry.
  - There are an **estimated 250 eVTOL concepts or more being fine-tuned** to bring alive the concept of UAM.
    - Some of these include the use of multi-rotors, fixed-wing and tilt-wing concepts backed by sensors, cameras and even radar. Here the key word here is "autonomous connectivity".
    - Some of these are in various test phases and there are also others undergoing test flights so as to be certified for use.
  - In short, **eVTOLs have been likened to a third wave in an aerial revolution.**
    - The first being the advent of commercial flying and the second, the age of helicopters.

## How are Developments in eVTOLs being Made?

- The roles eVTOLs **adopt depends on battery technology** and the limits of onboard electric power.
- Power is **required during the key phases of flight** such as take off, landing and flight (especially in high wind conditions).
- **Weight is also an important factor.**
  - BAE Systems, for example, is **looking at formats using a variety of Lithium batteries.**
    - BAE Systems is a British multinational arms, security, and aerospace company based in London, England.
  - Nano Diamond Batteries is looking at **"Diamond Nuclear Voltaic (DNV) technology"** using minute amounts of **carbon-14 nuclear waste** encased in layered industrial diamonds to create self-charging batteries.
- **The use of only batteries and looking at hybrid technologies** such as hydrogen cells and batteries depending on the flight mission has been questioned by experts.
- There is even one that **uses a gas-powered generator** that powers a small aircraft engine, in turn charging the battery system.
  - But **whatever the technology, t**here will be very stringent checks and certification requirements.

## What are the Challenges?

- **Crash Prevention Systems:**
  - As the technology so far is a **mix of unpiloted and piloted aircraft,** the areas in focus include "crash prevention systems".
  - These use cameras, radar, **GPS (Global Positioning System)** and infrared scanners.
- **Ensuring Safety:**
  - There are also **issues such as ensuring safety in case of powerplant** or rotor failure. Aircraft protection from cyberattacks is another area of focus.
- **Navigation and Flight Safety:**
  - A third area is in **navigation and flight safety and the use of technology** when operating in difficult terrain, unsafe operating environments and also bad weather.

## What is the Value of the Market?

- The global market for eVTOLs was put at **USD8.5 million in 2021** and is to grow to **USD30.8 million by 2030.**
- The **demand will be on account of green energy** and noise-free aircraft, cargo carrying concepts and the need for new modes of transport.
- The **UAM market is expected to expand at a compound annual growth rate of 25%** between 2018-25.
  - By 2025, it is anticipated to be a USD74 billion market. This includes the eVTOLs market since UAM ideally focuses on the use of eVTOLs.

Note:

# Sodium-Ion Battery

### Why in News?

Recently, University of Houston (US) scientists developed an electrolyte that contributes significantly to making sodium ion batteries more commercially viable.

- Sodium-based battery technology might soon be a viable alternative to lithium-based ones.

### What is Sodium Ion Battery?

- They are rechargeable batteries which require **sodium ion movement between electrodes** during the charging and discharging of the battery, **the cathode for these batteries is manufactured from sodium**.

### What are the issues with Lithium-Ion?

- **Lithium-Ion** extraction led to environment harming mining practices.
- **It releases harmful chemicals** which further spell into the rivers and its ecosystem.
- **Non reusable** as its recycling process is very expensive.

### What are the Benefits of Sodium-Ion?

- It's **cheaper to produce** than their lithium counterparts because of the **abundance of the raw materials** required to make them.
- They are energy dense, non-flammable, and operate well in colder temperatures.
- Further they can store more energy per unit weight, this could make them well-suited for larger applications such as electric vehicles.
- They are less likely to experience thermal runaway, a condition that can cause fires in lithium-ion batteries.

# Cholera

### Why in News?

Researchers identified the decline of **antimicrobial resistance in Cholera-Causing Bacteria**.

### What is Cholera?

- **About:**
  - It is a **life-threatening infectious disease** and a public health hazard.
  - Cholera is an **acute, diarrheal illness caused by infection of the intestine with the bacterium *Vibrio cholerae*.**
  - The infection is often mild or without symptoms, but sometimes can be severe.
- **Symptoms:**
  - Profuse watery diarrhoea
  - Vomiting
  - Leg cramps
- **Transmission:**
  - A person may get **cholera by drinking water or eating food contaminated with the cholera bacterium.**
  - The disease can spread r**apidly in areas with inadequate treatment of sewage and drinking water.**
- **Vaccine:**
  - Currently there are **three WHO pre-qualified oral cholera vaccines (OCV), Dukoral, Shanchol, and Euvichol-Plus.**
  - All three vaccines require two doses for full protection.

# Monkeypox

### Why in News?

Recently, the **WHO (World Health Organisation)** has Declared Global Health Emergency and sounded the highest alarm on the **Monkeypox Virus.**

- More than 16,000 cases of the virus - that was once largely confined to Africa - have been reported so far this year 2022.

### What does Declaring an Emergency for Global Health Mean?

- **About:**
  - Declaring a global emergency means the **monkeypox outbreak is an "extraordinary event"** that could spill over into more countries and requires a coordinated global response.
- **Elements helped consider Health Emergency:**
  - The virus has spread to **"non-endemic countries".** This virus has spread rapidly to many countries that have not seen it before.
  - Three criteria for **declaring a public health emergency of international concern have been met** as per WHO.

Note:

- The three criteria for such a declaration are that it is an **"Extraordinary Event," that it "Constitutes a Public Health Risk" to other State**s through the international spread of disease and that it **"potentially requires a coordinated international response."**
- The number - within a month - has **grown five-fold.**
- Scientific principles, evidence and other relevant information, are currently insufficient, leaving many unknowns.
- The risk to **human health, international spread, and the potential for interference with international traffic.**

➢ **Previously Declared Emergency:**

- WHO previously declared emergencies for public health crises such as the **Covid-19 pandemic, the 2014 West African Ebola outbreak, the Zika virus in Latin America in 2016** and the ongoing effort to eradicate **Polio**.
- The emergency declaration mostly **serves as a plea to draw more global resources and attention to an outbreak.**

### *What is Monkeypox?*

➢ **About:**

- Monkeypox is **a viral zoonotic disease with symptoms** similar to smallpox, although with less clinical severity.
- The infection was **first discovered in 1958 following two outbreaks of a pox-like disease in colonies of monkeys** kept for research — which led to the name 'monkeypox'.

➢ **Symptoms:**

- Infected people break out in a rash that looks a lot like chicken pox. But the fever, malaise, and headache from Monkeypox are usually more severe than in chicken pox infection.
- In the early stage of the disease, **Monkeypox can be distinguished from smallpox because the lymph gland gets enlarged.**

➢ **Transmission:**

- Primary infection is through direct contact with the blood, bodily fluids, or cutaneous or mucosal lesions of an infected animal. Eating inadequately cooked meat of infected animals is also a risk factor.
- Human-to-human transmission can result from close contact with infected respiratory tract secretions, skin lesions of an infected person or objects recently contaminated by patient fluids or lesion materials.
- Transmission can also occur by inoculation or via the placenta (congenital monkeypox).

➢ **Vulnerability:**

- It spreads rapidly and can cause one out of ten deaths if infected.

➢ **Treatment and Vaccine:**

- There is no specific treatment or vaccine available for Monkeypox infection,
- But the **European Union** has recommended a **Small Pox Vaccine, Imvanex to treat** monkeypox after the WHO declared monkeypox a global health emergency.

## 5G & Fiberisation

### *Why in News?*

India is preparing to auction off airwaves to rollout **5G** services in the country.

➢ The infrastructure needed for such a rollout requires existing radio towers to be connected via **optical-fibre cables**.

### *What do we know about Optical Fibre?*

➢ **About:**

- Optical fibre is the **backbone of the digital infrastructure** — the data is transmitted by **light pulses travelling through long strands of thin fibre**.
- **Metal wires** are preferred for transmission in optical fibre communication as **signals travel with fewer damages**.
  - The optical fibre works on the principle of total internal reflection (TIR).
- **Light rays** can be used to transmit a huge amount of data (In case of long straight wire **without any bend**).
  - In case of a bend, the optical cables are designed such that they bend all the light rays inwards (using TIR).

➢ **Benefits:**

- **High Speed:**

Note:

- Fiber provides more bandwidth and has standardized performance up to 10 Gbps and beyond, something that it is impossible to achieve when using copper.
- More bandwidth means that fiber can carry more information with far greater efficiency than copper wire.

❍ **Range of Transmission:**
- Since data travels in the form of light in fiber-optic cables, very little signal loss occurs during transmission and data can move at higher speeds and greater distances.

❍ **Not susceptible to interference:**
- Fiber-optic cable is also much less susceptible to noise and electromagnetic interference than copper wire.
- It is so efficient, in fact, that roughly 99.7% of the signal reaches the router in most cases.

❍ **Durability:**
- Fiber-optic cable is completely immune to many environmental factors that affect copper cable.
- The core is made of glass, which is an insulator, so no electric current can flow through.

### *What do we mean by Fiberisation?*

➢ **About:**

❍ The process of **connecting radio towers with each other via optical fibre cables** is called fiberisation.

❍ The backhaul is a component of the **larger transport that is responsible for carrying data across the network**.
- It represents the part of the network that connects the core of the network to the edge.

❍ It is necessary to **increase the density of mobile towers** to provide better coverage to consumers and businesses.

## Increasing Efficacy of Antibiotics

### *Why in News?*

Recently, Scientists have developed **a new approach to revitalise the efficacy of existing antibiotics.**

**What are Antibiotics and Drug Resistance?**

➢ **Antibiotics:**

❍ Antibiotics are r**emarkable drugs capable of killing biological organisms** in one's body without harming the body.

❍ These are used for everything from **preventing infections during surgeries to protecting cancer patients undergoing chemotherapy.**
- India is the world's largest consumer of antibiotics. India's excessive antibiotic usage is leading to a powerful never before seen mutation within bacteria.

➢ **Drug Resistance:**

❍ Drug resistance happens when **one overuses antibiotics in the treatment of humans**, animals as well as plants.
- When a new antibiotic is introduced, it can have great, even lifesaving results but only for some time. After that, the bacteria adapts and gradually the antibiotics become less effective.

❍ Antibiotic resistance **has the potential to affect people at any stage** of life. When a person is infected with antibiotic resistant bacteria, not only the treatment of that patient becomes difficult, but antibiotic resistant bacteria may spread to other people as well.

❍ When antibiotics do not work, t**he situation may lead to more complicated diseases**, the use of stronger and expensive drugs and gradually more deaths caused by bacterial infections.

❍ The spread of antibiotic resistance worldwide is **undermining decades of progress in fighting bacterial infections.**

**What are the Initiatives Related to Drug Resistance?**

➢ **India:**

❍ **National Programme on AMR containment:** Launched in 2012. Under this programme, AMR Surveillance Network has been strengthened by establishing labs in State Medical College.

❍ **National Action Plan on AMR:** It focuses on **One Health approach** and was launched in April 2017 with the aim of involving various stakeholder ministries/departments.

Note:

- **AMR Surveillance and Research Network (AMRSN):** It was launched in 2013, to generate evidence and capture trends and patterns of drug resistant infections in the country.
- **AMR Research & International Collaboration:** Indian Council of Medical Research (ICMR) has taken initiatives to develop new drugs /medicines through international collaborations in order to strengthen medical research in AMR.
- **Antibiotic Stewardship Program:** ICMR has initiated antibiotic stewardship program (AMSP) on a pilot project across India to control misuse and overuse of antibiotics in hospital wards and ICUs.

➢ **Global:**

- **World Antimicrobial Awareness Week (WAAW):**
  - Held annually since 2015, WAAW is a global campaign that aims to raise awareness of antimicrobial resistance worldwide and encourage best practices among the general public, health workers and policy makers to slow the development and spread of drug-resistant infections.
- **The Global Antimicrobial Resistance and Use Surveillance System (GLASS):**
  - WHO launched the GLASS in 2015 to continue filling knowledge gaps and to inform strategies at all levels.
  - GLASS has been conceived to progressively incorporate data from surveillance of AMR in humans, surveillance of the use of antimicrobial medicines, AMR in the food chain and in the environment.

# Abort Mission for Gaganyaan

## *Why in News?*

**Indian Space Research Organisation (ISRO)** will conduct **two unmanned 'Abort Mission'** in 2022 **to ensure crew safety during the Gaganyaan mission**.

➢ This is a part of **ISRO's roadmap for the country's first manned flight to space**.

➢ The first test vehicle for this purpose will be **launched in September 2021.**

## *What is Gaganyaan Mission?*

➢ **About:**

- Gaganyaan is a mission by the **Indian Space Research Organisation (ISRO).**
- Under the Gaganyaan schedule (to be launched in 2023):
  - Three flights will be sent into orbit.
  - There will be two unmanned flights and one human spaceflight.
- The Gaganyaan system module**, called the Orbital Module** will have three Indian astronauts, including a woman.
- It will circle Earth at **a low-earth-orbit** at an altitude of 300-400 km from earth for 5-7 days.

➢ **Payloads:**

- The payload will consist of:
  - Crew module: Spacecraft carrying human beings.
  - Service module: Powered by two liquid propellant engines.
  - It will be equipped with emergency escape and emergency mission abort.

➢ **Launch:**

- **GSLV Mk III, also called the LVM-**3 (Launch Vehicle Mark-3,) the three-stage heavy lift launch vehicle, will be used to launch Gaganyaan as it has the necessary payload capability.

➢ **Training in Russia:**

- In June 2019, the Human Space Flight Centre of the ISRO and the Russian government-owned Glavkosmos signed a contract for the training, which includes Russian support in the selection of candidates, their medical examination, and space training.
  - The candidates will study in detail the systems of the Soyuz manned spaceship, as well as be trained in short-term weightlessness mode aboard the Il-76MDK aircraft.
  - The Soyuz is a Russian spacecraft. The Soyuz carries people and supplies to and from the space station.
  - The Il-76MDK is a military transport plane specially designed for parabolic flights of trainee astronauts and space tourists.

Note:

**What are the other Upcoming Projects?**

- **Chandrayaan-3 Mission:** India has planned a new moon mission named **Chandrayaan-3.** It is likely to be launched in 2022.
- **Shukrayaan Mission:** The ISRO is also planning a mission to Venus, tentatively called Shukrayaan.
- **XpoSat:** Space observatory, XpoSat, designed to study cosmic x-rays.
- **Aditya L1 mission:** It will see an Indian spacecraft going 1.5 million kms away to the L1 or Lagrangian point between the Sun and Earth.
  - There are five Lagrangian points between any two celestial bodies where the gravitational pull of both the bodies on the satellite is equal to the force required to keep the satellite in orbit without expending fuel, meaning a parking spot in space.

# James Webb Space Telescope's First Images

## *Why in News?*

Recently, **National Aeronautics and Space Administration's (NASA)** released a set of images and science products of five different regions of the sky, taken with the James Webb Space Telescope.

- It includes a **galaxy cluster which appeared 4.6 billion years ago.**
- It is the deepest and finest infrared image of some of the **most distant and oldest galaxies ever discovered.**
- These **characteristics will aid scientists in learning more about each of these ancient galaxies' mass, age, history, and composition**.

