

60 DAY RAPID REVISION (RARE) SERIES Prelims 2025

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| SCIEN | ICE AND TECHNOLOGY | 5 |
|------------|--|----|
| MAY | 2024 | 5 |
| 1. | GLOBAL LEADERS GROUP ON ANTIMICROBIAL RESISTANCE | 5 |
| 2. | SALMONELLA | 5 |
| 3. | 3.BIOHACKING | 5 |
| 4. | SUPERSONIC MISSILE-ASSISTED RELEASE OF TORPEDO (SMART) SYSTEM | 6 |
| 5. | CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO) | 6 |
| 6. | OXYTOCIN | 6 |
| 7. | WEST NILE FEVER | 7 |
| 8. | FOOT ROT (BAKANE DISEASE) | 8 |
| 9. | SICKLE CELL DISEASE | 8 |
| 10 | . KAWASAKI DISEASE | 9 |
| 11 | AUROBAS (NORTHERN AND SOUTHERN LIGHTS) | 9 |
| 12 | LITHUM | 10 |
| 13 | KAMIKAZE DRONE | 11 |
| 14 | OF FANDER FLOWERS | 11 |
| 15 | ZERO-DAY VI II NERABII ITY | 12 |
| 16 | | 12 |
| 17 | | 12 |
| 10 | | 13 |
| 10 | | 15 |
| 19 | | 14 |
| 20 | | 14 |
| 21 | . SOIL NAILING AND HYDROSEEDING | 15 |
| 22 | | 15 |
| 23 | BLUE ORIGIN'S NEW SHEPARD-25 MISSION | 16 |
| 24 | | 17 |
| 25 | INDIAN COUNCIL OF MEDICAL RESEARCH (ICMR) | 18 |
| 26 | .PIG BUTCHERING SCAM | 18 |
| 27 | COPERNICUS EMERGENCY MANAGEMENT SERVICE (CEMS) | 18 |
| 28 | . GRAPHITE | 19 |
| 29 | ZERO DEBRIS CHARTER | 19 |
| 30 |). SQUARE KILOMETRE ARRAY (SKA) | 21 |
| 31 | .CARBON FIBER | 21 |
| 32 | . PREFIRE (POLAR RADIANT ENERGY IN THE FAR INFRARED EXPERIMENT) | 22 |
| 33 | . IN-SPACe | 23 |
| 34 | . GOLDEN RICE | 23 |
| 35 | . DJIBOUTI RELEASES GM MOSQUITOES TO FIGHT MALARIA | 24 |
| JUNE | 2024 | 25 |
| 1.1 | MICROCEPHALY | 25 |
| 2.1 | | 25 |
| 2.1 | IAMES WERE SPACE TELESCOPE SPOTS FARLIEST-KNOWN GALAXY | 26 |
| л. Л. (| CHANG'E-6 CRAFT | 20 |
| 5.0 | | 27 |
| 5. | | 27 |
| 0./ | ADITIA-LI MISSION | 20 |
| 7.0 | | 20 |
| 8.0 | | 29 |
| 9./ | | 29 |
| 10 | I. DRUGS CONTROLLER GENERAL OF INDIA (DCGI) | 30 |
| 11 | .PUSHPAK KEUSABLE LANDING VEHICLE (KLV) | 31 |
| 12 | | 31 |
| 13 | S.STREPTOCOCCAL TOXIC SHOCK SYNDROME (STSS) | 31 |
| 14 | .DIGI YATKA | 32 |
| 15 | .VOYAGER 1 | 32 |

| 16.NAGASTRA-1 | |
|---|----|
| 17. INNOVATIONS FOR DEFENCE EXCELLENCE (IDEX) | |
| JULY 2024 | |
| 1.GSAT-20 | |
| 2.PROJECT-751 | |
| 3.MARS ODYSSEY | |
| 4.ADITYA-L1 | |
| 5.HOLOGRAM TECHNOLOGY | |
| 6.AXIOM-4 | |
| 7.SHIGELLA INFECTION | |
| 8.CHOLERA | |
| 9.THE CREW HEALTH AND PERFORMANCE EXPLORATION ANALOG (CHAPEA) | |
| 10.CHANDIPURA VIRUS INFECTION (CHPV) | |
| 11.COALITION OF EPIDEMIC PREPAREDNESS INNOVATIONS (CEPI) | |
| 12.NATIONAL QUANTUM MISSION (NQM) | |
| 13.SAGITTARIUS A* | |
| 14.NIPAH VIRUS | |
| 15.INS BRAHMAPUTRA | |
| 16.NASA'S PERSEVERANCE ROVER | |
| 17.INTEGRATED DISEASE SURVEILLANCE PROGRAMME (IDSP) | |
| 18.THE DEFENCE ACQUISITION COUNCIL (DAC) | |
| AUGUST 2024 | 45 |
| 1. LIGHT COMBAT AIRCRAFT TEJAS | |
| 2.INDIAN NAVAL SUBMARINE (INS) SHALKI | |
| 3.EARTH OBSERVATION SATELLITE-8 (EOS-8) | |
| 4.NEUTRON STARS | |
| 5.MPOX | |
| 6.DENGUE FEVER | |
| 7.DIRECTORATE GENERAL OF QUALITY ASSURANCE (DGQA) | |
| 8.POLIOMYELITIS (POLIO) | |
| 9. JUPITER ICY MOONS EXPLORER (JUICE) | |
| 10.ATOMIC POWER STATIONS | |
| 11.TANAGER-1 | |
| 12.CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO) | |
| 11.TANAGER-1 | 53 |
| 12.CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO) | |
| SEPTEMBER 2024 | 55 |
| 1. DRUGS AND COSMETICS ACT, 1940 | 55 |
| 2. DRUG REPURPOSING | |
| 3. HEPATITIS | |
| 4. HELIUM | |
| 5. Vishvasya-Blockchain Technology Stack | |
| 6. DIGITAL PUBLIC INFRASTRUCTURE (DPI) | |
| 7. POLARIS DAWN MISSION | |
| 8. MINI MOON | |
| 9. SQUARE KILOMETRE ARRAY (SKA) | |
| 10. VENUS | |
| 11. QUANTUM TECHNOLOGY | |
| 12. NATIONAL QUANTUM MISSION (NQM) | |
| 13. DENGUE | 59 |
| 14. PARAM RUDRA | 59 |
| 15. CHIKUNGUNYA | 59 |
| | |

| 16. THERMOBARIC WEAPONS | 60 |
|--|----|
| OCTOBER 2024 | |
| 1. MARBURG VIRUS | |
| 2. AKASHTEER SYSTEMS | |
| 3. PROGERIA | |
| 4. MICRORNAS | |
| 5. TRACHOMA | |
| 6. 2024 CHEMISTRY NOBEL | |
| 7. CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO) | |
| 8. EUROPA CLIPPER MISSION | |
| 9. OSSIFICATION TEST | |
| 10. DIPHTHERIA | |
| 11. INDIAN PHARMACOPOEIA (IP) | |
| 12. TROJAN ASTEROIDS | |
| 13. KALA-AZAR | |
| 14. MOONLIGHT PROGRAMME | |
| 15. INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) | |
| 16. RISE MISSION | |
| 17. BETELGEUSE | |
| NOVEMBER 2024 | |
| 1. ARTEMIS III | 69 |
| 2 LIDAR | 69 |
| 3 ADITYA-I 1 MISSION | 70 |
| 4 GLOBAL HEALTH EMERGENCY CORPS | 70 |
| 5. OBPHAN DRUGS | |
| 6. LID-568 | |
| 7 LASSA FFVFR | 72 |
| 8. TITANIUM | |
| 9. ALLULOSE | |
| 10. CYANOBACTERIA | |
| 11. RNA EDITING | |
| 12. GLUTEN | |
| 13. VOYAGER 2 | |
| 14. WALKING PNEUMONIA | |
| 15. WORLD DIABETES DAY | |
| 16. ONE DAY ONE GENOME INITIATIVE | |
| 17. VIKING MISSION | |
| 18. IN - SPACE | |
| 19. KYASANUR FOREST DISEASE (KFD) | |
| 20. PROBA 3 | |
| 21. TUNGSTEN | |
| DECEMBER 2024 | |
| | 80 |
| 2 ΑΝΤΗΡΑΧ | 80 |
| 3 COPERNICUS PROGRAM | 80 |
| 4. MARBURG VIRUS DISEASE (MVD) | |
| 5. DISEASE X | |
| 6. WILLOW CHIP | |
| 7. INFRARED RADIATION | |
| 8. SPADEX MISSION | |
| 9. BIO-BITUMEN | |
| 10. GENCAST | |
| | |

| 11. PARKER SOLAR PROBE | |
|--|-----|
| JANUARY 2025 | |
| 1. UNDERWATER TELESCOPES TO DETECT 'GHOST PARTICLES' | |
| 2. NOROVIRUS | |
| 3. PIG-BUTCHERING SCAM | |
| 4. GENOME INDIA PROJECT | |
| 5. FIREFLY SATELLITE CONSTELLATION | |
| 6. SCRAMJET- SUPERSONIC COMBUSTION RAMJET | |
| 7. FENTANYL | |
| 8. VIKAS ENGINE | |
| 9. GUILLAIN-BARRE SYNDROME | |
| 10. ASTEROID | |
| 11. ORGANOPHOSPHATE | |
| 12. SLEEPING SICKNESS | |
| 13. NUCLEAR FUSION | |
| FEBRUARY 2025 | |
| 1. GRAPHICS PROCESSING UNITS (GPU) | |
| 2. SMALL MODULAR REACTORS (SMRS) | |
| 3. SAMUDRAYAAN MISSION | |
| 4. SUZETRIGNE | |
| 5. 2024 YR4 | |
| 6. NAVIGATION WITH INDIA CONSTELLATION (NAVIC) | |
| 7. GARBHINI-DRISHTI | |
| 8. EBOLA VIRUS | |
| 9. CO2 BATTERY | |
| 10. BOMBAY BLOOD GROUP | |
| 11. NEUTRINOS AND ANTI-NEUTRINOS | |
| 12. SHIV SHAKTI POINT | |
| 13. SHATAVARI | |
| 14. GRAPHENE | 100 |
| 15. LYMPHATIC FILARIASIS (LF) | 100 |
| 16. MALARIA | 101 |
| 17. EINSTEIN RING | 101 |
| 18. JAGADISH CHANDRA BOSE | 102 |
| 19. DISTRIBUTED DENIAL OF SERVICE (DDOS) ATTACK | 102 |
| 20. INDIRECT PROMPT INJECTION ATTACKS | 103 |
| 21. PROJECT WATERWORTH | 103 |
| 22. EXPERIMENTAL ADVANCED SUPERCONDUCTING TOKAMAK (EAST) | 104 |
| 23. EVO 2 | 104 |
| 24. MAJORANA 1 | 105 |
| 25. SELENIUM | 105 |
| 26. PUNCH MISSION | 106 |
| 26. SPHEREX | 106 |



SCIENCE AND TECHNOLOGY



1. GLOBAL LEADERS GROUP ON ANTIMICROBIAL RESISTANCE

- The European Society for Clinical Microbiology and Infectious Diseases (ESCMID) and the Global Leaders Group (GLG) on Antimicrobial Resistance (AMR) recently organized a high-level event titled "Forging Partnerships Between Science and Policy" and it was held in Barcelona, Spain.
- > The Global Leaders Group on Antimicrobial Resistance (GLG) is a collective of world leaders and experts from various sectors united to expedite political action against AMR.
- The GLG was established in 2020, following the recommendation of the Interagency Coordination Group (IACG) on AMR.
- > Antimicrobial Resistance (AMR):
- Antimicrobial Resistance (AMR) is the ability of microbes, such as bacteria, to resist the effects of drugs that were once effective against them.
- These drug-resistant microbes are often called 'superbugs'.
- > While AMR is a natural phenomenon, its main cause is the use of antimicrobial drugs.

2. SALMONELLA

- Salmonella is a group of bacteria that can cause gastrointestinal illness and fever, a condition known as salmonellosis.
- > These bacteria **naturally reside in animals' intestines** and can be found in their faeces.
- Humans can contract salmonella if they come into contact with infected animals or contaminated items in their environment.
- This ubiquitous and hardy bacteria can survive for several weeks in a dry environment and several months in water.
- > People infected with salmonella might experience diarrhea, fever, and stomach cramps.

3.BIOHACKING

- Recently, the Biohacking India 2.0 event took place in New Delhi.
- Biohacking refers to the practice of using science and technology to optimize and enhance the human body's performance and well-being.
- It includes practices aimed at improving physical and mental performance, longevity, and overall wellbeing.
- Currently, there are no laws in India that specifically address biohacking.
- > Techniques :
- Dietary Modifications: Implementing diets like ketogenic or intermittent fasting to boost energy and health.
- Supplementation: Using vitamins, minerals, or nootropics to enhance cognitive function and physical performance.
- > Physical Training: Customized exercise routines to build strength and endurance.
- Sleep Optimization: Techniques to improve sleep quality and duration.

- > Mindfulness Practices: Meditation and deep breathing exercises for mental well-being.
- **Biometric Monitoring:** Using devices to track health metrics for insights into health and performance.
- > **Biofeedback Devices:** Devices to train the body's physiological responses.

4. SUPERSONIC MISSILE-ASSISTED RELEASE OF TORPEDO (SMART) SYSTEM

- The SMART system is designed and developed by the Defence Research and Development Organisation (DRDO).
- It serves as a next-generation missile-based lightweight torpedo delivery system.
- The primary objective of SMART is to enhance the anti-submarine warfare (ASW) capability of the Indian Navy beyond the conventional range of lightweight torpedoes.
- Key Features: Canisterized Hybrid System and Quick Reaction System

5. CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO)

- Starting from May 15, 2024, the Central Drugs Standard Control Organisation (CDSCO) will be the sole authority responsible for granting no-objection certificates (NOCs) to pharmaceutical companies that manufacture drugs.
 - The CDSCO is the Central Drug Authority responsible for discharging functions assigned to the Central Government under the Drugs and Cosmetics Act of 1940.
- It operates under the Ministry of Health & Family Welfare and serves as the National Regulatory Authority (NRA) for India.
- CDSCO's responsibilities include: Approval of Drugs, Clinical Trials, Setting Standards for Drugs, Quality Control of Imported Drugs, Coordination with State Drug Control Organizations, Specialized Licenses, Medical Devices Oversight
- Drugs Controller General of India (DCGI): The DCGI is the head of the CDSCO department. DCGI approves licenses for specific categories of drugs, including blood products, IV fluids, vaccines, and sera in India. Additionally, DCGI sets standards for drug manufacturing, sales, import, and distribution within the country.

6. OXYTOCIN

- Oxytocin, often referred to as the "love hormone," is a crucial hormone produced in the brain's hypothalamus and secreted by the pituitary gland in mammals during various physiological processes.
- > It plays dual roles as both a hormone and a neurotransmitter.
- > Functions:
- > Oxytocin helps contract the uterus during labour, facilitating childbirth.
- It promotes the release of breast milk.
- > Oxytocin is associated with social interactions, trust, and emotional bonding.
- Misuse in Dairy Industry to increase milk production. The same hormone, when consumed through milk, can affect human health.
- In April 2018, the Indian government banned the use of oxytocin on milch cattle due to these concerns. The administration of oxytocin is considered as an "animal cruelty" and a cognizable offense under Section 12 of the Prevention of Cruelty to Animals Act, 1960.
- > Alternative Solution:

Carbetocin, a WHO-recommended alternative to oxytocin, is more stable, effective at higher temperatures, and retains efficacy for three years at 30°C and 75% humidity.

7. WEST NILE FEVER

- Multiple cases of West Nile fever reported in Kerala
- > West Nile Fever (WNV) is an infectious disease caused by the West Nile virus (WNV).
- West Nile virus belongs to the flavivirus family and is related to viruses that cause other diseases such as St. Louis encephalitis, Japanese encephalitis, and yellow fever.
- > It is a mosquito-borne, single-stranded RNA virus.



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> Global Prevalence:

- > WNV outbreaks occur along major bird migratory routes.
- The virus was first identified in Uganda in 1937 and has since been found in various regions including Europe, Africa, Asia, Australia, and North America.
- The virus is commonly found in regions including Africa, Europe, the Middle East, North America, and West Asia.
- > Prevalence in India:
- > In India, WNV activity has been reported in southern, central, and western regions.
- > Antibodies against WNV were first detected in humans in Mumbai in 1952.
- WNV has been isolated from mosquitoes in Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka and Kerala.
- > Transmission Cycle:
- > The principal vector for transmission is the Culex species of mosquitoes.
- Birds act as reservoir hosts for the virus.
- > Infected mosquitoes transmit WNV between humans and animals, including birds.
- Prevention and Control:
- There is currently no vaccine available for humans; therefore, prevention and supportive care are key in managing the risk and impact of this disease.
- Preventive measures include mosquito control, avoiding mosquito bites, and monitoring bird populations.

8. FOOT ROT (BAKANE DISEASE)

- The Punjab Agricultural University (PAU), Ludhiana, has developed biocontrol agent Trichoderma asperellum (2% WP), and registered it with the Central Insecticides Board and Registration Committee (CIBRC)
- Foot Rot, also known as Bakanae Disease, is a significant fungal disease affecting rice, particularly the Basmati variety.
- > Foot Rot is caused by the fungus Gibberella fujikuroi (also known as Fusarium monoliforme).
- > It primarily affects the **roots and basal stems of rice plants.**
- > The disease is characterized by:
- Abnormal elongation of seedlings
- Seedlings turning pale yellow
- Eventually, the seedlings dry up and die
- Foot Rot not only affects yield but also poses health risks due to mycotoxin contamination in the affected rice grains.
- > Management:
- Historically, chemical fungicides were used to manage Foot Rot. However, their environmental impact and residue concerns have led to the search for alternative solutions.
- The recent registration of Trichoderma asperellum 2% WP by Ludhiana's Punjab Agricultural University (PAU) offers an eco-friendly approach. Trichoderma, when applied to seeds or seedlings, can suppress the growth of the Foot Rot pathogen.
- Crop rotation, proper drainage, and avoiding waterlogged conditions can help reduce disease incidence.

9. SICKLE CELL DISEASE

- Recently, a 12-year-old boy from USA, became the first person in the world with sickle cell disease to
- begin a commercially approved gene therapy that may cure the condition.
- Sickle Cell Disease (SCD) is a chronic single gene disorder that affects the structure of haemoglobin, the molecule responsible for carrying oxygen in red blood cells (RBCs).
- People with SCD have atypical haemoglobin molecules called haemoglobin S, which can distort RBCs into a sickle or crescent shape.
- This distortion leads to several complications, including chronic anaemia, acute painful episodes (known as sickle cell crises), organ infarction (tissue damage due to blocked blood flow), and chronic organ damage.
- > Unfortunately, SCD significantly reduces life expectancy for affected individuals.
 - Treatment Options:
- > Blood Transfusions: These helps relieve anaemia and reduce the risk of pain crises.
- Hydroxyurea: A medication that reduces the frequency of painful episodes and prevents long-term complications.
- Bone Marrow or Stem Cell Transplantation: In some cases, this approach can be used to replace the defective stem cells with healthy ones.
 - Government Initiatives in India:
- The National Health Mission in India supports states in preventing and managing Sickle Cell Disease (SCD).
- > The government aims to eliminate Sickle Cell Anaemia by 2047.

Technical operational guidelines have been released for prevention and control of hemoglobinopathies, including sickle cell anaemia.

10. KAWASAKI DISEASE

- > Kawasaki disease is a rare but serious condition that primarily affects children **under the age of 5.**
- It's also known as mucocutaneous lymph node syndrome.
- > Kawasaki disease can lead to complications, particularly affecting the heart.
- If untreated for a prolonged period it may lead to heart complications such as inflammation of the coronary artery, inflammation of heart muscles, problems associated with heart valves, and weakening of the blood walls in the heart.
- Treatment usually involves intravenous immunoglobulin (IVIG) to reduce inflammation and fever, along with aspirin to prevent blood clots.
- Early diagnosis and treatment are crucial to reduce the risk of complications, especially involving the heart.
- It is not an infectious disease, that is, it does not spread between people
- The cause is not fully understood, but it's believed to involve an abnormal immune response triggered by an infection or other environmental factors in genetically predisposed individuals.

> Symptoms

- Symptoms of Kawasaki disease include a fever greater than 102.2 degrees Fahrenheit (39 degrees Celsius) for five or more days. And the child has at least four of the following symptoms:
- > A rash on the main part of the body or in the genital area.
- > An enlarged lymph node in the neck.
- Very red eyes without a thick discharge.
- Red, dry, cracked lips and a red, swollen tongue.
- Swollen, red skin on the palms of the hands and the soles of the feet. Later the skin on fingers and toes peels.
- > Other symptoms might include:Belly pain, Diarrhea, Fussiness, Joint pain, Vomiting.
- Risk factors include:
- Age: Children below 5 years are at high risk
- Gender: Boys are more likely than girls to develop Kawasaki disease
- > Ethnicity: Japanese or Korean children are at higher risk to develop Kawasaki disease

11. Auroras (Northern and Southern lights)

- The night sky was lit up by northern lights, or aurora borealis, at Hanle village in Ladakh. Northern lights were also witnessed in other parts of the world, including in the United States and the United Kingdom. Meanwhile, southern lights, or aurora australis, were spotted in countries such as New Zealand and Australia.
- Auroras are essentially natural lights that appear as bright, swirling curtains in the night sky and can be seen in a range of colours, including blue, red, yellow, green, and orange.
- These lights primarily appear near the **poles** of both the northern and southern hemispheres all year round but sometimes they expand to lower latitudes.
- In the north, the display is called the aurora borealis (Northern lights); in the south, it is known as the aurora australis (Southern lights).
- Why do auroras occur?

- It is due to activity on the surface of the Sun. The star continuously releases a stream of charged particles, mainly electrons and protons, and magnetic fields called the solar wind.
- As the solar wind approaches the Earth, it is deflected by the planet's magnetic field, which acts like a protective shield.
- However, some of the charged particles are trapped in the magnetic field and they travel down the magnetic field lines at the north and south poles into the upper atmosphere of the Earth.
- These particles then interact with different gases present there, resulting in tiny flashes that light up the night sky. When solar wind particles collide with oxygen, a green colour light is produced. Interaction with nitrogen produces shades of blue and purple.
- Auroras expand to midlatitudes when the solar wind is extremely strong. This happens when the activity on the Sun's surface goes up, leading to solar flares and coronal mass ejections (CMEs), which are essentially extra bursts of energy in the solar wind.
- In such cases, the solar wind is so intense that it can result in a geomagnetic storm, also known as a magnetic storm a temporary disturbance of the Earth's magnetic field. It is during a magnetic storm that auroras can be seen in the mid-latitudes.
- One such geomagnetic storm was kicked off on Friday after a CME hit the Earth. That's why auroras were visible in several parts of the world.
- Geomagnetic storms can also affect space-dependent operations like Global Positioning Systems (GPS), radio and satellite communications, flight operations, power grids, and space exploration programmes.

12. LITHIUM

- > Lithium is a chemical element with the symbol Li and atomic number 3.
- > It is a soft, silvery-white alkali metal that is highly reactive and flammable.
- Lithium is the most important mineral for the energy transition, a fundamental component of lithiumion batteries, which power electric vehicles and battery energy storage systems.
- > India is **100 per cent** reliant on imports for its lithium.
- > Physical Properties:
- Lithium is a silvery-white metal.
- > It has a standard atomic weight of approximately 6.94.
- Lithium is the lightest metal and the lightest solid element, and it is known for its low density and high electrochemical potential.
- > At standard temperature and pressure, lithium is a solid.
- It has a melting point of 180.50 °C (356.90 °F) and a boiling point of 1330 °C (2426 °F).
- > Chemical Properties:
- Lithium is part of the alkali metal group and has a single valence electron in its outer shell, which it readily donates to form cations and ionic bonds.
- Occurrence and Production:
- Lithium occurs in a number of pegmatitic minerals, but is also commonly obtained from brines and clays.
- > It's extracted commercially from spodumene and lepidolite.
- Lithium reserves are primarily found in salt flats (salars), particularly in countries like Chile, Argentina, Australia, and China.

Uses:

- Lithium and its compounds have several industrial applications, including heat-resistant glass and ceramics, lithium grease lubricants, flux additives for iron, steel and aluminium production, lithium batteries, and lithium-ion batteries.
- > Lithium is also used in the treatment of bipolar disorder.
- > Safety Precautions:
- > Lithium is corrosive and requires special handling to avoid skin contact.
- Ingesting lithium can be fatal. Lithium toxicity, which occurs at only slightly higher doses than the medicinal levels, can cause drowsiness, slurred speech, and even seizures.

13.KAMIKAZE DRONE

- Kadet Defence Systems (P) in collaboration with the Defence Research Development Organisation (DRDO)—has developed the country first Kamikaze drones or Loitering Aerial Munitions (LAM) for the armed forces.
- A Kamikaze Drone, also known as a suicide drone or a loitering munition, is a type of unmanned aerial vehicle (UAV) that is specifically designed to carry out a one-time attack on a target.
- > The name comes from the World War 2 era's feared Japanese kamikaze pilots, who conducted suicide attacks by intentionally crashing their explosive filled aircraft into enemy targets.
- Unlike traditional drones that are used for surveillance or remote strikes, kamikaze drones are intended to be employed as a direct offensive weapon.
- These drones are typically designed to loiter around a target area until a target is located, then attack the target by crashing into it.
- > They enable faster reaction times against hidden targets that emerge for short periods without placing high-value platforms near the target area.
- > They also allow more selective targeting as the attack can be changed mid-flight or aborted.
- Interestingly, India has developed its first kamikaze drone, and the armed forces have already ordered 24 of these suicide drones, to be supplied in 2024.
- Multiple versions of the indigenously designed, developed, and India-manufactured Loitering Aerial Munitions (LAM) systems are being developed to meet different operational requirements.
- > Which other countries have such drones?
- Although the US Kamikaze might be the most advanced in this class of drones, Russia, China, Israel, Iran and Turkey all have some versions of it.
- There have been also multiple occasions where Russia has used such suicide drones to launch attacks in Ukraine following their invasion. Iranian-backed Houthi rebels also used them to blow up Saudi oil facilities in 2019.

14.OLEANDER FLOWERS

- Nerium oleander, commonly known as oleander or rosebay, is a plant cultivated worldwide in tropical, subtropical, and temperate regions.
- Known for its drought tolerance, the shrub is often used for ornamental and landscaping purposes.
- In Kerala, the plant is known by the names of arali and kanaveeram and is grown along highways and beaches as a natural, green fencing. There are different varieties of oleander, each with a flower of a different colour

- The Ayurvedic Pharmacopoeia of India (API), a government document that describes the quality, purity, and strength of drugs used in Ayurveda, mentions oleander. According to API, an oil prepared from the root bark can be used to treat skin diseases.
- Charka [Charak Samhita] has prescribed the leaves of white-flowered variety externally in chronic and obstinate skin diseases of serious nature including leprosy.
- Bhavaprakasha has described Karvira [another name of the plant] as a visha (poison) and indicated it in treatment of vrana (infected wounds), kustha (skin diseases including leprosy), krimi (microbes and parasites), kandu (itching) etc
- Ingestion or inhalation of smoke from burning oleander can be intoxicating. This is due to the properties of cardiac glycosides (a type of chemical) including oleandrin, folinerin, and digitoxigenin, which are present in all parts of the plant.
- Cardiac glycosides are steroidal compounds capable of exerting pharmacological effects on cardiac muscle. The primary therapeutic value of these glycosides lies in their ability to exert profound tonic effects on the heart [stronger and faster heart contractions].
- Effects of oleander toxicity include nausea, diarrhea, vomiting, rashes, confusion, dizziness, irregular heartbeat, slow heartbeat, and, in extreme cases, death.

15. ZERO-DAY VULNERABILITY.

- **Google** released a security update for Chrome to fix a zero-day vulnerability.
- > A Zero-Day Vulnerability is an undiscovered flaw in an application or operating system.
- The term "Zero day" refers to the fact that the software or device vendor has zero days to fix the flaw because malicious actors can already use it to access vulnerable systems. The unknown or unaddressed vulnerability is referred to as a zero-day vulnerability or zero-day threat.
- A Zero-Day Exploit is a cyberattack vector that takes advantage of this unknown or unaddressed security flaw. A zero-day attack is when a malicious actor uses a zero-day exploit to plant malware, steal data, or otherwise cause damage to users, organizations, or systems.
- Zero-day vulnerabilities—especially in widely-used operating systems or computing devices—are a severe security risk. They leave huge numbers of users or entire organizations wide open to cybercrime until the vendor or the cybersecurity community identifies the problem and releases a solution.
- A similar but separate concept, Zero-Day Malware, is a virus or malware for which the signature is unknown or as yet unavailable, and therefore undetectable by many antivirus software solutions or other signature-based threat detection technologies.

16.GEOMAGNETIC STORM

- A Geomagnetic storm, also known as a magnetic storm, is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave.
- The disturbance that drives the magnetic storm may be a solar coronal mass ejection (CME) or a corotating interaction region (CIR), a high-speed stream of solar wind originating from a coronal hole.
- The frequency of geomagnetic storms increases and decreases with the sunspot cycle. During solar maximum, geomagnetic storms occur more often, with the majority driven by CMEs.
- > The increase in the solar wind pressure initially compresses the magnetosphere.
- The solar wind's magnetic field interacts with the Earth's magnetic field and transfers an increased energy into the magnetosphere. Both interactions cause an increase in plasma movement through

the magnetosphere (driven by increased electric fields inside the magnetosphere) and an increase in electric current in the magnetosphere and ionosphere.

- During the main phase of a geomagnetic storm, electric current in the magnetosphere creates a magnetic force that pushes out the boundary between the magnetosphere and the solar wind.
- Several space weather phenomena tend to be associated with or are caused by a geomagnetic storm. These include solar energetic particle (SEP) events, geomagnetically induced currents (GIC), ionospheric storms and its disturbances that cause radio and radar scintillation, disruption of navigation by magnetic compass and auroral displays at much lower latitudes than normal.

17. XENOTRANSPLANTATION

- The first recipient of a modified pig kidney transplant passed away on May, around two months after the surgery was carried out.
- Xenotransplantation, derived from the Greek word "xenos" meaning "foreign" or "strange", is the transplantation of living cells, tissues, or organs from one species to another. The transplanted cells, tissues, or organs are referred to as xenografts or xenotransplants.
- This process is contrasted with allotransplantation (the transplantation from one individual to another of the same species with a different genotype), syngeneic transplantation or isotransplantation (transplants between two genetically identical individuals of the same species), and autotransplantation (transplants from one part of the body to another in the same person)
- Xenotransplantation involving the heart was first tried in humans in the 1980s. The need for such a procedure was felt because of the significant gap between the number of transplantations needed by patients and the availability of donor organs.
- > It offers a potential treatment for end-stage organ failure.
- A report from the Harvard Medical School, whose physicians were involved in Slayman's operation, said 69 genomic edits were made to the pig kidney in his case. The gene editing technology CRISPR-Cas9 was employed to "Remove certain pig genes that produce sugars with antibodies our immune systems react to" and "Add certain human genes to improve the kidney's compatibility with humans."
- Pig heart valves have been used for replacing damaged valves in humans for over 50 years now. 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.
- In January 2022, the first xenotransplantation of a genetically-modified pig heart was done. However, the patient passed away after two months due to a range of factors, including being tainted with a latent virus in the pig heart, which may have contributed to the dysfunction of the transplant.

18. 55 CANCRI E

- A thick atmosphere has been detected around a planet that's twice as big as Earth in a nearby solar system. The so-called super Earth known as **55 Cancri e** is among the few rocky planets outside our solar system with a significant atmosphere, wrapped a blanket of carbon dioxide and carbon monoxide.
- > 55 Cancri e, also known as Janssen, is an **exoplanet** that orbits a Sun-like host star, 55 Cancri A.
- The planet is located in our Milky Way galaxy about 41 light-years from Earth, in the constellation Cancer. A light year is the distance light travels in a year, 5.9 trillion miles (9.5 trillion km). Four other planets, all gas giants, are known to orbit its host star.
- It was discovered on August 30, 2004. It was the first super-Earth discovered around a main sequence star.

- The mass of the exoplanet is about eight Earth masses and its diameter is about twice that of the Earth.
- > It is the innermost planet in its planetary system, taking less than 18 hours to complete an orbit.
- Due to its proximity to its star, 55 Cancri e is extremely hot, with temperatures on the day side exceeding 3,000 Kelvin.
- Infrared observations using two instruments aboard the James Webb Space Telescope indicated the presence of a substantial if inhospitable atmosphere, perhaps continuously replenished by gases released from a vast ocean of magma.
- Being so close to its star, any atmosphere should be stripped away by stellar irradiation and winds. But gases dissolved in the vast lava ocean thought to cover the planet may keep bubbling up to replenish the atmosphere
- > All of the previous exoplanets found to have atmospheres were gaseous planets, not rocky ones
- An exoplanet is any planet beyond our solar system. Most orbit other stars, but free-floating exoplanets, called rogue planets, orbit the galactic center and are untethered to any star.

19. KEELING CURVE

- The Keeling Curve is a graph that represents the concentration of carbon dioxide (CO2) in Earth's atmosphere.
- It is based on continuous measurements taken at the Mauna Loa Observatory on the island of Hawaii from 1958 to the present day.
- It is the longest uninterrupted instrumental record of atmospheric CO2 in the world, and it is commonly regarded as one of the best and most recognizable products of a long-term scientific study.
- The curve is named after the scientist Charles David Keeling, who started the monitoring program and supervised it.
- Keeling's measurements showed the first significant evidence of rapidly increasing carbon dioxide (CO2) levels in the atmosphere.
- The Keeling Curve shows both the seasonal and annual changes in atmospheric carbon dioxide concentrations.
- During the spring and summer months, plants absorb CO2 for photosynthesis which causes a temporary dip in the curve. In the fall and winter, when many plants die off and decompose, releasing CO2 back into the atmosphere, the curve goes back up.

20. FLiRT

- The new coronavirus variant called KP.2 nicknamed FLiRT that has been linked to rising cases of Covid-19 in the United States, United Kingdom, and South Korea, has been in circulation in India since November 2023, genomic surveillance data show.
- KP.2 is a descendant of the JN.1 variant of the virus. It is a sub-variant of the Omicron lineage with new mutations.
- FLIRT, the nickname of KP.2, is based on the letters representing two immune escape mutations that allow the virus to evade antibodies.
- FLIRT is characterised by its ability to evade immunity from vaccines and previous infections. Its symptoms are similar to those of earlier variants, including fever, cough, fatigue, and digestive issues.
- The US Center for Disease Control and Prevention (CDC) notes that there are currently no indicators suggesting that KP.2 would cause more severe illness than other strains.

- However, FLIRT has a heightened transmission rate and, like its parent JN.1, it is likely to drive a wave of infections. Also, the infections are likely to spread silently because without severe symptoms, most people are unlikely to get themselves tested.
 - India's Case
- ➤ A little more than half of the 250 KP.2 genomes sequenced by INSACOG 128 sequences were from Maharashtra. The highest number of KP.2 sequences were found in March.
- India has been reporting the highest proportion of KP.2 sequences in the world, global data show.
- KP.2 sequences made up 29% of Covid-19 sequences uploaded by India to the Global Initiative on Sharing All Influenza Data (GISAID), the world's largest repository of these sequences, over the last 60 days.
- ▶ However, JN.1 continues to be the dominant variant of SARS-CoV-2 in the country.

21. SOIL NAILING AND HYDROSEEDING

- > Tamil Nadu is using soil nailing and hydro seeding measures to prevent landslips in Nilgiri's.
- Soil nailing and hydroseeding are both techniques commonly used in civil engineering and landscaping for soil stabilization and erosion control.
- Soil nailing is a technique used to reinforce and stabilize soil slopes, excavations, and retaining walls.
- It involves the insertion of relatively slender reinforcing elements (usually steel bars or rods) into the ground at predetermined angles and spacing. These elements, known as nails or soil nails, are typically installed into pre-drilled holes and then grouted into place. The nails provide additional support to the soil mass, preventing slope failure or collapse.
- Soil nailing is commonly used in situations where traditional retaining wall structures may be impractical or too costly.
- It's often employed in road and railway construction, mining operations, and for stabilizing slopes in urban areas.
- The technique can be particularly effective in areas with soft or loose soils, where stability is a concern.
- Hydroseeding is a method used for establishing vegetation, controlling erosion, and reclaiming disturbed land.
- It involves spraying a slurry mixture onto the ground, typically consisting of seed, fertilizer, mulch, and sometimes tackifiers or soil stabilizers, combined with water. The slurry is applied using specialized hydroseeding equipment, which evenly distributes the mixture over the target area. It facilitate the growth of grass and plant-life, that will help hold the top soil together and prevent erosion.
- Hydroseeding offers several advantages over traditional seeding methods. It provides better seedto-soil contact, which promotes faster germination and more uniform growth. The mulch in the slurry helps retain moisture and protect the seeds from erosion and environmental stressors.
- Hydroseeding allows for large areas to be seeded quickly and efficiently, making it a popular choice for landscaping, reclamation projects, and erosion control on construction sites.

22.MERCURY POLLUTION

- The Governments of Albania, Burkina Faso, India, Montenegro and Uganda have united to combat chemical pollution, launching a \$134-million 'Phasing out mercury measuring devices in healthcare' project to eliminate the use of mercury in medical devices.
- Mercury is a chemical element symbolized by Hg on the periodic table. It's the only common metal that is liquid at ordinary temperatures. It's heavy, silvery-white, and slowly tarnishes in moist air.

- Mercury occurs naturally in the earth's crust, but human activities, such as mining and fossil fuel combustion, have led to widespread global mercury pollution.
- Mercury is a persistent, bioaccumulative, toxic pollutant. When released into the environment, it accumulates in water laid sediments where it converts into toxic methylmercury and enters the food chain. Mercury contamination is a significant public health and environmental problem because methylmercury easily enters the bloodstream and affects the brain.
- Mercury is introduced into the environment in three ways. First, mercury is emitted into the air naturally from volcanoes, the weathering of rocks, forest fires, and soils. Second, mercury is emitted into the air from the burning of fossil fuels and municipal or medical waste. Lastly, mercury can be reintroduced into the environment through natural processes such as evaporation of ocean water.
- Human exposure to mercury occurs from eating fish and shellfish contaminated with methylmercury.
- Mercury can also be found in beauty products, particularly skin-lightening creams, but also eye makeup and eye-cleansing products.
- Globally, artisanal and small-scale gold mining is the largest source of anthropogenic mercury emissions (37.7%), followed by stationary combustion of coal (21%).
- Medical thermometers and sphygmomanometers (devices which measure blood pressure) contain mercury and are harmless as long as they remain intact.
- However, when these devices break or are taken out of service, the mercury they contain can escape into the environment where it vaporises, exposing health care workers and patients to harmful fumes. Inhalation can cause damage to the lungs, kidneys and nervous system, while the waste generated can contaminate the immediate area of the spill, as well as a facility's wastewater.
- > Phasing out mercury measuring devices in healthcare project
- Led by the United Nations Environment Programme (UNEP), with funding from the Global Environment Facility (GEF) and executed by the World Health Organization (WHO), the Phasing out mercury measuring devices in healthcare project will develop and implement nation-wide strategies to stop the import, export and manufacture of thermometers and sphygmomanometers, encourage the adoption of accurate, affordable and safe mercury-free alternatives, while improving the management of mercury-containing medical waste.

23.BLUE ORIGIN'S NEW SHEPARD-25 MISSION

- Entrepreneur and pilot Gopichand Thotakura made history as the first Indian tourist to journey into space, during Sunday's Blue Origin's New Shepard-25 mission.
- > Blue Origin is the space tourism and exploration firm founded by billionaire Jeff Bezos
- > New Shepard is a fully reusable suborbital launch vehicle developed by Blue Origin for space tourism.
- Named after astronaut Alan Shepard, the first American in space and the fifth person to walk on the Moon, New Shepard is designed for vertical take-off and landings.
- During its 11-minute journey, astronauts soar past the Kármán line (100 km/62 miles), the internationally recognized boundary of space.
- > The vehicle is fully autonomous, with no pilots. The crew capsule, which seats six, features environmentally controlled comfort and some of the largest windows to have flown in space.

- New Shepard's BE-3PM engine uses highly efficient liquid oxygen and hydrogen, producing only water vapor as a byproduct during flight. Nearly 99% of New Shepard's dry mass is reused, making it an environmentally friendly choice for space travel.
- > Blue Origin NS-25 was launched on 19 May 2024.
- NS-25 was be the first crewed New Shepard flight since NS-22 in August 2022. The New Shepard fleet was grounded following a September 2022 engine failure on an uncrewed mission. The vehicle resumed flight in December 2023.

24.MALARIA VACCINE

- Serum Institute of India (SII), the world's largest manufacturer of vaccines by number of doses, marked a significant milestone with the shipment of the first set of R21/Matrix-M malaria vaccine to seven-eight countries in Africa.
- Malaria is a mosquito-borne infectious disease caused by parasites of the genus Plasmodium. Five species of Plasmodium commonly infect humans. The three species associated with more severe cases are P. falciparum (which is responsible for the vast majority of malaria deaths), P. vivax, and P. Knowlesi.
- The disease is widespread in the tropical and subtropical regions that exist in a broad band around the equator. This includes much of sub-Saharan Africa, Asia, and Latin America.
- It is spread exclusively through bites of infected female Anopheles mosquitoes. When an infected mosquito bites a person, it injects the malaria parasites into their bloodstream.
- Common symptoms include fever, chills, headache, muscle aches, and fatigue. Severe cases can lead to organ failure, coma, and death.
- > Prevention:
- Insecticide-treated bed nets are effective in preventing mosquito bites during sleep.
- Prophylactic antimalarial drugs can be taken by travelers to endemic areas.
- Recently, the WHO recommended the R21/Matrix-M vaccine for children, in addition to the RTS,S/AS01 vaccine. These vaccines aim to reduce malaria cases and deaths.
- Antimalarial medications, such as artemisinin-based combination therapies (ACTs), are used to treat malaria. Early diagnosis and prompt treatment are crucial.
- > The R21/Matrix-M vaccine is a promising addition to malaria prevention efforts. It's designed to protect against the Plasmodium falciparum parasite, which causes the most severe form of malaria.
- The R21 vaccine contains a protein from the malaria parasite (R21) combined with an adjuvant called Matrix-M. The adjuvant enhances the immune response.
- Clinical trials have shown that the R21/Matrix-M vaccine provides significant protection against malaria. It reduced the risk of symptomatic malaria by 75% in children during the 12 months following vaccination.
- > The vaccine is recommended for children aged 5 months and older.
- The vaccine is administered in a three-dose series, with the first two doses given one month apart and the third dose six months after the second.
- > The WHO's recommendation aims to accelerate the vaccine's deployment in malaria-endemic regions, particularly sub-Saharan Africa.
- The low-cost, high-efficacy R21/Matrix-M malaria vaccine was developed by the University of Oxford and SII leveraging Novavax's adjuvant technology.
- R21//Matrix-M vaccine is the second malaria vaccine to be authorised for use in children in malariaendemic regions.

25.INDIAN COUNCIL OF MEDICAL RESEARCH (ICMR)

- In 1911, the Government of India set up the Indian Research Fund Association (IRFA) with the specific objective of sponsoring and coordinating medical research in the country.
- After independence, it was redesignated as the Indian Council of Medical Research (ICMR) in 1949, with a considerably expanded scope of functions.
- > Apex body in India for formulation, coordination and promotion of biomedical research
- > Conduct, coordinate and implement medical research for the benefit of the Society
- Translating medical innovations in to products/processes and introducing them in to the public health system
- The ICMR is funded by the Government of India through the Department of Health Research, Ministry of Health and Family Welfare.
- In 2007, the organization established the Clinical Trials Registry India, which is India's national registry for clinical trials.
- ICMR's 26 national institutes address themselves to research on specific health topics like tuberculosis, leprosy, cholera and diarrhoeal diseases, viral diseases including AIDS, malaria, kalaazar, vector control, nutrition, food & drug toxicology, reproduction, immuno-haematology, oncology, medical statistics, etc.
- Its 6 regional medical research centres address themselves to regional health problems, and also aim to strengthen or generate research capabilities in different geographic areas of the country
- > The **governing body** of the council is presided over by the **union Health minister**.
- It is assisted in scientific and technical matters by a scientific advisory board comprising eminent experts in different biomedical disciplines. The board, in its turn, is assisted by a series of scientific advisory groups, scientific advisory committees, expert groups, task forces, steering committees etc. which evaluate and monitor different research activities of the council.

26.PIG BUTCHERING SCAM

- A pig butchering scam is a deceitful scheme where people are convinced to invest money, often in cryptocurrency, into what seems like a genuine opportunity.
- These scams are widespread and lead to big financial losses for victims worldwide, as the scammers disappear after collecting large sums of money.
- The term "pig butchering" refers to the process of fattening the victim emotionally before ultimately deceiving them financially. While these scams have been around for years, their prevalence has surged, particularly during the Covid-19 pandemic.
- Through dating apps, social media platforms, or other online avenues, perpetrators meticulously craft false identities and personas to establish trust and rapport with their victims.
- They manipulate victims into believing they have found genuine companionship through charming conversation and flattery. Over time, the fraudsters introduce investment opportunities that promise high returns with minimal risk.
- Once the victim is sufficiently invested emotionally, the scammers capitalise on their trust to persuade them to invest in fraudulent schemes, often involving cryptocurrencies or other speculative assets.

27.COPERNICUS EMERGENCY MANAGEMENT SERVICE (CEMS)

After the helicopter crash involving Iranian President Ebrahim Raisi, the European Union had activated its rapid response mapping service (CEMS) to assist in locating the Iranian leader.

- The Copernicus Emergency Management Service (EMS) is a service funded by the European Commission (EU) that provides timely and accurate geospatial information for disaster management, humanitarian crises, and man-made emergencies.
- The CEMS provides continuous observations and forecasts for droughts, floods, and forest fires at the global and European levels. The EMS also provides access to open data sources and in-situ data.
- CEMS provides maps and analyses based on satellite imagery. These maps can be generated before, during, or after a crisis.
- The service covers a wide range of disaster types, including extreme weather events, geophysical hazards (such as earthquakes), man-made disasters (like oil spills), and humanitarian crises.
- CEMS offers on-demand detailed information for selected emergency situations worldwide. This information is derived from satellite remote sensing and supplemented by available in situ or open data sources.
- Rapid Mapping provides geospatial information within hours or days of a service request. It supports emergency management activities immediately after a disaster occurs.
- This component supplies geospatial information for disaster management activities, including prevention, preparedness, risk reduction, and recovery phases.
- CEMS provides highly accurate and continuously updated information on the presence of human settlements and population using the Global Human Settlement Layer (GHSL).
- Population grids quantify the amount of people exposed to hazards, while built-up surface grids help estimate settlement typologies

28. GRAPHITE

- India is in talks with Sri Lanka to acquire graphite mines in the island nation.
- **Graphite** is a crystalline form of the element carbon.
- It consists of stacked layers of graphene. Graphite occurs naturally and is the most stable form of carbon under standard conditions.
- Key characteristics and uses of graphite:
- Graphite has a planar and layered structure. Each layer, known as graphene, has carbon atoms arranged in a honeycomb-like network. The layers can move past each other easily as they are held together by weak van der Waals bonds.
- Properties: Graphite is greyish black, opaque, and lighter than diamond. It is smooth and slippery to touch and is a good conductor of heat and electricity. It is soft due to weak Vander Waals forces and has a melting point of about 1800K.
- Uses: Graphite is consumed on a large scale for uses in pencils, lubricants, and electrodes. It also has high thermal and electrical conductivity and high thermal stability, making it useful in applications for processing materials at high temperatures.
- Types: There are two widely-known types of graphite: alpha and beta. They have almost the same material properties, but the layers of graphene stack a little differently.
- > Under high pressures and temperatures, graphite converts to diamond.
- > Graphite features on the list of 30 critical minerals, which was released by the government last year.
- Sri Lankan graphite is considered among the purest in the world with more than 98% carbon content.

29.ZERO DEBRIS CHARTER

On May 22, 2024, twelve nations signed the Zero Debris Charter at the ESA/EU Space Council, solidifying their commitment to the long-term sustainability of human activities in Earth orbit.

- The Zero Debris Charter is an initiative by the European Space Agency (ESA). It was unveiled at the ESA Space Summit in Seville in November 2023.
- Charter contains both high-level guiding principles and specific, jointly defined targets to get to Zero Debris by 2030.
- Space debris are defunct human-made objects in space principally in Earth orbit which no longer serve a useful function. These include derelict spacecraft, mission-related debris, fragmentation debris from the breakup of derelict rocket bodies and spacecraft. In addition to derelict human-made objects left in orbit, space debris includes fragments from disintegration, erosion, or collisions; solidified liquids expelled from spacecraft; unburned particles from solid rocket motors; and even paint flecks.
- Space debris represents a risk to spacecraft. Because of the high speeds at which objects orbit Earth, a collision with even a small piece of space debris can damage a spacecraft.
- In 1996, a French satellite was hit and damaged by debris from a French rocket that had exploded a decade earlier.
- In February, 2009, a defunct Russian spacecraft collided with and destroyed a functioning US Iridium commercial spacecraft. The collision added more than 2,300 pieces of large, trackable debris and many smaller debris to the inventory of space junk. The International Space Station (ISS) orbits Earth at an altitude of just over 400 km. In the two decades since its launch, about 30 'collision avoidance

| PARAGRAPH 1. Guiding principles | Recognise the following principles as guiding our collective endeavour towards space safety and sustainability: 1. Space debris should not be intentionally released during space activities and the unintentional generation of space debris should be minimised. 2. Adverse effects of space debris, including, but not restricted to, their impact on the population, infrastructures and the Earth environment when re-entering the atmosphere, and on dark and quiet skies, should be anticipated and mitigated to the greatest possible extent. 3. Constant and collaborative efforts should be made to improve our |
|---------------------------------------|--|
| | knowledge and understanding of the population of space debris of all sizes, our impact on it and its impact on us. |
| PARAGRAPH 2. | Commit to collectively contribute to the progressive achievement of the following targets for 2030, within our respective abilities and constraints: |
| Jointly defined targets | The probability of space debris generation through collisions and break- ups should remain below 1 in 1000 per object during the entire orbital lifetime. A suitable aggregate probability threshold for constellations of satellites in the low Earth orbit region should be identified. |
| | Timely clearance of low Earth orbit and geostationary Earth orbit regions should be achieved with a probability of success of at least 99% after end of mission, including through external means when necessary. |
| | The casualty risk from re-entering objects should remain significantly lower than 1 in 10 000, striving towards zero casualty. A suitable aggregate risk threshold for constellations of satellites in the low Earth orbit region should be identified. |
| | Routine and transparent information sharing should be facilitated and active participation in strengthening global space traffic coordination mechanisms should be encouraged. |
| | 5. Access to timely and accurate data on space objects down to a size of 5 cm or smaller in low Earth orbit and 20 cm or smaller in geostationary Earth orbit should be improved to enhance decision making capabilities for collision avoidance. |

manoeuvres' have been performed in order to dodge space debris, with three taking place in 2020 alone.

➢ Not only a hazard, space debris increases the cost for satellite operators. Satellite operators in the geostationary orbit have estimated protective and mitigation measures account for about 5-10 per cent of mission costs and for lower-Earth orbits the cost is higher.

> The Charter is needed because satellites in orbit underpin our modern lives. They are used for space science, Earth observation, meteorology, climate research, telecommunication, navigation and much more. However, swirling fragments of past space endeavours are trapped in orbit around Earth, threatening our future in space.

> The Zero Debris Charter aims to shape the global consensus on space sustainability.

➢ By gathering a wide and varied array of space entities to define ambitious and measurable space debris mitigation and remediation targets for 2030, the Zero Debris Charter has already built a diverse community of actors in Europe and beyond.

The charter is a non-legally binding agreement.

30. SQUARE KILOMETRE ARRAY (SKA)

- The first prototype dish antenna which will be replicated towards building the world's largest radio telescope has achieved results from the first light. Square Kilometre Array (SKA) Observatory is the proposed telescope which is being planned to be constructed across the two continents.
- The prototype, named SKAMPI, obtained the 'first light', that is the desired results during the testing phase. SKAMPI captured the images of the southern sky at 2.5GHz wavelength.
- The Square Kilometre Array (SKA) is an international radio telescope project being built in Australia (low-frequency) and South Africa (mid-frequency). The project is an intergovernmental effort to build the world's largest radio telescope.
- The combining infrastructure, the Square Kilometre Array Observatory (SKAO), and headquarters, are located at the Jodrell Bank Observatory in the United Kingdom.
- The telescopes will cover two different frequency ranges, and are named to reflect this. SKA-Mid, an array of 197 traditional dish antennas, is being built in South Africa's Karoo region, while SKA-Low, an array of 131,072 smaller tree-like antennas, is being built in Western Australia. The arrays will both be spread across large distances, with the most distant antennas being separated by 150 km in South Africa, and 74 km in Australia.
- Radio astronomy requires radio quietness the absence of all the electronic noise that human beings create with their technology. This noise, known as radio frequency interference (RFI), is to radio astronomy what light pollution is to optical astronomy.
- SKA-Mid and SKA-Low need quiet skies to detect extremely faint signals from the distant Universe, and that means getting away from human-made electrical noise. The two SKA telescope sites have been chosen due to their radio quietness. In South Africa, the SKA-Mid site is within the Karoo Central Astronomy Advantage Area, while in Western Australia, the SKA-Low site is within CSIRO's Murchison Radio-astronomy Observatory, on the traditional lands of the Wajarri Yamaji. These sites enjoy the national regulatory status of radio quiet zones that protect them from ground-based interference.
- By linking lots of antennas together using a technique called interferometry, SKA-Mid and SKA-Low can each act as one enormous telescope.
- Rather than a traditional big telescope, interferometers instead use many smaller individual elements which are connected together in an array, with their data combined digitally using powerful computers. This technique is known as "aperture synthesis" and is used in many modern radio telescopes.
- Aperture synthesis enables an array to act like one big telescope equivalent in size to the distance between the two furthest antennas, something that would be impossible to build as a single structure. The SKA telescopes both follow this design, linked by thousands of kilometres of optical fibre. Both SKA-Mid and SKA-Low can also be divided into sub-sets of antennas which can be used for different observations, making them extremely versatile.
- > The construction phase of the project began on 5 December 2022 in both South Africa and Australia.
- Including the telescope hosting countries, there are over ten countries Canada, China, Germany, France, India, Italy, the United Kingdom are among others participating in this multi-billion-dollar mega science project.

31.CARBON FIBER

- Vice President recently visited National Aerospace Limited (NAL) facilities and laid the foundation stone of the Centre for Carbon Fiber and Prepregs in Bengaluru.
- Carbon fiber, also known as graphite fiber or carbon graphite, is a material consisting of thin, strong crystalline filaments of carbon. These fibers are about 5 to 10 micrometers in diameter and composed mostly of carbon atoms.

- > The **properties** of carbon fibers include:
 - High stiffness
 - High tensile strength
 - High strength-to-weight ratio
 - High chemical resistance
 - High-temperature tolerance
 - Low thermal expansion
- These properties make carbon fiber popular in various fields such as aerospace, civil engineering, military, motorsports, and other competition sports. However, they are relatively expensive compared to similar fibers, such as glass fibers, basalt fibers, or plastic fibers.
- Carbon fibers are usually combined with other materials to form a composite. For example, when permeated with a plastic resin and baked, it forms carbon-fiber-reinforced polymer which has a very high strength-to-weight ratio and is extremely rigid although somewhat brittle. Carbon fibers are also composited with other materials, such as graphite, to form reinforced carbon-carbon composites, which have a very high heat tolerance.
- Carbon fiber-reinforced materials are used to make aircraft and spacecraft parts, racing car bodies, golf club shafts, bicycle frames, fishing rods, automobile springs, sailboat masts, and many other components where light weight and high strength are needed.