## *What is James Webb Space Telescope?*

- **About:**
  - The telescope is the **result of an international collaboration** between **NASA,** the **European Space Agency (ESA) and the Canadian Space Agency which was launched in December 2021.**
  - It is currently at a point in space known as the Sun-Earth **L2 Lagrange point**, approximately 1.5 million km beyond Earth's orbit around the Sun.
    - The Lagrange Point 2 is one of the five points in the orbital plane of the Earth-Sun system.
    - Named after Italian-French mathematician Josephy-Louis Lagrange, the points are in any revolving two-body system like Earth and Sun, marking where the gravitational forces of the two large bodies cancel each other out.
    - Objects placed at these positions are relatively stable and require minimal external energy or fuel to keep themselves there, and so many instruments are positioned here.
  - It's the largest, most powerful infrared space telescope ever built.
  - It's the successor to Hubble Telescope.
  - It can **see backwards in time** to just after the Big Bang by looking for galaxies that are so far away that the light has taken many billions of years to get from those galaxies to our telescopes
- **Objectives:**.
  - It will examine every phase of cosmic history: from the Big Bang to the formation of galaxies, stars, and planets to the evolution of our own Solar System.
  - The goals for the **Webb** can be grouped into **four themes.**
    - The first is to look back around 13.5 billion years to see the first stars and galaxies forming out of the darkness of the early universe.
    - Second, to compare the faintest, earliest galaxies to today's grand spirals and understand how galaxies assemble over billions of years.
    - Third, to see where stars and planetary systems are being born.
    - Fourth, to observe the atmospheres of extrasolar planets (beyond our solar system), and perhaps find the building blocks of life elsewhere in the universe.

# What is the Difference between Hubble & James Webb Telescope?

- **Wavelength:**
  - The **James Webb Space Telescope** would be observing infrared radiations most primarily covering between 0.6 to 28 microns.
  - **Hubble**'s work involved watching the ultraviolet and the visible spectrum of light. It observes the range of 0.8 to 2.5 microns.

Note:

- **Orbits:**
  - Webb Telescope would not be orbiting the Earth. It would be orbiting the sun from 1.5 million kilometres away from the Earth.
  - Hubble orbits the Earth at an altitude of 575 kilometres from it.
- **Vision:**
  - As per NASA, Hubble can see the smallest and the newest of all galaxies.
  - Webb would be able to see the Newborn galaxies as well.
  - Webb's near and mid-infrared instruments would be helpful in studying the first formed galaxies and exoplanets.

### *What are the Other Space Exploration Missions?*

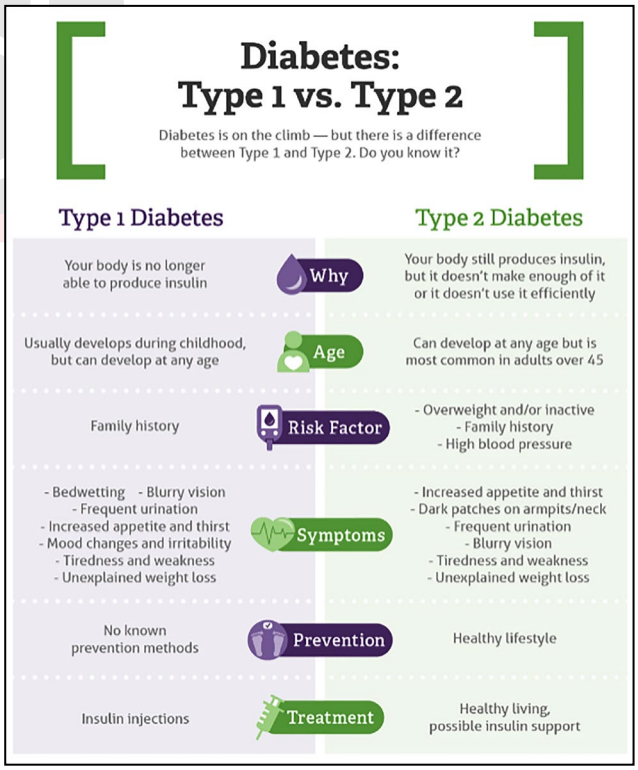
- **Pioneer**
  - It was the **first spacecraft to visit the solar system's most photogenic gas giants, Jupiter and Saturn**.
  - Pioneer 10 was the first probe to travel through the solar system's asteroid belt, a field of orbiting rocks between Mars and Jupiter.
- **Voyager**
  - Shortly after the Pioneers made their flybys, the Voyager 1 and Voyager 2 probes followed. They made **many important discoveries about Jupiter and Saturn**, including rings around Jupiter and the presence of volcanism on Jupiter's moon.
  - Voyager 1 is **currently the farthest man-made object from Earth**, at more than a hundred times the distance from the Earth to the sun, and more than twice as far as Pluto.
- **Chandra**
  - Since 1999, the Chandra X-ray Observatory has been **scanning the skies in X-ray light, looking at some of the most distant and bizarre astronomical events**.
  - Because Earth's pesky atmosphere blocks out most X-rays, astronomers couldn't view the universe in this high-energy, short-wavelength light until they sent Chandra up to space.
- **SPHEREx's**
  - The **Spectro-Photometer for the History of the Universe and Ices Explorer (SPHEREx)** is a planned two-year mission **that will survey the sky in optical as well as near-infrared light which, though not visible to the human eye, serves as a powerful tool for answering cosmic questions**.
  - It would be launched in 2024.
  - Astronomers will use the mission to gather data on more than 300 million galaxies, as well as, more than 100 million stars in our own Milky Way.

## Coping with Type-1 Diabetes

### *Why in News?*

Recently, **Indian Council of Medical Research (ICMR)** issued guidelines regarding diagnosis, treatment, and management for type-1 diabetes.

- This is the **first time the ICMR has issued guidelines** specifically for type 1 diabetes, which is rarer than type 2.




### *What do we Need to know about Diabetes?*

- **About:** Diabetes is a **Non-Communicable Disease (NCD)** that occurs either when the pancreas does not produce enough insulin (a hormone that regulates blood sugar, or glucose), or when the body cannot effectively use the insulin, it produces.

Note:

- **Types of Diabetes:**
  - **Type 1 Diabetes:**
    - It is also known as juvenile diabetes (as it mostly affects children of age 14-16 years), this type occurs when the body fails to produce sufficient insulin.
    - It is predominantly diagnosed in children and adolescents. Although the prevalence is less, it is much more severe than type 2.
  - **Type 2 Diabetes**:
    - It affects the way the body uses insulin. While the body still makes insulin.
    - Type 2 diabetes can occur at any age, even during childhood. However, this type of diabetes occurs most often in middle-aged and older people.
  - **Gestational Diabetes**: This type occurs in women during pregnancy when the body sometimes becomes less sensitive to insulin. Gestational diabetes does not occur in all women and usually resolves after giving birth.
- **Impacts of Diabetes:** It affects the **five major organs namely**, Kidney, Heart, Blood vessels, Nervous System, and Eyes (retina).
- **Factors Responsible:** Factors that lead to increase in diabetes are an unhealthy diet, lack of physical activity, harmful use of alcohol, overweight/obesity, tobacco use, etc.

### *What are the Treatments?*

- **Glucose monitoring:** Continuous glucose monitoring devices can help monitor the blood glucose levels throughout 24 hours with the help of a sensor.
- **Artificial pancreas:** It can automatically deliver insulin when required.

### *What are Related Initiatives?*

- **National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS):**
  - In order to prevent and control major NCDs, this **initiative was launched by India in 2010** with focus on strengthening infrastructure, human resource development, health promotion, early diagnosis, management and referral.
- **World Diabetes Day:**
  - It is observed on **14th November every year.** The 2022 campaign will focus on access to diabetes education. access to diabetes education.
- **Global Diabetes Compact:**
  - **WHO launched a Global Diabetes Compact** to better fight the disease while marking the centenary of the discovery of insulin.

## Ultrathin Heteroprotein Film

### *Why in News?*

Scientists have developed **Ultra-Thin Hetero Protein films** with excellent **thermal, mechanical and pH stability** which can pave the way **for expanding applications of thin films in biomedical and food packaging industries.**

- It consists of two globular proteins: **Bovine Serum Albumin (BSA)** and **Lysozyme (Lys).** They used the technique called using Langmuir-Blodgett (LB) technique which gives the **films thickness in the order of nanometer.**
- Globular proteins or spheroproteins are spherical proteins and are one of the common protein types. Globular proteins are **somewhat water-soluble, unlike the fibrous or membrane proteins.**

**What are the Proteins?**

- **About:**
  - Proteins are **composed of amino acids**, arranged into different groups. These fundamental amino acid sequences are specific and its arrangements are controlled by the **DNA (Deoxyribonuceicacid).**
  - There are two types of protein molecules, fibrous proteins and globular proteins.
    - Fibrous proteins are insoluble and elongated.
    - Globular proteins are soluble and compact.
- **Functions:**
  - **Enzymes:** Enzymes mostly carry out all numerous chemical reactions which take place within a cell. They also help in regenerating and creating DNA molecules and carry out complex processes.
  - **Hormones:** Proteins are involved in the creation of various types of hormones which help in balancing the components of the body. For example hormones like insulin, which helps in regulating blood sugar and secretin. It is also involved in the digestion process and formation of digestive juices.

Note:

- **Antibody:** Antibody also known as an immunoglobulin. It is a type of protein which is majorly used by the immune system to repair and heal the body from foreign bacteria. They often work together with other immune cells to identify and separate the antigens from increasing until the white blood cells destroy them completely.
- **Energy:** Proteins are the major source of energy that helps in the movements of our body. It is important to have the right amount of protein in order to convert it into energy. Protein, when consumed in excess amounts, gets used to create fat and becomes part of the fat cells.

# Cyber Safety and National Security

## *Why in News?*

Recently, the **National Conference on Cyber Safety and National Security** concluded in New Delhi.

- The conference is **part of the efforts to create mass awareness** for the prevention of cybercrimes in the country.
- It is also part of the **Azadi Ka Amrit Mahotsav** to celebrate India's progress and achievements in the 75th year of India's Independence.

## *What is Cyber Safety?*

- **About:**
  - A set of activities and other measures intended to **protect cyberspace networks, related hardware and devices software, and the information they contain and communicate**, including software and data from all threats **including threats to national security**.
- **Relation with National Security**:
  - Since **Cyber-armies** have been formed to launch cyberattacks against India, **cyber security** is closely connected to national security.
    - A cyber-army is a group of soldiers highly skilled in information technology with cyber skills.

## *What distinguishes Cybercrime from Traditional Criminal Activity?*

- **Cybercrime**, also called **computer crime**, the use of a computer as an instrument to further illegal ends, such as committing fraud, trafficking in child pornography and **intellectual property** stealing identities or violating privacy.
  - Most **cybercrime is an attack on information about individuals, corporations, or governments.**
  - Although the attacks **do not take place on a physical body as traditional criminal activity, they do take place on the personal or corporate virtual body,** which is the set of informational attributes that define people and institutions on the Internet.

## *What are the Present Government Initiatives for Cyber Safety?*

- **Cybercrime portal:**
  - It aims to enable citizens to report online content pertaining to **Child Pornography/ Child Sexual Abuse Material or sexually explicit content such as Rape/Gang Rape** (CP/RGR).
- **Indian Cyber Crime Coordination Centre (I4C):**
- The prevention of cybercrimes is being handled through seven pillars under **I4C and CIS Division of Ministry of Home Affairs** -
  - National Cyber Crime Threat Analytics Unit
  - National Cyber Crime Reporting Portal
  - National Cyber Crime Training Centre
  - National Cyber Crime Research and Innovation Centre
  - Joint Cyber Crime Coordination
  - National Cyber Crime Ecosystem Management Unit
  - National Cyber Crime Forensic Laboratory
- **CERT-In:**
  - India's national agency for cybersecurity, **The Indian Computer Emergency Response Team** (CERT-In), has led to a reduction in cyber-attacks on government networks due to its advancements in tackling the nation's cybersecurity.
- **Cyber Surakshit Bharat:**
  - It is an initiative from the **Ministry of Electronics and Information Technology (MeitY)** that aims at creating a robust cybersecurity ecosystem in India. This aligns with the government's vision for a **'Digital India'. The National E-Government Division (NeGD) sponsored this program.**
- **Cyber Swachhta Kendra:**
  - It is an installation under the **Ministry of Electronics and Information Technology (MeitY)** aims to create

Note:

secure cyberspace for Indian users by detecting botnet infections and enabling end-users to clean their systems and secure their systems thereafter to prevent further infections.

- **Personal Data Protection Bill:**
  - Worldwide data breaches served a threat to personal security for Indian citizens, the PDP Bill was approved by the union government

# Critical Information Infrastructure

## *Why in News?*

Recently, the Union Ministry of Electronics and IT (MeitY) has declared IT (Information Technology) resources of **ICICI Bank, HDFC Bank and NPCI**(National Payments Corporation of India) as '**critical information infrastructure'.**

## *What is Critical Information Infrastructure?*

- The **Information Technology Act of 2000** defines **Critical Information Infrastructure as a computer resource,** the incapacitation or **destruction** of which shall **have debilitating impact on national security, economy, public health or safety.**
- The **government**, under **the IT Act of 2000,** has the **power to declare** any data, **database, IT network or communications infrastructure as CII** to protect that digital asset.
- Any person who secures access or attempts to **secure access to a protected system in violation of the law** can be punished with **a jail term of up to 10 years.**

## *How are CIIs protected in India?*

- **NCIIPC as Nodal Agency:**
  - Created in January 2014, the **National Critical Information Infrastructure Protection Centre (NCIIPC)** is the **n**odal agency for taking all measures to protect the nation's critical information infrastructure.
- **Mandate of NCIIPC:**
  - It is mandated to **guard CIIs from unauthorized access,** modification, use, disclosure, disruption, incapacitation or distraction.
  - It will **monitor and forecast national-level threats to CII** for policy guidance, expertise sharing and situational awareness for early warning or alerts.
  - In the event of **any threat to critical information infrastructure** the **NCIIPC may call for information and give directions to the critical sectors** or persons serving or having a critical impact on Critical Information Infrastructure.
- **Basic Responsibility:**
  - The basic responsibility for protecting the CII system **shall lie with the agency running that CII.**

# India's first Biotech Startup Expo 2022

## *Why in News?*

Recently, Prime Minister has inaugurated the **Biotech Startup Expo - 2022**.

- It is a **reflection of the expansive growth of the biotech sector** in the country.

## *What are the Key Highlights of the Expo?*

- **About:**
  - The Biotech Startup Expo 2022 will provide **a common platform to connect investors, entrepreneurs, scientists, researchers, industry leaders, manufacturers, bio-incubators, regulators and government officials.**
  - The expo is being organised by the Department of **Biotechnology and Biotechnology Industry Research Assistance Council (BIRAC)** to mark the completion of ten years of BIRAC.
  - It will showcase **applications of biotechnology in various fields** including healthcare, agriculture, genomics, clean energy, biopharma, industrial biotechnology and waste-to-value.
- **Theme:** 'Biotech Startup Innovations: Towards AatmaNirbhar Bharat'.

**What is Biotechnology and its Application?**

- Biotechnology is **technology that utilizes biological systems**, living organisms or parts of this to develop or create different products.
- Brewing and baking bread are examples of processes that fall within the concept of biotechnology (use of yeast (= living organism) to produce the desired product).

Note:

- Such traditional processes usually utilize the living organisms in their natural form (or further developed by breeding), while the more modern form of biotechnology will generally involve a more advanced modification of the biological system or organism.

- Biotechnology deals with **industrial scale production of biopharmaceuticals and biologicals using genetically modified microbes**, fungi, plants and animals.
- The applications of biotechnology include **therapeutics, diagnostics, genetically modified crops for agriculture, processed food, bioremediation, waste treatment, and energy production.**

**What are the Related Initiatives?**

- **UNATI Atal Jai Anusandhan Mission Programmes.**
- **Biotechnology Parks and Incubators.**
- **National Biopharma mission**
- **'UMMID' initiative**
- **Genome India**
- **LOTUS HR project**
- **Biotech-KISAN**

# India's First Liquid Mirror Telescope

### *Why in News?*

Recently, **Devasthal Observatory campus** owned by **Aryabhatta Research Institute of Observational Sciences (ARIES)**, Nainital in Uttarakhand has set-up the **International Liquid-Mirror Telescope (ILMT).**

### *What are the Key Highlights about ILMT?*

- It has become the **world's first Liquid-Mirror Telescope (LMT) to be commissioned for astronomy** and also one of its kind to be operational anywhere in the world.
- **Asteroids, supernovae, space debris and all other celestial objects** will be observed using ILMT from an altitude of **2,450 metres in the Himalayas.**
- Previously built telescopes either tracked **satellites** or were deployed for military purposes.
- ILMT will be the **third telescope facility to come up at Devasthal.**
  - Devasthal is **one of the world's original sites** for obtaining astronomical observations.
  - **Devasthal Optical Telescope (DOT)** and **Devasthal Fast Optical Telescope (DFOT)** are the other two telescope facilities at Devasthal.
- In **October 2022, full-scale scientific operations** of ILMT will be started.
- It will be working along with **India's largest operating Devasthal Optical Telescope (DOT).**
- The countries involved in ILMT's development are **India, Belgium, Canada, Poland and Uzbekistan.**

### *How is LMT Different from Conventional Telescope?*

- A LMT is a **stationary** telescope whereas a conventional telescope **moves along the direction of the object** of interest in the sky.
- A LMT will survey and capture **any and all possible celestial objects** such as stars, galaxies, supernovae explosions, asteroids and even space debris. However, a conventional captures **just a piece of sky at a given point of time.**
- LMT comprises mirrors with a **reflective liquid (ILMT has mercury as reflective liquid)**. On the other hand, a conventional telescope uses **highly-polished glass mirrors.**
- While ILMT will be capturing **images of the sky on all nights, c**onventional telescopes observe specific objects in the sky for fixed hours only.

# Bharat Drone Mahotsav 2022

### *Why in News?*

Recently, India's biggest Drone Festival - **Bharat Drone Mahotsav 2022** was inaugurated in **New Delhi** by the Prime Minister.

- **A virtual award of drone pilot certificates, panel discussions, product launches, display of a 'Made in India' Drone Taxi prototype, flying demonstrations, among others** were the key events.

### *What are Drones?*

- **Drone** is a layman terminology for **Unmanned Aircraft (UA).**

Note:

- Originally developed for the military and aerospace industries, drones have found their way into the mainstream because of the enhanced levels of safety and efficiency they bring.
- A drone's autonomy level can range from remotely piloted (a human controls its movements) to advanced autonomy, which means that it relies on a system of sensors and **LIDAR detectors** to calculate its movement.

**What are the Drone Rules, 2021?**

- In 2021, the Ministry notified **liberalized drone rules with the aim to encourage R&D and to make India a drone hub.**
  - It abolished several permissions and approvals. The number of forms that need to be filled was reduced from 25 to five and the types of fee brought down from 72 to 4.
  - No permission is required for operating drones in green zones and no remote pilot license is necessary for non-commercial use of micro and nano drones.
  - Payloads up to 500kg have been allowed so the drones can be used as unmanned flying taxis.
  - Further, foreign ownership of companies operating drones has also been permitted.

**What is the PLI Scheme for Drones?**

- The government **also approved a Production-Linked Incentive (PLI) scheme for Drones** and their components with an allocation of Rs. 120 crore for three financial years.
- The PLI Scheme for the drones and drone components industry addresses the strategic, tactical, and operational uses of this revolutionary technology.

**What is the Drone Shakti Scheme?**

- The Union Budget **pushed for promotion of drones through startups and skilling at Industrial Training Institutes (ITIs).**
- Startups will be promoted to facilitate '**Drone Shakti**' through varied applications and for **Drone-As-A-Service (DrAAS)**. Courses for skilling will also be started in selected ITIs across all States.
  - DrAAS allows enterprises to avail various services from drone companies, removing the need for them to invest in drone hardware or software, pilots, and training programmes.
  - Sectors where drones can be employed are endless. These include photography, agriculture, mining, telecom, insurance, telecom, oil & gas, construction, transport, disaster management, geo-spatial mapping, forest and wildlife, defence and law enforcement to name a few.
- Drones **will also be promoted for crop assessment, digitisation of land records, spraying of insecticides and nutrients (Kisan Drones).**
- The drone services industry **is expected to grow to over Rs 30,000 crore in next three years and generate over five lakh jobs.**

# Transfer of in-orbit Communication to NewSpace India Ltd (NSIL)

## *Why in News?*

Recently, the government has **approved the transfer of 10 in-orbit communication satellites from the Government of India to NewSpace India Ltd (NSIL).**

- The **entire GSAT series, except GSAT-7 and 7A, will go to NSIL,** and thereby to companies intending to develop downstream satcom businesses. The new CMS (communication satellite) series is already operated by NSIL

**Four Pillars of Space Reforms**

- **Allowing the private sector** freedom of innovation.
- **Government playing the enabler's role.**
  - Formation of Indian Space Association (ISpA): It aspires to be a collective voice of Indian Sapce Industry.
- **Preparing youngsters** for the future.
  - Recently, ATL Space Challenge 2021 has been launched. This is to ensure that students of classes 6 to 12 are given an open platform where they can innovate and enable themselves to solve digital age space technology problems.
- **Treating the space sector as a resource** for the progress of the common man.
  - Development projects are being monitored by satellite imaging, space technology is being used in settlement of Fasal Bima Yojna claims and disaster management planning, and the NAVIC system is helping fishermen.

Note:

### What is NewSpace India Ltd (NSIL)?

- **About:**
  - NSIL is a **Central Public Sector Enterprise** of the Government of India.
  - It was **established in 2019** under the administrative control of the **Department of Space.**
  - NSIL is the **commercial arm of Indian Space Research Organisation** (ISRO) with the primary **responsibility of enabling Indian industries to take up high technology space related activities.**
  - **Headquarters:** Bengaluru
- **Mission:**
  - **Owning satellites for Earth Observation and Communication applications** and providing space-based services
  - **Building satellites and launching** them as per demand
  - **Providing Launch Services** for satellite belonging to customer
  - **Building launch vehicles through Indian Industry** and launch as per satellite customer requirement
  - **Space based Services** related to Earth Observation and Communication satellites on commercial basis
  - Satellite building through Indian Industry
  - Technology Transfer to Indian Industry

## Artificial Light to Fight Against Malaria

### Why in News?

Recently, a study demonstrated that **artificial lights can be used as a weapon to fight against malaria.**

**What is Malaria?**

- **About:**
  - **Malaria** is a **life-threatening mosquito borne blood disease caused by plasmodium parasites.** It is predominantly found in the **tropical and subtropical areas of Africa, South America as well as Asia.**
- The parasites spread through the **bites of infected female Anopheles mosquitoes.**
- After entering the human body, parasites initially multiply within the liver cells and then **attack the Red Blood Cells (RBCs) resulting in their rupture.**
  - There are **5 parasite species** that cause malaria in humans, and **2 of these species – *Plasmodium falciparum* and *Plasmodium vivax* – pose the greatest threat.**
  - **Symptoms** of malaria include **fever and flu-like illness, including shaking chills, headache, muscle aches, and tiredness.**
  - It is **preventable as well as curable.**
- **Malaria Vaccine:**
  - Known by its lab initials as **RTS, S but branded as Mosquirix,** the vaccine has passed lengthy scientific trials that found it to be **safe and reducing the risk of malaria by nearly 40%,** the best recorded.
  - It was developed by **GlaxoSmithKline (GSK)** company and **approved by the European Medicines Agency in 2015.**
  - The RTS, S vaccine **trains the immune system to attack the malaria parasite (Plasmodium (P.) falciparum, the deadliest species of the malaria parasite).**
- **Global Scenario:**
  - Although a **decline** in total no. of cases from about **81.1 cases per 1,000 population to 59 per 1,000 since 2000,** the world has not yet won the war against Malaria.
  - Globally, **around 240 million cases and 6,00,000 deaths** were reported in **2020.**
  - **Africa** carries the **world's largest disease burden for Malaria.**
  - In Africa, **94% of global cases and 96% of global deaths** have been recorded. It is alarming that **children aged five or younger** account for **80% of these deaths.**
- **Challenges**
  - Though vaccines look promising, **antimalarial drug resistance** specifically in East Africa is rising.
  - **Genetic mutations in the parasite** enables them to **escape routine diagnosis.**
  - **Increased resistance to insecticides** has been evolving in the mosquitoes.
- **Need of the hour**
  - This situation undermines the **requirement for sharpening the vector control options, and exploring new strategies.**

Note:

# Artificial Intelligence (AI) Chips

## *Why in News?*

The adoption of **Artificial Intelligence (AI) chips** have risen in recent times with chipmakers designing different types of these chips to power AI applications.

## *What are AI chips?*

- **About:**
  - AI chips are **built with specific architecture and have integrated AI acceleration** to support **deep learning-based applications.**
    - Deep learning, more commonly known as Active Neural Network (ANN) or Deep Neural Network (DNN), is a subset of machine learning and comes under the broader umbrella of AI.
- **Functions:**
  - It **combines a series of computer commands or algorithms** that stimulate activity and brain structure.
  - DNNs **go through a training phase, learning new capabilities from existing data.**
    - DNNs can then inference, by applying these capabilities learned during deep learning training to make predictions against previously unseen data.
    - Deep learning can make the process of collecting, analysing, and interpreting enormous amounts of data faster and easier.
  - Chips like these, with **their hardware architectures, complementary packaging, memory, storage, and interconnect solutions**, make it possible for AI to be integrated into applications across a wide spectrum to turn data into information and then into knowledge.
- **Types of AI Chips Designed for Diverse AI Applications:**
  - Application-Specific Integrated Circuits (ASICs), Field-Programmable Gate Arrays (FPGAs), Central Processing Units (CPUs) and GPUs.
- **Applications:**
  - AI applications include **Natural Language Processing (NLP), computer vision,** robotics, and network security across a wide variety of sectors, including **automotive, IT, healthcare, and retail**.
- **Reasons for the Rise:**
  - The increasing adoption of **AI chips in data centres** is one of the major factors driving the growth of the market.
  - Additionally, the **rise in the need for smart homes and cities**, and the surge in investments in AI start-ups are expected to drive the growth of the global AI chip market.
    - The Worldwide AI chip industry accounted for approx. USD 8 billion in 2020 and is expected to reach USD 195 billion by 2030, growing at a Compound Annual Growth Rate (CAGR) of 37.4% from 2021 to 2030.

### THE GIST

**AI chips with their hardware architectures and complementary packaging, memory, storage and interconnect technologies, make it possible to infuse AI into a broad spectrum of applications to help turn data into information and then into knowledge.**

**The use of AI chips for NLP applications has increased due to the rise in demand for chatbots and online channels such as Messenger, Slack, and others that use NLP to analyse user messages and conversational logic.**

**Nvidia Corporation, Intel Corporation, IBM Corporation, Alphabet Inc., Samsung Electronics Co., Ltd, and Apple Inc. are some of the key players in the AI chip market.**

Note:

# Respiratory Syncytial Virus (RSV)

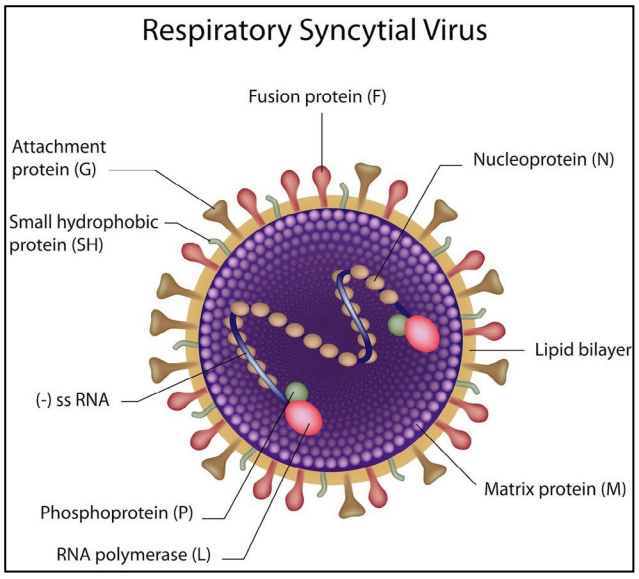
## Why in News?

Recently, in a study it was found that the lower respiratory infections caused by the **Respiratory Syncytial Virus (RSV)** are more frequent in children under the age of five.

- According to a report published by the **Lancet**, it is responsible for the death of 1,00,000 children in the world during the year 2019.

## What is the Respiratory Syncytial Virus (RSV)?

- **About:**
  - **Respiratory Syncytial Virus** is a common respiratory virus.
  - It is characterized by its **highly contagious nature** i.e., it has a high potential to infect people.
  - It exacerbated the seasonal lung infection**.**
  - It commonly infects children especially under **2 to 6 years** of age.
  - In most of the cases it has symptoms like the **common cold** but in advanced stages it converts into **phenumonia** and **bronchiolitis**..




## What is the Cure for Respiratory Syncytial Virus?

- There is no reliable cure available for RSV infection.
- Scientists, Government and concerning authority are promoting research and development in this domain to find out appropriate medicine and vaccination to save the life of infants and children.

# HS200 Solid Rocket Booster for Gaganyaan Mission

## Why in News?

Recently, the **Indian Space Research Organization (ISRO)** has completed the static test of the **human-rated solid rocket booster (HS200)** for Gaganyaan programme.