32. PREFIRE (POLAR RADIANT ENERGY IN THE FAR INFRARED EXPERIMENT)

- On May 2024, the National Aeronautics and Space Administration (NASA) launched one of the two CubeSats to study heat emissions from Earth's poles, specifically the Arctic and Antarctica. This mission, named PREFIRE, aims to understand how these regions influence global climate.
- CubeSats are essentially miniature satellites whose basic design is a 10 cm x 10 cm x 10 cm (which makes up for "one unit" or "1U") cube just a little bigger than a Rubik's cube and weight not more than 1.33 kg. Depending on the CubeSat's mission, the number of units can be 1.5, 2, 3, 6, and 12U, according to NASA.
- These satellites were first developed in 1999 as educational tools. However, owing to their low cost and less mass in comparison to traditional satellites, they began to be put in orbit for technology demonstrations, scientific research, and commercial purposes.
- Each of the PREFIRE satellites is a 6U CubeSat. They measure around 90 cm in height and nearly 120 cm in width when the solar panels, which will power the satellite, are deployed. The two satellites will be placed in a near-polar orbit (a type of low Earth orbit) at an altitude of about 525 kilometres.
- Why do researchers want to measure heat emissions at Earth's poles?
- It has to do with the Earth's energy budget, which is the balance between the amount of heat incoming to Earth from the Sun and the amount of heat outgoing from Earth into space. The difference between the two determines the planet's temperature and climate.
- A large amount of the heat radiated from the Arctic and Antarctica is emitted as far-infrared radiation — wavelengths of 3 μm to 1,000 μm within the infrared range of electromagnetic radiation. However, there is currently no way to measure this type of energy. As a result, there is a gap in knowledge about the planet's energy budget.
- The PREFIRE mission will change that. Its two CubeSats can study far-infrared radiation from the Earth's pole and the data collected by them would help scientists better understand the energy budget of the planet.
- The observations will help understand the fundamentals of Earth's heat balance, allowing to better predict how our ice, seas, and weather will change in the face of global warming.

- Each of the PREFIRE CubeSat is equipped with a thermal infrared spectrometer known as Thermal Infrared Spectrometer (TIRS) to measure the amount of infrared and far-infrared radiation from the Arctic and Antarctica. The spectrometer features specially shaped-mirrors and detectors for splitting and measuring infrared light, according to NASA.
- The CubeSats will also measure the amount of far-infrared radiation trapped by atmospheric water vapour and clouds at the poles and how this influences the greenhouse effect in the region.

33. IN-SPACe

- Indian National Space Promotion and Authorization Centre (IN-SPACe) has released the norms, guidelines and procedures (NGP) for implementation of Indian Space Policy, 2023, in respect of authorisation of space activities.
- Indian National Space Promotion and Authorisation Centre (IN-SPACe) is a single-window, independent, nodal agency that functions as an autonomous agency in the Department of Space (DOS).
- It was constituted in October 2021 as part of the far-reaching reforms in the space sector brought out by the Government of India, aiming towards boosting private sector participation in the entire range of space activities
- IN-SPACe is responsible to promote, enable, authorize and supervise various space activities of nongovernmental entities including building launch vehicles & satellites and providing space-based services; sharing space infrastructure and premises under the control of DOS/ISRO; and establishing of new space infrastructure and facilities.
- The agency acts as an interface between ISRO and Non-Governmental Entities (NGEs) and assesses how to utilize India's space resources better and increase space-based activities.
- It also assesses the needs and demands of private players, including educational and research institutions, and explores ways to accommodate these requirements in consultation with ISRO.

34. GOLDEN RICE

- A court in the Philippines recently revoked biosafety permits for commercial propagation of genetically modified golden rice and Bt eggplant.
- Golden Rice is a new type of rice that contains beta carotene (provitamin A, a plant pigment that the body converts into vitamin A as needed). This compound is what gives this grain its yellow-orange or golden color, hence its name.
- Golden Rice is developed through genetic engineering. While ordinary rice does produce beta carotene, it is not found in the grain. Thus, scientists used genetic engineering to add the compound to the grain a minor tweak that improved the grain's nutritive value.
- The beta carotene in Golden Rice, which was made possible by the addition of two new enzymes, is identical to the beta-carotene found in green leafy and yellow-colored vegetables, orange-colored fruit, and even in many vitamin supplements and food ingredients.
- Like ordinary rice, Golden Rice does not require any special cultivation practices, and generally has the same yield and agronomic performance.
- While vitamin A can be obtained from food products and supplements, challenges regarding their availability, accessibility, and affordability make it difficult to address the problem of vitamin A deficiency (VAD).
- As rice is a staple food in many vitamin A-deficient communities in Asia, Golden Rice can be a significant help in improving these areas' vitamin A status once the grain becomes available for public consumption.

35. DJIBOUTI RELEASES GM MOSQUITOES TO FIGHT MALARIA

- Genetically modified (GMO) mosquitoes were released in Djibouti, East Africa on May 23, 2024 to fight malaria.
- The release is part of the 'Djibouti Friendly Mosquito Programme' started two years ago to stop the spread of Anopheles stephensi, an invasive species of mosquito.
- In 2012, when Anopheles stephensi was first detected in Africa, Djibouti reported 27 cases of malaria. By 2020, the country's malaria caseload had crossed 73,000.
- > This highly invasive mosquito had migrated to Africa from South Asia and the Arabian Peninsula.
- The invasive mosquito has continued to spread to other countries in the African continent, with cases reported in Ethiopia and Sudan in 2016, Somalia in 2019 and Nigeria in 2020.
- Unlike other malaria-carrying mosquitoes in Africa that primarily breed in rural areas, Anopheles stephensi is well adapted to the urban environment. This characteric is particularly dangerous for Djibouti, where 70 per cent of the population live in the capital city and are exposed to the malaria vector. It bites both during the day and at night and is resistant to chemical insecticides.
- To combat these urban invaders, Oxitec, a biotechnology company developed a method that uses mosquitoes to fight mosquitoes. They have released genetically altered male mosquitoes carrying a special gene that prevents their female offspring from reaching adulthood.
- The laboratory-produced mosquitoes carry a "self-limiting" gene that prevents female mosquito offspring from surviving to adulthood when they mate.
- Only their male offspring survive but would eventually die out, according to the scientists behind the project.
- The method targets female mosquitoes, which are responsible for malaria transmission. By reducing the female mosquito population, scientists hope to significantly decrease the spread of the disease. Male mosquitoes do not bite and therefore cannot transmit malaria.
- About Malaria
- Malaria is a disease caused by a parasite. The parasite is spread to humans through the bites of infected mosquitoes.
- Anopheles mosquitoes are the type of mosquito that transmit malaria from one person to another. Not all Anopheles mosquitoes have malaria, but if they bite a person with malaria, they can become infectious. Once they bite another person, this continues the cycle of spreading malaria from mosquito to people.
- There are 5 Plasmodium parasite species that cause malaria in humans and 2 of these species P. falciparum and P. vivax pose the greatest threat.

JUNE 2024

1.MICROCEPHALY

A gene called SASS6 and its variants have been implicated in a developmental process that causes microcephaly

- Microcephaly is a condition in which a baby's head is much smaller than normal. Most children with microcephaly also have a small brain, poor motor function, poor speech, and abnormal facial features, and are intellectually disabled.
- Microcephaly may be present at birth(congenital) or it may develop in the first few years of life.
- Although there's no treatment for microcephaly, early intervention with speech, occupational and other supportive therapies may help enhance a child's development and improve quality of life.
- \triangleright

2.INDIA METEOROLOGICAL DEPARTMENT (IMD)

- It is the principal agency responsible for meteorological observations, weather forecasting, and seismology.
- It functions under Ministry of Earth Sciences (MoES) with its headquarter at Mausam Bhawan, Lodhi Road, New Delhi.
- IMD is also one of the six Regional Specialised Meteorological Centres of the World Meteorological Organisation. It has the responsibility for forecasting, naming and distribution of warnings for tropical cyclones in the Northern Indian Ocean region, including the Malacca Straits, the Bay of Bengal, the Arabian Sea and the Persian Gulf.

Here are some key details about IMD:

- Established in **1875**, IMD is the National Meteorological Service of the country.
- IMD is headquartered in **Delhi** and operates hundreds of observation stations across India and Antarctica.
- > It deals with all matters relating to meteorology, seismology, and associated subjects.
- IMD provides a variety of services such as rainfall information, monsoon information, cyclone information, agromet advisory services, climate services, urban meteorological services, aviation services, climate hazard & vulnerability atlas, geospatial services, and forecasts.
- IMD plays a crucial role in providing weather updates and warnings, which are vital for various sectors including agriculture, aviation, and disaster management.

> It also provides specialized forecasts and conducts research in meteorology and allied subjects.

Additional Information - History of meteorology in India:

- Early philosophical writings of the 3000 B.C. era, such as the Upanishadas, contain serious discussion about the processes of cloud formation and rain and the seasonal cycles caused by the movement of earth round the sun.
- Varahamihira's classical work, the Brihatsamhita, written around 500 A.D., provides a clear evidence that a deep knowledge of atmospheric processes existed even in those times.
- Kautilya's Arthashastra contains records of scientific measurements of rainfall and its application to the country's revenue and relief work.
- Kalidasa in his epic, 'Meghdoot', written around the seventh century, even mentions the date of onset of the monsoon over central India and traces the path of the monsoon clouds.
- Meteorology, as we perceive it now, may be said to have had its firm scientific foundation in the 17th century after the invention of the thermometer and the barometer and the formulation of laws governing the behaviour of atmospheric gases.

- It was in 1686 that Edmond Halley, a British scientist, published his treatise on the Indian summer monsoon, which he attributed to a seasonal reversal of winds due to the differential heating of the Asian land mass and the Indian Ocean.
- India is fortunate to have some of the oldest meteorological observatories of the world. The British East India Company established several such stations, for example, those at Calcutta in 1785 and Madras (now Chennai) in 1796 for studying the weather and climate of India.
- The Asiatic Society of Bengal founded in 1784 at Calcutta, and in 1804 at Bombay (now Mumbai), promoted scientific studies in meteorology in India. In the first half of the 19th century, several observatories began functioning in India under the provincial governments.
- A disastrous tropical cyclone struck Calcutta in 1864 and this was followed by failures of the monsoon rains in 1866 and 1871. In the year 1875, the Government of India established the India Meteorological Department, bringing all meteorological work in the country under a central authority. The first Director General of Observatories was Sir John Eliot who was appointed in May 1889 at Calcutta headquarters. The headquarters of IMD were later shifted to Shimla, then to Poona (now Pune) and finally to New Delhi.

3.JAMES WEBB SPACE TELESCOPE SPOTS EARLIEST-KNOWN GALAXY

NASA's James Webb Space Telescope (JWST) has discovered the earliest-known galaxy, bright and massive despite forming in the universe's infancy. The discovery was part of the JWST Advanced Deep Extragalactic Survey (JADES).

- This galaxy, called JADES-GS-z14-0, measures about 1,700-light years across. A light year is the distance light travels in a year, which is 9.5 trillion km.
- The galaxy has a mass equivalent to 500 million stars the size of our Sun and is rapidly forming new stars about 20 every year.
- Until now, the earliest-known galaxy dated to about 320 million years after the Big Bang.
- The JADES team in the same study disclosed the discovery of the second oldest-known galaxy, from about 303 million years post-Big Bang. That one, JADES-GS-z14-1, is smaller with a mass equal to about 100 million sun-sized stars, measuring roughly 1,000 light years across and forming about two new stars per year.

James Webb Space Telescope (JWST)

- The James Webb Space Telescope (JWST), also known as Webb, is a large infrared telescope with a 6.5-meter primary mirror.
- The mirrors are made of ultra-lightweight beryllium. Webb's biggest feature is a tennis court sized five-layer sunshield that attenuates heat from the Sun more than a million times.
- Webb is designed to conduct infrared astronomy. Its high-resolution and high-sensitivity instruments allow it to view objects too old, distant, or faint.
- Webb's revolutionary technology will study every phase of cosmic history—from within our solar system to the most distant observable galaxies in the early universe.
- Over the last two years, scientists have used JWST to explore what astronomers refer to as Cosmic Dawn – the period in the first few hundred million years after the big bang where the first galaxies were born.
- Webb is an international collaboration between NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA).
- The Webb was launched on **25 December 2021** on an Ariane 5 rocket from Kourou, French Guiana.
- In January 2022 it arrived at its destination, a solar orbit near the Sun–Earth L2 Lagrange point, about 1.5 million kilometers (930,000 mi) from Earth.

4.CHANG'E-6 CRAFT

- The Chang'e 6 mission, part of China's lunar exploration program named after the moon goddess, is the second mission designed to return samples. It follows Chang'e 5, which brought samples from the moon's near side in 2020.
- In 2020 Chang'e-5 brought back 1.7kg of material from an area called Oceanus Procellarum on the Moon's near side.
- The current mission was launched on 3 May 2024 and the lander touched down on the lunar far side on 1 June 2024 in a huge crater known as the South Pole-Aitken Basin.
- In the mission, the lander is to use a mechanical arm and a drill to gather up to 2kilograms of surface and underground material for about two days.
- An ascender atop the lander will then take the samples in a metal vacuum container back to another module that is orbiting the moon. The container will be transferred to a re-entry capsule that is due to return to Earth in the deserts of China's Inner Mongolia region about June 25.
- Missions to the moon's far side are more difficult because it doesn't face the Earth, requiring a relay satellite to maintain communications. The terrain is also more rugged, with fewer flat areas to land.
- This mission will enable an unprecedented comparison between the moon's unexplored far side and its well-studied Earth-facing side. The South Pole-Aitken Basin is one of the largest known impact craters in the solar system.
- China is the only country to have reached the far side of the moon twice, the previous mission being the Chang'e-4 in 2019.



5.STROMATOLITES

Living stromatolites, ancient geological structures formed by algae, have been discovered on Sheybarah Island in the Red Sea, Saudi Arabia.

These 3.48-billion-year-old life forms were previously known to exist only in locations like Shark Bay, Australia, and the Exuma Islands, Bahamas.

Stromatolites are layered sedimentary formations created mainly by photosynthetic microorganisms such as cyanobacteria, sulfate-reducing bacteria, and Pseudomonadota (formerly proteobacteria).

- These microorganisms produce adhesive compounds that cement sand and other rocky materials to form mineral "microbial mats". These mats build up layer by layer, growing gradually over time.
- They exhibit a variety of forms and structures, including conical, stratiform, domal, columnar, and branching types.
- Stromatolites are considered the oldest living lifeforms on our planet. They are living fossils and provide important records of some of the most ancient life.
- These biotic structures were instrumental in the Great Oxygenation Event over two billion years ago, introducing oxygen into the atmosphere and transforming the planet's habitability.
- Being photosynthetic, cyanobacteria produce oxygen as a by-product. Photosynthesis is the only major source of free oxygen gas in the atmosphere.
- As stromatolites became more common 2.5 billion years ago, they gradually changed the Earth's atmosphere from a carbon dioxide-rich mixture to the present-day oxygen-rich atmosphere.
- This major change paved the way for the next evolutionary step, the appearance of life based on the eukaryotic cell (cell with a nucleus).

- The oxygenation event initially wiped out many of their competitors, allowing stromatolites to dominate the biosphere during the Archean eon, when life had just begun to bud.
- However, as life forms adapted to the oxygen-rich atmosphere, stromatolites began to decline, only reappearing in the geological record after mass extinctions or in extreme environments.
- The rediscovery of stromatolites on Sheybarah Island also offers potential insights into the search for extraterrestrial life, particularly on Mars.
- By studying stromatolites, which thrived before Earth had an oxygenated atmosphere, scientists can develop models to recognise potential signs of life on other planets.

6.ADITYA-L1 MISSION

The Indian Space Research Organisation (ISRO) recently released images of the Sun captured by **Aditya-L1** during May Solar Storm.



- Aditya-L1 is India's first space-based solar mission to study the Sun.
- It was launched on September 2, 2023, by the Indian Space Research Organisation (ISRO) into a halo orbit around the Sun-Earth Lagrange point 1 (L1).
- Aditya-L1 would provide an uninterrupted view of the Sun for prolonged periods, overcoming the limitations of Low Earth Orbits where the view is frequently blocked by the Earth itself.

Objectives

- Understanding Coronal Heating and Solar Wind Acceleration.
- > Understanding initiation of Coronal Mass Ejection (CME), solar flares and near-earth space weather.
- Understanding coupling and dynamics of the solar atmosphere.
- Understanding solar wind distribution and temperature anisotropy.

Significance

- Aditya-L1 will facilitate India to establish its own solar observatory in space, which would have numerous applications in day-to-day life.
- > Its success would place ISRO into an elite space club along with NASA and ESA.
- Understanding the Sun's complex magnetic behaviour is crucial to advancing space weather prediction, securing technological assets and unravelling stellar evolution.

Payloads

- Aditya-L1 carries seven payloads to examine the Sun's properties using visible and X-ray spectrometers, a coronagraph, analysers for solar winds and energetic particles, and magnetometers.
- This multi-wavelength observation capacity will probe the Sun's corona, the chromosphere, the photosphere, flares and coronal mass ejections.

7.QUANTUM DATA

Researchers have advanced quantum data production, storage, and retrieval using a specialized photon source, a step closer to the quantum internet.

- Quantum data refers to information stored and processed using the principles of quantum mechanics.
- Unlike classical data, which is represented by binary states (0s and 1s), quantum data is represented by quantum bits or qubits.
- Qubits can exist in multiple states simultaneously due to a property called superposition, and they can be entangled with other qubits, allowing for a kind of interconnectedness and correlation that classical bits cannot achieve.

Applications of Quantum Data:

- Cryptography: Quantum key distribution (QKD) leverages the principles of quantum mechanics to create secure communication channels that are theoretically immune to eavesdropping.
- Optimization problems: Quantum algorithms can potentially solve complex optimization problems more efficiently than classical algorithms.
- Simulating Quantum Systems: Quantum computers can simulate other quantum systems, which is useful for understanding chemical reactions, materials science, and fundamental physics.

8.CRISPR-CAS9

Researchers recently used **CRISPR-Cas9** to alter photosynthesis for the first time.

- CRISPR-Cas9 is a gene-editing technology that can alter the genetic sequence of a specific gene by removing, adding, or altering sections of the DNA sequence.
- It was developed from a similar gene-editing system in bacteria that they use to respond to invading pathogens like viruses.
- The CRISPR-Cas9 system consists of two key molecules that introduce a change (mutation) into the DNA:
- **Cas9:** An enzyme that acts as a pair of 'molecular scissors' that can cut the two strands of DNA at a specific location in the genome so that bits of DNA can then be added or removed.
- **Guide RNA (gRNA):** A piece of RNA that consists of a small piece of pre-designed RNA sequence (about 20 bases long) located within a longer RNA scaffold. The scaffold part binds to DNA and the pre-designed sequence 'guides' Cas9 to the right part of the genome.
 - The guide RNA is designed to find and bind to a specific sequence in the DNA.
 - Cas9 follows the guide RNA to the same location in the DNA sequence and makes a cut across both strands of the DNA. Once the DNA is cut, researchers use the cell's own DNA repair machinery to add or delete pieces of genetic material, or to make changes to the DNA by replacing an existing segment with a customized DNA sequence.
 - CRISPR-Cas9 has a lot of potential as a tool for treating a range of medical conditions that have a genetic component, including cancer, hepatitis B, or even high cholesterol.

9.ATOMIC CLOCK

A new type of portable **atomic clock** has been introduced that offers very accurate timekeeping at sea.

> An atomic clock is a highly precise timekeeping device.

- An atomic clock maintains time by measuring the vibrations of atoms, specifically the oscillations of electrons within these atoms.
- Atomic clocks measures time based on the resonant frequency of atoms, typically caesium-133 or rubidium-87.
- > Atomic clocks are essential in various fields due to their unparalleled accuracy.

Key uses of atomic clocks

- Global Positioning System (GPS): Atomic clocks are crucial for GPS satellites, providing the precise timing needed for accurate location determination.
- Telecommunications: They synchronize the time in telecommunications networks, ensuring the smooth transmission and reception of data.
- Scientific Research: Atomic clocks are used in experiments where precise timing is critical, such as in particle physics and astronomy.
- Time Standards: Cesium atomic clocks define the international time standard, Coordinated Universal Time (UTC), which is used worldwide.
- Financial Markets: They provide the exact time stamps necessary for the synchronization of financial transactions.
- Internet: For managing the timing of data transfer across the global network, ensuring consistency and reliability.
- Space Exploration: Used in space missions to ensure accurate timing for navigation and scientific measurements.
- > **Deep Space Network:** Helps in tracking and communicating with interplanetary spacecraft.
- Quantum Computing: Atomic clocks are used in the development of quantum computers for timing the operations at quantum scales.

10.DRUGS CONTROLLER GENERAL OF INDIA (DCGI)

The DCGI has mandated medical device license holders and manufacturers to report adverse events involving life-saving equipment on the **Materiovigilance Programme of India (MvPI)** platform.

- The Drugs Controller General of India (DCGI) is the head of the Central Drugs Standard Control Organisation (CDSCO) in India.
- > The DCGI is responsible for the approval of licenses for specified categories of drugs, including blood and blood products, IV fluids, vaccines, and sera.
- The DCGI also plays a crucial role in drug regulation in the country, ensuring the safety, efficacy, and quality of drugs.
- DCGI operates under the Ministry of Health & Family Welfare and establishes standards for drug manufacturing, sales, import, and distribution in the country.

Materiovigilance Programme of India (MvPI)

- The Materiovigilance Programme of India (MvPI) is a national initiative launched on July 6, 2015, by the Ministry of Health & Family Welfare, Government of India.
- Its primary objective is to monitor the safety and ensure the quality of medical devices used in the country.
- The program systematically collects, analyzes, and acts on data related to adverse events caused by medical devices to aid in regulatory decisions and recommendations on their safe use.

11.PUSHPAK REUSABLE LANDING VEHICLE (RLV)

ISRO successfully completed the third and final Pushpak RLV Landing Experiment (LEX-03).

- The Pushpak Reusable Landing Vehicle (RLV) is an innovative spacecraft developed by the Indian Space Research Organisation (ISRO).
- > Its primary purpose is to carry payloads into space and then return to Earth for reuse.

Objective and Significance:

- The RLV aims to significantly reduce the cost of space missions by enabling multiple uses of the same vehicle.
- > By reusing the RLV, India can make space access more affordable and sustainable.

Technical Details:

- The RLV is designed as a space plane with a low lift-to-drag ratio.
- It transports payloads to low Earth orbits and returns to Earth for reuse.
- The vehicle's indigenous systems include local navigation, instrumentation, and sensor systems developed by ISRO.

Future Prospects:

India aims to scale up the RLV to serve as the first stage of its reusable two-stage orbital launch vehicle.

12.SICKLE CELL DISEASE

- Sickle Cell Disease (SCD) is a chronic single-gene disorder that affects red blood cells.
- It is a haemoglobin disorder.
- SCD causes a debilitating systemic syndrome characterized by chronic anaemia, acute painful episodes, organ infarction, and chronic organ damage.
- It significantly reduces life expectancy.

Symptoms:

- Chronic Anaemia: Leads to fatigue, weakness, and paleness.
- > Painful Episodes (Sickle Cell Crisis): Intense pain in bones, chest, back, arms, and legs.
- Delayed Growth and Puberty.

Treatment:

- Blood Transfusions: Relieve anaemia and reduce pain crises.
- > Hydroxyurea: Helps reduce painful episodes and prevent long-term complications.
- > Bone Marrow or Stem Cell Transplantation.

Government Initiatives:

- > National Health Mission supports states in preventing and managing SCD.
- > Mission to eliminate Sickle Cell Anaemia by 2047 announced in Union Budget 2023-24.
- > Technical guidelines released for prevention and control of hemoglobinopathies.
- > Integrated centres established in tribal districts for treatment and diagnosis.

13.STREPTOCOCCAL TOXIC SHOCK SYNDROME (STSS)

A severe and frequently fatal bacterial infection known as streptococcal toxic shock syndrome (STSS) is striking a record number of people in Japan.

- Streptococcal Toxic Shock Syndrome (STSS) is a rare but severe bacterial infection caused by group A Streptococcus (GAS) bacteria.
- It occurs when these bacteria enter deep tissues and the bloodstream, releasing toxins that cause a rapid and dangerous response in the body.

Spread:

- Streptococcal Toxic Shock Syndrome (STSS) can be contagious and spread through respiratory droplets or direct contact.
- Group A strep bacteria can also spread through food if not handled properly.

Symptoms:

- Initial symptoms include fever, chills, muscle aches, nausea, and vomiting.
- Within 24 to 48 hours, it can lead to low blood pressure, organ failure, rapid heart rate, and fast breathing.
- > In adults, serious symptoms like limb pain, swelling, fever, and low blood pressure may occur.

Prevention:

Practicing good hygiene, such as regular handwashing and covering your mouth while coughing and sneezing, can help prevent STSS.

14.DIGI YATRA

The Digi Yatra Foundation plans to expand its system to include hotels, rail travel, and public places, in the **Digi Yatra system**.

- Digi Yatra Initiative is a project by the Ministry of Civil Aviation to create a Biometric Enabled Seamless Travel experience (BEST) using Facial Recognition Technology (FRT) for passengers at airports.
- > The **primary goal** is to streamline the boarding process and enhance the airport experience by eliminating manual verification of tickets and IDs at various checkpoints.
- It provides a decentralized mobile wallet-based identity management platform which is cost effective and addresses privacy/data protection issues in implementation of Digi Yatra
- > Digi Yatra aligns with the Digital India vision to transform India into a digitally empowered society.

Digi Yatra Foundation:

- It has been set up as a joint venture (JV) company in 2019 under Section 8 of the Companies Act, 2013.
- > The Foundation was formed, with the objective of creating the Digi Yatra Central Ecosystem (DYCE).

15.VOYAGER 1

NASA has successfully restored **Voyager 1** to working order several months after it encountered a grave computer problem.

- Voyager 1 Spacecraft is a space probe launched by NASA on September 5, 1977, about two weeks after its twin Voyager 2.
- It aims to study the outer Solar System and beyond.
- Voyager 1's mission has included flybys of Jupiter and Saturn, with the goal of studying their moons, rings, and magnetic fields.
- It is currently the most distant human-made object from Earth.
- It was the first spacecraft to cross the heliosphere, the boundary where the influences outside our solar system are stronger than those from our Sun.
- It crossed into interstellar space in August 2012, making it the first human-made object to venture out of the solar system.
- It discovered a thin ring around Jupiter and two new Jovian moons: Thebe and Metis.
- At Saturn, Voyager 1 found five new moons and a new ring called the G-ring.

- Voyager 1 carries a golden record that contains sounds and images selected to portray the diversity of life and culture on Earth, in the event that it is ever encountered by extraterrestrial life.
- According to NASA, Voyager 1 has enough fuel to keep its instruments running untilat least 2025. By then, the spacecraft will be approximately 13.8 billion miles (22.1 billion kilometers) away from the sun.

16.NAGASTRA-1

The Indian Army has recently inducted the Nagastra-1 suicide drones.

- Nagastra-1 is India's first indigenous loitering drone, designed for precision strikes with over 75% indigenous content.
- Nagastra-1 was developed by Economic Explosives Ltd (EEL), a subsidiary of Solar Industries, in collaboration with Z-Motion from Bangalore.
- It has a range of 30 km, an accuracy of 2 meters, and features low acoustic signature and electric propulsion.

Potential Applications of the Nagastra-1:

- Precision Strikes: They are designed for precision strikes on enemy training camps, launch pads, and infiltrators, which reduces the risk to soldiers.
- Silent Operation: Due to their electric propulsion and low acoustic signature, these drones are silent and ideal for stealthy infantry operations.
- **Cost-Efficient:** They offer a cost-efficient alternative to conventional missiles and precision munitions.
- Targeting Soft-Skin Threats: Nagastra-1 is particularly effective against lower-priority targets such as groups of infiltrating terrorists near the border.