## What is the HS200 Solid Rocket Booster?

- The booster engine is **part of the Geosynchronous Satellite Launch Vehicle MkIII (GSLV Mk III) rocket** that will carry Indian astronauts to space.
  - The GSLV Mk-III rocket which will be used for the Gaganyaan mission will have **two HS200 boosters** which will supply the thrust for lift-off.
  - The HS200 is a 20-metre-long booster with a diameter of 3.2 metres and is the **world's second largest operational booster using solid propellants.**
- The HS200 is the **human-rated version of the S200 rocket booster of satellite launch vehicle GSLV Mk III,** popularly known as LVM3.
  - Since Gaganyaan is a crewed mission, the GSLV Mk-III will have improvements to increase reliability and safety to meet the requirements of 'human rating.'
- The S200 motor - the first stage of the LVM3 launch vehicle **designed to deliver 4,000 kg satellites to geosynchronous transfer orbit** - was configured as a strap-on rocket booster.
- This full-duration test of the first stage of the launch vehicle marks a major milestone for the Gaganyaan programme.
- Design and development of the HS200 booster was completed at the Vikram Sarabhai Space Centre (VSSC) in Kerala's Thiruvananthapuram, and propellant casting was completed at Sriharikota.
- Out of the three propulsion stages of LVM3, the human-rated versions of the second-stage known as L110-G loaded with liquid propellant and the third stage C25-G with cryogenic propellant are in the final phase of qualification, including tests with static firing.

Note:

**What is GSLV?**

- GSLV is a much more powerful rocket, meant to carry heavier satellites much deeper into space. Till date, GSLV rockets have carried out 18 missions, of which four ended in failure.
- It can take 10,000-kg satellites to lower earth orbits.
- The indigenously developed Cryogenic Upper Stage (CUS), forms the third stage of GSLV Mk II.
- Mk-III versions have made ISRO entirely self-sufficient for launching its satellites.
  - Before this, it used to depend on the European Arianne launch vehicle to take its heavier satellites into space.
  - GSLV-Mk III is a fourth generation, three stage launch vehicle with four liquid strap-ons. The indigenously developed CUS, which is flight proven, forms the third stage of GSLV Mk III.
  - The rocket has three-stages with two solid motor strap-ons (S200), a liquid propellant core stage (L110) and a cryogenic stage (C-25).

# India's First 5G Testbed

## *Why in News?*

Recently, Prime Minister **inaugurated the country's first 5G testbed** that will enable **start-ups** and industry players to test their products locally, thereby reducing dependence on facilities abroad.

## *What is 5G Technology?*

- **About:**
  - 5G is the **5th generation mobile network**. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks.
  - It **enables a new kind of network** that is designed to connect virtually everyone and everything together including machines, objects, and devices.
  - Internet speeds in the **high-band spectrum of 5G has been tested to be as high as 20 Gbps (gigabits per second)**, while, in most cases, the maximum internet data speed in 4G has been recorded at 1 Gbps.
  - In India, **Satcom Industry Association-India (SIA)** has voiced concerns over the Government's plan to include the **Millimetre Wave (mm Wave) bands** in the 5G spectrum auction.
- **Significance:**
  - 5G technology would also **bring positive changes in the governance of the country,** ease of living and **ease of doing business**.
    - This would boost growth in every sector like agriculture, health, education, infrastructure and logistics.
  - This will also **increase convenience and create many employment opportunities.**

# PARAM PORUL Supercomputing Facility

## *Why in News?*

**PARAM PORUL**, a state-of-the art **Supercomputer at NIT Tiruchirappalli** under **National Supercomputing Mission (NSM)** was inaugurated.

- PARAM PORUL supercomputing facility is established **under Phase 2 of the NSM.** Majority of the components have been manufactured and assembled within the country, along with an indigenous software stack developed by C-DAC, in line with the **Make in India initiative.**.

## *What are the Features of PARAM PORUL?*

- PARAM PORUL system is equipped with a mix of CPU (Central Processing Unit) nodes, GPU (Graphics Processing Unit) nodes, High Memory nodes, High throughput storage and high-performance InfiniBand interconnect to cater the computing needs of various scientific and engineering applications.
  - This system is based on **Direct Contact Liquid Cooling technology** to obtain a high-power usage effectiveness and thereby reducing the operational cost.
  - Multiple applications from various scientific domains such as Weather and Climate, Bioinformatics, Computational Chemistry, Molecular Dynamics, Material Sciences, Computational Fluid Dynamics etc. have been installed on the system for the benefit of researchers.

## *What is the National Supercomputing Mission?*

- **In 2015**, the National Supercomputing Mission was launched to enhance the research capacities and

Note:

capabilities in the country by connecting them to form a Supercomputing grid, with National Knowledge Network (NKN) as the backbone.
  - The NKN project is aimed at establishing a strong and robust Indian network which will be capable of providing secure and reliable connectivity.
  - A supercomputer is a computer that performs at or near the currently highest operational rate for computers.
- The Mission **plans to build and deploy 24 facilities with cumulative compute power of more than 64 Petaflops.**
  - Generally, PETAFLOP is a measure of a Supercomputer's processing speed and can be expressed as a thousand trillion floating point operations per second.
- It **supports the government's vision of 'Digital India' and 'Make in India' initiatives.**
- The Mission is being **jointly steered by the Department of Science and Technology (DST) and the Ministry of Electronics and Information Technology (MeitY).**
  - It is **implemented by the Centre for Development of Advanced Computing (C-DAC), Pune, and the IISc, Bengaluru.**
- The mission was planned in **three phases:**
  - Phase I looking at assembling supercomputers,
  - Phase II looking at manufacturing certain components within the country.
  - Phase III where a supercomputer is designed by India.
- **Recent developments under National Supercomputing Mission:**
  - Under Phase 1 & Phase 2, 15 systems with computer power of 22 Petaflops (PF) have been built at IIT's, C-DAC, NIT, JNCASR, and IISER.
  - NSM deployed **"PARAM Ganga"** at IIT Roorkee in March 2022 with a supercomputing capacity of 1.66 Petaflops as a part of phase 2.
  - **PARAM Siddhi-AI** is the fastest supercomputer in India built under NSM with a capacity of 5.26 PF.
    - USA's Frontier is the world's fastest supercomputer.

# Direct Seeding of Rice

## *Why in News?*

Recently, the Punjab government announced **Rs 1,500 incentive per acre** for farmers opting for **Direct Seeding of Rice (DSR)**.

- In 2021, 18% (5.62 lakh hectares) of the total rice area in the state was under DSR against the government target of bringing 10 lakh hectares under it.

## *What is DSR and How is it Different from Normal Transplanting of Paddy?*

- **Transplanting Paddy:**
  - In transplanting paddy, farmers **prepare nurseries where the paddy seeds are first sown** and raised into young plants.
  - The nursery seed bed is **5-10%** of the area to be transplanted.
  - These seedlings are then **uprooted and replanted 25-35 days later in the puddled field.**
- **Direct Seeding of Rice (DRS):**
  - In DSR, the **pre-germinated seeds are directly drilled into the field** by a tractor-powered machine.
  - There is **no nursery preparation or transplantation involved** in this method.
  - Farmers have to **only level their land and give one pre-sowing irrigation**.

**Rice**

- Rice is a staple food for most of the population in India.
- It is a **kharif crop** which requires **high temperature, (above 25°C)** and **high humidity** with annual **rainfall above 100 cm.**
  - In the **areas of less rainfall, it is grown with the help of irrigation.**
- In **southern states and West Bengal, the climatic conditions allow the cultivation of two or three crops** of rice in an agricultural year.
  - In West Bengal farmers grow three crops of rice called **'aus', 'aman' and 'boro'.**
- About **one-fourth of the total cropped area in India is under rice cultivation.**
  - **Leading producer states:** West Bengal, Uttar Pradesh, and Punjab.
  - **High Yielding States:** Punjab, Tamil Nadu, Haryana, Andhra Pradesh, Telangana, West Bengal and Kerala.
- India is the **second-largest producer of rice after China.**

Note:

# Air Independent Propulsion Technology

## Why in News?

Recently, France's Naval Group declined the bid for the **P-75I Project**, citing it does not use **AIP (Air-Independent Propulsion) Technology** yet.

- Around 10 countries have developed or are close to building AIP technology, and almost 20 nations have AIP submarines.

**What is the P-75I project?**

- In June 1999, the Cabinet Committee on Security approved a 30-year plan for the Navy to indigenously build and induct 24 submarines by 2030.
- In the first phase, two lines of production were to be established — the first, P-75; the second, P-75I. Each line was to produce six submarines.
  - While the six P-75 submarines are diesel-electric, they can be fitted with AIP technology later in their lives.
- This P-75I project envisages indigenous construction of submarines equipped with the state-of-the-art Air Independent Propulsion system at an estimated cost of Rs. 43,000 crore.

## What is AIP?

- **About:**
  - AIP is a technology for **conventional non-nuclear submarines.**
  - Submarines are essentially of **two types: conventional and nuclear.**
  - The **conventional submarines use diesel-electric engines**, which require them to surface almost daily to get atmospheric oxygen for fuel combustion.
  - If fitted with an AIP system, the **submarine will need to take in oxygen only once** a week.
  - The indigenously developed AIP, which is one of the key missions of the Naval Materials Research Laboratory (NMRL - DRDO), is considered one of the ambitious projects of the DRDO (Defence Research and Development Organisation) for the Navy.
- **Fuel Cell Based AIP system:**
  - In a **fuel cell** based AIP, an electrolytic fuel cell releases energy by combining hydrogen and oxygen, with only water as the waste product ensuring less marine pollution.
  - The cells are highly efficient, and do not have moving parts, thus ensuring that the submarine has a low acoustic emission of sound.

## What submarines does India have now?

- India has **16 conventional diesel-electric submarines, which are classified as SSKs.** After the last two Kalvari Class subs are commissioned under P-75, **this number will go up to 18**.
- India also has t**wo nuclear ballistic submarines, classified SSBN (Submersible Ship Ballistic Missile Nuclear).**
- By the time P-75I is completed under the 30-year project, **India is projected to have six diesel-electric, six AIP-powered, and six nuclear attack submarines.**

# Tissue Culture Plants

## Why in News?

Recently, the Centre through the **Agricultural and Processed Food Products Export Development Authority (APEDA)** conducted a webinar on **"Export Promotion of Tissue Culture Plants"** such as Foliage, Live Plants, Cut Flowers, and Planting Material" with **Department of Biotechnology (DBT)** accredited tissue culture laboratories spread across India.

- The aim is to **boost exports of tissue culture plants.**

## What is Tissue Culture?

- It is the **production of new plants from a small piece of plant tissue or cells** removed from the growing tips of a plant in a suitable growth medium.
- In this process the **growth medium or culture solution is very important** as it is used for growing plant tissue because it contains various plant nutrients in the form of 'jelly' known as agar and plant hormones which are necessary for the growth of plants.

## What are the Applications of Plant Tissue Culture?

- To **study the respiration and metabolism** of plants.
- For the **evaluation of organ functions in plants.**
- To **study the various plant diseases** and work out methods-for their elimination.

Note:

- **Single cell clones are useful for genetic,** morphological and pathological studies.
- Embryonic cell suspensions can be used for large scale clonal propagation.
- Somatic embryos from cell suspensions can be stored for long term in germplasm banks.
- In the production of **variant clones with new characteristics**, a phenomenon referred to as somaclonal variations.
- **Production of haploids** (with a single set of chromosomes) for improving crops.
- **Mutant cells can be selected from cultures** and used for crop improvement.
- **Immature embryos can be cultured in vitro to produce hybrids**, a process referred to as embryo rescue.

# Open-RAN Architecture

## *Why in News?*

The Ministry of Communications has signed a Memorandum of Understanding (MoU) with M/s VVDN Technologies Private Limited to facilitate registered startups, innovators and MSMEs working in the field of **Open RAN (Radio Access Network)** to get **their product tested at the existing lab of M/s VVDN.**

- Such testing certification shall **accelerate the research innovation in domestic design and manufacturing**. It is aimed that India shall be emerging as a design leader in **5G**/O-RAN. This test certification eco system will make India as design testing and certification hub of Asia.

## *What is O-RAN?*

- **About:**
  - Open-RAN is not a technology, **but rather an ongoing shift in mobile network architecture** that allows networks to be built **using subcomponents from a variety of vendors.**
    - O-RAN has **an open, multi-vendor architecture** for deploying mobile networks, as opposed to the single-vendor proprietary architecture.
    - O-RAN **uses software to make hardware manufactured by different companies** work together.
  - The key concept of Open RAN is **"opening" the protocols and interfaces between the various subcomponents (radios, hardware and software) in the RAN.**
    - **Radio Access Network (RAN):**
      - It is the part of a telecommunications system that connects individual devices to other parts of a network through radio connections.
      - A RAN resides between user equipment, such as a mobile phone, a computer or any remotely controlled machine, and provides the connection with its core network.
  - As a technical matter this is what the industry refers to as a disaggregated RAN.
- **Elements of RAN:**
  - The Radio Unit (RU) is where the radio frequency signals are transmitted, received, amplified and digitized. The RU is located near, or integrated into,the antenna.
  - The Distributed Unit (DU) is where the real-time, baseband processing functions reside. The DU can be centralized or located near the cell site.
  - The Centralized Unit (CU) is where the less time-sensitive packet processing functions typically reside.
- **Functioning of Open RAN:**
  - It is the interface between the RU, DU and the CU that are the main focus of Open RAN.
  - By opening and standardizing these interfaces (among others in the network), and incentivizing implementation of the same, networks can be deployed with a more modular design without being dependent upon a single vendor.
  - Making these changes can also allow the DU and CU to be run as virtualized software functions on vendor-neutral hardware.
- **Traditional RAN:**
  - In a traditional RAN system, the radio, hardware and software are proprietary.
    - This means that nearly all of the equipment comes from one supplier and that operators are unable to, for example, deploy a network using radios from one vendor with hardware and software from another vendor.
  - **Problems:**
    - Mixing and matching cell sites from different providers typically leads to a performance reduction.

Note:

- The result is that most network operators, while supporting multiple RAN vendors, will deploy networks using a single vendor in a geographic region which can create vendor lock-in with high barriers to entry for new innovators.

# GPS Aided GEO Augmented Navigation

## *Why in News?*

Recently, **Airports Authority of India (AAI)** successfully conducted a light trial using **GAGAN {GPS (Global Positioning System) Aided GEO Augmented Navigation} based LPV (Localizer Performance with Vertical Guidance) Approach Procedures.**

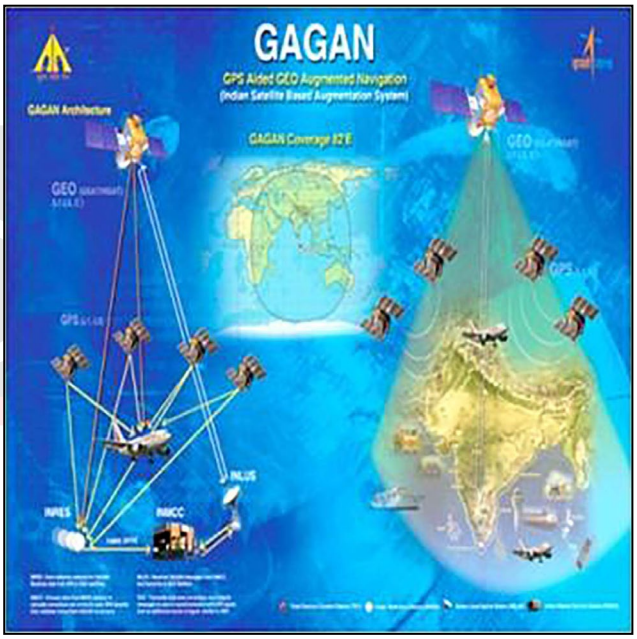
- Many airports including the ones under **Regional Connectivity Scheme** are being surveyed for the development of **GAGAN-based LPV Instrument Approach Procedures.**
- This is being done so that **suitably equipped aircraft can derive maximum benefit** in terms of improved safety during landing, reduction in delays, diversions and cancellations, reduction in fuel consumption, etc.

## *What is LPV?*

- LPV is a **Satellite Based Procedure** which has been used by aircraft **for landing purposes.**
- LPV approaches make aircraft possible **to land at airports not equipped with expensive Instrument Landing Systems**, which includes many small regional and local airports.
- Lowering the decision height up to 250 ft provides a **substantial operational benefit in poor weather and low visibility conditions.**
- Thus, any airport which hitherto would require higher visibility minima, will be able to accept aircraft benefiting remote airports which are devoid of precision approach capability equipment.

## *What is GAGAN?*

- **About:**
  - It is a **Space Based Augmentation System (SBAS)** jointly developed by **ISRO (Indian Space Research Organisation)** and AAI to provide the best possible navigational services over Indian FIR (Flight Information Region) with the capability of expanding to neighboring FIRs.
  - GAGAN is **a system of satellites and ground stations that provide GPS signal corrections,** giving you better position accuracy.
  - It is the **first such system developed for India and neighboring countries in the equatorial region.**
  - GAGAN System was **certified by DGCA (Directorate General of Civil Aviation) in 2015 for Approach with Vertical Guidance (APV 1) and en-route (RNP 0.1) operations.**
    - There are only four Space-Based augmentation systems available in the world namely India (GAGAN), US (WAAS) Europe (EGNOS) and Japan (MSAS).




- **Services Offered:**
  - Aviation, Forest management, Railways signaling, Scientific Research for Atmospheric Studies, Natural Resource and Land Management, Location based services, Mobile, Tourism.
- **Coverage Area:**
  - GAGAN GEO footprint **expands from Africa to Australia and GAGAN system has capability to cater 45 reference stations** for expansion to neighboring countries.
  - GAGAN provides **a civil aeronautical navigation signal consistent with International Civil Aviation Organization (ICAO)** Standards and Recommended Practices (SARPs) as established by the Global Navigation Satellite System (GNSS) Panel.

Note:

### What is a Global Positioning System?

- GPS is a **satellite navigation system, used to determine the ground position of an object.** It is a U.S.-owned utility that provides users with Positioning, Navigation, and Timing (PNT) services.
- It is a **network 24 satellite** which provides service to civilian and military users. The civilian service is freely available to all users on a continuous, worldwide basis. The military service is available to U.S. and allied armed forces as well as approved Government agencies.

## First Human Case of H3N8 Bird Flu

### Why in News?

**China's National Health Commission (NHC)** announced that a four-year-old boy was found to have been infected with the **H3N8 variant of Bird Flu** after developing several symptoms, including fever.

- H3N8 variant has previously been detected elsewhere in the world in **horses, dogs, birds and seals.**
- However, before this no human cases of **H3N8 have been reported.**

### What is Bird Flu?

- Avian influenza—known informally as **avian flu or bird flu—refers to "influenza caused by viruses adapted to birds".**
  - Most avian influenza viruses do not infect humans, however, some, such as **A(H5N1) and A(H7N9), have caused serious infections in people.**
- There is **no vaccine against H5N1.**
- **Most avian influenza viruses do not infect humans**, however some, such as A(H5N1) and A(H7N9), cross the species barrier and cause disease or subclinical infections in humans and other mammals as well.
- The Avian (H5N1) virus subtype, a highly pathogenic virus, **first infected humans in 1997 during a poultry epidemic outbreak in Hong Kong SAR, China.**

### What are Types of Influenza Virus?

- There are four types of influenza viruses: **influenza A, B, C, and D.**
- Influenza A and B are the two types of influenza that cause **epidemic seasonal infections nearly every year.**
  - Avian influenza Type A viruses
    - Type A viruses are classified based on two proteins on their surfaces – Hemagglutinin (HA) and Neuraminidase (NA).
    - There are about 18 HA subtypes and 11 NA subtypes.
    - Several combinations of these two proteins are possible e.g., H5N1, H7N2, H9N6, H17N10, H18N11 etc.
- **Influenza C mainly occurs in humans**, but has been known to also occur in dogs and pigs.
- **Influenza D is found mainly in cattle.** It's not known to infect or cause illness in humans yet.

## Bernardinelli-Bernstein Comet

### Why in News?

Recently, the **National Aeronautics and Space Administration's (NASA) Hubble Space Telescope** has confirmed that the **huge Bernardinelli-Bernstein comet** is indeed the **largest icy comet nucleus** ever seen by astronomers.

- The nucleus is **called the C/2014 UN271** which has an estimated **diameter of almost 129 kilometres.**
- The nucleus is **around 50 times larger** than that of most known comets, and its mass is estimated to be around 500 trillion tonnes.

### What is the Bernardinelli-Berstein Comet?

- The **comet** was **discovered by astronomers Pedro Bernardinelli and Gary Bernstein** in archival images from the Dark Energy Survey at an astronomical observatory in Chile.
  - It was **discovered in November 2010** and has been intensively studied since.
- The comet **has been travelling towards the sun for over a million years** and it is believed to have originated in the **Oort Cloud**.
  - Oort Cloud is a **distant region of the solar system** that is predicted to be the source of most comets.
  - The Oort Cloud is **still only a theoretical concept** as the comets that constitute it are too faint and distant to be directly observed. It was **first hypothesised** by Dutch astronomer Jan Oort in **1950.**

Note:

- The Bernardinelli-Berstein comet **follows a 3-million-year-long elliptical orbit** and has an **estimated temperature of minus 348 degrees Fahrenheit.**
  - It is **warm enough to sublimate carbon monoxide (CO)** from the surface to produce the dusty coma.

### What are the Key Highlights about CO?

- **Carbon monoxide (CO)** is a colourless, odourless, tasteless and highly toxic gas that is slightly less dense than air.
- It is **short-lived** (stay only a few months) in the atmosphere.
- It is **produced from the exhaust of internal combustion engines** and incomplete combustion of various other fuels.

### What is a Comet?

- Comets are **large objects made of dust and ice** that orbit the Sun.
  - The word comet comes from the **Latin word 'Cometa'** which means 'long-haired'.
- The earliest known record of a comet sighting was made by an **astrologer in 1059 BC.**
- **Comets or 'dirty snowballs'** are mostly made of dust, rocks and ice and can range in their width from a few miles to tens of miles wide.
- **When they orbit closer to the sun,** they heat up and **release debris of dust and gases.**
  - The **solid portions of comets consisting** mostly of water, ice and embedded dust particles are inactive when far away from the sun.
  - When near the sun, **the icy cometary surfaces vaporize** and throw off large quantities of gas and dust thus forming the enormous atmosphere and tails.
  - The released **gases form a glowing head that can often be larger than a planet** and the debris forms a tail that can stretch out to millions of miles.
  - Each time a comet passes the sun, it loses some of its material and it will eventually disappear completely as a result.
  - **Comets may be occasionally pushed into orbits closer to the Sun** and the Earth's neighbourhood due to forces of gravity.

## Jupiter's Moon Europa

### Why in News?

A team of researchers from Stanford University have found the possibility of **water on one of Jupiter's moons Europa**, a prime candidate for life in the solar system.

- Earlier, **NASA's(National Aeronautics and Space Administration) Dawn spacecraft, dwarf planet Ceres** reportedly found **salty water underground.**
- **Earlier, Scientists also found signatures of water vapor in the atmosphere of K2-18b.**

### What is Europa?

- Europa is **slightly smaller than Earth's moon** and its diameter is about one-quarter that of the Earth.
- Even though Europa has a **very thin oxygen atmosphere, it is considered one of the most promising places in the solar system** to find present-day environments that are suitable for life beyond the Earth.
- It is also believed that underneath **Europa's icy surface the amount of water is twice that on Earth.**
- Scientists believe **Europa's ice shell is 15-25 km thick and is floating on an ocean, which is estimated to be between 60-150 km deep.**
- Interestingly, while its diameter is less than the Earth's, **Europa probably contains twice the amount of the water in all of the Earth's oceans.**
- **NASA** is expected to launch its **Europa Clipper in 2024.**
  - The module will **orbit Jupiter and conduct multiple close flybys to Europa to gather data on the moon's atmosphere,** surface and its interior.

### What is Jupiter?

- Fifth in line from the Sun, Jupiter is, by far, the **largest planet in the solar system** – more than twice as massive as all the other planets combined.
  - Jupiter, Saturn, Uranus and Neptune are called **Jovian or Gas Giant Planets.** These have thick atmosphere, **mostly of helium and hydrogen.**
- Jupiter's iconic **Great Red Spot** is a giant storm bigger than Earth that has raged for hundreds of years.
- Jupiter **rotates once about every 10 hours** (a Jovian day), but takes about **12 Earth years** to complete **one orbit of the Sun** (a Jovian year).
- Jupiter has **more than 75 moons.**

Note:

- The planet Jupiter's **four largest moons are called the Galilean satellites** after Italian astronomer Galileo Galilei, who first observed them in 1610.
- These large moons, named **Io, Europa, Ganymede, and Callisto**, are each distinctive world.

- In 1979, the **Voyager mission** discovered Jupiter's faint **ring system.**
- **Nine spacecraft** have visited Jupiter. Seven flew by and two have orbited the gas giant. **Juno**, the most recent, arrived at Jupiter in 2016.

# Perseverance Rover Captures Eclipse on Mars

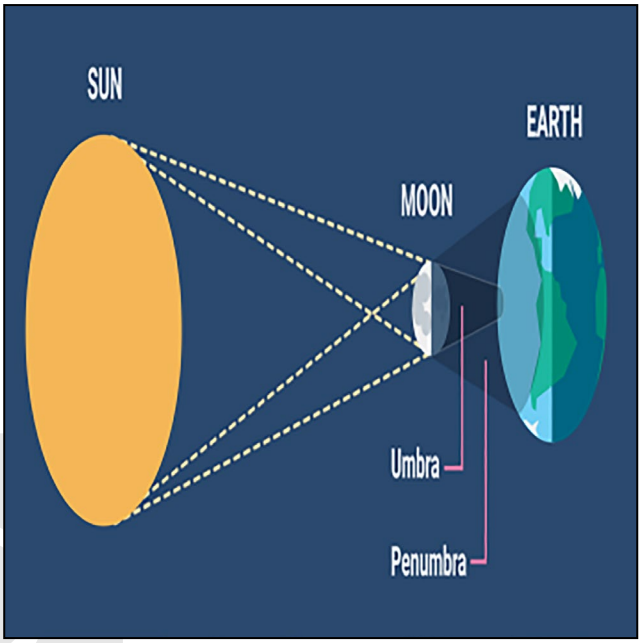
## *Why in News?*

Recently, **NASA's (National Aeronautics and Space Administration) Perseverance Rover** has captured a **solar eclipse** on **Mars**.

- Perseverance Mars rover captured an eclipse featuring Phobos, one of Mars' two moons. Phobos is moving very slowly towards Mars, and millions of years from now, they will collide.
- These observations can help **scientists better understand the moon's orbit and how its gravity pulls on the Martian surface**, ultimately shaping the Red Planet's crust and mantle.

## *What is Solar Eclipse?*

- A **solar eclipse** is a phenomenon that occurs when the moon comes in the way of the sun's light. The moon's shadow casts itself on Earth, blocking out the sun's light (as seen from Earth).
- The moon's shadow has **two** parts: **a central region (umbra)** and **an outer region (penumbra)**. Depending upon which part of the shadow passes over the Earth, one of **three types** of solar eclipses could be observed:
  - **Total Solar Eclipse**- The entire central portion of the sun is blocked out by the moon.
  - **Partial Solar Eclipse-** Only part of the sun's surface is blocked out.
  - **Annular Solar Eclipse**- The sun is covered in such a way that only a small ring-like sliver of light is seen from the sun's disc. This ring is known as the ring of fire.
    - An annular eclipse happens when the moon is farthest from Earth. As the moon is farther away from Earth, it seems smaller and is unable to block the entire view of the sun, because of which the ring-like structure could be observed.




## *What is Perseverance Rover?*

- **About:**
  - Perseverance is the most advanced, most expensive and most sophisticated **mobile laboratory sent to Mars.**
  - It is different from previous missions because it is capable of drilling and collecting core samples of the most promising rocks and soils and setting them aside in a "cache" on the surface of Mars.
  - It is the centerpiece of **NASA's Mars 2020 mission** which also included the small robotic and coaxial helicopter Ingenuity.
- **Launch**: 30th July 2020
- **Landing**: 18th February 2021
- **Power Source:**
  - A **Multi-Mission Radioisotope Thermoelectric Generator (MMRTG)** which converts heat from the natural radioactive decay of plutonium (Plutonium Dioxide) into electricity.
- **Objectives:**
  - Perseverance's primary objective is **looking for signs of ancient microbial life.**

Note:

- The rover is **studying and analyzing the Red Planet's regolith, rock and dust, and is the first rover to collect and cache samples.**

## Jupiter Like Protoplanet

### *Why in News?*

Recently, the **Hubble Space Telescope** has photographed a **Jupiter**-like **protoplanet** forming through a process that researchers have described as **intense and violent.**

- The Hubble Space Telescope is a project of international cooperation between **National Aeronautics and Space Administration (NASA)** and ESA (European Space Agency).

### *What is a Protoplanet?*

- Protoplanets are small celestial objects that are the size of a moon or a bit bigger. They are small planets, like an even smaller version of a **dwarf planet.**
  - Astronomers believe that these objects form during the creation of a solar system.
- The most popular theory of how a solar system is formed says that a **giant cloud of molecular dust collapsed, forming one or more stars.**
- Then a cloud of gas forms around the new star. As a result of gravity and other forces, **the dust and other particles in this cloud collide and stick together** forming larger masses.
- While **some of these objects break apart on impact, a number of them continue to grow.**
- Once they reach a certain size – around a kilometre – these objects are large enough to attract particles and other small objects with their gravity. **They continue to get larger until they form protoplanets.**

### *What is NASA's Disk Instability Theory?*

- According to NASA, this discovery supports a long-debated theory called **"disk instability,"** which tries to explain how planets similar to Jupiter are formed.
  - The model is for giant planet formation where a protoplanetary disk becomes dense and cool enough to be unstable to gravitational collapse and thereby resulting in the formation of a gaseous protoplanet.
- According to the Disk Instability theory, **matter slowly moves inwards in this disc as dust particles grow to centimetre-sized pebbles.**
- This is seen as the first step towards the formation of **kilometre-sized planetesimals** that eventually come together to form planets.
  - **Planetesimals** are solid objects thought to exist in protoplanetary disks and debris disks.

## Nipah virus Infection (NiV)

### *Why in News?*

Recently, Scientists detected the **presence of IgG antibodies against Nipah virus infection (NiV)** in 51 bats that were captured from Karnataka, Kerala, Tamil Nadu and Puducherry.