17. INNOVATIONS FOR DEFENCE EXCELLENCE (IDEX)

Defence Ministry signs 350th contract under **Innovations for Defence Excellence (iDEX)** for miniaturised satellite.

- > The iDEX initiative was launched by the Hon'ble PM in April 2018.
- Innovation for Defence Excellence (iDEX) is an ecosystem initiated by the Ministry of Defence to foster innovation and technology development in the defence and aerospace sectors by engaging Industries including MSMEs, start-ups, individual innovators, R&D institutes & academia.
- iDEX is funded and managed by a 'Defence Innovation Organization (DIO)' which has been formed as a 'not for profit' company as per Section 8 of the Companies Act 2013 for this purpose, by the two founder members i.e. Defence Public Sector Undertakings (DPSUs) - HAL & BEL.
- iDEX will function as the executive arm of DIO, carrying out all the required activities while DIO will provide high level policy guidance to iDEX.
- Objectives:
 - FACILITATE
 - Facilitate rapid development of new, indigenized, and innovative technologies for the Indian defence and aerospace sector, to meet needs for these sectors in shorter timelines
 - o CREATE

- Create a culture of engagement with innovative startups, to encourage co-creation for defence
 - and aerospace sectors
- EMPOWER
 - Empower a culture of technology co-creation and co-innovation within the defence and aerospace sectors.
- Funding and Support:
 - $\circ\,$ iDEX provides grants through the Support for Prototype and Research Kickstart (SPARK) Framework.
 - These grants fund projects in technological areas identified through the Defence India Startup Challenges (DISC) and open challenges.
 - iDEX follows steps such as challenge curation, outreach, screening, selection, and grant appraisal to catalyze open innovation and deliver defense-grade products.

JULY 2024

1.GSAT-20

- GSAT-20 is a communications satellite that will be launched by the NewSpace India Limited (NSIL), with the assistance of SpaceX's Falcon-9.
- The satellite is also known as GSAT-N2 or CMS-03.
- The satellite is designed to provide high-speed broadband internet connectivity, digital video transmission and audio transmission.
- It is being launched to address the growing broadband communication needs of India, particularly in remote regions like Andaman and Nicobar Islands and Lakshadweep Islands.

Features:

- High-throughput communication satellite
- Ka-band frequency
- 40 beams with 2 polarisations each
- Pan-India coverage, including Andaman & Nicobar and Lakshadweep Islands
- 4,700 kg weight

Benefits:

- Enhances broadband connectivity in remote areas.
- Supports digital India initiatives.
- Boosts internet speed and capacity.
- Facilitates seamless video and audio transmission.
- Meets growing demand for satellite-based services
- Strengthens India's communication infrastructure.
- Supports economic growth and development.

2.PROJECT-75I

- Project 75I is a submarine acquisition project of the Indian Navy.
- > It aims to acquire diesel-electric submarines under the Ministry of Defence.
- The project was conceived in 1997 and was revived in 2017.
- > The project is now expected to be delivered by mid-2030s.

The objective of Project 751

- Replace the Indian Navy's aging Sindhughosh-class submarines with modern, conventional, dieselelectric attack submarines.
- > Enhance the Indian Navy's underwater warfare capabilities.
- Procure six submarines with advanced features like anti-surface warfare, land-attack capability, and air-independent propulsion.
- Boost the Indian Navy's strength and capabilities in the Indian Ocean region.
- Support the Indian government's "Make in India" initiative by building the submarines in collaboration with Indian shipyards.

3.MARS ODYSSEY

- > Mars Odyssey is a NASA spacecraft that embarked on a mission to explore Mars.
- Mars Odyssey was launched on April 7, 2001 from Cape Canaveral Air Force Station, Florida.
- Its primary goal was to map the chemical elements and minerals that constitute the Martian surface.
 By doing so, it created the first global map of Mars, providing valuable insights into its composition.
Mars Odyssey holds the record for the longest continually active mission in orbit around a planet other than Earth. It successfully completed its primary science mission from February 2002 through August 2004.

The main mission of the Mars Odyssey was to:

- Detect water and ice
- Study the geology of Mars
- Study the radiation environment of Mars
- Search for evidence of past or present life on Mars
- Act as a communication relay for future Mars missions

4.ADITYA-L1



- Aditya-L1 is India's first space-based solar mission to study the Sun.
- It was launched on September 2, 2023, by the Indian Space Research Organisation (ISRO) into a halo orbit around the Sun-Earth Lagrange point 1 (L1).
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- Aditya-L1 would provide an uninterrupted view of the Sun for prolonged periods, overcoming the limitations of Low Earth Orbits where the view is frequently blocked by the Earth itself.

Major Science Objectives of Aditya L1 Mission

- Understanding Coronal Heating and Solar Wind Acceleration.
- Understanding initiation of Coronal Mass Ejection (CME), solar flares and near-earth space weather.
- Understanding coupling and dynamics of the solar atmosphere.
- Understanding solar wind distribution and temperature anisotropy.

Advantages of Placing a solar observatory at L1

- Lagrangian Point 1 or L1 is one of the gravitationally stable points in space where the gravitational forces of two large bodies, like the Sun and Earth, balance out.
 - Located about 1.5 million km from Earth towards the Sun, L1 provides an uninterrupted view of the Sun without any eclipses or occultations.
 - It can continuously monitor the Sun without any blocking of view. This allows tracking solar storms heading towards Earth from their origin on the Sun's surface.
 - Maintaining position at L1 requires relatively little fuel since the gravitational forces are balanced.
 - L1 provides an early vantage point to observe coronal mass ejections and solar flares before they affect Earth. This increases lead time for space weather predictions.

5.HOLOGRAM TECHNOLOGY

Japan has introduced redesigned yen banknotes incorporating advanced 3D hologram technology to enhance security measures against counterfeiting

- Holograms are three-dimensional (3D) images created by recording light patterns that mimic how our eyes perceive objects in space.
- Unlike traditional photographs or flat images, holograms capture depth and parallax, making them appear lifelike and immersive.

> Their intricate design makes them a robust defence against counterfeiting.

Applications:

- **Visual Displays**: Holographic displays for advertising, art, and entertainment.
- > **Data Storage:** Holographic data storage for high-capacity storage.
- Microscopy: Holographic microscopy for biological imaging.
- > Interferometry: Precise measurements in fields like metrology and engineering.
- Medical Imaging: Holographic techniques in medical diagnostics.

6.AXIOM-4

- The Indian Space Research Organisation (ISRO) has selected two out of its four trained Gaganyaan astronauts to participate in the Axiom-4 mission.
- The Axiom-4 mission is a private spaceflight to the International Space Station (ISS) conducted by Axiom Space in collaboration with NASA.
- It will be the fourth private astronaut mission to the ISS.
- > The mission will last for fourteen days.
- Spacecraft: The spacecraft used for the Axiom-4 mission is a SpaceX Crew Dragon.
- Indian Involvement: The Indian Space Research Organisation (ISRO) has shortlisted two of its four trained Gaganyaan astronauts to participate in the mission.

Objectives:

- > The mission aims to facilitate commercial activities in space, including scientific research, technological development, and space tourism.
- It will demonstrate the viability of commercial space stations as platforms for business and innovation.
- **Diverse Crew:**The Axiom-4 mission will carry a diverse crew of astronauts from different countries.
- Scientific Experiments: During the mission, various scientific experiments and technological tests will be conducted in the unique microgravity environment of space.

Gaganyaan Mission

- The Gaganyaan Mission is India's ongoing project to send a 3-day manned mission to the Low Earth Orbit (LEO) of 400 km with a crew of 3 members and bring them safely back to Earth.
- > The objective of the program is to demonstrate India's human spaceflight capabilities.
- As part of this program, two unmanned missions and one manned mission are approved by the Government of India.
- Upon its completion, India will become the fourth nation, after the US, Russia, and China, to undertake a manned spaceflight mission.

7.SHIGELLA INFECTION

- Recently, the Indian Council of Medical Research (ICMR) has found an Indian partner to manufacture the breakthrough vaccine for shigella infection.
- > It is an intestinal infection caused by a family of bacteria known as shigella.

- The four species of Shigella are Shigella sonnei, Shigella flexneri, Shigella boydii and Shigella dysenteriae.
- Symptoms: Diarrhea, Stomach pain or cramps, Fever, Nausea or vomiting.
- Transmission:
 - It is very contagious. Shigella is transmitted via the fecal—oral route, through direct personto-person contact, or indirectly through contaminated food, water, or fomites.
 - Spread of Shigella through both direct and indirect sexual contact has been widely reported, primarily among men who have sex with men (MSM).
 - Humans are the primary natural reservoir, although nonhuman primates also can be infected.
 - Vulnerable Groups: Children under age 5 are most likely to get shigella infection, but it can occur at any age.
 - > Vaccine: Currently, no vaccines are available for shigella.

Precautions:

- Wash hands thoroughly before and after meals.
- Wash hands properly after bowel movements.
- Ensure drinking water is clean.
- Consume fresh fruits and vegetables.

8.CHOLERA

- Cholera is an acute diarrhoeal infection caused by consuming food or water contaminated with the bacterium Vibrio cholerae.
- It leads to severe diarrhea and dehydration, and if left untreated, can be fatal within hours, even in healthy individuals.
- The disease is prevalent in areas with poor sanitation, crowding, war, and famine, and outbreaks are more common in warm climates.
- Cholera is predictable and preventable, and can be eliminated with access to clean water, sanitation facilities, and good hygiene practices.

Treatment:

- Vaccines: Three WHO pre-qualified oral cholera vaccines (OCV) Dukoral, Shanchol, and Euvichol-Plus, requiring two doses for full protection.
- **Rehydration Therapy:** Oral rehydration salts (ORS) and intravenous fluids.
- Antibiotics: To reduce the duration and severity of the illness.
- **Zinc Supplementation:** Especially for children to reduce the duration of diarrhea.

9.THE CREW HEALTH AND PERFORMANCE EXPLORATION ANALOG (CHAPEA)

- CHAPEA is a series of analog missions conducted by NASA to simulate year-long stays on the surface of Mars.
- It aims to assess and collect data regarding NASA's food system and physical and behavioral health patterns in humans, which will help during future space missions.
- Each mission will consist of four crew members living in Mars Dune Alpha, an isolated 1,700-squarefoot habitat.
- The first CHAPEA crew completed their 378-day mission on July 6, 2024.

Mars Dune Alpha:

- Mars Dune Alpha is a 3D-printed structure located at Johnson Space Center in Houston, Texas.
- > It simulates a realistic Mars habitat to support long-duration, exploration-class space missions.
- Significance: CHAPEA's findings will be crucial for planning long-duration space missions and ensuring the well-being of astronauts on Mars.

10.CHANDIPURA VIRUS INFECTION (CHPV)

- > The Chandipura virus (CHPV) belongs to the Rhabdoviridae family.
- It was first identified in 1965 in Chandipura, a village in Maharashtra.

Transmission:

- > Sandflies, particularly species of the genus Phlebotomus, are the primary vectors for CHPV transmission.
- > These tiny blood-sucking insects are prevalent in tropical and subtropical regions.

Symptoms:

- > Initial symptoms include sudden onset of high fever, severe headache, and muscle pain.
- As the infection progresses, it can lead to altered consciousness, seizures, and, in severe cases, coma and death.
- Early detection and treatment are crucial for patient survival.
- > Treatment: As of now, there is no antiretroviral treatment or vaccine accessible for treatment.

Affected Regions:

- Most cases are reported from north Gujarat, where the dry temperature favours sandfly breeding.
- Children under 15 years are particularly vulnerable due to their lower immunity against viral infections.

11.COALITION OF EPIDEMIC PREPAREDNESS INNOVATIONS (CEPI)

- The Coalition of Epidemic Preparedness Innovations (CEPI) is a global partnership that aims to accelerate the development of vaccines and other biologic countermeasures against epidemic and pandemic threats.
- CEPI was launched in 2017 as an innovative partnership.
- > It brings together public, private, philanthropic, and civil organizations.
- Founding partners include the governments of Norway and India, the Bill & Melinda Gates Foundation, the Wellcome Trust, and the World Economic Forum.

Mission:

- CEPI's mission is to ensure that vaccines and other biologic tools are accessible to all people in need.
- It focuses on developing vaccines for high-priority public health threats and emerging infectious diseases.

Research and Development:

- > CEPI supports the development of vaccine candidates and technology platforms.
- It has worked on more than 50 vaccine candidates against known high-risk pathogens and potential future threats (such as Disease X).
- > CEPI's five-year plan (2022-2026) includes the ambitious "100 Days Mission" to develop safe, effective vaccines against new threats within just 100 days.

India's Role:

- The Department of Biotechnology, Ministry of Science and Technology, India, supports the Ind-CEPI Mission.
- > This mission focuses on rapid vaccine development and epidemic preparedness.
- India's Biotechnology Industry Research Assistance Council (BIRAC) plays a key role in implementing this mission.

12.NATIONAL QUANTUM MISSION (NQM)

- The National Quantum Mission (NQM), approved by the Union Cabinet on April 19, 2023 at a total cost of Rs.6003.65 crore from 2023-24 to 2030-31.
- NQM falls under the purview of the Department of Science & Technology (DST) within the Ministry of Science & Technology.
- The National Quantum Mission (NQM) seeks to foster scientific and industrial research and development in Quantum Technology (QT).
- By nurturing an innovative ecosystem, India aims to become a global leader in Quantum Technologies & Applications (QTA).

Deliverables:

- Developing intermediate-scale quantum computers with 50-1000 physical qubits using superconducting and photonic technology.
- **Establishing satellite-based secure quantum communications** within India and with other countries.
- Implementing inter-city quantum key distribution and multi-node Quantum networks with quantum memories.

Focus Areas:

- Magnetometers with high sensitivity in atomic systems and Atomic Clocks for precision timing, communications, and navigation.
- Designing and synthesizing quantum materials (superconductors, novel semiconductors, topological materials) for quantum devices.
- Developing single photon sources/detectors and entangled photon sources for quantum communications and sensing.

Thematic Hubs (T-Hubs):

- These hubs, located in top academic and National R&D institutes, will drive research in specific domains:
- Quantum Computing
- Quantum Communication
- Quantum Sensing & Metrology
- Quantum Materials & Devices

Broader Impact:

- The NQM aligns with national priorities such as Digital India, Make in India, Skill India, and Sustainable Development Goals (SDG).
- Its applications span various sectors, including communication, health, finance, energy, space, and security.

Quantum Technology:

- Quantum technology is a field of science and engineering that deals with the principles of quantum mechanics, which is the study of the behaviour of matter and energy at the smallest scale.
- Quantum mechanics is the branch of physics that describes the behaviour ofmatter and energy at the atomic and subatomic level.

13.SAGITTARIUS A*

- Sagittarius A*, often abbreviated to Sgr A* and pronounced "Sagittarius A star", is a supermassive black hole.
- It is located at the center of our spiral galaxy, the Milky Way.
- It resides near the border of the constellations Sagittarius and Scorpius, about 5.6° south of the ecliptic.



- It is mostly dormant and only occasionally absorbs gas or dust, but nonetheless has an estimated mass 4.3 million times that of the sun.
- It has a diameter of around 14.6 million miles (23.5 million kilometers).
- It is a strong source of radio waves. Most of the radio radiation is from a synchrotron mechanism, indicating the presence of free electrons and magnetic fields.
- > The event horizon of the black hole has a radius of 12 million km (7 million miles).
- Black Hole:
- A black hole is an astronomical object with a gravitational pull so strong that nothing, not even light, can escape it.
- A black hole forms when a massive star exhausts its nuclear fuel and collapses under its own weight. The core collapse triggers a supernova explosion, blowing off the star's outer layers.
- If the crushed core contains more than about three times the Sun's mass, no known force can stop its collapse, leading to the formation of a black hole.

Black holes come in different sizes:

- Stellar-mass black holes: These have three to dozens of times the Sun's mass and are spread throughout our Milky Way galaxy.
- Supermassive black holes: These giants weigh 100,000 to billions of solar masses and reside in the centers of most large galaxies, including ours.
- Intermediate-mass black holes: These are less common and weigh between 100 and more than 10,000 solar masses.

Event Horizon:

- > The event horizon is a critical concept in black hole physics. It defines the boundary around a black hole beyond which nothing can escape, not even light.
- > once an object crosses the event horizon, it is inexorably drawn toward the black hole's singularity.
- The escape velocity required to break free from the event horizon exceeds the speed of light, making escape impossible.



The Nipah virus (NiV) is a zoonotic virus, meaning it can be transmitted from animals to humans.

Fruit bats (particularly species belonging to the Pteropus genus) are natural hosts of the virus, and pigs can also carry it.

Human transmission occurs through direct contact with infected bats, pigs, or other individuals.

It was first identified during an outbreak in

Malaysia in 1998-1999 among pig farmers and those in close contact with pigs and later spread to Bangladesh and eastern India.

India experienced outbreaks in Siliguri (2001) and Kerala (since 2018).

Symptoms and Severity:

- > The incubation period ranges from 4 to 14 days after exposure.
- Initial symptoms resemble influenza: fever, headache, muscle pain, and sore throat.
- Severe cases can lead to encephalitis (brain inflammation), respiratory issues, seizures, and coma.
- > Mortality rates vary (40% to 75%) depending on the outbreak and healthcare infrastructure.

Treatment:

- > There is no specific medication or vaccine for Nipah virus.
- Managing symptoms is the primary approach.
- Prevention involves:
- Avoiding exposure to sick animals (especially bats and pigs).
- Disinfecting surfaces.
- Taking precautions around infected individuals.

15.INS BRAHMAPUTRA

- > The INS Brahmaputra is an Indian Navy warship.
- > The INS Brahmaputra belongs to the Brahmaputra-class of guided missile frigates.
- Brahmaputra-class is designed and built in India.
- It is an enhancement of the Godavari class frigates.
- > INS Brahmaputra was commissioned into the Indian Navy in April 2000.
- The ship has a length of 125 meters and a beam (width) of 14.4 meters.
- It is capable of sailing at a speed of 30 knots (approximately 55.6 kilometers per hour).
- The INS Brahmaputra is armed with an impressive array of weapons:
 - Surface-to-surface missiles
 - Surface-to-air missiles
 - Medium-range guns
 - Anti-submarine rockets
 - Radars
 - SonarsState-of-the-art electronic warfare systems

16.NASA'S PERSEVERANCE ROVER

- NASA's Perseverance rover recently made an intriguing discovery that could shed light on the ancient history of Mars and the possibility of past microbial life.
- The rover has identified a rock named "Cheyava Falls" that exhibits intriguing characteristics, suggesting it may have hosted microbial life billions of years ago.
- Perseverance is part of NASA's Mars 2020 Mission, which aims to study the geology, climate, and potential habitability of Mars.
- Its primary goal is to seek signs of ancient microbial life and collect samples for possible return to Earth.

Launch and Landing:

- Launched on July 30, 2020, from Cape Canaveral, Florida, Perseverance embarked on its journey to Mars.
- It successfully landed in Jezero Crater on February 18, 2021, after a complex entry, descent, and landing sequence.

Physical Characteristics:

- > Perseverance is approximately 3 meters long, 2.7 meters wide, and 2.2 meters tall.
- Despite its car-like size, it weighs only about 1,025 kilograms due to careful design and lightweight materials.

Scientific Instruments:

- > The rover is equipped with a suite of scientific instruments, including cameras, spectrometers, and environmental sensors.
- > Its robotic arm features a drill for sampling rocks and regolith (soil) from the Martian surface.

Power Source:

- Perseverance relies on a Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) for electricity.
- The MMRTG converts heat from the radioactive decay of plutonium into electrical power, allowing the rover to operate even in harsh Martian conditions.

Sample Collection and Return:

- Perseverance will collect rock and soil samples, encase them in sealed tubes, and leave them on the Martian surface.
- A future mission (possibly by another rover) will retrieve these samples and bring them back to Earth for detailed analysis.

17.INTEGRATED DISEASE SURVEILLANCE PROGRAMME (IDSP)

- > The Integrated Disease Surveillance Programme (IDSP) is a decentralized, state-based surveillance system in India.
- It was initiated in 2004 with the assistance of the World Bank.
- > The primary objective of IDSP is to detect early warning signals of impending disease outbreaks and facilitate an effective response in a timely manner.
- Purpose: IDSP aims to strengthen and maintain a decentralized, laboratory-based, IT-enabled disease surveillance system for epidemic-prone diseases.
- **Reporting:** The program includes online reporting from all states and union territories.

- Surveillance: IDSP monitors disease trends and detects and responds to outbreaks during their early stages through trained Rapid Response Teams (RRTs).
- National Health Program: It is one of the major National Health Programs under the National Health Mission.

Program Components:

- Integration and Decentralization: Surveillance units are established at the central, state, and district levels.
- Human Resource Development: Training for State Surveillance Officers, District Surveillance Officers, RRTs, and other medical staff.
- > Information Technology: Leveraging technology for data collection, analysis, and dissemination.
- Strengthening Public Health Laboratories: Enhancing diagnostic capabilities.
- > Intersectoral Coordination: Addressing zoonotic diseases.

18.THE DEFENCE ACQUISITION COUNCIL (DAC)

- > The Defence Acquisition Council (DAC) is the highest decision-making body in the Defence Ministry for deciding on new policies and capital acquisitions for the three services (Army, Navy and Air Force) and the Indian Coast Guard.
- > The Minister of Defence is the Chairman of the Council.
- It was formed, after the Group of Ministers recommendations on 'Reforming the National Security System', in 2001, post Kargil War (1999).

Composition:

- > The Defence Minister chairs the DAC.
 - The DAC includes the following members:
 - Minister of State for Defence
 - Chief of Army Staff, Chief of Air Staff, and Chief of Naval Staff
 - > Defence Secretary, Defence Production Secretary, and Defence R&D Secretary
 - Chief of Integrated Defence Staff and Director General Acquisition

Functions:

- Approval for Capital Acquisition: The DAC grants approval for Acceptance of Necessity (AoN) for capital acquisition proposals.
- Categorization of Proposals: It categorizes acquisition proposals into:
 - Buy: Outright purchase
 - **Buy and Make**: Purchase followed by licensed production or indigenous development **Make**: Indigenous production and research and development
- Long-Term Integrated Perspective Plan (LTPP): Provides in-principal approval for the 15-year LTPP for the Defence Forces.

AUGUST 2024

1. LIGHT COMBAT AIRCRAFT TEJAS

- The Light Combat Aircraft (LCA) Tejas is an indigenously developed, single-seat, multirole fighter aircraft by the Defence Research and Development Organisation (DRDO) and Hindustan Aeronautics Limited (HAL) in India.
- It has been in service with the Indian Air Force since 2016.
- > The Tejas is designed for air superiority, ground attack, and reconnaissance missions.
- > Its features include a delta wing design, composite materials, and advanced avionics.

Features:

- Size and Weight: Smallest and lightest in its class of contemporary supersonic combat aircraft.
- > Tail Design: Features a fin but lacks a horizontal tail.
- > Weight: Approximately 5,450 kg, with a maximum take-off weight of 13,500 kg.
- > Engine: Powered by a single uprated General Electric F404-GE-IN20 engine.
- > Weaponry: Designed to carry a range of air-to-air and air-to-surface precision-guided weapons.

2.INDIAN NAVAL SUBMARINE (INS) SHALKI

- INS Shalki is a Shishumar-class diesel-electric submarine.
- > It holds the distinction of being the first-ever submarine built in India.
- INS Shalki was commissioned into the Indian Navy on February 7, 1992.

The primary roles of INS Shalki:

- Underwater Surveillance and Reconnaissance: INS Shalki is equipped to operate stealthily underwater, gathering intelligence and monitoring maritime activities.
- > Anti-Submarine Warfare (ASW): It plays a crucial role in detecting and neutralizing enemy submarines. Its sensors and torpedoes are designed for ASW operations.
- Mine Laying and Clearance: Submarines like INS Shalki can lay mines to create defensive barriers or clear existing minefields.
- Strategic Deterrence: As part of India's naval forces, INS Shalki contributes to the country's strategic deterrence capabilities.
- > Training and Exercises: It serves as a training platform for submariners and participates in naval exercises to enhance operational readiness.

3.EARTH OBSERVATION SATELLITE-8 (EOS-8)

- > The Earth Observation Satellite-8 (EOS-8) is an advanced satellite developed by the Indian Space Research Organisation (ISRO).
- EOS-8 is scheduled to be launched on August 15, 2024, using the Small Satellite Launch Vehicle (SSLV)-D3 from Sriharikota, Andhra Pradesh.
- EOS-8 is part of ISRO's ongoing efforts to build a robust constellation of Earth observation satellites, contributing to both national and global needs.
- The spacecraft mission configuration is set to operate in a Circular Low Earth Orbit (LEO) at an altitude of 475 km with an inclination of 37.4°, and has a mission life of 1 year.
- > EOS-8 payloads:EOS-08 carries three payloads:
- Electro Optical Infrared Payload (EOIR): The EOIR payload is designed to capture images in the Mid-Wave IR (MIR) and Long-Wave IR (LWIR) bands, both during the day and night, for applications such

as satellite-based surveillance, disaster monitoring, environmental monitoring, fire detection, volcanic activity observation, and industrial and power plant disaster monitoring.

- Global Navigation Satellite System-Reflectometry payload (GNSS-R): The GNSS-R payload demonstrates the capability of using GNSS-R-based remote sensing for applications such as ocean surface wind analysis, soil moisture assessment, cryosphere studies over the Himalayan region, flood detection, and inland waterbody detection.
- SiC UV Dosimeter : the SiC UV Dosimeter monitors UV irradiance at the viewport of the Crew Module in the Gaganyaan Mission and serves as a high-dose alarm sensor for gamma radiation.

4.NEUTRON STARS



> Neutron stars are the collapsed cores of massive stars that have undergone a supernova explosion.

They are among the densest objects in the universe, second only to black holes.

Typically, neutron stars have a diameter of about 20 kilometers (12 miles) and a mass between 1.18 and 1.97 times that of the Sun.

How Are Neutron Stars Formed?

- Supernova Explosion: When a massive star (usually 10-25 times the mass of the Sun) exhausts its nuclear fuel, it can no longer support itself against gravitational collapse. This leads to a supernova explosion.
- Core Collapse: The core of the star collapses under gravity, causing protons and electrons to combine into neutrons. This process results in an incredibly dense core composed almost entirely of neutrons.
- Formation of Neutron Star: If the core's mass is between about 1 and 3 solar masses, the newlycreated neutrons can halt further collapse, resulting in a neutron star. If the core's mass exceeds this limit, it will continue to collapse into a black hole.

Characteristics of Neutron Stars

- Density: Neutron stars are extremely dense. A sugar-cube-sized amount of neutron star material would weigh about a billion tons on Earth.
- Magnetic Fields: They have very strong magnetic fields, which can be billions of times stronger than Earth's magnetic field.
- Rotation: Neutron stars can rotate very rapidly, sometimes hundreds of times per second. These rapidly rotating neutron stars are known as pulsars.
- Temperature: Newly formed neutron stars can have surface temperatures of around 10 million K. Over time, they cool down, but even older neutron stars can still be quite hot.

5.MPOX

What to know about the monkeypox virus Monkeypox is a zoonotic virus, which transmits disease from animals to humans, with symptoms very similar to smallpox but less severe



Mpox, formerly known as monkeypox is caused by the monkeypox virus, which belongs to the same family as the virus that causes smallpox.

Symptoms: Common symptoms include a rash that goes through several stages before healing, fever, swollen lymph nodes, muscle aches, and fatigue.

> **Transmission:** The virus spreads through direct contact with infectious lesions, contaminated objects, and respiratory droplets from close contact. It can also spread from animals to humans.

Severity: While most people recover fully, severe cases can occur, especially in children, people with weakened immune systems, and those with a history of eczema.