### *What is Antibody?*

- Antibody, also called immunoglobulin, is a **protective protein produced by the immune system** in response to the presence of a foreign substance, called an antigen.
- A wide range of substances are **regarded by the body as antigens**, including disease-causing organisms and toxic materials.
- Antibodies recognize and attack onto antigens in order to remove them from the body.

**What are the Different Types of Antibodies?**

- **IgG:**
  - It is the **main antibody in blood and it has a powerful ability to bind to bacteria** and toxins, and thus it takes on an important role in the biological defense system.
  - It is the **only isotype that can pass through the placenta**, and IgG transferred from the mother's body protects a newborn.
- **IgM:**
  - It is **constructed of five units of basic Y-shaped structures** and is mainly distributed to the blood. Produced first upon pathogen invasion by B cells, IgM has a key role in the initial immune system defense for protecting the body.
    - The B-cell, also called B-lymphocyte, is a type of white blood cell that plays a significant role in protecting your body from infection.

Note:

- **IgA:**
  - While in blood, **IgA is mainly present as monomers** (the shape of a single Y), but it forms dimers (a combination of 2 Ys) in secretions such as bowel fluid, nasal discharge, and saliva, to prevent bacterial invasion from a mucous membrane. It is also present in breast milk and protects the gastrointestinal tract of newborns from bacterial and viral infection.
- **IgD:**
  - It is **present on the surface of B cells** and it is reported to play a role in the induction of antibody production and the prevention of respiratory tract infections.
- **IgE:**
  - It is believed that **IgE was originally related to immunity reactions to parasites.** By binding to mast cells, **IgE is believed to be involved in allergies such as pollinosis.**

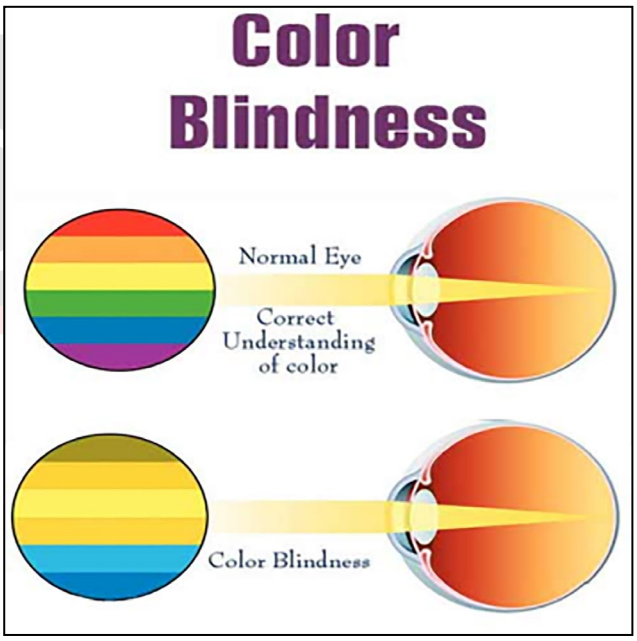
### *What are the Key Highlights about the Nipah virus?*

- **About:**
  - It is a **zoonotic virus** (it is transmitted from animals to humans).
  - The organism which causes Nipah Virus encephalitis is an RNA or **Ribonucleic acid virus** of the family Paramyxoviridae, genus Henipavirus, and is closely related to Hendra virus.
    - Hendra virus (HeV) infection is a rare emerging zoonosis that causes severe and often fatal disease in both infected horses and humans.
  - It **first broke out in Malaysia and Singapore** in 1998 and 1999.
  - It **first appeared in domestic pigs** and has been found among several species of domestic animals including dogs, cats, goats, horses and sheep.
- **Transmission:**
  - The disease spreads through **fruit bats** or 'flying foxes,' of the genus Pteropus, who are natural reservoir hosts of the Nipah and Hendra viruses.
  - The **virus is present in bat urine** and potentially, bat faeces, saliva, and birthing fluids.
- **Symptoms:**
  - The human infection presents as an **encephalitic syndrome** marked by fever, headache, drowsiness, disorientation, mental confusion, coma, and potentially death.
- **Prevention:**
  - Currently, there are **no vaccines for both humans and animals.** Intensive supportive care is given to humans infected by Nipah virus.

## Colour Blindless

### *Why in News?*

Recently, the **Supreme Court** has directed the **Film and Television Institute of India (FTII)** not to exclude candidates suffering from **colour blindness** from its **courses on film making and editing and asked it to make changes to its curriculum instead.**




### *What is Colour Blindness?*

- **About:** Colour blindness is the **inability to see colours in the normal way.** Colour blind individuals often **cannot distinguish between certain colours** — usually **greens** and **reds**, and sometimes **blues** as well.
  - It is also known as **colour deficiency.**
- **Anatomy:** Two types of cells in the **retina detect light:**
  - **Rods:** These help in distinguishing between **light and dark.**
  - **Cones:** These help in detecting **colour.**
  - There are three types of cones that see colour — **red, green, and blue** — and our brains use the

Note:

information from these cells to perceive colour.
    - Colour blindness can be the result of the **absence of one or more of these cone cells, or their failure to work properly.**
- **Different Kinds:** Colour blindness may be of **different kinds and degrees.**
    - In a situation where **all three cone cells** are present **but one of them is malfunctioning**, mild colour blindness may occur.
    - **Mildly colour blind people** often see all colours properly only when the light is good.
    - In the most **severe kind** of colour blindness, **vision is black-and-white**, that is, everything appears as a **shade of grey**. This is not very common.
- **Causes:**
    - **Congenital Colour Blindness**: Most colour blind people are **born with the condition (congenital colour blindness)**. Congenital colour vision deficiencies are **usually passed on genetically.**
        - This type of Colour blindness generally affects both eyes, and the condition remains roughly the same for as long as the individual is alive.
    - **Medical Conditions:** A problem with colour vision that arises later in **life could be the result of disease, trauma, or ingested toxins.**
        - If colour blindness arises out of disease, one eye may be affected differently from the other, and the difficulty could worsen over time.
        - Medical conditions that may increase the risk of getting colour blindness include glaucoma, diabetes, Alzheimer's, Parkinson's, alcoholism, leukaemia, and sickle-cell anaemia.
- **Treatment:** Colour blindness cannot as **yet be treated or reversed.**
    - However, it can be **corrected to some extent by wearing special contact lenses or colour filter glasses.**
    - There is some research that suggests **gene replacement therapy** can help modify the condition.
- **Gender Differentiation: Men** suffer from a **higher incidence of colour blindness** than **women.**
    - Around the world, **every tenth male is estimated to have some form of colour deficiency.**
    - Men of Northern European descent are considered to be especially vulnerable.
- **Restriction in Jobs:** Colour blindness impairs in some ways the **ability to do certain kinds of jobs**, such as being a **pilot or joining the armed forces.**
    - However, it depends on the severity of the colour blindness, and the **rules in place in different jurisdictions.**
    - There are an **estimated 300 million people in the world** with colour vision deficiency.
- **Initiative Taken by Government:** In June 2020, India's **Ministry of Road Transport and Highways** amended the **Central Motor Vehicles Rules 1989** to enable citizens with mild to medium colour blindness **to obtain a driver's licence.**

### *What is the Film and Television Institute of India?*

- The **Film and Television Institute of India (FTII)** was set up by the Government of India in 1960, in the premises of the erstwhile **Prabhat Studios in Pune.**
- Prabhat Studio was a pioneer in the **business of filmmaking** and shifted to Pune from Kolhapur in 1933.
- It is an autonomous body under the Union **Ministry of Information and Broadcasting.**

## GSLV-F10

### *Why in News?*

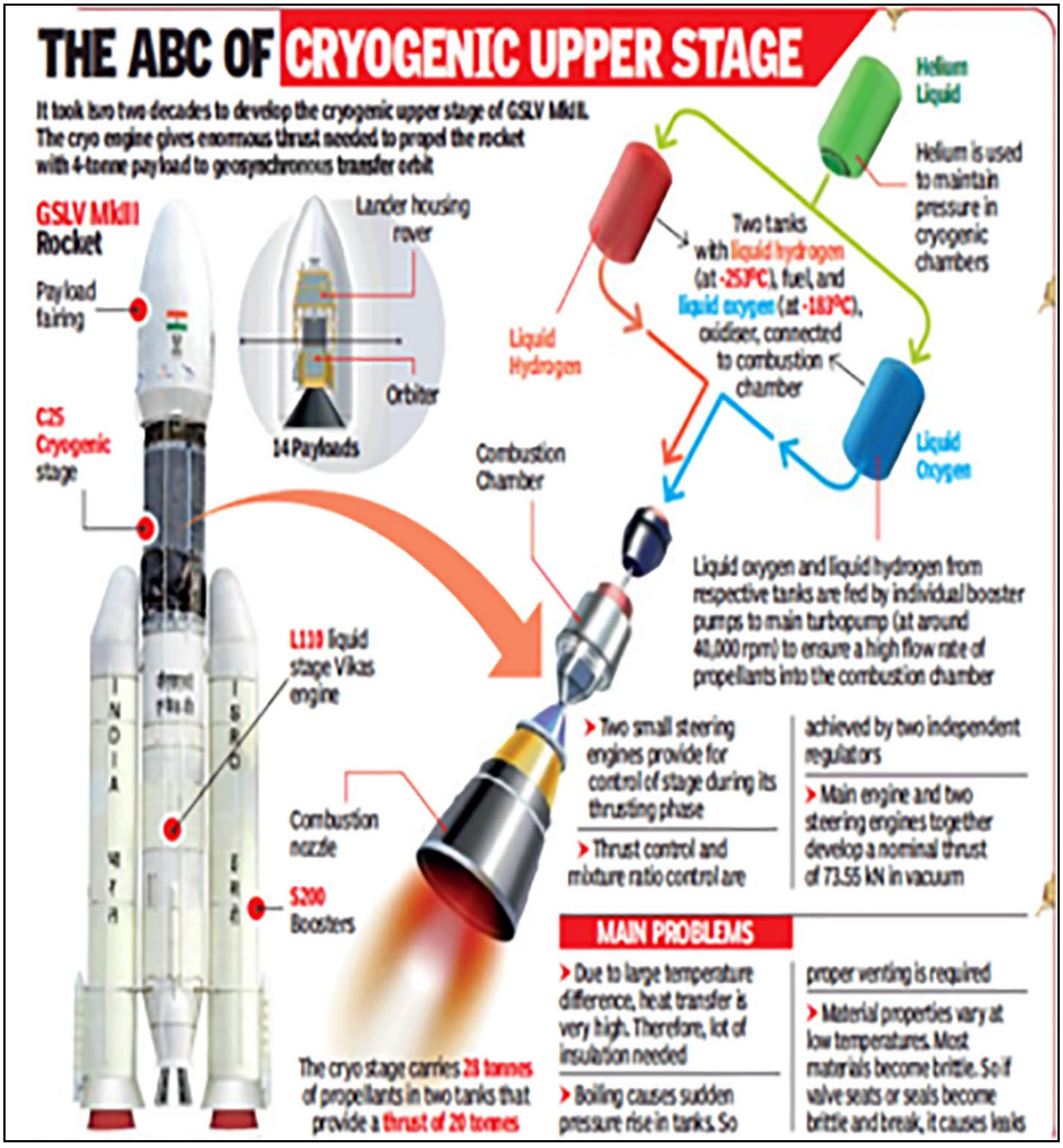
In 2021, a high-level panel was established to examine the **failed Geosynchronous Satellite GSLV-F10/Earth Observation Satellites (EOS)-03 mission** and recommended measures for making the **Cryogenic Upper Stage (CUS)** more robust.

- The **Geosynchronous Satellite Launch Vehicle (GSLV)** with improvements added to its CUS is expected to be ready in the second half of this year.

### *What is Cryogenic Upper Stage?*

- GSLV follows a **solid fuel first stage** with another **liquid fuel stage coming next. The second stage is followed by a third stage** known as **CUS.**
    - It was the rocket's **crucial third stage**, which then failed to ignite and led to the **failure of the GSLV-F10.**
- The cryogenic stage is **technically a very complex system compared to solid or earth-storable liquid propellant stages** due to its use of **propellants at extremely low temperatures** and the **associated thermal and structural problems.**

Note:




### *What are Earth Observation Satellites?*

- **Earth observation satellites** are satellites equipped with **remote sensing technology.**
  - Earth observation is the gathering of information about Earth's physical, chemical and biological systems.
- Many earth observation satellites have been employed on sun-synchronous orbit.
- Other earth observation satellites launched by ISRO include **RESOURCESAT- 2, 2A, CARTOSAT-1, 2, 2A, 2B, RISAT-1 and 2, OCEANSAT-2, Megha-Tropiques, SARAL and SCATSAT-1, INSAT-3DR, 3D, etc.**

Note:

| Launch vehicles used by ISRO | |
|---|---|
| Satellite Launch Vehicle (SLV): | ➢ The first rocket developed by ISRO was simply called **SLV, or Satellite Launch Vehicle.**<br>➢ It was followed by the **Augmented Satellite Launch Vehicle or ASLV.** |
| Augmented Satellite Launch Vehicle (ASLV): | ➢ SLV and ASLV both could carry small satellites, **weighing up to 150 kg**, to lower earth orbits.<br>➢ ASLV operated till the early **1990s before PSLV** came on the scene. |
| Polar Satellite Launch Vehicle (PSLV): | ➢ PSLV's first launch was in 1994, and it has been ISRO's main rocket ever since. Today's PSLV, however, is **vastly improved and several times more powerful than the ones** used in the 1990s.<br>❍ It is the first Indian launch vehicle to be equipped with liquid stages.<br>➢ PSLV is the **most reliable rocket used by ISRO till date**, with 52 of its 54 flights being successful.<br>❍ It successfully launched two spacecraft – **Chandrayaan-1** in 2008 and **Mars Orbiter Spacecraft** in 2013 – that later traveled to Moon and Mars respectively.<br>❍ ISRO **currently uses two launch vehicles – PSLV and GSLV** (Geosynchronous Satellite Launch Vehicle), but there are lots of different variants of these. |
| Small Satellite Launch Vehicle (SSLV): | ➢ SSLV is targeted at rising global demand for the launch of small and micro-satellites.<br>➢ SSLV is meant to offer **cost-effective launch services for satellites up to 500 kg**.<br>➢ It is supposed to carry an indigenous earth observation satellite EOS-03 into space. |
| Geosynchronous Satellite Launch Vehicle (GSLV): | ➢ GSLV is a much **more powerful rocket**, meant to carry **heavier satellites much deeper into space.** Till date, GSLV rockets have carried out 18 missions, of which **four ended in failure.**<br>➢ It **can take 10,000-kg satellites** to lower earth orbits.<br>➢ The indigenously developed **Cryogenic Upper Stage (CUS),** forms the third stage of GSLV Mk II.<br>➢ Mk-III versions have made ISRO entirely **self-sufficient for launching its satellites.**<br>❍ Before this, it used to depend on the European Arianne launch vehicle to take its heavier satellites into space.<br>❍ GSLV-Mk III is a fourth generation, three stage launch vehicle with four liquid strap-ons. The indigenously developed CUS, which is flight proven, forms the third stage of GSLV Mk III.<br>❍ The rocket has three-stages with two solid motor strap-ons (S200), a liquid propellant core stage (L110) and a cryogenic stage (C-25). |
| Reusable Rockets/ Future Rockets: | ➢ The future rockets are meant to be reusable. Only a small part of the rocket would be destroyed during the mission.<br>➢ The bulk of it would **re-enter the earth's atmosphere and land very much like an airplane,** and can be used in future missions.<br>➢ Reusable rockets would **cut down on costs and energy,** and also reduce space debris, which is becoming a serious problem because of the large number of launches.<br>➢ **Fully-reusable rockets are still to be developed,** but partially-reusable launch vehicles are already in use.<br>➢ ISRO has **also developed a reusable rocket, called RLV-TD (Reusable Launch Vehicle Technology Demonstrator)** which has had a successful test flight in 2016. |

Note:

# Wright Mons Mountain: Pluto

## Why in News?

Recently, new findings about Pluto have been reported by the **National Aeronautics and Space Administration's** (NASA) **New Horizons probe.**

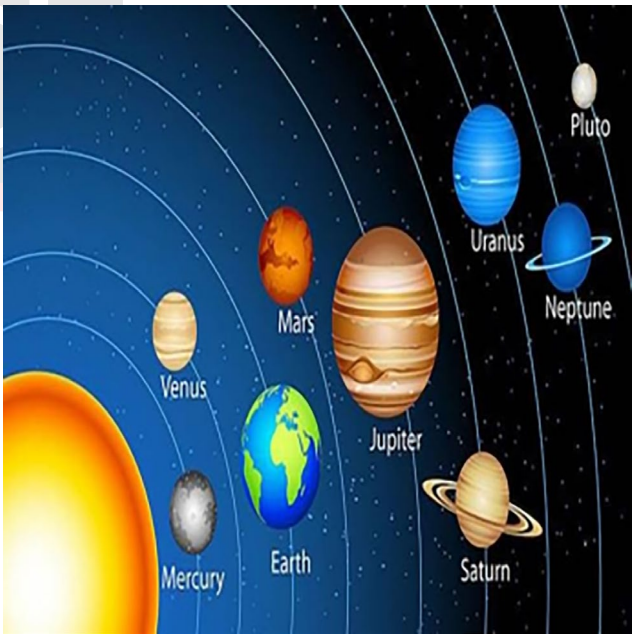
- The probe reported that **icy lava flows** have recently (no more than a billion years ago) covered substantial tracts of its surface.
- The findings drew particular attention to a **mountainous feature named Wright Mons.**
- The **only spacecraft to visit Pluto is NASA's New Horizons**, which passed close by in July 2015.

## What is Wright Mons?

- A **mountainous feature named Wright Mons** was found on Pluto, which rises 4-5km above its surroundings. It is about 150km across its base and has a central depression (a hole) 40-50km wide, with a floor at least as low as the surrounding terrain.
  - Wright Mons, was informally **named by the New Horizons team in honour of the Wright brothers.**
- Scientists claim that **Wright Mons is a volcano**, and cite the lack of impact craters as evidence that it is not likely to be older than 1-2 billion years.
  - An impact crater is formed when an object like an asteroid or meteorite crashes into the surface of a larger solid object like a planet or a moon.
- Its **volume exceeds 20 thousand cubic kilometres.** Although considerably **less than the volume of Mars's biggest volcanoes**, this is similar to the **total volume of Hawaii's Mauna Loa**, and much greater than the volume of its above sea-level portion.
- The **slopes of Wright Mons and much of its surroundings are seen to be crowded with hummocks** up to 1km high and mostly 6-12km across.
- Scientists conclude that t**hese hummocks are made primarily of water-ice,** rather than nitrogen- or methane-ice that covers some other young regions on Pluto.
  - They argue that this is **consistent with the material strength necessary to form and preserve these domes,** but they do recognise small patches of much weaker nitrogen-ice, mainly in the central depression.
- The hummocks were likely created by some sort of ice volcanism, known by the technical term **"cryovolcanism"** – erupting icy water rather than molten rock.
- Pluto's bulk density shows that it **must have rock in its interior,** but its **outer regions are a mixture of ices (water, methane, nitrogen and probably ammonia and carbon monoxide, too, all of which are less than a third as dense as rock)** in the same way that the crust of the Earth and other rocky planets is a mixture of several silicate minerals.
- Many **other areas of Pluto have been around long enough to accumulate large numbers of impact craters** – no recent icy lava flows have covered them.

## What are some Key Facts about Pluto?

- Pluto was categorised as a **dwarf planet.** In 2006, Pluto was categorised with three other objects in the solar system that are about the same small size as Pluto: Ceres, Makemake and Eris.




  - Pluto was embraced as the solar system's ninth planet upon **discovery by Clyde Tombaugh in 1930.**
  - The crucial part of the definition of planet adopted by the **International Astronomical Union (IAU)** in 2006 is that a planet should have **"cleared the neighbourhood of its own orbit".**
  - Pluto clearly does not comply with this definition – **it has rivals of comparable mass in addition to being overshadowed by the vastly more massive Neptune.**

Note:

- These **objects, along with Pluto, are much smaller than the "other" planets.**

- Pluto – which is **smaller than Earth's Moon** – has a heart-shaped glacier that's the size of Texas and Oklahoma. It has blue skies, spinning moons, mountains as high as the Rockies, and **it snows – but the snow is red.**
- Pluto is about 1,400 miles wide. That's about **half the width of the United States, or 2/3 the width of Earth's moon.**
- Pluto orbits the Sun about 3.6 billion miles away on average, about **40 times as far as Earth**, in a region called the **Kuiper Belt.**
- A **year on Pluto is 248 Earth years**. A day on Pluto lasts 153 hours, or about 6 Earth days.
- Pluto has a **thin atmosphere of nitrogen, methane and carbon monoxide.** The atmosphere has a blue tint and distinct layers of haze.
- Pluto has **5 moons**. The **largest, Charon,** is so big that Pluto and Charon orbit each other like a double planet.
- Pluto's surface is far **too cold, -228 to -238$^{0C}$,** to sustain life as we know it.

# GSAT 7B & India's Other Military Satellites

## *Why in News?*

Recently, the **Ministry of Defense** has given the Acceptance of Necessity for the GSAT-7B satellite. This satellite will be a **dedicated satellite for the Indian Army.**

- The satellite would help the **Indian Army enhance its surveillance in border areas.**
- Currently, India has only two dedicated military satellites — the **GSAT-7 (Rukmini) and GSAT-7A (Angry Bird)** — used by the **Indian Navy and Air Force respectively.**

## *What will be the role of the GSAT 7B satellite?*

- Till date, the Indian Army has been dependent on **GSAT-7A and other satellites,** but with this new state-of-the-art technology, the Army will have **new eyes in the sky.**
- The military-grade satellite will be a **force multiplier in providing fail-safe communication support.**
- The GSAT 7B will primarily fulfil the **communication needs of the Army.**
- While many features of this satellite are still a **closely guarded secret,** it is expected that the **state of the art, multi-band, military-grade satellite** shall be a shot in the arm for the communication and **surveillance needs of the Army.**
- Such a satellite would be of **utmost importance for the Indian Army** as it currently faces a double threat of **China and Pakistan lurking at its borders.**
- The use of such a satellite would also mean that the **Army's vast array of radio communication equipment** could come under a single platform.

## *What is the role of GSAT 7 Satellite?*

- GSAT 7 series satellites are advanced satellites developed by the **Indian Space Research Organisation (ISRO)** to meet the communication needs of the defence services.
- The **GSAT 7 (Rukmini)** provides a gamut of services for military communication needs, which includes low bit voice rate to **high bit rate data facilities, including multi-band communications.**
  - It is **India's first military satellite.**
- The GSAT 7 satellite was launched in **August 2013 from an Ariane 5 ECA rocket from Kourou in French Guiana.**
- It is a **2,650 kg satellite** which has a footprint of nearly **2,000 nautical miles in the Indian Ocean region.**
  - This satellite is mainly used by the Indian Navy for its communication needs.
- The satellite carries payloads in **Ultra-High Frequency (UHF), C-band and Ku-band, and helps the Navy** to have a secure, real time communication link between its land establishments, surface ships, submarines and aircraft.
  - UHF, C-band and Ku-band are different **Satellite frequency bands**
- The satellite was injected into a **Geosynchronous Transfer Orbit (GTO)** of 249 km perigee (nearest point to earth), **35,929 km apogee (farthest point to earth) and an inclination of 3.5 degree with respect to the equator**.

Note:


### What is the role of the GSAT 7A satellite?

- The GSAT 7A was launched in 2018 **from the Satish Dhawan Space Centre in Sriharikota (Andhra Pradesh).**
- The satellite helps in boosting the connectivity between the ground radar stations, airbases and the **airborne early warning and control aircraft (AEW&C) of the IAF.**
- It also helps in satellite controlled operations of **unmanned aerial vehicles (UAVs)** which gives a great deal of reliability to the operations as compared to ground controlled operations.
- This satellite has **10 channels in Ku band with switchable frequency for mobile users,** one fixed Gregorian or parabolic antenna, and four steerable antennas.
- A GSAT 7C satellite is on the cards for the IAF, and a proposal to this effect was cleared by the DAC in 2021.

### What other kinds of military satellites does India have?

- An **Electromagnetic Intelligence Gathering Satellite (EMISAT)**, developed by ISRO, was launched in April 2020 through a **Polar Satellite Launch Vehicle (PSLV-C45).**
  - It has an **Electronic Intelligence (ELINT) package called Kautilya**, which allows the interception of ground-based radar and also carries out electronic surveillance across India.
  - This satellite circles the **globe pole-to-pole**, and is helpful in gathering information from radars of countries that have borders with India.
- India also has a **RISAT 2BR1 synthetic aperture radar imaging satellite,** which was launched in December 2019 from Sriharikota.

## ExoMars 2022

### Why in News?

The **European Space Agency's ExoMars 2022 mission** won't launch in September, 2022 as planned after the agency suspended all cooperation with Russia's space program Roscosmos.

- Earlier, the Russian space agency Roscosmos held that it will not cooperate with Germany on joint experiments in the Russian segment of the **International Space Station (ISS)**.

### What is the ExoMars 2022 Mission?

- **About:**
  - **It is a two-stage mission:**
    - First Part:
      - Its first mission launched **atop a Proton-M rocket in 2016 and consisted of the European Trace Gas Orbiter** and test lander called Schiaparelli.
      - The orbiter was successful while the test lander failed during its descent to Mars.
    - Second Part:
      - It comprises **a rover and surface platform**:
      - This **second part of the mission** was originally planned for July 2020. But it was postponed until this September due to technical issues.
  - **ESA and National Aeronautics and Space Administration (NASA)** were the original ExoMars collaborators, but NASA dropped out in 2012 due to budgeting problems.
  - **Russia took NASA's place** in the project in 2013.
- **Objective:**
  - The primary aim of the mission is to **check if there has ever been life on Mars** and also understand the history of water on the planet.
    - The European rover will drill to the sub-surface of Mars to collect samples from about 2 m of depth.
  - The main goal is to **land ESA's rover at a site** which has high-potential for finding well-preserved organic material, particularly from the history of the planet.

Note:

# Recombination of Viruses

## Why in News?

The recent study published in **Nature Microbiology** revealed a few things about the **mutation in viruses, increased fitness and recombination of viruses**.

| DNA VIRUSES VERSUS RNA VIRUSES | |
|---|---|
| DNA viruses refer to viruses whose genetic information is stored in the form of DNA | RNA viruses refer to viruses whose genetic information is stored in the form of RNA |
| Contain DNA as their genetic material | Contain RNA as their genetic material |
| Most are double-stranded | Most are single-stranded |
| Replicated inside the nucleus of the host cell | First transcribed and then replicated in the cytoplasm |
| Viral DNA is first transcribed into RNA, and then mRNA is translated into viral proteins | Can bypass transcription during protein synthesis since they already contain RNA in the genome |
| Stable due to the lower mutation rate | Unstable due to the higher mutation rate |
| Shows an accurate replication | Shows an error-prone replication |
| Contain a large genome | Contain a small genome |
| Newly-synthesized viral DNA is packed into a pre-formed capsid called procapsid | Newly-synthesized viral RNA is not packed in a procaspid |
| Include Class I, II, and VII of the Baltimore classification of viruses | Include Class III, IV, V, and VI of the Baltimore classification of viruses |
| Ex: Adenoviruses, Herpesviruses, Poxviruses, Parvoviruses, and Hepadnaviruses | Ex: Reoviruses, Picornaviruses, Togaviruses, Rhabdoviruses, and Retroviruses |
| Smallpox, herpes, and chickenpox are diseases of DNA viruses | Aids, Ebola hemorrhagic fever, SARS, common cold, etc. are some diseases of RNA viruses |

Visit www.pediaa.com

## What is Mutation?

- Mutation is an **alteration in the genetic material (the genome) of a cell** of a living organism or of a virus that is more or less permanent and that can be transmitted to the cell's or the virus's descendants.
- The genomes of organisms are all composed of **Deoxyribonucleic Acid (DNA), whereas viral genomes can be of DNA or Ribo Nucleic Acid (RNA)**.

# PACER Scheme

## Why in News?

Recently, the **Polar Science and Cryosphere (PACER) scheme** has been approved for continuation by the **Union Cabinet from 2021 to 2026.**

## What is PACER Scheme?

- PACER encompasses the following six components.
  - **Construction of polar research vessel**
  - **Construction of the third research base in Antarctica**
  - **Indian scientific endeavours in the Arctic**
  - **Polar expeditions-Antarctica**
  - **Southern Ocean Expedition**
- It is implemented through the **National Centre for Polar and Ocean Research (NCPOR).**

## What is the National Centre for Polar and Ocean Research (NCPOR)?

- It is an autonomous institute under the **Ministry of Earth Sciences.**
- Its responsibilities include:
  - Management and upkeep of the Indian Antarctic Research Bases **"Maitri" and "Bharati", and the Indian Arctic base "Himadri".**
  - Management of the Ministry's research vessel **Ocean Research Vehicle (ORV) Sagar Kanya** as well as the other research vessels chartered by the Ministry.
    - The ORV Sagar Kanya is a versatile ocean observing platform equipped with technologically advanced scientific equipment and related facilities.
  - Playing a facilitatory role in the scientific research activities being undertaken by several national institutions and organisations in **Antarctica, the**

Note:

**Arctic and in the Indian Ocean sector of the Southern Ocean.**

- Playing a lead role in the geoscientific surveys of the country's **Exclusive Economic Zone (EEZ)** and its extended continental shelf beyond 200m, deep-sea drilling in the Arabian Sea basin through the **International Ocean Discovery Program (IODP)**, exploration for ocean non-living resources such as gas hydrates and multi-metal sulphides in mid-ocean ridges.