> Prevention: Preventive measures include avoiding close

contact with infected individuals or animals, practicing good hygiene, and getting vaccinated if recommended.

Global Impact: Mpox was declared a global health emergency by the World Health Organization in 2022 due to its widespread outbreak.

Global Public Health Emergency

- A global public health emergency is a formal declaration by the World Health Organization (WHO) that signals a serious, sudden, unusual, or unexpected health event that requires immediate international action.
- This declaration is intended to mobilize resources, coordinate international response efforts, and raise awareness about the health threat.

6.DENGUE FEVER

- Dengue fever is a mosquito-borne illness caused by the dengue virus (Genus Flavivirus), which is prevalent in tropical and subtropical regions.
- Dengue fever is transmitted by the bite of infected female mosquitoes, primarily of the species Aedes aegypti.
- Symptoms: Common symptoms include sudden high fever, severe headaches, pain behind the eyes, severe joint and muscle pain, rash, and mild bleeding (e.g., nose or gum bleed).
- Transmission: The virus is transmitted to humans through the bite of infected Aedes mosquitoes. Dengue isn't contagious from person to person except when passed from a pregnant person to their child.
- Diagnosis and Treatment: Diagnosis is typically done through blood tests. There is no specific antiviral treatment for dengue; supportive care includes pain relievers, bed rest, and fluids.
- Prevention: Preventive measures include avoiding mosquito bites by using repellents, wearing longsleeved clothing, and eliminating mosquito breeding sites.

7.DIRECTORATE GENERAL OF QUALITY ASSURANCE (DGQA)

The Directorate General of Quality Assurance (DGQA) is an Inter-Service organization under the Department of Defence Production, Ministry of Defence, India.

- Its primary purpose is to provide Quality Assurance (QA) for a wide range of arms, ammunition, equipment, and stores supplied to the Indian Armed Forces.
- Quality Assurance: Ensuring the quality of defence products, both imported and indigenous, for the Army, Navy (excluding Naval Armaments), and common user items for the Air Force.
- > Import Substitution: Promoting the use of domestically produced goods instead of imports.
- Development Projects: Collaborating with the Defence Research and Development Organisation (DRDO) on various projects.
- Documentation and Standardization: Minimizing the variety of components and equipment through standardization.
- Support to Small Scale Industries: Promoting and supporting small scale industries involved in defense production.
- > Post Procurement Services: Providing services after the procurement of goods.
- **Technical Consultancy:** Offering technical advice to users, the Ministry, and production agencies.
- Facilitating Intellectual Property Rights (IPRs): Additionally, DGQA is involved in new initiatives such as facilitating Intellectual Property Rights (IPRs) for defence innovations, establishing world-class test labs, and granting certifications for defence manufacturers procured from Private Sector, Public Sector Undertakings, and Ordnance Factories.

Nipun Munition

- Nipun is a soft-target munition designed and developed by the Armament Research & Development Establishment (ARDE), in association with the High Energy Materials Research Laboratory (HEMRL), Pune.
- The 'Nipun' munition is advanced anti-personnel mine designed to enhance the operational capabilities of the Indian Armed Forces.
- It is part of India's efforts to modernize its defence equipment and ensure the safety and effectiveness of its military operations.
- > NIPUN is highly user-friendly and deadly against the enemy.

8.POLIOMYELITIS (POLIO)

- > Poliomyelitis also known as polio, is an infectious disease caused by the poliovirus.
- It mainly targets nerve cells in the spinal cord and brain stem that control muscle movement. Nerve cells controlling sensation are generally not affected.
- > It can cause irreversible paralysis and even death by affecting the nervous system.
- > It predominantly affects children under five.
- The naturally-occurring poliovirus, called the wild-type poliovirus, has been eliminated in most countries and causes few cases of polio.
- Another version of the virus, called the vaccine-derived poliovirus (VDPV), is more widespread and now causes most infections worldwide. VDPV exists mainly in a few countries that use an oral vaccine with a weakened poliovirus.

Vaccines:

- Oral Polio Vaccine (OPV): Administered as a birth dose, followed by three primary doses at 6, 10, and 14 weeks, and a booster dose at 16-24 months.
- Injectable Polio Vaccine (IPV): Given as an additional dose along with the third DPT (Diphtheria, Pertussis, and Tetanus) vaccine under the Universal Immunization Programme (UIP).

India's Polio-Free Status: India was declared polio-free by the WHO in 2014, with the last wild poliovirus case reported in 2011.

Wild Polioviruses and Vaccine-Derived Polioviruses

- > Wild polioviruses (WPVs): Wild polioviruses are the naturally occurring strains of the poliovirus.
- > There are three serotypes of wild poliovirus: type 1, type 2, and type 3.
- > Immunity to one serotype does not confer immunity to the others.
- > WPVs are highly infectious and spread primarily through the fecal-oral route, often via contaminated water or food. They can also spread through person-to-person contact.
- As of now, WPVs are endemic only in Afghanistan and Pakistan. Type 2 WPV was declared eradicated in 2015, and type 3 in 2019. Only type 1 WPV remains.

Vaccine-Derived Poliovirus (VDPV)

- Vaccine-Derived Poliovirus (VDPV) originates from the strain used in the oral polio vaccine (OPV), which contains a live, weakened poliovirus. This virus replicates in the intestine, helping the immune system produce antibodies and develop immunity.
- In rare cases, especially in under-immunized populations, the excreted vaccine virus can circulate, undergo genetic changes, and potentially revert to a form capable of causing paralysis. This is known as circulating vaccine-derived poliovirus (cVDPV).

Types of VDPV:

- > Circulating VDPV (cVDPV): Occurs when the mutated virus spreads in the community.
- Immunodeficiency-related VDPV (iVDPV): Found in individuals with primary immunodeficiency disorders.
- > Ambiguous VDPV (aVDPV): Cases that cannot be classified as either cVDPV or iVDPV.
- Global Context: Since 2000, over 10 billion doses of OPV have been administered globally, resulting in 24 cVDPV outbreaks in 21 countries, with fewer than 760 cases.

9.JUPITER ICY MOONS EXPLORER (JUICE)

- > The Jupiter Icy Moons Explorer (JUICE) is a mission launched by the European Space Agency (ESA).
- > It is designed to study Jupiter and its three largest moons: Ganymede, Callisto, and Europa.
- Launch Date: April 14, 2023
- Launch Vehicle: Ariane 5 rocket
- > Launch Site: Guiana Space Centre in French Guiana

Scientific Goals:

Study of Jupiter's Moons:

- Sanymede: Investigate its magnetic field, subsurface ocean, and geological history.
- **Europa:** Examine its ice shell and potential for habitability.
- > **Callisto:** Understand its ancient surface and subsurface ocean.
- > Jupiter's Atmosphere and Magnetosphere:
- Analyze the planet's complex atmosphere and magnetic environment.
- > Study the interactions between Jupiter and its moons.
- > Habitability and Planetary Formation:
- > Explore the conditions that might support life in the subsurface oceans of these moons.
- Investigate how gas giants and their moons form and evolve.

10.ATOMIC POWER STATIONS

- India's second home-built 700 MW nuclear power reactor at Kakrapar Atomic Power Station (KAPS) in Gujarat began operating at full capacity.
- India is constructing 14 more 700 MW nuclear power reactors of the same design, expected to begin operations progressively by 2031-32.
- > An atomic power station, also known as a nuclear power plant, is a facility that generates electricity using nuclear energy.
- India has 23 nuclear reactors in operation in 8 nuclear power plants, with a total installed capacity of 7,380 MW.
- These reactors are located in different states and use both Pressurised Heavy Water Reactors (PHWRs) and Light Water Reactors (LWRs).

Some of the nuclear power stations in India include:

- > Tarapur Atomic Power Station (TAPS), Maharashtra
- > Rajasthan Atomic Power Station (RAPS), Rajasthan
- Kudankulam Nuclear Power Plant (KKNPP), Tamil Nadu
- ▶ Kaiga Generating Station (KGS), Karnataka
- > Narora Atomic Power Station (NAPS), Uttar Pradesh
- > Kakrapar Atomic Power Station (KAPS), Gujarat
- > Madras Atomic Power Station (MAPS), Tamil Nadu
- > Kalpakkam (Indira Gandhi Centre for Atomic Research), Tamil Nadu

Key Components of atomic power station:

- Nuclear Reactor: The core component where nuclear fission occurs. In fission, the nuclei of atoms (usually uranium or plutonium) split, releasing a significant amount of heat.
- Heat Exchanger/Steam Generator: The heat produced in the reactor is used to convert water into steam.
- > **Turbine:** The steam drives a turbine, which is connected to a generator.
- Generator: Converts the mechanical energy from the turbine into electrical energy.
- > Cooling System: Cools down the steam back into water to be reused in the system.

Advantages:

- Low Greenhouse Gas Emissions: Compared to fossil fuels, nuclear power plants emit very low amounts of greenhouse gases.
- > High Energy Density: A small amount of nuclear fuel can produce a large amount of energy.

India's nuclear energy goals

- Short to Mid-Term Goals (by 2031-32):
- Increase Capacity: Triple the current nuclear power capacity from 7,480 MW to 22,480 MW.
- New Reactors: Commission 20 new nuclear power plants, adding nearly 15,000 MW to the power grid.
- Ongoing Projects: Complete the construction and commissioning of 10 reactors totalling 8,000 MW in states like Gujarat, Rajasthan, Tamil Nadu, Haryana, Karnataka, and Madhya Pradesh.
- Long-Term Goals (by 2047):
- > 100 GW Target: Achieve a nuclear power capacity of 100 GW.
- Private Sector Involvement: Encourage private sector participation to meet investment requirements for this expansion.

11.TANAGER-1

- The Tanager-1 satellite is an advanced Earth observation satellite developed by Planet Labs in collaboration with NASA's Jet Propulsion Laboratory (JPL) and the Carbon Mapper Coalition.
- Tanager-1 is designed to detect and track methane and carbon dioxide emissions, which are significant greenhouse gases contributing to global warming.
- > The satellite aims to identify "super-emitters," which are sources that release large amounts of these gases, enabling targeted mitigation efforts.
- The satellite operates in a low Earth orbit, which allows it to cover large areas of the Earth's surface and revisit specific locations frequently.
- Tanager-1 is part of a broader initiative to deploy a constellation of satellites for continuous monitoring of greenhouse gas emissions, enhancing global coverage and data accuracy.

Technology and Capabilities:

- Imaging Spectrometer: Tanager-1 is equipped with an advanced imaging spectrometer that can capture high-resolution images and spectral data. This technology allows it to detect specific gas emissions with great accuracy.
- Data Collection: The satellite collects data on the concentration and distribution of methane and carbon dioxide in the atmosphere, providing valuable information for climate scientists and policymakers.

Impact and Applications:

- Climate Change Mitigation: By identifying and tracking greenhouse gas emissions, Tanager-1 supports efforts to reduce these emissions and combat climate change.
- Policy and Regulation: The data collected by Tanager-1 can inform environmental policies and regulations, helping governments and organizations to implement effective measures to reduce emissions.
- Research and Development: Scientists and researchers can use the data from Tanager-1 to study the sources and impacts of greenhouse gases, leading to better understanding and innovative solutions.

12.CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO)

- > The Central Drugs Standard Control Organisation (CDSCO) operates under the Ministry of Health and Family Welfare in India.
- The Central Drugs Standard Control Organisation was established as India's national regulatory body for cosmetics, pharmaceuticals, and medical devices.

Functions:

Drug Approval and Regulation.

- New Drug Approvals: CDSCO evaluates and approves new drugs, ensuring their safety, efficacy, and quality.
- Clinical Trials Oversight: It monitors and regulates clinical trials conducted by pharmaceutical companies.

Quality Control and Standards:

- Quality Assurance: CDSCO ensures that drugs, medical devices, and cosmetics meet quality standards.
- Setting Standards: It establishes guidelines for drug manufacturing, labeling, and packaging.

Pharmacovigilance:

> CDSCO collects and analyses adverse drug reactions (ADRs) to safeguard public health.

> It takes necessary actions if safety concerns arise.

Import and Export Control:

> CDSCO regulates the import and export of drugs, ensuring compliance with legal requirements.

Medical Devices and Cosmetics:

- It oversees the safety and quality of medical devices and cosmetics.
- > CDSCO classifies medical devices based on risk levels.

Licensing and Inspections:

- > CDSCO grants licenses to drug manufacturers, importers, and distributors.
- > It conducts inspections to verify compliance with regulations.

Public Awareness and Education:

- CDSCO educates healthcare professionals and the public about safe drug use.
- It disseminates information on recalls, warnings, and updates.
- India's second home-built 700 MW nuclear power reactor at Kakrapar Atomic Power Station (KAPS) in Gujarat began operating at full capacity.
- India is constructing 14 more 700 MW nuclear power reactors of the same design, expected to begin operations progressively by 2031-32.
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SEPTEMBER 2024

1. DRUGS AND COSMETICS ACT, 1940

- The Supreme Court stayed the Centre's removal of Rule 170 from the Drugs and Cosmetics Rules, 1945, keeping previous regulations in effect to ensure drug and cosmetic safety until a final verdict.
- This rule regulated drug and cosmetic quality, safety, and compliance under the Drugs and Cosmetics Act, 1940.
- It ensured quality control, consumer safety, and adherence to manufacturing guidelines.
- Drugs and Cosmetics Act, 1940
 - 2 Ensures drug and cosmetic safety, efficacy, and quality.
 - **Regulated by DTAB and Central Drugs Laboratory.**
 - ☑ Controls import, manufacture, and sale.
 - Defines schedules, rules, and penalties for violations.

2. DRUG REPURPOSING

- Researchers are exploring the repurposing of existing drugs, including antidepressants, for cancer treatment.
- One study suggests Selegiline (L-deprenyl), an MAO inhibitor, may be effective in treating breast cancer, including estrogen and progesterone-positive (ER+ & PR+) and triple-negative breast cancer (TNBC).
- Drug repurposing involves finding new uses for existing or investigational drugs.
- The goal is to identify compounds with established safety profiles and therapeutic benefits that may be effective for different medical conditions.
- **Benefits of Drug Repurposing:**
 - **Cost-Effective**: Uses existing drugs with known safety, reducing testing costs.
 - **Faster Development**: Accelerates treatment availability, especially in urgent situations.
 - **Wide Applications**: Effective for diverse conditions, including rare diseases and cancer.
- **Examples**:
 - Sildenafil (Viagra): Initially for hypertension, now for erectile dysfunction.
 - **Thalidomide**: Repurposed from morning sickness to treat leprosy and myeloma.
- Challenges:
 - **Regulatory Hurdles**: Complex approval processes.
 - Intellectual Property: Patent issues may arise.

3. HEPATITIS

- Hepatitis is liver inflammation caused by viral infections, alcohol, medications, and autoimmune diseases.
- Indian Immunologicals Ltd (IIL) launched Havisure, India's first indigenous Hepatitis A vaccine for children.
- Havisure is a two-dose vaccine given at 12 months and six months later, recommended for routine immunization and high-risk individuals, including travelers to regions with high hepatitis A prevalence.

Types of Hepatitis:

- **Viral:**
- B Hepatitis A: Caused by HAV, spread through contaminated food/water, usually acute.
- P Hepatitis B: Caused by HBV, spread through body fluids, can be acute or chronic.
- **Hepatitis C**: Caused by HCV, spread through blood, often chronic.

- B Hepatitis D: Occurs only in those infected with hepatitis B, caused by the hepatitis D virus (HDV).
- P Hepatitis E: Caused by HEV, spread through contaminated water.
- **Non-Viral:**
- 2 Alcohol: Excessive alcohol causes alcoholic hepatitis.
- 2 Medications/Toxins: Certain drugs and toxins inflame the liver.
- 2 Autoimmune: The immune system attacks liver cells.
- **Symptoms:**

Fatigue, nausea, abdominal pain, jaundice, dark urine, pale stool, and fever.

- **?** Treatment:
 - **A & E**: Self-resolving with supportive care.
 - B & C: Antiviral medications, long-term management for chronic cases.
 - 2 Autoimmune: Immunosuppressive drugs.
- **Vaccination:**
 - A & B: Vaccines available.
 - **C & D**: No vaccines (B vaccine prevents D).
 - **E**: Vaccine available, limited use.

4. HELIUM

- Two NASA astronauts aboard Boeing's **Starliner** will remain on the **International Space Station** for months due to **propulsion system issues**, including **helium leaks**.
- Belium (He) is a colorless, odorless, non-toxic, and inert gas with the lowest boiling point.
- It is non-flammable and unreactive.
- Despite being the second most abundant element in the universe, helium is rare on Earth. It forms underground through radioactive decay and gets trapped in natural gas deposits.
- Major reserves are in the U.S., Qatar, and Algeria, but once released, helium escapes into space, making it nonrenewable.
- It is essential for MRI cooling, space technology, gas chromatography, and semiconductors.
- It also plays a key role in aerospace, defense, and medical treatments.
- Due to its limited supply and rising demand, helium is a strategic resource.
- With India relying on imports, securing its availability is crucial.

5. Vishvasya-Blockchain Technology Stack

- The Indian government launched the Vishvasya-Blockchain Technology Stack to enhance digital security, transparency, and trust. It provides Blockchain-as-a-Service (BaaS) for various permissioned blockchain applications.
- The infrastructure is geographically distributed across NIC Data Centers in Bhubaneswar, Pune, and Hyderabad, ensuring scalability and reliability.
- Its key objectives include:
- Strengthening **digital security and trust** in service delivery.
- Promoting **blockchain research** and addressing challenges like skilled manpower and vendor dependency.
- Positioning India as a global leader in blockchain technology for economic and social development.

6. DIGITAL PUBLIC INFRASTRUCTURE (DPI)

- Digital Public Infrastructure (DPI) enables efficient, inclusive, and secure service delivery across public and private sectors through scalable and interoperable platforms.
- **Rey Elements:**
- Digital Identity: Systems like Aadhaar provide unique IDs for accessing services.
- Digital Payments: UPI enables seamless, secure financial transactions.
- Data Exchange: DigiLocker allows secure data sharing with privacy.
- Public Platforms: India Stack offers reusable services like Aadhaar, UPI, and e-KYC.
- P Benefits:
- Inclusivity: Expands access to essential services.
- **Efficiency**: Streamlines and speeds up service delivery.
- **Cost-Effectiveness**: Reduces transaction costs.
- Innovation: Supports the creation of new services and economic growth.

7. POLARIS DAWN MISSION



The Polaris Dawn mission, led by Jared Isaacman and SpaceX, advances private spaceflight for future Moon and Mars missions.

Isaacman and Sarah Gillis performed the first commercial spacewalk, testing new suits.

The crew reached 1,400 kilometers, the highest orbit since Apollo, with Gillis and Menon as the first women at that

altitude.

- They studied space radiation in the Van Allen belt, crucial for future deep-space missions.
- The crew conducted 40 experiments on microgravity and space radiation. They also tested laser communication with Starlink satellites.

8. MINI MOON



Mini-moons are small asteroids temporarily captured by Earth's gravity. Only four have been discovered, none still orbiting Earth.

Asteroid 2024 PT5 will orbit Earth from September 29 to November 25, 2024, before escaping. It won't complete a full orbit, making it a "temporarily captured flyby."

- About 2024 PT5:
- Discovered by NASA's ATLAS system.
- 33 feet long, too small for the naked eye.
- Originates from the Arjuna asteroid belt.
- Study helps understand Earth-crossing asteroids and

resources for space exploration.

9. SQUARE KILOMETRE ARRAY (SKA)

The Square Kilometer Array (SKA) is set to be the world's largest and most sensitive radio telescope, aimed at exploring the universe in detail. It will be split between South Africa's Karoo region and Western Australia's Murchison region.

- ? The SKA consists of:
- SKA-Mid: 197 dish antennas in South Africa for mid-frequency radio waves. ?
- SKA-Low: 131,072 antennas in Australia for low-frequency radio waves. ?
- With a combined area of 1 square kilometre, it will be 50 times more sensitive than existing telescopes, ? using interferometry for high-resolution images.
- Scientific goals include studying cosmology, dark matter, astrobiology, and fundamental physics. ?

10. VENUS



Earth's "Twin": Similar in size and mass but vastly different in environment.

Rotation: Spins retrograde (opposite to most planets), ? with a day (243 Earth days) longer than its year (225 days).

Brightness: Third brightest object in the sky after the ? Sun and Moon.

- **Extreme Conditions:** ?
- Atmosphere: 96% carbon dioxide, thick sulfuric acid 0

clouds.

- Hottest Planet: 465°C due to a runaway greenhouse effect.
- Surface Pressure: 92 times Earth's. 0
- No liquid water due to intense heat and pressure. 0
- Volcanic Landscape: Most volcanic planet, with 90% basalt surface and evidence of recent eruptions. 0
- **Missions to Venus** 0
- ? NASA: Mariner 2 (1962, first planetary flyby), upcoming VERITAS & DAVINCI.
- ESA: Venus Express (studied atmosphere & magnetic field). ?
- ? Japan: Akatsuki (studied climate, but contact lost in April 2024).

11. QUANTUM TECHNOLOGY

- ? Quantum technology leverages quantum mechanics, the physics of atomic and subatomic particles, to overcome limitations of classical physics.
- It enables advancements in computation, communication, and sensing through principles like wave-? particle duality, superposition, entanglement, and Heisenberg's Uncertainty Principle.
- ? **Superposition:** Qubits exist in multiple states, enabling faster problem-solving.
- Entanglement: Linked particles reflect changes instantly, enhancing secure communication. ?
- ? **Interference:** Optimizes quantum algorithms by amplifying probable outcomes.

? These principles drive breakthroughs in **computation**, **cryptography**, and **precision sensing**. **12. NATIONAL QUANTUM MISSION (NQM)**

- India's National Quantum Mission (2023-2031) with ₹6,003.65 crore aims to advance quantum technology in four areas:
 - Quantum Computing: Develop quantum computers with 20-1000 qubits over 8 years.
 - **Quantum Communication:** Create secure satellite-based communication up to 2000 km.

- **Quantum Sensing & Metrology:** Enhance precision with magnetometers and atomic clocks.
- **Quantum Materials & Devices:** Design superconductors and semiconductors for quantum devices.

13. DENGUE

- Dengue is transmitted primarily by Aedes aegypti mosquitoes, though Aedes albopictus has contributed to its spread in Europe (2023). The virus is not contagious but can be passed from a pregnant mother to her child.
- Symptoms & Severity
- Mild cases: Fever, headache, muscle/joint pain, nausea, rashes.
- Severe cases (Dengue Hemorrhagic Fever): Internal bleeding, shock, and death.
- **Global & Indian Trends**
- **2023:** Over **12 million cases** and **6,991 deaths** globally (WHO).
- India: Dengue expanded from 8 states (2001) to all states & UTs (2022).
- **Factors Driving Spread (Lancet)**
- **Urbanization:** Dense populations and stagnant water aid mosquito breeding.
- **Climate Change:** Rising temperatures enable mosquitoes to thrive in new areas.
- **Human Movement:** Global travel accelerates disease transmission.
- Prevention & Vaccines
- WHO recommends Dengvaxia (Sanofi) and QDenga (Takeda), but they are not approved in India. Other Aedes-borne diseases like chikungunya and Zika are also increasing, with Zika first reported in India in 2016.

14. PARAM RUDRA

- Prime Minister Modi dedicated three Param Rudra supercomputers and a High- Performance Computing System for weather and climate to the nation.
- PARAM Rudra supercomputers, developed by C-DAC under the National Supercomputing Mission (NSM), are deployed in Pune, Delhi, and Kolkata for advanced scientific research.
- **Deployments & Applications:**
- **GMRT, Pune** Supports astronomical research, including Fast Radio Bursts (FRBs). (1 petaflop)
- IUAC, Delhi Facilitates research in material science and atomic physics. (3 petaflops)
- S.N. Bose Centre, Kolkata Advances studies in physics, cosmology, and earth sciences. (838 teraflops)
- **FLOPs in Computing:**
- FLOPs (Floating-Point Operations per Second) measure computational performance, crucial in high-performance computing (HPC) and AI. FLOPs scale:
- GigaFLOPs (GFLOPs) Billions of operations/sec
- TeraFLOPs (TFLOPs) Trillions of operations/sec
- PetaFLOPs (PFLOPs) Quadrillions of operations/sec
- While FLOPs indicate computing power, factors like memory bandwidth and system architecture also impact performance.

15. CHIKUNGUNYA

- **Transmission & Spread:**
- Spread by Aedes aegypti (urban) and Aedes albopictus (rural).
- Prevalent in tropical and subtropical regions (Africa, Asia, Americas).
- Symptoms & Impact:
- B High fever, severe joint pain, muscle pain, headache, fatigue, rash.

- Non-fatal but may cause **prolonged joint pain**, affecting daily life.
- **Diagnosis & Treatment:**
- **Confirmed via RT-PCR and ELISA tests.**
- D No cure; treatment focuses on **pain relief and hydration**.
- Prevention & Control:
- **2** Eliminate mosquito breeding sites, use insecticides and repellents.
- No vaccine available, making prevention essential.
- **Public Health & Government Response:**
- Chikungunya outbreaks strain healthcare systems, especially in dengue and Zika-prone areas.
- India's NVBDCP emphasizes vector control, awareness, and early detection.

16. THERMOBARIC WEAPONS

- Russia's use of **thermobaric weapons** in Ukraine has gained attention due to their destructive power.
- Often called "vacuum bombs," these weapons rely on atmospheric oxygen to fuel an explosive reaction.
- Unlike conventional explosives, thermobaric bombs release a fuel cloud that ignites, creating a hightemperature blast wave followed by a vacuum effect.
- This intense overpressure and vacuum make them especially lethal in confined spaces like bunkers and tunnels, causing massive structural damage and severe harm to the human body.
- Thermobaric weapons originated in the US during the Vietnam War in the 1960s, initially as fuel-air explosives (FAEs) for clearing minefields.
- The **ODAB-1500 bomb**, used by Russia in Ukraine, represents the latest evolution of these weapons.

OCTOBER 2024

1. MARBURG VIRUS

- Origin & History:
 - Identified in 1967 during outbreaks in Germany (Marburg, Frankfurt) and Serbia (Belgrade).
 - Inked to lab work with African green monkeys from Uganda.
 - 2 The African fruit bat (Rousettus aegyptiacus) is the natural host.
- Transmission:
 - 2 Animal to Human: Exposure to caves or mines with infected bats.
 - B Human to Human: Direct contact with bodily fluids or contaminated surfaces.
 - 2 Healthcare workers and family members are at high risk.
- Symptoms:
 - Incubation: 2-21 days.
 - 2 Early Signs: Fever, chills, headache, muscle aches.
 - 2 Severe Cases: Hemorrhaging, organ failure, shock.
- Diagnosis & Treatment:
 - Izab tests confirm infection.
 - I No specific antiviral treatment or vaccine.
 - ☑ Supportive care improves survival.
- Prevention & Control:
 - 2 Avoid contact with fruit bats and infected individuals.
 - ☑ Use protective gear in healthcare settings.
 - 2 Community engagement and infection control help contain outbreaks.



2. AKASHTEER SYSTEMS

The Indian Army has acquired 100 Akashteer systems, developed by Bharat Electronics Limited (BEL), to strengthen air defence.

- Rey Features
- Integrated Network: Connects radars, surveillance assets, and communication nodes.
- Automated Operations: Provides real-time situational awareness and control.
- Mobile & Resilient: Vehicle-based control centers ensure functionality in tough conditions.
- **Faster Threat Response: Enables quick detection, tracking, and engagement of aerial threats.**
- 2 Reduced Friendly Fire: Enhances safety of allied aircraft.
- The system boosts defence readiness against high-speed missile threats, crucial in modern warfare.

3. PROGERIA

- Sammy Basso, Longest-Living Progeria Survivor, Passes Away at 28.
- Progeria (Hutchinson-Gilford Progeria Syndrome HGPS) is a rare genetic disorder causing rapid aging in children.
- Cause & Mechanism
 - Caused by a mutation in the LMNA gene, which affects lamin A protein responsible for cell structure.