- It is located in the **state of Goa.**

### What are Other Major Initiatives of the Ministry of Earth Sciences?

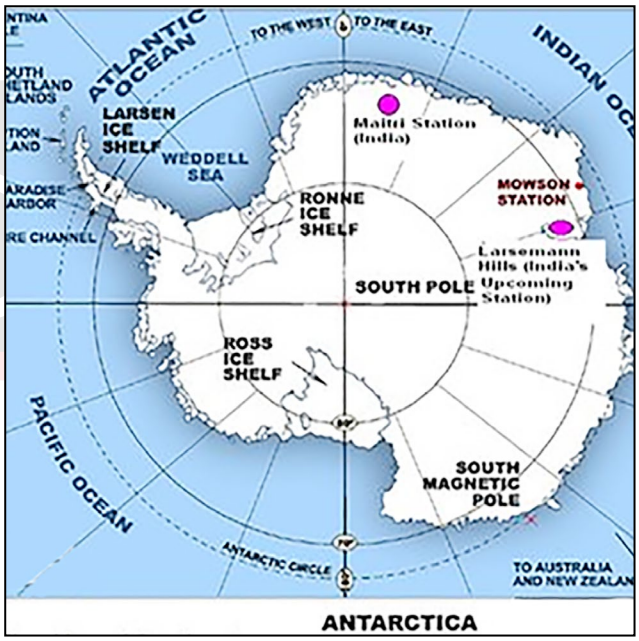
- **IndARC**
- **Ocean Services, Technology, Observations, Resources Modelling and Science (O-SMART)**
- **ACROSS Scheme**

### What are India's Arctic Missions?

- India launched its **first scientific expedition** to the Arctic Ocean in 2007.
- India opened a research base named **"Himadri" in Svalbard, Norway** in July 2008 to carry out studies in disciplines like **Glaciology, Atmospheric sciences & Biological sciences.**


### What are India's Antarctic Missions?

- India officially acceded to the **Antarctic Treaty System** on 1st August 1983.
- On 12th September 1983, India became the **fifteenth Consultative Member of the Antarctic Treaty.**
- India is expanding its **infrastructure development in Antarctica.**
- The **newest base commissioned in 2015 is Bharati.**
- India is **rebuilding its station, Maitri,** to make it bigger and last for at least 30 more years.
- **Dakshin Gangotri,** the first Indian base established in 1984, has weakened and become just a supply base.
- **Sagar Nidhi:** In 2008, India commissioned the Sagar Nidhi, for research.
  - It is an **ice-class vessel,** it can cut through the thin ice of 40 cm depth and is the first Indian vessel to navigate Antarctic waters.



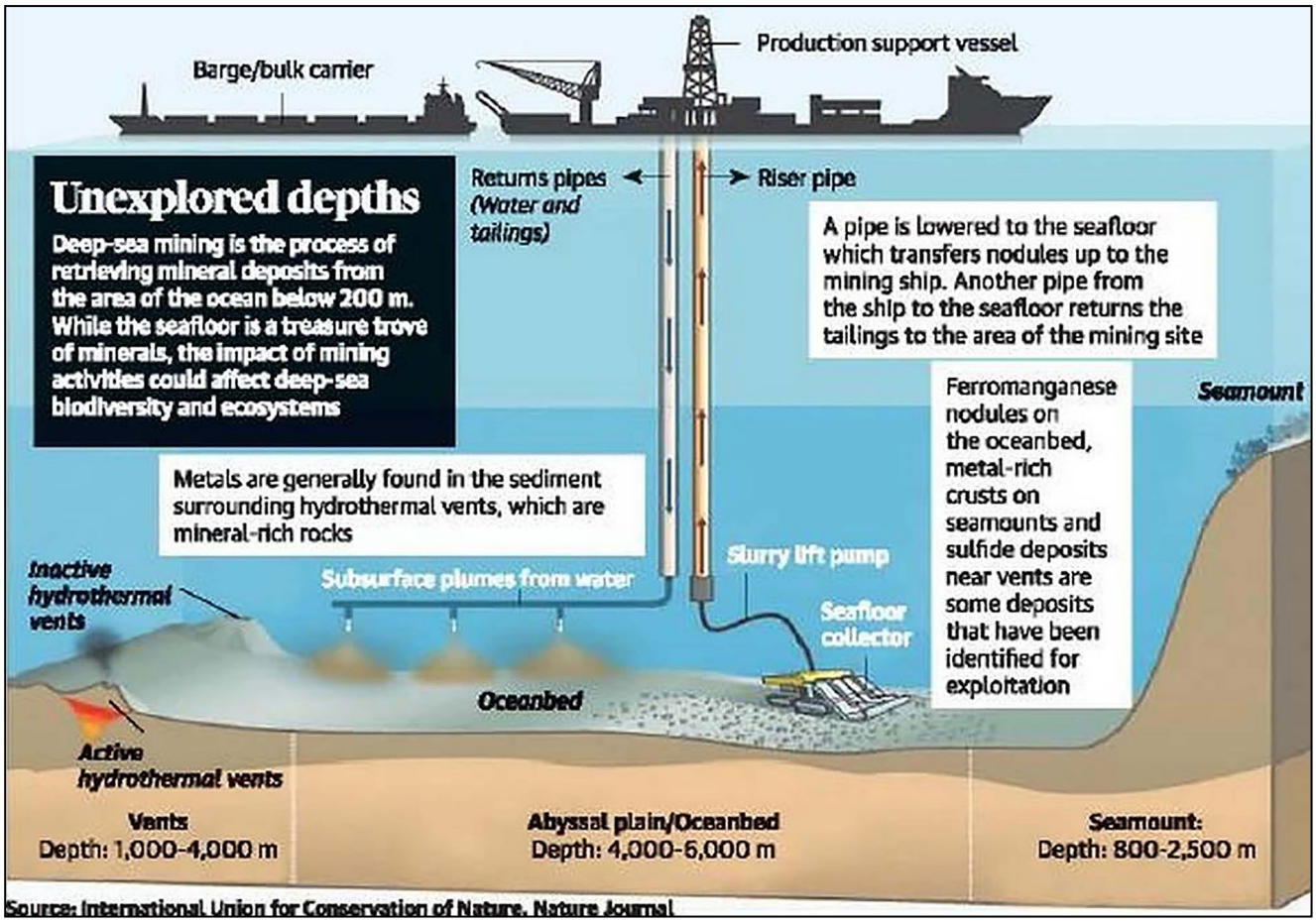

## Deep Ocean Mission

### Why in News?

Recently, the Ministry of Earth Sciences has launched the **Deep Ocean Mission (DOM)**.

- DOM is a **mission mode project** to support the **Blue Economy Initiatives** of the Government of India.
- Earlier, the Ministry of Earth Sciences had also rolled out the draft **Blue Economy Policy**.
- **Blue Economy** is the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and **ocean ecosystem health**.

Note:




### *What are the Major Components of DOM?*

- **Development of Manned Submersible Vehicle:**
  - A manned submersible will be developed to carry three people to a depth of 6,000 metres in the ocean with a suite of scientific sensors and tools.
  - NIOT & **ISRO** is jointly developing a **Manned Submersible Vehicle**.
  - **National Institute of Ocean Technology (NIOT),** an autonomous institute under the Ministry of Earth Sciences.
- **Development of Technologies for Deep Sea Mining:**
  - An **Integrated Mining System** will be also developed for mining polymetallic nodules at those depths in the central Indian Ocean.
    - Polymetallic nodules are rocks scattered on the seabed containing iron, manganese, nickel and cobalt.
  - The exploration studies of minerals will pave the way for commercial exploitation in the near future, as and when commercial exploitation code is evolved by the **International Seabed Authority**, a **United Nations (UN) organisation**.
- **Development of Ocean Climate Change Advisory Services:**
  - It entails developing a suite of observations and models to understand and provide future projections of important climate variables on seasonal to decadal time scales.
- **Technological Innovations for Exploration and Conservation of Deep-sea Biodiversity:**
  - Bio-prospecting of deep-sea flora and fauna including microbes and studies on sustainable utilisation of deep-sea bio-resources will be the main focus.
- **Deep Ocean Survey and Exploration:**
  - It will explore and identify potential sites of multi-metal **Hydrothermal Sulphides** mineralization along the Indian Ocean mid-oceanic ridges.

Note:

- **Energy and Freshwater from the Ocean:**
  - Studies and detailed engineering design for offshore **Ocean Thermal Energy Conversion (OTEC)** powered **desalination plants** are envisaged in this proof of concept proposal.
  - OTEC is a technology that uses ocean temperature differences from the surface to depths lower than 1,000 metres, to extract energy.
- **Advanced Marine Station for Ocean Biology:**
  - It is aimed at the development of human capacity and enterprise in ocean biology and engineering.
  - It will translate research into industrial application and product development through on-site business incubator facilities.

### *What are other Blue Economy Initiatives*

- **India-Norway Task Force on Blue Economy for Sustainable Development:**
  - It was inaugurated jointly by both the countries in 2020 to **develop and follow up joint initiatives between the two countries**.
- **Sagarmala Project:**
  - The **Sagarmala project** is the strategic initiative for **port-led development** through the extensive use of IT-enabled services for the modernization of ports.
- **O-SMART:**
  - India has an umbrella scheme by the name of **O-SMART** which aims at regulated use of oceans, marine resources for sustainable development.
- **Integrated Coastal Zone Management:**
  - It focuses on the conservation of coastal and marine resources, improving livelihood opportunities for coastal communities etc.
- **National Fisheries Policy:**
  - India has a **National Fisheries policy** for promoting the **'Blue Growth Initiative'** which focuses on sustainable utilisation of fisheries wealth from marine and other aquatic resources.

## NETRA Project & Space Junk

### *Why in News?*

With **space junk** posing an increasing threat to Indian assets in space, the **Indian Space Research Organisation (ISRO)** is building up **its orbital debris tracking capability.**

- In this pursuit, a space debris tracking **radar** with a **range of 1,500 km and an optical telescope** will be inducted as part of establishing an effective surveillance and tracking network under the **Network for Space Objects Tracking and Analysis (NETRA) project.**

### *What is Space Junk?*

- Space junk or debris consist of **spent rocket stages, dead satellites, fragments of space objects and debris** resulting from **Anti-satellite (ASAT) System (ASAT).**
- Hurtling at an average speed of 27,000 kmph in **Low Eart Orbit (LEO),** these objects pose a very real threat as collisions involving **even centimetre-sized fragments can be lethal to satellites.**
- This free floating space debris is a **potential hazard for operational satellites** and colliding with them can leave the satellites dysfunctional.
  - This is referred to as **Kessler Syndrome**, named after **National Aeronautics and Space Administration (NASA)** scientist Donald Kessler in 1978.
  - It says if there is too much space junk in orbit, it could result in a **chain reaction where more and more objects will collide and create new space junk in the process**, to the point where Earth's orbit becomes unusable – **a Domino Effect.**

### *What is the NETRA Project & Its Advantage?*

- **About:** 'Project NETRA' is an **early warning system in space** to detect debris and other hazards to Indian satellites.
  - Once operational, it will give India its own capability in **Space Situational Awareness (SSA)** like the other space powers.
- **Need:** With countries launching more and more satellites, each one of them being a **strategic or commercial asset, avoiding collisions** could become a challenge in the future.
  - For protecting its space assets, the ISRO was forced to perform 19 **Collision Avoidance Manoeuvres (CAM) in 2021.**
- **Modus Operandi:** Under NETRA, the ISRO plans to put up many observational facilities: **connected radars, telescopes, data processing units and a control centre**.
- **Benefits:** NETRA can spot, track and catalogue objects as **small as 10 cm, up to a range of 3,400 km and equal to a space orbit of around 2,000 km.**
  - The NETRA effort would **make India a part of international efforts** towards tracking, warning about and mitigating space debris.
  - More importantly, the SSA also has a **military quotient** to it and adds a new ring to the country's overall security, **against attacks from air, space or sea.**

Note:

- This is a vital requirement for **protecting our space assets and a force multiplier.**

# Cluster Bombs and Thermobaric Weapons

## Why in News?

Human rights groups **Amnesty International and Human Rights Watch** accused Russia of using cluster bombs and vacuum bombs in the **ongoing war (on Ukraine).**

- Amnesty International said **international humanitarian law prohibits the use of inherently indiscriminate weapons** such as cluster munitions. Launching indiscriminate attacks **that kill or injure civilians constitutes a war crime.**
- International humanitarian law is **a set of rules that seek to limit the effects of armed conflict.** It protects people who are not or are no longer participating in hostilities and restricts the means and methods of warfare.

## What are cluster munitions?

- A **cluster munition means a "conventional munition that is designed to disperse or release explosive submunitions** each weighing less than 20 kilograms, and includes those explosive submunitions".
- Essentially, cluster munitions are **non-precision weapons that are designed to injure or kill human beings indiscriminately over a large area,** and to destroy vehicles and infrastructure such as runways, railway or power transmission lines.
- They can be dropped **from an aircraft or launched in a projectile** that spins in flight, scattering many bomblets as it travels.
- Many of these bomblets end up not exploding, but continue to lie on the ground, often partially or fully hidden and difficult to locate and remove, posing a threat to the civilian population for long after the fighting has ceased.
- The **Convention on Cluster Munitions** specifically identifies "cluster munition remnants", which include "failed cluster munitions, abandoned cluster munitions, unexploded submunitions and unexploded bomblets"

## What is a thermobaric weapon?

- Thermobaric weapons — also known **as aerosol bombs, fuel air explosives, or vaccum bombs** — use oxygen from the air for a large, high-temperature blast.
- A thermobaric weapon causes **significantly greater devastation than a conventional bomb** of comparable size.
- The weapons, which go off in two separate stages, can be fired as rockets from tank-mounted launchers or dropped from aircraft.
- As they hit their target, a first explosion splits open the bomb's fuel container, releasing a cloud of fuel and metal particles that spreads over a large area.
- A second explosion then occurs, igniting the aerosol cloud into a giant ball of fire and sending out intense blast waves that can destroy even reinforced buildings or equipment and vaporize human beings.

## What is the Convention on Cluster Munitions?

- The Convention on Cluster Munitions is a **United Nations-adopted legal instrument that prohibits all use**, production, transfer and stockpiling of cluster munitions.
- It establishes **a framework for cooperation and assistance to ensure adequate assistance to survivors and their communities**, clearance of contaminated areas, risk reduction education and destruction of stockpiles.
- It was adopted in Dublin, Ireland in 2008, and was opened for signature in Oslo, Norway. It **entered into force in 2010 after the requirement of 30 ratifications** was complete.
- Currently, the convention has 110 State Parties and 13 Signatory States.
- Countries that ratify the convention are obliged to never use cluster munitions, and also to never develop, produce, otherwise acquire, retain, stockpile or transfer to anyone cluster munitions.
- **India has not signed the convention and is not a party to it.** Other countries that are not parties are the **US, Russia, China, Pakistan and Israel, among others.**
  - **Vacuum bombs are not prohibited by any international law or agreement,** but their use against civilian populations in built-up areas, schools or hospitals, could attract action under the **Hague Conventions of 1899 and 1907.**
  - Hague Convention is any of **a series of international treaties that were issued from international conferences** held at The Hague in the Netherlands in 1899 and 1907. They **establish the laws and customs of war in the strict sense**, by defining the rules that belligerents must follow during hostilities.

Note:

| Key Points | Details |
| --- | --- |
| | |

**Summary**

| Key Points | Details |
| --- | --- |
| | |

**Summary**