- 2 Leads to the production of progerin, an abnormal protein that weakens cells and accelerates aging.
- Rey Symptoms
 - **Rapid aging begins between 1-2 years.**
 - Physical traits: Growth failure, hair and fat loss, aged skin, joint stiffness, and heart disease.
 - Intellectual development remains normal.
 - Dife expectancy: 13-15 years, with most deaths due to heart attacks or strokes.
- Diagnosis & Treatment
 - **Genetic testing confirms the LMNA mutation.**
 - No cure, but treatments include heart medications, physical therapy, and aspirin for stroke prevention.
 - Description: Lonafarnib (FDA-approved) helps manage symptoms and extends life expectancy.

Research & Future Prospects

- 2 Studies focus on reducing progerin accumulation.
- 2 Stem cell research and gene therapy offer potential future treatments.

4. MicroRNAs

- The 2024 Nobel Prize in Physiology or Medicine was awarded to Victor Ambros and Gary Ruvkun for discovering microRNA and its role in post-transcriptional gene regulation.
- What is microRNA?
 - Small, non-coding RNA (19–24 nucleotides) that regulates protein production by silencing mRNA.
- Protein Production & miRNA Role:
 - **Transcription: DNA is copied into mRNA in the nucleus.**
 - Translation: mRNA moves to the ribosome, where tRNA helps form proteins.
 - miRNA Regulation: miRNA binds to mRNA, inhibiting protein synthesis.
- Nobel-Winning Discovery:
 - Studying C. elegans, Ambros found that lin-4 produced a short RNA that suppressed lin-14.
 - 2 Ruvkun discovered that lin-4 blocked protein synthesis rather than mRNA production.
 - They confirmed microRNA regulates gene expression, later proven universal in animals.
- Applications:
 - B Gene Regulation: miRNAs fine-tune cell function by controlling multiple genes.
 - Medical Impact: Abnormal miRNA activity is linked to cancer and genetic disorders like hearing loss and skeletal defects.

5. TRACHOMA

The WHO has declared India trachoma-free, making it the third country in South-East Asia to achieve this milestone.

What is Trachoma?

- A contagious bacterial eye infection caused by Chlamydia trachomatis.
- The leading infectious cause of preventable blindness, especially in poor communities.
- Blindness from trachoma is irreversible.
- Transmission & At-Risk Groups:
 - Spreads through eye/nasal discharge, contaminated items, and flies.
 - Primarily affects children, but repeated infections cause blindness in adulthood.
- Symptoms:

- 2 Early signs: Itching, irritation, blurred vision, and eye pain.
- 2 Severe cases lead to trichiasis (inward-turned eyelids), corneal scarring, and blindness.
- 2 WHO's Global Elimination Initiative:
 - 2 Aims to eliminate trachoma by 2030 using the SAFE strategy:
 - S: Surgery for trichiasis
 - A: Antibiotics for infections
 - F: Facial cleanliness
 - E: Environmental improvements (clean water & sanitation)
- O India's Efforts:
 - National Programme for Control of Blindness (NPCB) (1976) focused on early detection, treatment, and awareness.
 - 2 Adoption of WHO's SAFE strategy helped eliminate trachoma.

6. 2024 CHEMISTRY NOBEL

- Awarded to David Baker for computational protein design and Demis Hassabis & John Jumper for developing protein structure prediction technologies.
- Protein and the Folding Problem
 - Proteins, made of 20 amino acids, are essential for life.
 - D Their 3D structure determines function, but scientists long struggled to predict how they fold.
 - I1962 Nobel: John Kendrew & Max Perutz mapped the first 3D protein structures using X-ray crystallography.
 - **1972** Nobel: Christian Anfinsen discovered that amino acid sequences dictate structure.
 - In 1969, scientists found proteins fold directly into their correct shape, a mystery termed the proteinfolding problem.
 - By 2018, only 1.7 lakh protein structures were known, a fraction of the 200 million in nature.
- 2 AlphaFold: AI Revolution in Protein Prediction
 - DeepMind, co-founded by Hassabis, launched AlphaFold in 2018.
 - Uses deep learning to predict protein structures with high accuracy.
 - AlphaFold 2 (2020): Accuracy rivaled X-ray crystallography.
 - AlphaFold 3 (led by Jumper): Predicts protein interactions.
 - These models can determine structures in hours but cannot explain why proteins adopt certain shapes.
- Protein Design: David Baker's Contribution
 - **Developed computational tools for designing new proteins with specific functions.**
 - In 2003, used the Rosetta software (developed in 1999) to create a novel protein.
- Applications:
 - 2022 COVID-19 antiviral nasal spray, featuring lab-designed proteins targeting the virus's spike protein.
 - Protein design has vast potential for medicine and biotechnology.

7. CENTRAL DRUGS STANDARD CONTROL ORGANISATION (CDSCO)

- The Central Drugs Standard Control Organisation (CDSCO) has met WHO benchmarks for vaccine safety, efficacy, and quality.
- About CDSCO

- India's National Regulatory Authority (NRA) under the Ministry of Health & Family Welfare.
- Punctions like the FDA (U.S.) and EMA (EU).
- P Headquarters: New Delhi, with multiple offices and labs across India.
- Regulates drug approvals, clinical trials, quality control of imports, and enforcement of the Drugs and Cosmetics Act.
- I Jointly grants licenses for critical drugs like vaccines, blood products, and IV fluids with state regulators.
- Recent Developments
 - 2 WHO Global Benchmarking Tool (GBT VI) assessed India's regulatory system.
 - India retained Maturity Level 3, scoring highest in several areas.
 - 2 Earlier Benchmarking (2017): Done using GBT V, now upgraded to a stricter GBT VI.
- India's Role in Global Vaccine Supply
 - **2** 36 major vaccine manufacturers produce for both domestic and global markets.
 - Supplies vaccines to 150 countries, making India a key global vaccine provider.

8. EUROPA CLIPPER MISSION



NASA's Europa Clipper will explore Jupiter's moon Europa, a key target in the search for life. The mission will last several years, with multiple flybys studying Europa's ice shell, ocean, composition, and geology.

Mission Highlights

Largest NASA planetary spacecraft, with 100-ft (30m) solar arrays.

Arrives at Jupiter in April 2030, ending in 2034 with a planned crash into Ganymede.

Nine advanced instruments, including high-resolution cameras, magnetometers, and ice-penetrating radar.

2 49 close flybys, reaching as low as 16 miles (25 km) above Europa.

Scans nearly the entire moon while avoiding Jupiter's radiation.

Europa: A Potential Ocean World

- Similar in size to Earth's Moon, covered by 10–15 miles (16–24 km) of ice.
- Likely hides a deep ocean (80+ miles/130+ km) beneath.
- 2 Hubble spotted possible geysers erupting from its surface.
- Discovered by Galileo in 1610, along with Ganymede, Io, and Callisto.
- Other moons Ganymede and Callisto may also have subsurface oceans, but their thicker ice shells make exploration difficult.

9. OSSIFICATION TEST

- In Bone Ossification Test determines bone maturity, mainly for growth assessment and legal age verification.
- Rey Points
 - Image: Ossification is the process of bone formation.
 - 2 X-rays of bones, especially the hand, wrist, clavicle, humerus, and femur, help estimate skeletal age.

- **Radiologists compare results with standard age charts.**
- Image: Used in pediatrics, forensic investigations, and legal cases involving age disputes and juvenile justice.

10. DIPHTHERIA

- Diphtheria is a serious bacterial infection caused by Corynebacterium diphtheriae, which produces a toxin that damages respiratory tissues.
- Symptoms
 - 2 Sore throat, fever, swollen neck glands, weakness
 - 2 Thick grey coating forms in the throat, making breathing and swallowing difficult

Iransmission

- Spreads through respiratory droplets (coughing, sneezing)
- 2 Can also spread via contact with infected sores or ulcers
- High-risk groups: Close contacts and household members
- Prevention
 - ☑ Vaccination is the best protection.
 - DPT vaccine (Diphtheria, Pertussis, Tetanus) is given under the Universal Immunization Programme (UIP).
 - Booster doses and full vaccine coverage are essential.

11. INDIAN PHARMACOPOEIA (IP)

- The Drugs Controller General of India (DCGI) announced that 11 countries now recognize the Indian Pharmacopoeia (IP) as their standard.
- About Indian Pharmacopoeia (IP)
 - Published by the Indian Pharmacopoeia Commission (IPC) under the Ministry of Health & Family Welfare.
 - **B** Sets quality, purity, and strength standards for drugs in India.
 - Compliance is mandatory under the Drugs and Cosmetics Act, 1940.

History & Evolution

- First published: 1955.
- Latest edition: Indian Pharmacopoeia 2022.
- IPC established: 2009 to manage updates and publication.
- Key Features
 - Defines standards for APIs, dosage forms, and drug products.
 - **Test Methods: Covers chemical, biological, and standardization techniques.**
 - 2 Reference Standards: Ensures uniform drug quality across India.
- Indian Pharmacopoeia Commission (IPC)
 - 2 Autonomous body under the Ministry of Health & Family Welfare.
 - **Responsible for updating IP, research, and drug quality promotion.**
- Significance
 - Ensures safe, high-quality medicines.
 - 2 Aligned with WHO & ICH for global acceptance.
 - Supports India's pharmaceutical exports.

12. TROJAN ASTEROIDS

- Scientists have identified 2019 UO14 as Saturn's first known Trojan asteroid, confirming the presence of these celestial bodies around all giant planets in our solar system.
- What Are Trojan Asteroids?
 - Trojan asteroids share a planet's orbit around the Sun, residing in stable Lagrange Points (L4 & L5).
 - Lagrange Points are positions where gravitational forces of two larger bodies balance the motion of a smaller object, keeping it stable.
 - Among the five Lagrange Points (L1 to L5), L4 and L5 are stable, allowing Trojan asteroids to remain in orbit for long periods.
- Discovery & Significance
 - Pirst Trojan asteroid was discovered by Max Wolf in 1906 (Jupiter's Trojans).
 - 2 Studying these asteroids helps understand solar system evolution.
- Findings on Saturn's Trojan 2019 UO14
 - Discovered in 2019, confirmed as a Saturnian Trojan in recent research.
 - I Likely trapped at Saturn's L4 position around 2,000 years ago.
 - Expected to stay in its orbit for another thousand years.
- Possible reasons for its late discovery:
 - Planetary migration & collisions.
 - Smaller stable regions around Saturn's L4 & L5 compared to Jupiter.
 - o Long-term gravitational interactions affecting stability.

13. KALA-AZAR

- A severe parasitic disease caused by Leishmania donovani.
- ? Transmission
 - 2 Spread through the bite of infected female phlebotomine sandflies.
- Symptoms
 - Pever (irregular bouts).
 - Weight loss.
 - Splenomegaly & Hepatomegaly (enlarged spleen & liver).
 - Anemia (low RBC count).
- Endemic Regions
 - Pound in India (Bihar, Jharkhand, UP, West Bengal), East Africa, and Brazil.
- Diagnosis & Treatment
 - Diagnosis: Detection of parasites in bone marrow or spleen aspirates.
 - Ireatment: Antimonial drugs.
- Prevention & Control
 - Vector control: Insecticide spraying & bed nets.
 - Part of National Vector Borne Disease Control Programme (NVBDCP).
- Kala-Azar is the second deadliest parasitic disease after malaria, with a fatality rate of 95%-100% if untreated.

14. MOONLIGHT PROGRAMME



Izero Launch Timeline: Initial services by 2028, fully operational by 2030.

Developed By: European Space Agency (ESA).

Objective: Establish a dedicated satellite constellation for lunar communications and navigation services.

Key Features

Satellite Constellation: Five satellites—four for communication, one for navigation.

Range: Enables data transfer over 400,000 km between Earth and the Moon.

?

Coverage Focus: Lunar south pole, a key target for future missions due to its solar power potential and polar ice resources (water, oxygen, rocket fuel).

Significance

- 2 High-Speed Communication: Ensures low-latency data transfer.
- 2 Autonomous Landings: Supports precise landings and surface mobility.
- Sustainable Exploration: Lays the groundwork for a lunar economy by providing reliable infrastructure.
- Global Support: Will assist missions from space agencies and private companies over the next two decades.

15. INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

- Founded: 1957 as an autonomous international agency under the UN.
 Origin: Inspired by U.S. President Eisenhower's "Atoms for Peace" speech in 1953.
 Headquarters: Vienna, Austria. Reports to both the UN General Assembly and Security Council.
- P Mandate
 - Promote the peaceful use of nuclear energy.
 - Prevent the military use of nuclear technology, especially for weapons.
- Key Objectives
 - Ensure safe and secure nuclear energy use in power, medicine, and agriculture.
 - 2 Monitor compliance with nuclear non-proliferation treaties, including the NPT.
 - Prevent the diversion of nuclear materials for military purposes.
- P Functions
 - **Safeguards & Verification: Inspects nuclear facilities to prevent weaponization.**
 - **Technical Cooperation:** Assists nations in using nuclear technology for peaceful applications.
 - **Safety & Security: Establishes nuclear safety standards and security measures.**
 - 2 Nuclear Energy Development: Facilitates the exchange of knowledge and best practices.
- Membership
 - Open to all UN members and others willing to follow its statute.
- Recognition
 - 2005 Nobel Peace Prize awarded to the IAEA and Director General Mohamed ElBaradei for nuclear non-proliferation efforts.
- India & IAEA
 - Pounding member of the IAEA.
 - Signed a safeguards agreement in 2009 under the India-U.S. Civil Nuclear Agreement, allowing IAEA inspections of civilian nuclear facilities.

Actively contributes to nuclear safety, security, and technical cooperation. ?



RISE is a European Space Agency (ESA) mission aimed at ? servicing satellites in orbit. It focuses on repairs, refueling, repositioning, and deorbiting to promote a sustainable space environment.

Mission Overview ?

? Scheduled for launch in 2028, with an 8-year mission in geostationary orbit.

? Aims to extend satellite lifespans, reducing the need for frequent new launches.

Helps minimize space debris by servicing satellites ? before they become defunct.

? Significance

? Enhances satellite flexibility by addressing issues in orbit.

- Reduces costs and promotes efficient space operations. ?
- Supports sustainable space activities by limiting waste and extending satellite utility. ?



17. BETELGEUSE

? Betelgeuse is a red supergiant star in the Orion constellation, marking the hunter's left shoulder.

? It is usually the 10th-brightest star in the night sky and is about 500 light-years from Earth.

? One of the largest known stars, Betelgeuse has a diameter nearly 1,000 times that of the Sun.

? It is around 100,000 times more luminous and has an estimated mass of 10-20 times that of the Sun.

As a variable star, its brightness changes over time.

It has a short-term cycle of about a year and a longer six-

year cycle, likely influenced by the orbital motion of its companion, "Betelbuddy," through surrounding dust.

- In late 2019 and early 2020, Betelgeuse experienced an unusual dimming event, sparking speculation ? of an impending supernova.
- However, recent studies suggest the dimming was caused by a large dust ejection. ?

NOVEMBER 2024



1. ARTEMIS III

Artemis III is NASA's highly anticipated mission to return humans to the Moon after over 50 years. It will mark the first crewed lunar landing since 1972.

- Launch: No earlier than September 2026
- **Crew:** Four astronauts
- Duration: About 30 days
- Objectives:

Lunar South Pole Landing: First human mission to this unexplored region, potentially rich in water ice.

Scientific Research: Astronauts will conduct experiments, collect samples, and study lunar resources.

Mission Components:

SLS Rocket: Launches Orion from Kennedy Space Center.

Orion Spacecraft: Transports the crew to lunar orbit and back.

?

?

Starship HLS: SpaceX's lander will carry astronauts to the surface and return them to Orion.



2.LiDAR

What is LiDAR?

A remote sensing technology that uses pulsed laser light to measure distances.

- Generates **precise 3D maps** of Earth's surface.
- Types of LiDAR:
- **Topographic LiDAR:** Uses **near-infrared lasers** to map land.

Bathymetric LiDAR: Uses water-penetrating green light to measure seafloor and riverbeds.

- Below It Works:
- I LiDAR consists of a laser, scanner, and GPS receiver.
- Airplanes and helicopters are commonly used to collect data.
- The laser fires rapidly, reflecting off surfaces like **vegetation**, **buildings**, and terrain.
- The system calculates travel time of light pulses to determine elevation.
- **GPS and Inertial Measurement System (IMS)** refine data for accuracy.

Data Processing:

- Initial data forms a "**point cloud**", capturing all surface reflections.
- I Light intensity variations help distinguish vegetation, structures, and terrain.
- **"Bare earth" Digital Elevation Models (DEM)** can be created by removing structures and vegetation.

3. ADITYA-L1 MISSION

Isro's next mission — The Sun

Aditya-L1, the first space-based Indian solar observatory, will take off on Sept 2, Isro said. A look at what the mission, in which a probe will be placed millions of kilometres between Earth and Sun, entails.



4. GLOBAL HEALTH EMERGENCY CORPS

? Overview:

- **WHO initiative** to improve global readiness for health emergencies.
- **Established in 2023** after lessons from **COVID-19** emphasized the need for better **coordination**.
- Functions as a collaborative platform for countries and health networks to enhance prevention, preparedness, response, and resilience (HEPR).

Strategic Vision:

- 2 A **globally coordinated** health emergency workforce with:
- Connected leaders in health emergencies.
- Surge capacities for rapid response.
- A trained workforce to handle crises.

• Key Features:

- Integrated Workforce: A structured team operating at national, regional, and global levels.
- Collaborative Framework: Promotes coordinated efforts among members for stronger collective responses.
- **Rapid Deployment:** Enables **quick mobilization** to tackle emerging health threats globally.

5. ORPHAN DRUGS

Definition & Global Perspective:

- **Orphan drugs** are developed to treat **rare diseases**, often life-threatening.
- In the U.S., a disease is rare if it affects fewer than 200,000 people.
- In the EU, a disease is rare if it affects fewer than 1 in 10,000 people.
- India lacks a formal definition, but the National Policy for Rare Diseases (NPRD) 2021 provides a framework for diagnosis and treatment.

Classification of Rare Diseases in India (NPRD 2021):

- **Group 1:** Curable with one-time interventions (e.g., Lysosomal Storage Disorders treated with HSCT).
- **Group 2:** Requires lifelong management but has lower treatment costs (e.g., Maple Syrup Urine Disease).
- **Group 3:** Treatment exists but is costly and lifelong (e.g., Gaucher & Pompe Disease).
- **Incentives for Orphan Drug Development:**
 - **Market exclusivity, tax credits** for R&D, and **fee waivers** for regulatory applications.

Challenges in India:

- B High R&D costs make drug development financially risky.
- **Limited patient availability** complicates clinical trials.
- **Expensive treatments** (e.g., enzyme replacement therapy for Gaucher's disease costs crores annually).
- **Lack of comprehensive data** on rare diseases hampers progress.
- NPRD provides a framework but lacks strong financial and regulatory incentives for drug development.



6. LID-568

Overview:

LID-568 is a recently discovered supermassive black hole, existing 1.5 billion years after the Big Bang.

- Among the earliest known black holes in the universe.
- Key Characteristics:

Extreme Accretion: Consumes matter at 40 times its Eddington limit.

- Mass: Estimated at 7.2 million times the Sun's mass.
- B Host Galaxy: Resides in a dwarf galaxy with low gas and

dust emissions.

- Significance:
 - Challenges Growth Models: Its rapid growth suggests supermassive black holes formed faster than previously believed.
- Exceeding Theoretical Limits: Accretion beyond the Eddington limit challenges existing black hole physics.
- **Role of Outflows:** Strong gas outflows may help stabilize the system by releasing excess energy.



Lassa Fever is a viral hemorrhagic illness caused by the Lassa virus.

Transmission

Animal-to-Human: Spread through contact with urine or feces of infected Mastomys rats, common in West Africa.

Human-to-Human: Transmitted via bodily fluids, especially in healthcare settings lacking protective measures.

Geographic Spread

Endemic in West Africa, notably Nigeria,Sierra Leone, Liberia, and Guinea.

International travel increases the risk of global spread.

?

?

- **Early Signs:** Fever, malaise, headache, sore throat, nausea, and abdominal pain.
- **Severe Cases:** Hemorrhaging, respiratory distress, and **multi-organ failure** with **high mortality**.
- Diagnosis & Prevention

Symptoms

- Diagnosed through ELISA and RT-PCR tests.
- **No specific vaccine available** yet.
- India: No recorded cases, but classified as a disease of international significance by the Ministry of Health due to potential risks from global travel.

8. TITANIUM

Titanium (Ti) is a strong, lightweight, and corrosion-resistant metal with atomic number 22.

- **Rey Properties**
 - Strength & Weight: As strong as steel but 45% lighter.
 - Corrosion Resistance: Naturally forms a protective oxide layer, resisting seawater, acids, and chlorine.
 - Bigh Melting Point: About 1,668°C (3,034°F), making it ideal for high-temperature applications.
 - **Oxidation:** Forms **titanium dioxide (TiO₂)**, enhancing corrosion resistance.
 - Alloying: Combined with aluminum, iron, vanadium, and molybdenum for better mechanical properties.
 - **Biocompatibility: Non-toxic** and suitable for **medical implants** and surgical tools.
- Major Uses
 - Aerospace: Used in jet engines, aircraft frames, and missiles due to its strength, lightness, and heat resistance.

- Medical & Dental: Ideal for implants, prosthetics, and surgical instruments as it does not react with body tissues.
- Automobile & Sports: Found in high-performance car engines, exhausts, bicycles, golf clubs, and tennis rackets.
- Pigments & Cosmetics: Titanium dioxide (TiO₂) is used in paints, plastics, cosmetics, and sunscreens for UV protection.

Extraction & Production

- ☑ Ores: Mined from ilmenite (FeTiO₃) and rutile (TiO₂), with Australia, South Africa, Canada, and India as top producers.
- **Extraction:** The **Kroll process** is widely used.
- **Recycling: Highly recyclable**, reducing costs in industries like aerospace.

9. ALLULOSE

Rey Facts

- Pound naturally in small amounts in figs, raisins, and jackfruit.
- A monosaccharide, similar to glucose and fructose.
- Provides 0.4 kcal/gram, about 10% of the calories of regular sugar.
- 2 Absorbed but not metabolized, contributing minimal calories.

Health Benefits

- **Low Glycemic Index:** Has little effect on **blood sugar and insulin**, making it **diabetes-friendly**.
- 2 Weight Management: Low-calorie content supports weight control.
- **2** Comparison with Other Sweeteners
 - Dulike artificial sweeteners (e.g., aspartame, sucralose), allulose is naturally occurring.
 - **Tastes similar to sugar** without the **bitter aftertaste** of some low-calorie alternatives.
- Safety & Regulation
 - Recognized as "Generally Recognized As Safe" (GRAS) by the U.S. FDA.
 - In India, its regulatory status is evolving, with rising interest due to growing health awareness.

10. CYANOBACTERIA



Cyanobacteria are photosynthetic bacteria found in aquatic and terrestrial ecosystems. They are among the oldest organisms on Earth and played a key role in oxygenating the atmosphere during the Great Oxygenation Event (2.5 billion years ago).

- Structure
- Prokaryotic (lack a nucleus), unlike eukaryotic algae.

Contain **chlorophyll a** and pigments like **phycocyanin and phycoerythrin**, giving them a **blue-green color**.

Photosynthesis & Nitrogen Fixation

Perform oxygenic photosynthesis, producing oxygen

like plants.

- Autotrophic, generating food using sunlight.
- Certain species (Anabaena, Nostoc) have heterocysts that fix atmospheric nitrogen, aiding soil fertility.

P Habitat & Ecological Role

- Pround in freshwater, marine, and extreme environments (hot springs, polar regions, deserts).
- Primary producers, forming the base of aquatic food chains.
- Improve soil fertility through nitrogen fixation, benefiting crops like rice.
- **Contributed to Earth's oxygenation**, enabling **aerobic life evolution**.
- P Help form **stromatolites**, some of the **oldest fossils** on Earth.
- **Potential Hazards**
 - Harmful Algal Blooms (HABs): Excessive growth in nutrient-rich water can produce toxins harmful to humans and aquatic life.
 - **Cyanotoxins** (e.g., microcystins) contaminate water sources, posing health risks.



- Cells create mRNA using DNA instructions, but errors may lead to faulty proteins and disorders. RNA editing fixes these errors before protein production.
- ADAR Enzyme (Adenosine Deaminase Acting on RNA): Converts adenosine (A) to inosine (I), which mimics guanosine, allowing error correction.
- **Guide RNA (gRNA):** Directs ADAR to specific mRNA sites for targeted editing.
- **Scientists hope this technique can treat genetic disorders** through precise mRNA modifications.
- RNA vs. DNA Editing
 - **RNA editing is temporary**, reducing long-term risks, unlike permanent DNA modifications.
 - **RNA uses ADAR enzymes**, naturally found in humans, minimizing immune reactions.
 - DNA editing tools (e.g., CRISPR-Cas9) use bacterial proteins, which may trigger immune responses.
 - RNA editing offers a **safer, flexible** alternative for gene therapy.

12. GLUTEN

- Gluten is a protein group found in wheat, barley, and rye, providing elasticity and moisture to foods.
 It gives bread its chewy texture.
- **Composition**
 - **Gliadin:** Helps dough rise during baking.

Glutenin: Provides elasticity.

Health Implications

- **Celiac Disease:** An autoimmune disorder where gluten damages the small intestine, leading to nutrient malabsorption.
- **Wheat Allergy:** An immune reaction to wheat proteins, including gluten.
- **Non-Celiac Gluten Sensitivity:** Causes digestive discomfort without celiac disease or wheat allergy.
- Izabeling Regulations
 - **FSSAI mandates gluten labeling** on food products in India.

LOW-ENERGY CHARGED PARTICLE

Image: Book of the section of the s

HIGH-GAIN ANTENNA

Gluten is widely present in Indian staples like wheat-based rotis and parathas.



ULTRAVIOLET SPECTROMETER

MAGING NARROW ANGLE & IMAGING WIDE ANGLE

PHOTOPOLARIMETER INFRARED

BUS' HOUSING ELECTRONICS

OPTICAL CALIBRATION TARGET

PLASMA

Launch & Mission:

Launched on August 20, 1977, under NASA's Voyager program.

 Studied Jupiter, Saturn, Uranus,
 Neptune, along with their moons, rings, and magnetic fields.

- **Unique Achievement:**
- The only spacecraft to visit both Uranus and Neptune.

Explored all four giant planets of the solar system.

PLANETARY RADIO ASTRONOMY AND PLASMA WAVE ANTENNA (2) **Key Flybys:**

RADIOISOTOPE THERMOELECTRIC GENERATOR (3)

CONTRACTOR CONTRACTOR CONTRACTOR

- **Jupiter (1979):** Discovered volcanic activity on Io.
- Saturn (1981): Analyzed its rings and atmosphere.
- **Uranus (1986):** Identified a tilted magnetic field and new moons.
- **Neptune (1989):** Discovered the **Great Dark Spot** and **fastest winds** in the solar system.
- Beyond the Solar System:
 - Crossed the heliopause into interstellar space on November 5, 2018.
 - 2 Continues to send data on the **outer heliosphere and interstellar space**.
- **Golden Record & Power:**
 - **Carries a golden disc with Earth's sounds and images** for potential extraterrestrial contact.
 - Powered by a **Radioisotope Thermoelectric Generator (RTG)**, allowing it to function far from the Sun.

14. WALKING PNEUMONIA

Overview:

- A mild form of pneumonia caused by *Mycoplasma pneumoniae*.
- **Called** "walking" as **patients can continue daily activities** despite infection.
- Symptoms:
 - **Resembles a cold or mild respiratory infection** with **cough, sore throat, low fever, and fatigue**.
 - Develops gradually and may last for weeks, making diagnosis difficult.
- **Cause & Transmission:**

- Caused by *Mycoplasma pneumoniae*, which **lacks a cell wall** and is **resistant to penicillin**.
- **Spreads through respiratory droplets in crowded places** like schools and dormitories.

Diagnosis & Treatment:

- Identified via physical exams, chest X-rays, serological tests, or PCR.
- 2 Treated with **antibiotics** like macrolides (*azithromycin*), **doxycycline**, or **fluoroquinolones**.
- **Bed rest, hydration, and OTC medications** help manage symptoms.
- **Complications:**
 - Usually not life-threatening, but can be severe in elderly or immunocompromised individuals if untreated.

15. WORLD DIABETES DAY

Significance:

November 14 is observed as World Diabetes Day to honor Sir Frederick Banting, co-discoverer of insulin.

Pancreas & Insulin

- Pancreas: A dual-function organ with:
- Exocrine function: Produces digestive enzymes.
- Endocrine function: Produces hormones, including insulin, to regulate blood sugar.

Insulin:

- A hormone produced by beta cells in the islets of Langerhans.
- Role:
- P Helps glucose enter cells for energy.
- Stores excess glucose as glycogen in the liver and muscles.
- Maintains blood sugar within 70–140 mg/dL.
- **Discovery of Insulin (1921)**
- Discovered by Frederick Banting and Charles Best, under John Macleod's guidance.
- **James Collip** later purified insulin, making it safe for human use.
- Nobel Prize (1923): Awarded to Banting & Macleod, though Banting felt Best deserved it, and Macleod credited Collip. Both shared their prize money.
- Insulin & Mass Production
 - Banting sold the patent for \$1 to ensure affordable insulin production.
 - 2 Early insulin was extracted from **dogs and cows**, but **not scalable** for mass use.
 - Recombinant DNA technology (1980s): Scientists inserted the human insulin gene into E. coli bacteria, enabling large-scale production of human-identical insulin.

16. ONE DAY ONE GENOME INITIATIVE

- Launched by: Department of Biotechnology (DBT) & Biotechnology Research and Innovation Council (BRIC).
- Purpose: Unlock India's vast microbial potential.
- **Objectives:**
 - Microbial Exploration: Identify India's unique microbial species and their roles in agriculture, environment, and health.
 - **Genomic Data:** Provide **free access** to genomic data for scientific collaboration.
 - Innovation: Drive research and real-world applications.

Rey Features:

- **Genome Sequencing:** Maps bacterial genomes to understand their potential uses.
- Public Access: Data, infographics, and genome details will be freely available.
- Significance:
 - **Environmental Protection:** Supports sustainable management of ecosystems.
 - **Agriculture:** Enhances soil fertility, pest control, and nutrient cycling.
 - B Human Health: Aids in digestion, immunity, and mental well-being.

17. VIKING MISSION

New Hypothesis: NASA's Viking mission may have unintentionally destroyed potential Martian life.

Context:

I The landers' methods might have been too intrusive for microbial life, if it existed.

Learning Corner:

- Purpose: Study Mars' surface, atmosphere, and potential for life.
- **Missions:** Viking 1 & Viking 2 (each had an orbiter and lander).

Launch Dates:

- Viking 1: August 20, 1975
- O Viking 2: September 9, 1975
- **D** Landings:
- O Viking 1: July 20, 1976
- Viking 2: September 3, 1976

• Key Objectives:

- Search for Life: Conduct biological experiments.
- Surface & Atmosphere: Analyze soil, weather, and air composition.
- **Mapping:** Capture high-resolution images of Mars' terrain.

Rey Discoveries:

- **Atmosphere:** Mostly CO₂, with nitrogen and argon traces. Thin, ~1% of Earth's pressure.
- Surface & Soil: No clear signs of life; perchlorates detected.
- **Weather:** Observed dust storms, temperature shifts, and frost.
- **Water Evidence:** Found signs of ancient water flow.
- Significance:
 - Pirst successful Mars landers with in-situ analysis.
 - Provided crucial data for later missions like Pathfinder, Curiosity, and Perseverance.



18. IN - SPACe

The Indian National Space Promotion and Authorization Centre (IN-SPACe) is an autonomous agency under the Department of Space (DOS). Established in June 2020, it facilitates private sector participation in India's space sector.

Purpose:

Promote Private Participation: Supports nongovernment entities (NGEs) in space ventures.

Authorize & Supervise: Regulates space operations through a structured framework.

Boost Space Economy: Strengthens India's space ecosystem and economy.

Share Infrastructure: Grants NGEs access to DOS/ISRO facilities.

Develop New Infrastructure: Aids in building new space facilities.

19. KYASANUR FOREST DISEASE (KFD)

- KFD is a zoonotic viral disease endemic to forested regions of India. It was first identified in 1957 in the Kyasanur Forest, Karnataka.
- The disease is caused by the **Kyasanur Forest Disease Virus (KFDV)**, a member of the **Flavivirus genus** (*Flaviviridae* family).
- Also known as Monkey Fever.
- **Transmission:**
 - Primary Hosts: Small mammals (monkeys, rodents).
 - **Vectors:** Ticks (Haemaphysalis spinigera).
 - **Human Infection:** Through tick bites or contact with infected animals.
 - **Endemic Areas:** Karnataka, Goa, Kerala, Maharashtra, and Tamil Nadu.
- Symptoms:
 - Incubation: 3–8 days.
 - **Acute Phase: High fever, headache, muscle pain, bleeding, vomiting, diarrhea.**
 - **Recovery Phase:** Some relapse with neurological issues like tremors or mental disturbances.
- **Prevention:**
 - **Vaccination:** KFD vaccine with **annual booster doses** in endemic areas.
 - Personal Protection: Use protective clothing, tick repellents, and avoid contact with infected animals.
 - **Environmental Control:** Reduce **tick populations** in affected regions.



20. PROBA 3

Proba-3 is an advanced ESA mission designed to study the Sun's corona using a unique dual-satellite system. It has a two-year mission life and will orbit Earth in a highly elliptical path (apogee: 60,530 km, perigee: 600 km).

Mission Design & Instruments:

Tandem Satellites – Two satellites will separate after launch and fly in precise formation to create a solar coronagraph.
 ASPIICS (Coronagraph) – Blocks bright sunlight to reveal the inner and outer solar corona.
 DARA (Radiometer) – Measures the Sun's total energy output (total solar irradiance).
 3DEES (Spectrometer) – Monitors electron fluxes in Earth's radiation belts.

Why is Proba-3 Unique?

Artificial Solar Eclipse – The Occulter Spacecraft (200 kg) will cast a shadow onto the Coronagraph Spacecraft (340 kg),

mimicking solar eclipse. а **Extended Observation Time** – Unlike natural eclipses (~10 minutes, 1.5 times a year), Proba-3 will equivalent 50 create six-hour eclipses, to events annually. Precision Flight Formation – The satellites will maintain a 150-metre separation to ensure stable coronagraph imaging.

☑ Enhanced Solar Research – By blocking the Sun's intense light, Proba-3 will provide uninterrupted corona observations, improving our understanding of solar activity.

21. TUNGSTEN

- Also Known As Wolfram
- Appearance Steel-gray to white metal
- Melting Point Highest among metals at 3,410°C (6,170°F)
- Density 19.3 g/cm³, making it extremely dense
- **Electrical Conductivity** Excellent conductor
- Hardness Exceptionally strong and hard
- **Occurrence & Availability**
 - Critical Mineral Listed among India's 30 critical minerals
 - **Ores** Found in wolframite and scheelite
 - **Abundance** Comparable to **tin and molybdenum**, but **rarer than uranium**

Uses of Tungsten

- **Light Bulbs** Previously used in incandescent filaments
- Alloys Strengthens steel and other metals
- **Electronics** Used in electronic devices and components
- Aerospace Ideal for high-temperature applications
- Medical Used in imaging devices and radiation shielding
- Tungsten's unique properties make it essential in industrial, electronic, and aerospace applications.

DECEMBER 2024

1. NAFITHROMYCIN

- The government has soft-launched Nafithromycin, India's first indigenously developed antibiotic to tackle antimicrobial resistance (AMR).
- It offers hope in treating drug-resistant pneumonia, which causes over two million deaths globally each year.

Image: Provide the second se

- Treats: Community-Acquired Bacterial Pneumonia (CABP), affecting children, the elderly, and immunocompromised individuals.
- India's Burden: 23% of global pneumonia cases occur in India.
- **D** Marketed as: "Miqnaf" by Wolkardt Pharmaceuticals.
- Developed with: BIRAC (Biotechnology Industry Research Assistance Council) under the Department of Biotechnology.
- Unique Feature: Targets both typical and atypical pathogens, making it a breakthrough after 30+ years without new antibiotics in this class.

What is Pneumonia?

- 2 Affects the lungs, causing alveoli (air sacs) to fill with pus and fluid, making breathing difficult.
- **Causes**:
- Bacteria: Streptococcus pneumoniae (most common).
- Viruses: Influenza, COVID-19.
- Fungi & Mycoplasma can also cause pneumonia.

2. ANTHRAX

A female elephant was **found dead**, likely due to **anthrax**, during routine forest patrols.

What is Anthrax?

- A serious bacterial infection caused by *Bacillus anthracis*.
- The bacteria form **spores** that survive in soil for years.
- 2 Wild animals and livestock can **inhale or ingest spores** while grazing.
- Once inside a host, bacteria activate, multiply, and release toxins, leading to severe illness or death.
- **Not contagious** like the flu but can infect humans through direct exposure.
- **Treatment** includes antibiotics and vaccines.

Types of Anthrax

- 2 Cutaneous: Enters through skin wounds (most common, least deadly).
- **Gastrointestinal**: Contracted by eating infected meat.
- Inhalation: Deadly form caused by breathing in spores.
- Injection: Affects drug users injecting heroin.

Anthrax & Bioterrorism

- **P** Found worldwide, especially in **countries lacking livestock vaccination**.
- Can be used as a biological weapon.
- **2001 U.S. attack**: Anthrax spores were mailed to officials, infecting 22 people and killing 5.

3. COPERNICUS PROGRAM

Launch: A new **Copernicus Sentinel satellite** was successfully launched from **French Guiana**.

- Purpose: Sentinel-1C enhances Copernicus, the world's most advanced Earth Observation system, ensuring redundancy and resilience.
- **Copernicus Programme: Europe's Earth Monitoring Initiative**
 - **Property GMES (Global Monitoring for Environment and Security).**
 - Objective: Provides accurate, timely, and accessible data for environmental management, climate change mitigation, and civil security.
- **Key Components**
 - **Space Component:**
 - Sentinel Satellites: Designed to monitor land, atmosphere, and oceans.
 - **Contributing Missions**: Other space agency satellites supporting Copernicus.
 - **In-Situ Measurements**:
 - Ground and Airborne Networks: Gather environmental data.
 - Data Integration: Combines satellite and in-situ data for a comprehensive Earth view.
- **Copernicus Services**:
 - Covers six themes: atmosphere, marine, land, climate, emergency, and security.
 - Free Access: Data is open to all users and the public.
 - Significance
 - Sentinel-1C enhances **global monitoring** for **climate action**, **disaster response**, **and security**, reinforcing Europe's role in **sustainable development and scientific research**.

4. MARBURG VIRUS DISEASE (MVD)

- Overview: A highly infectious virus causing Marburg Virus Disease (MVD), a severe hemorrhagic fever in humans and primates.
- Causative Agents: Marburg virus (MARV) and Ravn virus (RAVV) from the Filoviridae family, which also includes Ebola virus.
- First Detected: In 1967 during lab work in Germany and Serbia with African green monkeys from Uganda.

Transmission

- **Natural Host: Egyptian fruit bat (Rousettus aegyptiacus).**
- Animal to Human: Through bat feces, saliva, or infected animal tissues.
- B Human to Human: Via blood, bodily fluids, or contaminated objects.
- **High-Risk Activities**: Burial ceremonies and close contact with infected individuals.

Symptoms

- **Early Signs**: High fever, headache, chills, muscle pain, and rash.
- **Severe Symptoms: Liver failure, shock, bleeding**, and **multi-organ dysfunction**.
- **Fatality Rate**: Ranges from **24% to 88%**, depending on strain and care.

Diagnosis & Treatment

- Diagnosis: Blood tests like ELISA or RT-PCR.
- **Treatment**: No specific antiviral drugs; supportive care includes **rehydration** and **symptom management**.
- Prevention: Avoid contact with bats, wear protective gear, and isolate infected patients.

5. DISEASE X

- Not a real disease, but a placeholder for an **unknown future pathogen** that could trigger a global health crisis.
- Coined by WHO in 2018 to prepare for unpredictable outbreaks.
- COVID-19 is considered the first real example of Disease X, as it emerged unexpectedly and required a rapid global response.
- Future Disease X scenarios may arise from zoonotic diseases, pathogen mutations, lab accidents, or bioterrorism.

6. WILLOW CHIP

Breakthrough Achievement

Willow performed a computation in under five minutes, a task that would take a supercomputer 10 septillion years (10²⁵) to complete.

Quantum Computing & Qubits

- Classical computers use bits (0 or 1) to process data.
- Qubits leverage quantum mechanics, allowing them to exist in multiple states simultaneously (e.g., 25% chance of 0 and 75% chance of 1).
- This enables quantum computers to **process information exponentially faster** than classical systems.

Willow Chip Features

- **Quantum Supremacy**: Outperforms classical computers in specific tasks.
- **Superconducting Qubits**: Highly sensitive but improved for better **stability & coherence**.
- **Error Correction**: Advanced techniques reduce noise and computation errors.

Potential Applications

- **Materials Science**: Designing advanced materials like superconductors and better batteries.
- Drug Discovery: Simulating complex molecules to accelerate medical research.
- **Artificial Intelligence**: Enhancing AI and machine learning capabilities.

7. INFRARED RADIATION

- Infrared (IR) radiation is electromagnetic radiation with wavelengths longer than visible light but shorter than microwaves.
- **Wavelength Range: 700 nm to 1 mm**, divided into:
 - Near IR (NIR): 700 nm 1,400 nm
 - Mid IR (MIR): 1,400 nm 3,000 nm
 - Far IR (FIR): 3,000 nm 1 mm
- Sources:
 - **Natural:** The **Sun**, **thermal radiation** from warm objects like **humans and animals**.
 - **Artificial:** Generated by heaters, lasers, LEDs, and electrical appliances.
- Properties:
 - Invisible to humans but felt as heat.
 - **Travels in straight lines** at the speed of light.
 - **Easily absorbed and emitted** by matter, especially water and carbon-based materials.

Applications:

Communication: Used in remote controls, IR sensors, and fiber optics.

- Astronomy: Helps study celestial objects obscured by cosmic dust.
- **Medical:**
- Infrared imaging detects inflammation and injuries.
- Used in physiotherapy for muscle pain relief.
- **Military & Security:**
- Used in night vision, thermal imaging, and targeting systems.
- **Environmental Monitoring:**
- Detects heat emissions, forest fires, and volcanic activity.
- Industrial:
- Applied in heat sensing, drying, and heating systems.

8. SPADEX MISSION

- Launch Date: December 30, 2024, onboard PSLV-C60.
- If successful, India will become the **fourth country** to achieve **in-space docking**.
- About SpaDeX:
 - SpaDeX (Space Docking Experiment) is an ISRO project to demonstrate rendezvous, docking, and undocking in low-Earth orbit.
 - This technology is crucial for linking satellites launched separately and for India's planned space station, Bharatiya Antariksh Station.

Mission Details:

- Spacecraft: Two small satellites—SDX01 (Chaser) and SDX02 (Target)—each weighing 220 kg.
- **Launch:** Aboard **PSLV-C60** from **Satish Dhawan Space Centre**.
- **Orbit: 470 km circular orbit** at 55° inclination.
- **Docking Process:**
- The spacecraft will dock, transfer electrical power, then undock.
- Post-docking, both satellites will operate their payloads for **up to two years**.

9. BIO-BITUMEN

- **Bitumen** is a black, viscous material from crude oil, mainly used in road construction.
- Lignin, a natural polymer in plant cell walls, is abundant in agricultural waste and can be processed into bio-bitumen.
- Bio-bitumen reduces greenhouse gas emissions by up to 70% compared to conventional bitumen.



Composition & Production

Peedstock Sources:

• Agricultural waste (straw, husks, lignocellulosic biomass).

• Algae, waste cooking oil, animal fats.

Organic waste from municipal and industrial sources.

Production Processes:

• Pyrolysis: Biomass is heated in oxygen-free conditions to produce bio-oil, refined into bio-bitumen.

- Hydrothermal Liquefaction: Converts wet biomass into bio-bitumen using high temperature & pressure.
- Catalytic Upgradation: Improves bio-bitumen's properties for better performance.
- Benefits
 - **Reduces Import Dependency:** Less reliance on fossil-based bitumen.
- **Environmental Impact:**
 - Utilizes agricultural waste, reducing stubble burning.
 - Lowers carbon footprint by at least 70%.

10. GENCAST

- **GenCast** is an **AI-based weather forecasting model** developed by **Google DeepMind**.
- It outperforms the European Centre for Medium-Range Weather Forecasts (ECMWF) ENS, predicting weather up to 15 days in advance.
- **Key Features**
 - Machine Learning-Based: Unlike traditional models that rely on physics-based equations, GenCast learns from decades of historical data.
 - Probabilistic Forecasting: Generates multiple possible scenarios, improving risk assessment for extreme weather events.
 - Faster & Efficient: Produces forecasts in eight minutes, using standard computational resources, unlike traditional supercomputing-dependent models.
 - Better Extreme Weather Prediction: Accurately forecasts tropical cyclones, heatwaves, and storms, allowing earlier warnings and better disaster preparedness.

11. PARKER SOLAR PROBE

Closest Approach & Speed

- On December 24, NASA's Parker Solar Probe made the closest-ever approach to the Sun.
- It passed 6.1 million km (3.8 million miles) above the surface.
- Traveling at **700,000 km/h (430,000 mph)**, it is the **fastest human-made object**.



- Mission Overview
- Launched in August 2018, the probe is designed to study the Sun's outer corona.

It uses **Venus flybys** to gradually move closer.

In 2021, it became the first spacecraft to fly through the corona.

Scientific Goals

Understand energy flow in the corona and solar wind acceleration.

Study the Sun's magnetic fields at their origin.

Analyze high-energy solar particles affecting space weather and Earth's magnetosphere.

Mission Design & Protection

- The probe follows a **series of closer orbits** using Venus' gravity.
- It is shielded by an 11.43 cm (4.5-inch) carbon-composite heat shield, enduring temperatures up to 1,377°C (2,500°F).

JANUARY 2025

1. UNDERWATER TELESCOPES TO DETECT 'GHOST PARTICLES'

SEA-FLOOR SENSORS

The energy and trajectory of a particle detected by the Cubic Kilometre Neutrino Telescope (KM3NeT) suggests that it was produced by a cosmic neutrino smashing into a molecule on Earth.



Scientists are setting up two telescopes under the **Mediterranean Sea** to detect **highenergy neutrinos**, also known as **ghost particles**. These telescopes are part of the **Cubic Kilometre Neutrino Telescope (KM3NeT)**.

Similar to the IceCube Neutrino Observatory in Antarctica, KM3NeT will detect deep-space neutrinos, but in water instead of ice.

Izearning Corner:

Neutrinos were first detected in 1959, though their existence was predicted in 1931.

- They are similar to electrons but have no electric charge.
- 2 Neutrinos are the **second most abundant subatomic particles** after **photons**.
- About a billion neutrinos pass through each cubic centimeter of space every second.

Why Study High-Energy Neutrinos?

- Scientists focus on rare, high-energy neutrinos that originate from supernovae, gamma-ray bursts, or colliding stars.
- These neutrinos help study space regions like the **Milky Way's center**, which are hidden by **dust** and cannot be observed using optical telescopes.

Why Build Underwater Neutrino Telescopes?

- Neutrinos rarely interact with matter, making them hard to detect.
- Detecting them requires a large, optically transparent, and dark environment to observe Cherenkov radiation—light emitted when neutrinos interact with water or ice.
- These flashes help track the **neutrino's path**, energy, and origin.

? Neutrino Observation Efforts:

- **Cubic Kilometre Neutrino Telescope (KM3NeT)**
- **A European research project** for neutrino detection.
- **Description** Located at the bottom of the Mediterranean Sea.
- Has two main detectors:
- ARCA (Astroparticle Research with Cosmics in the Abyss)
- ORCA (Oscillation Research with Cosmics in the Abyss)
- IceCube Neutrino Observatory
 - A pioneering astrophysical observatory in Antarctica.
 - **Description** Located **near the Amundsen-Scott South Pole Station** within the **Antarctic ice sheet**.
 - 2 Uses over 1 cubic kilometer of ice for neutrino detection.
 - **Operational since 2011**, it was the first telescope to detect high-energy neutrinos.

2. NOROVIRUS

- Norovirus is a highly contagious virus, often called the "winter vomiting bug." It causes acute gastroenteritis, leading to stomach and intestinal inflammation.
- Rey Features:

- Similar to **rotavirus**, it affects **all age groups**.
- Spreads through **contaminated food**, water, surfaces, and primarily via the oral-fecal route.
- Also known as **stomach flu** or the **stomach bug**.

Symptoms:

- **Vomiting and diarrhea** appear **1–2 days after exposure**.
- 2 Other symptoms include nausea, abdominal pain, fever, headaches, and body aches.
- 2 Severe cases may cause **dehydration** due to fluid loss.

Precautions:

- Infection can occur **multiple times** due to different strains.
- B Hand sanitizers are ineffective; the virus resists disinfectants and survives heat up to 60°C.
- 2 Wash hands with **soap and water**, especially after using the toilet and before handling food.
- Disinfect surfaces during outbreaks with hypochlorite solution (5,000 ppm).

? Treatment:

- **Self-limiting illness** lasting **2–3 days**.
- Most cases recover with rest and proper hydration, except for vulnerable groups like young children, the elderly, and malnourished individuals.

3. PIG-BUTCHERING SCAM

Pig butchering is a sophisticated investment scam combining romance fraud and financial deception. The term refers to how scammers "fatten up" victims by building trust before financially exploiting them.

How the Scam Works

- Initial Contact: Scammers approach victims via social media, dating apps, or messaging platforms, often posing as attractive, successful individuals.
- Building Trust: They cultivate emotional connections over time.
- Investment Pitch: Once trust is gained, they introduce fraudulent investment opportunities, often in cryptocurrency or forex.
- Fake Platforms: Victims are directed to counterfeit investment websites/apps, where fabricated profits encourage further deposits.
- Final Exploitation: Scammers disappear after extracting substantial funds, or the platform becomes inaccessible.
- **Cyber Slavery**
- **Cyber slavery** involves forced labor in online scams, often linked to human trafficking.
- Victims are lured by fake job offers, only to be trapped in scam operations under duress.
- Criminal syndicates run "fraud factories" in Southeast Asia, where trafficked individuals are forced to execute scams.

4. GENOME INDIA PROJECT

- **Launched in 2020**, the project aims to decode the genetic blueprint of India's diverse population.
- First Phase: Sequenced **10,000 genomes** from healthy individuals to create a baseline genetic map.
- **Funded by: Department of Biotechnology, Government of India**.
- **Led by: Over 20 research institutions**, including IISc, CSIR-CCMB, and NIMHANS.
- **Objectives & Impact**
- Develop a reference set of genetic variations from 99 communities.

- Create a biobank of 20,000 blood samples for future research.
- Provide genomic data as a digital public good via the Indian Biological Data Center (IBDC).
- Develop low-cost genetic chips for disease diagnosis and research.
- Paves the way for genome-based precision medicine in India.
- **Encourages young researchers** to explore genomics and health innovations.
- **Second Phase: Expanding Genome Sequencing**
- Aims to sequence one million genomes, including individuals with specific diseases.
- Comparing healthy and diseased genomes can help identify targets for new treatments and diagnostics.
- **Focus areas:** Cancer, chronic diseases (like diabetes), and neurological disorders.
- **Rare genetic diseases** found in Indian populations will also be studied.
- **A step towards personalized medicine and targeted therapies**.

FIREFLY OVERVIEW Total satellites in Phase 1(2025) 6 Satellite Mass 60 kg Spatial resolution (GSD) 5 m Revisit frequency 24 hours Bands 150 + Swath 40 km Wavelength 450-900 nm

5. FIREFLY SATELLITE CONSTELLATION

PM Narendra Modi praised Pixxel, India's first private company to launch its own satellite constellation.

Firefly is India's first private Earth-imaging satellite network, developed by Bengaluru-based Pixxel.

It provides high-resolution hyperspectral imagery for agriculture, mining, environment, and defense.

Rey Features

☑ Hyperspectral Imaging: Captures 160 spectral bands (470–900 nm) to detect subtle Earth changes.

High Resolution: Offers **5-meter GSD**, identifying features as small as 5 meters.

Wide Coverage: **40 km swath width**, allowing large-area imaging in one pass.

Deployment & Expansion

- Six satellites to be placed in a 550 km sun-synchronous orbit.
- First three launched via SpaceX Falcon-9; remaining three planned for mid-2025.
- **Future Expansion**: Aims for **24 satellites** to enhance **global coverage** and **real-time monitoring**.

6. SCRAMJET- SUPERSONIC COMBUSTION RAMJET

- India's Defence Research and Development Organisation (DRDO) recently conducted a groundbreaking active-cooled scramjet combustor ground test for 120 seconds. This marks a key milestone in developing next-generation hypersonic missiles.
- The test advances India's progress in hypersonic munitions.
- **Learning Corner:**
- Ramjets are air-breathing jet engines that use forward motion to compress air for combustion, without rotating compressors.
- They require assisted takeoff to reach speeds where they start producing thrust.
- Ramjets work best at Mach 3 but become inefficient above Mach 5 (hypersonic speeds).
- **Scramjets (Supersonic Combustion Ramjets):**
- Inlike ramjets, scramjets keep airflow **supersonic** throughout the combustion chamber.

- This makes their design and operation more complex.
- **P** Applications of Scramjet Technology:
 - **Hypersonic Missiles**: Faster response and extended range.
 - **Space Access**: Potentially reducing costs by minimizing onboard oxidizer needs.
 - 2 High-Speed Aircraft: Drastically cutting global travel time.
- **Challenges in Scramjet Development:**
 - **Thermal Management**: Handling extreme heat at hypersonic speeds.
 - Developing heat-resistant materials.
 - **Engine Integration**: Ensuring smooth operation with the airframe.

7. FENTANYL

- US President Donald Trump stated that his administration is considering a 10% punitive tariff on Chinese imports due to fentanyl shipments from China to the US via Mexico and Canada.
- The US is facing an **"opioid epidemic"**, with fentanyl playing a major role in overdose deaths.
- **Learning Corner:**
 - **Fentanyl** is a **potent synthetic opioid** approved by the **FDA** for **pain relief and anesthesia**.
 - It is **100 times stronger than morphine** and **50 times stronger than heroin** as an analgesic.
 - Medically used for cancer pain and post-surgical pain management, but overdoses can cause coma, respiratory failure, and death.
 - Opioids are drugs that mimic natural substances in the opium poppy, providing pain relief and euphoria, but are highly addictive.
 - Deter common opioids include **oxycodone**, morphine, codeine, and heroin.



- The Indian Space Research Organisation (ISRO) successfully demonstrated the restart capability of its Vikas liquid engine at the Propulsion Complex in Mahendragiri.
- This milestone aids future reusable launch vehicle development, improving stage recovery technologies.
- **Learning Corner:**
 - 2 Vikas Engine: A liquid-fuel rocket engine developed by ISRO.
 - **Used in PSLV, GSLV, and LVM3** launch vehicles.
 - Powers the PSLV's second stage, GSLV Mark I & II boosters and second stage, and LVM3's core stage.
 - ☑ Uses Unsymmetrical Dimethylhydrazine (UDMH) as fuel and Nitrogen Tetroxide (N₂O₄) as the oxidizer.

9. GUILLAIN-BARRE SYNDROME

- **A Rare Autoimmune Disorder**
- **GBS** occurs when the immune system attacks **peripheral nerves** by mistake.
- **Cause:** Often triggered by infections like **Campylobacter jejuni, influenza, or Zika virus**.
- **Symptoms:**
 - **Early Signs:** Tingling and weakness, usually beginning in the feet and legs.
 - Progression: Weakness spreads to the upper body, making movement difficult.
 - **Severe Cases:** Can lead to **paralysis, breathing issues, and heart irregularities**.
- **Diagnosis & Treatment:**
- Diagnosis: Based on symptoms, nerve conduction tests, and cerebrospinal fluid analysis.

P Treatment:

- Supportive Care to manage symptoms.
- Immunotherapy (IVIG or plasmapheresis) to reduce severity.
- **Recovery** varies; some recover fully, while others may experience lasting weakness or fatigue.
- Prevention:
 - Infection Control: Good hygiene, safe food handling, and vaccinations help reduce risks.

10. ASTEROID

- Daksh Malik, a Class 9 student from Noida, has gained recognition from NASA for discovering an asteroid, currently designated as '2023 OG40.' This achievement allows him to name the asteroid following its verification. Daksh participated in the International Asteroid Discovery Project (IADP) for 18 months, where he worked under the guidance of Dr. Patrick Miller from Hardin-Simmons University.
- **Asteroid Overview:**
- Definition: Asteroids are small, rocky bodies that orbit the Sun, primarily located in the Asteroid Belt between Mars and Jupiter. They are remnants from the early solar system that did not coalesce into planets.
- Composition: Asteroids can be metallic (iron and nickel), rocky, or carbon-rich.
- **Classification of Asteroids:**
- Delt Asteroids: Located between Mars and Jupiter.
- 2 Near-Earth Asteroids (NEAs): Orbit close to Earth and may pose collision risks.
- Trojan Asteroids: Share orbits with planets, notably Jupiter.
- Description: Apollo & Aten Groups: Subcategories of NEAs that cross Earth's orbit.
- **Significance of Asteroid Research:**
- Scientific Importance: Asteroids provide insights into the solar system's formation.
- Resource Potential: They may contain valuable metals and minerals for future mining.
- Impact Threats: Some asteroids could threaten Earth, necessitating deflection strategies.
- Space Missions: Numerous agencies conduct missions to explore asteroids.
- **Recent Missions & Developments:**
- NASA's DART Mission (2022): The first test of planetary defense aimed at altering an asteroid's trajectory.
- **OSIRIS-REx (2023):** Returned samples from asteroid Bennu to Earth.
- Japan's Hayabusa2 (2020): Collected and returned samples from asteroid Ryugu.
- Daksh's achievement is part of a broader initiative involving over 6,000 participants annually in the IADP, which encourages citizen scientists to analyze astronomical data for new discoveries.

11. ORGANOPHOSPHATE

- Organophosphates (OPs) are chemicals commonly used to protect crops from pests and to control insect-borne diseases. They disrupt nerve signal transmission in exposed organisms, often leading to fatal outcomes.
- **Uses of Organophosphates:**
- Agriculture: OPs are extensively used as insecticides, herbicides, and fungicides due to their broadspectrum effectiveness against pests.
- Medical Applications: In controlled doses, OPs can treat conditions such as glaucoma and myasthenia gravis by inhibiting the enzyme acetylcholinesterase, which regulates nerve function.

- Chemical Warfare: Certain OPs, including Sarin and VX gas, are classified as nerve agents and are used in military applications.
- Industrial Applications: OPs are utilized in manufacturing plasticizers, flame retardants, and lubricants.

B Health and Environmental Concerns:

Organophosphates can cause acute poisoning and long-term health effects in humans, such as neurological damage and endocrine disruption. Symptoms of poisoning include nausea, vomiting, muscle twitching, and respiratory distress. Severe cases may lead to seizures or even death.

The environmental impact is significant as OPs can contaminate soil and water bodies. They are persistent in the environment, leading to soil degradation and harming beneficial insects and aquatic life.

Regulatory Actions:

Due to their toxicity, many organophosphates have been restricted or banned in several countries. For instance, chlorpyrifos has faced restrictions in the European Union and the United States due to health concerns.

2 Alternatives and Solutions:

To mitigate the adverse effects of organophosphates, researchers are exploring biosurfactants that can degrade pesticide residues in soil. These naturally occurring compounds can help remediate pollution without further harming the environment. Additionally, promoting organic farming practices can reduce reliance on synthetic pesticides.

The ongoing challenge is balancing agricultural productivity with environmental sustainability and human health. As global agriculture continues to rely on organophosphates due to their effectiveness against resistant pests, understanding their implications is crucial for future agricultural practices.

12. SLEEPING SICKNESS

- The World Health Organization (WHO) has announced that Guinea has successfully eliminated the gambiense form of human African trypanosomiasis (HAT), commonly known as sleeping sickness, as a public health problem. This marks the first neglected tropical disease to be eliminated in Guinea.
- Overview of Sleeping Sickness
- Cause: Sleeping sickness is a vector-borne parasitic disease caused by the protozoan *Trypanosoma brucei*, transmitted through the bite of the tsetse fly (*Glossina species*), found only in sub-Saharan Africa.
- P Types:
 - Trypanosoma brucei gambiense (T.b. gambiense): Predominantly found in West and Central Africa, responsible for over 95% of cases and causes chronic infections that progress slowly.
 - Trypanosoma brucei rhodesiense (T.b. rhodesiense): Found in East and Southern Africa, it leads to acute infections that progress rapidly.
 - o Transmission
 - The disease spreads through:
 - Isetse fly bites from infected hosts.
 - Blood transfusions.
 - Organ transplants.
 - 2 Congenital transmission from mother to child.
 - Symptoms and Stages

- Early Stage: Symptoms include fever, headache, joint pain, itching, and swollen lymph nodes (Winterbottom's sign).
- **Late Stage:** The parasite invades the central nervous system, leading to sleep disturbances, confusion, mood changes, loss of coordination, and potentially coma and death if untreated.
- **Guinea's Achievement**
- Guinea's accomplishment is part of a broader trend in which seven other countries—Togo, Benin, Côte d'Ivoire, Uganda, Equatorial Guinea, Ghana, and Chad—have also been validated by WHO for eliminating the gambiense form of HAT. Additionally, Rwanda has eliminated the rhodesiense form.

P The success in Guinea is attributed to several factors:

- **Effective tsetse fly control measures.**
- ☑ Large-scale screening and awareness campaigns.
- Development of new safe and effective treatments through partnerships with organizations like the Drugs for Neglected Diseases initiative (DNDi).

13. NUCLEAR FUSION

- A Chinese fusion reactor set a new record by maintaining plasma confinement for over 17 minutes (1,000+ seconds).
- **Understanding Nuclear Fusion**
 - > Fusion occurs when two light atomic nuclei combine, releasing vast energy.
 - Process: Hydrogen isotopes Deuterium (²H) and Tritium (³H) fuse to form Helium (⁴He) and a neutron, generating energy.
 - **Conditions for Fusion**
 - **Extreme Heat:** Millions of degrees Celsius needed to overcome electrostatic repulsion.
 - > High Pressure: Denser plasma increases collision probability.
 - > **Confinement:** Plasma must be contained long enough for reactions to occur.

China's EAST Reactor

- > Did not generate electricity but **sustained plasma longer than before**.
- > Plasma is confined using **strong magnetic fields** since no material can contain such heat.
- > Real-world reactors must maintain this for hours or days to be viable.

Fusion Benefits

- > Massive Energy Output: One gram of fuel = energy from eight tonnes of coal.
- > Abundant Fuel Supply: Deuterium and tritium are widely available.
- > Eco-Friendly: No emissions and no hazardous nuclear waste like fission.
- **International Thermonuclear Experimental Reactor (ITER)**
 - > Largest fusion project, based in France, with **30+ participating nations**.
 - ➤ India is among seven core members.
 - > Expected to start **deuterium-tritium fusion by 2039**, producing **500 MW of power**.

FEBRUARY 2025

1. GRAPHICS PROCESSING UNITS (GPU)

What is a GPU?

A Graphics Processing Unit (GPU) is a specialized chip designed to rapidly process images and data. It's great at handling multiple tasks at once, making it ideal for graphics, video, and now AI and machine learning.

- What is a CPU?
- A Central Processing Unit (CPU) is the main processor of a computer. It handles general tasks like running the operating system and applications. CPUs are optimized for sequential tasks.
- **CPU vs GPU**

| P Feature | CPU | 2 GPU |
|------------|--------------------|-------------------------------------|
| Cores | Few powerful cores | Thousands of smaller cores |
| Processing | Sequential | Parallel |
| Best For | General computing | Graphics, AI, and large datasets |

- Why GPUs Matter for AI
- Parallelism: AI tasks involve large-scale matrix operations. GPUs excel at this due to their many cores.
- **Speed**: GPUs can handle massive datasets faster than CPUs.
- **Real-Time Performance**: Essential for time-critical applications like autonomous driving and chatbots.
- **Scalability**: GPUs can work in clusters for large AI models.
- **Tool Support**: Al tools like **TensorFlow** and **PyTorch** are GPU-optimized.
- **GPUs are key to powering India's AI goals and digital future.**

2. SMALL MODULAR REACTORS (SMRS)



The government has allocated ₹20,000 crore to develop five indigenously designed Small Modular Reactors (SMRs) by 2033.

SMRs are advanced nuclear reactors, smaller and modular compared to traditional ones.

Each unit can generate up to **300 megawatts (MW)** of electricity — about one-third of a conventional reactor.

- Key Features
 - Compact & Modular
 - SMRs are **factory-built** and assembled on-site.
- This lowers costs and speeds up construction.

- In the second second
- 2 Many use **passive cooling systems**, needing no external power.
- Designs are often underground or water-based for added protection.

?

- Flexible Use
- Can be placed in remote locations, small grids, or industrial areas.
- Useful for desalination, hydrogen production, and district heating.
- **Lower Costs**
- Smaller size means reduced capital investment.

- Ideal for **budget-limited** regions or industries.
- SMRs offer a safer, more affordable, and flexible path to clean nuclear energy.

| | 3. SAMUDRAYAAN MISSION | | | |
|---|---|--|--|--|
| ? | Samudrayaan is India's first manned deep-ocean exploration mission. | | | |
| ? | Launched in 2021 under the Deep Ocean Mission by the Ministry of Earth Sciences (MoES) . | | | |
| ? | Key Goals | | | |
| ? | Deep-Sea Exploration | | | |
| ? | Enables direct human observation of deep-sea regions. | | | |
| ? | Aims to study marine biodiversity and ecosystems. | | | |
| ? | Resource Assessment | | | |
| ? | Focuses on exploring polymetallic nodules rich in manganese, nickel, cobalt, and copper . | | | |
| ? | These minerals are crucial for electronics and renewable energy tech. | | | |
| ? | Technology Development | | | |
| ? | Drives innovation in underwater vehicles , robotics , and deep-sea tech. | | | |
| ? | Matsya 6000 Submersible | | | |
| ? | A manned submersible that can dive up to 6,000 meters. | | | |
| | | | | |
| ? | Built with a titanium alloy sphere to endure intense pressure. | | | |
| ? | Equipped with scientific tools and sensors for ocean research. | | | |
| ? | Why It Matters | | | |
| ? | India joins elite nations like the USA, Russia, Japan, France, and China in deep-sea manned missions. | | | |
| ? | Promotes sustainable use of marine resources. | | | |
| ? | Supports climate studies and tech development in robotics and energy. | | | |
| | | | | |

4. SUZETRIGNE

- The US FDA has approved suzetrigine, a non-opioid painkiller sold under the brand name Journavx by Vertex Pharmaceuticals.
- 2 Although expensive, suzetrigine is non-addictive, unlike traditional opioid painkillers.
- Opioid overdose cases have risen globally due to the increased availability of prescription opioids and potent illicit opioids.
- Chronic pain management heavily relies on opioids, contributing to addiction and overdose crises.
- What are Opioids?
- **Opioids** are drugs derived from or mimicking substances in the **opium poppy plant**.
- Common opioids include oxycodone, morphine, codeine, heroin, and fentanyl.
- Prescription opioids relieve pain by binding to brain receptors, blocking pain signals, and inducing pleasure or euphoria.
- While effective, opioids are highly addictive.
- **P** How Does Suzetrigine Work?
- Pain is a body's warning system, signaling damage via nociceptors (specialized nerve endings).
- Nociceptors activate upon tissue damage, sending signals through the spinal cord to the brain, where pain is perceived.
- Suzetrigine blocks pain signals before they reach the brain, unlike opioids which act on the brain itself.
- Since suzetrigine does not trigger pleasure or euphoria, it is unlikely to cause addiction or dependence.



A new dangerous asteroid has been discovered, and it has a 1-6% chance of colliding with Earth in 2032 (the highest since Apophis). Its potential impact could be comparable to an atomic bomb. 5. 2024 YR4 A newly discovered asteroid, 2024 YR4, has a slightly over 1%

chance of crashing into Earth in 2032, according to NASA.

Decoding the Context:

2024 YR4 is large but **not as massive** as the asteroid that wiped out the dinosaurs 66 million years ago.

Begin However, it could cause **significant localized damage** if it strikes a populated area.

Learning Corner:

Discovery: 2024 YR4 was spotted in December 2023 by a telescope in Chile.

- Size: It is about the size of a football field.
- Image: Closest Approach: Passed Earth at a distance of about 800,000kmonChristmasDay.

Future Path: It will fade from view soon and won't be visible

again until 2028. Scientists are using powerful telescopes to refine estimates of its path and size.

- P Measuring Size:
- Astronomers estimate asteroid size by measuring its brightness.
- B However, size calculations are tricky as **brightness** also depends on the asteroid's **surface reflectivity**.
- **Destruction Potential:**
- Torino Scale Rating: 2024 YR4 is rated **3** on a scale of **0 to 10**.
- Impact Energy: It could release 8 to 10 megatons of energy upon impact.

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- For comparison, the 2013 Chelyabinsk asteroid (half the size of YR4) released energy equivalent to 500 kilotons of TNT, about 30 times the Hiroshima bomb.
- **Asteroid Impacts:**
- 2 Thousands of small asteroids hit Earth's atmosphere daily but burn up due to friction.
- Large, catastrophic asteroids (over 1 km wide) are rare, striking roughly every 260 million years.
- Smaller asteroids, depending on their **speed and angle**, can still cause significant damage.
- Planetary Defence:
- Space agencies are developing defence systems like NASA's Double Asteroid Redirection Test (DART)
 the first mission aimed at preventing asteroid impacts.

6. NAVIGATION WITH INDIA CONSTELLATION (NAVIC)

- ISRO reported a partial failure of its NVS-02 navigation satellite due to non-firing of its engines in space.
 This adds to the setbacks faced by the Indian Regional Navigation Satellite System (IRNSS), also known as NavIC.
- **Decoding the Context:**
- The **IRNSS** was conceived in 1999 after the **Kargil War**, when India couldn't access the **US GPS** in the conflict zone.
- **Learning Corner:**
- A seven-satellite constellation for both defence and civilian use was proposed to be operational by **2016**, with the first satellite **IRNSS-1A** launched on **July 1, 2013**.
- By 2025, five of the 11 launched satellites in the NavIC program are fully operational.
- Satellites IRNSS-1B to 1K were launched between 2014-2025, completing the IRNSS constellation by 2016.
- What Went Wrong?
- Atomic clocks in several navigation satellites, including IRNSS and ESA's Galileo, faced failures starting mid-2016.

- The **IRNSS-1K (NVS-02)** failure last month, due to engine issues, left it in a **sub-optimal orbit**, making it a partial failure.
- Six of the **11 launched satellites** have faced partial failures.
- **Why is NavIC Important for India?**
- **NavIC** offers two services:
- Standard Positioning Service for commercial use.
- Restricted Service for defence forces.
- It provides **positioning data** with **accuracy better than 20 meters**, covering India and **1,500 km around**.
- A key reason for NavIC's development is reliability for defence use, ensuring independence from global systems like GPS (US), GLONASS (Russia), Galileo (Europe), Beidou (China), and QZSS (Japan).
- For NavIC to be widespread in India, ISRO must promote it to general positioning services, like mobile phones and vehicle manufacturers.

7. GARBHINI-DRISHTI

- India's biomedical research advanced with the launch of the **GARBH-INI-DRISHTI** data repository, part of the **GARBH-INI** program.
- **Learning Corner:**
- GARBH-INi stands for Interdisciplinary Group for Advanced Research on Birth Outcomes DBT India Initiative and is led by the Translational Health Science and Technology Institute (THSTI), in collaboration with the Department of Biotechnology (DBT).
- Garbhini-Drishti is a comprehensive data dashboard, offering insights into one of South Asia's largest pregnancy cohort datasets.
- Data Collection: It includes clinical, epidemiological, imaging, and biospecimen data from 12,000+ pregnant women, newborns, and postpartum mothers.
- **Research Focus:** The goal is to improve **maternal and neonatal health** through transformative research.
- Data Accessibility: It offers clear guidance on accessing the dataset for approved research, encouraging collaboration and impactful discoveries.
- Comprehensive Assessments: Participants undergo detailed assessments, including clinical evaluations, ultrasound imaging, and biospecimen collection, with post-natal follow-ups.
- Quality Control: The platform ensures reliable data through regular researcher training and monitoring for errors.

8. EBOLA VIRUS

- Uganda, in partnership with the World Health Organization (WHO) and global partners, has launched the first-ever clinical trial for a vaccine targeting the Sudan species of the Ebola virus.
- **Learning Corner:**
- **Ebola Virus Disease (EVD)** is a severe, often fatal illness caused by the **Ebolavirus** genus, affecting humans and primates.
- **Transmission:**
- Ebola spreads through contact with the blood, secretions, organs, or bodily fluids of infected animals, like bats, chimpanzees, and gorillas.
- Human-to-human transmission occurs via direct contact with infected fluids or contaminated materials (e.g., bedding, clothing).
- **Symptoms:**
- Symptoms begin 2 to 21 days after exposure, starting with fever, fatigue, muscle pain, and headache.
- This progresses to vomiting, diarrhea, rash, and possibly bleeding (from gums or blood in stools).
- Lab tests show low white blood cells and platelets, and elevated liver enzymes.
- Prevention & Control:

- Effective outbreak control involves case management, surveillance, contact tracing, and safe burials.
- Awareness, good hygiene, and personal protective equipment are key preventive measures.
- Recent Outbreak: Uganda is experiencing an outbreak of the Sudan strain of the Ebola virus as of February 2025.

9. CO2 BATTERY

- A CO₂ battery is an innovative energy storage system that uses carbon dioxide (CO₂) to store and release electrical energy, offering an alternative to lithium-ion batteries. It is ideal for long-duration energy storage and addresses the intermittency of renewable energy sources like wind and solar.
- Unlike Battery Energy Storage Systems (BESS), which rely on electrochemistry, CO₂ batteries use electro-mechanical turbomachinery. They operate on a Closed Brayton Thermodynamic Cycle with anhydrous CO₂ as the process fluid. Charging and discharging involve manipulating CO₂ between vapor and liquid states.
- **P** How CO₂ Batteries Work:
- **Energy Storage (Charging):**
- CO₂ gas is compressed and heated to around 400°C.
- The heated CO₂ is cooled in a heat exchanger, liquefying it.
- The liquid CO₂ is stored under pressure.
- **Energy Release (Discharging):**
- The liquid CO_2 is evaporated, absorbing heat and turning back to gas.
- The expanding CO₂ gas drives a turbine to generate electricity.
- The CO₂ is re-captured and reused in a closed-loop system.
- This system efficiently stores and releases energy over long periods, making it suitable for balancing supply and demand in power grids.
- Advantages of CO₂ Batteries:
- Cost-Effectiveness: Using readily available CO₂ and standard industrial components reduces costs compared to lithium-ion batteries.
- **Scalability**: The modular design makes it easy to scale for different storage needs.
- Environmental Benefits: The closed-loop system minimizes greenhouse gas emissions and offers a sustainable energy solution.
- **No Need for Critical Minerals**: These batteries do not require minerals like lithium and cobalt.

10. BOMBAY BLOOD GROUP

- A 30-year-old woman with the rare **Bombay blood group** underwent a successful kidney transplant in India, a procedure that overcame significant immunological and logistical challenges. This case is one of the few reported globally.
- Bombay blood group, first identified in India, is exceptionally rare, occurring in about 1 in 10,000 Indians and 1 in a million people worldwide.
- People with this blood group lack the **H** antigen, making them incompatible with all standard blood types, complicating blood transfusions and organ transplants.
- **Rey Characteristics:**
- Lack of H Antigen: In the ABO system, the H antigen is the base for A and B antigens. People with the Bombay blood group do not produce the H antigen due to a mutation in the FUT1 or FUT2 genes. As a result, their red blood cells do not express A, B, or H antigens.
- Anti-H Antibodies: Individuals with the Bombay blood group naturally produce anti-H antibodies. These antibodies react with the H antigen on the red blood cells of common blood types (O, A, B, AB), making transfusions and organ transplants highly risky.

11. NEUTRINOS AND ANTI-NEUTRINOS

- A compact neutrino detector has successfully identified antineutrinos at a nuclear power plant, marking a major advancement in particle physics.
- Inlike traditional detectors that require large infrastructure, this device weighs under three kilograms and detected antineutrinos from a reactor in Leibstadt, Switzerland.
- Neutrinos are neutral, charge-less particles with a tiny mass, making them difficult to detect. They interact weakly with matter and are produced in nuclear reactions, such as those in the Sun, supernovae, nuclear reactors, and particle accelerators.
- **Types of Neutrinos:**
- Solar Neutrinos: Produced in the Sun's core during nuclear fusion.
- > Atmospheric Neutrinos: Created when cosmic rays interact with Earth's atmosphere.
- ➤ **Reactor Neutrinos**: Emitted during nuclear fission in reactors.
- **Geoneutrinos**: Produced by radioactive decay inside Earth.
- > Cosmic Neutrinos: Originating from sources like supernovae and black holes.
- > Antineutrinos are the antiparticles of neutrinos, with opposite quantum numbers but similar properties.
- **2** Major Sources of Antineutrinos:
- > Nuclear Reactors: Large quantities produced during nuclear fission.
- > Beta Decay: Emitted during the beta decay of radioactive isotopes.
- > Cosmic Sources: Produced in astrophysical processes like supernovae.
- India's Neutrino Research: The India-based Neutrino Observatory (INO) in Tamil Nadu aims to study atmospheric neutrinos using the Iron Calorimeter (ICAL) detector.

12. SHIV SHAKTI POINT

- A study by scientists from the Indian Space Research Organisation (ISRO) estimates that the region where Chandrayaan-3 landed on the Moon is about 3.7 billion years old. This period coincides with the time when primitive microbial life emerged on Earth.
- India's Chandrayaan-3 mission achieved a historic milestone on August 23, 2023, becoming the fourth country to land on the Moon and the first to reach its South Pole.
- **Study Details:**
- A team from ISRO's Physical Research Laboratory (PRL) in Ahmedabad analyzed the landing site, now called the Shiv Shakti point, using data from the Pragyan rover on the Vikram lander.
- The site is surrounded by large impact craters:
- Manzinus (96 km diameter, 3.9 billion years old) to the north.
- **Boguslawsky** (95 km diameter, 4 billion years old) to the southeast.
- Schomberger (86 km diameter, 3.7 billion years old) to the south.
- Lunar images have helped scientists reconstruct the histories of Manzinus and Boguslawsky, both of which have flat crater floors and subdued walls.
- The craters are shallow, with Boguslawsky being hollower than Manzinus and Schomberger. Schomberger stands out for its well-preserved features, including a central peak, steep walls, raised rim, and an ejecta blanket.

13. SHATAVARI

- Shatavari is a medicinal herb used in Ayurveda for its adaptogenic and rejuvenating properties. It is native to India, Sri Lanka, and the Himalayas, thriving in tropical and subtropical climates.
- **Medicinal & Health Benefits:**
- In Known as the "Queen of Herbs" in Ayurveda for supporting women's reproductive health.
- Acts as a galactagogue, enhancing breast milk production, and helps maintain hormonal balance.

- Contains saponins, flavonoids, and alkaloids, offering anti-inflammatory, antioxidant, and immuneboosting effects.
- **Economic & Agricultural Importance:**
- Cultivated in tropical and subtropical regions of India, especially in Madhya Pradesh, Chhattisgarh, Kerala, and Tamil Nadu.
- **Recognized by the National Medicinal Plants Board (NMPB) for commercial cultivation.**
- **Government Initiatives & Conservation:**
- Promoted under the AYUSH program for herbal medicine development.
- Encouraged through the National Agroforestry Policy and Medicinal Plants Mission for sustainable farming.

14. GRAPHENE

- Graphene is a single layer of carbon atoms arranged in a honeycomb structure. It is the basic building block of other carbon allotropes like graphite, carbon nanotubes, and fullerenes.
- **Exceptional Properties:**
- ▶ **High Strength:** 200 times stronger than steel.
- > Superior Conductivity: High electrical and thermal conductivity.
- ➤ Lightweight and Flexible: Thin, yet bendable.
- > Transparent: Absorbs only 2% of light, nearly transparent.
- **P** Applications of Graphene:
- **Electronics & Communication:**
- Used in flexible transistors, quantum computers, and touchscreens.
- Potential replacement for silicon in semiconductors for efficient devices.
- **Energy Sector:**
- Enhances energy storage in supercapacitors and batteries.
- Improves efficiency in graphene-based solar cells.
- **Biomedical:**
- Used in biosensors, drug delivery, and artificial tissues.
- Its antibacterial properties aid in medical coatings.
- Defense & Aerospace:
- Lightweight, bulletproof armor.
- Radar-absorbing properties for stealth aircraft.
- **Water Purification & Environment:**
- Graphene membranes efficiently desalinate water.
- Used in air filters and pollutant removal.

15. LYMPHATIC FILARIASIS (LF)

- Lymphatic Filariasis (LF), also known as Elephantiasis or "Hathi Paon," is a neglected tropical disease caused by filarial parasites like Wuchereria bancrofti, Brugia malayi, and Brugia timori.
- > Transmission: LF is spread by mosquitoes (Culex, Anopheles, and Aedes species).
- Impact: It affects the lymphatic system, leading to severe swelling (lymphedema), hydrocele (scrotal swelling), and elephantiasis (skin thickening and limb enlargement).
- Symptoms:
- > Acute: Fever, pain, swollen lymph nodes, inflammation of skin and lymphatic vessels.
- > Chronic: Permanent swelling of limbs, genitals, and breasts (elephantiasis).
- ➤ India accounts for about 40% of global LF cases.
- **Government Efforts for Elimination:**
- Mass Drug Administration (MDA): Anti-filarial medicines are given to all eligible individuals in LFendemic areas to reduce parasite transmission.

- India's Roadmap for LF Elimination by 2027:
- MDA campaigns in endemic areas.
- Morbidity management and disability prevention for affected individuals.
- Vector control through mosquito habitat management.

16. MALARIA

- The WHO recently declared Georgia as the 45th country to eliminate malaria, marking a significant milestone in the fight against the disease.
- **Key Points:**
- Malaria is a life-threatening disease caused by Plasmodium parasites, transmitted through bites of infected Anopheles mosquitoes.
- > Five Plasmodium species cause malaria in humans:
- Plasmodium falciparum: Most severe, causes cerebral malaria.
- Plasmodium vivax: Causes recurring malaria, has dormant liver stage.
- **Plasmodium malariae**: Milder, can persist for years.
- **Plasmodium ovale**: Rare, found in Africa & Asia.
- Plasmodium knowlesi: Zoonotic, found in Southeast Asia.
- > Transmission Cycle:
- Infected mosquitoes bite humans, passing parasites into the bloodstream.
- Parasites multiply in the liver, then infect red blood cells, causing fever and chills.
- Some develop into gametocytes, which mosquitoes ingest, completing the cycle.
- > Global Impact:
- Malaria is endemic in tropical regions, particularly in Africa, South Asia, and South America.
- In India, malaria is declining but still prevalent in tribal, Northeast, and forested areas.
- > Vaccination:
- RTS,S/AS01 (Mosquirix): First WHO-approved malaria vaccine (2021).
- **R21/Matrix-M**: Another promising vaccine.
- Challenges in Vaccine Development:
- Complex Life Cycle: Malaria parasites have multiple stages, making it hard to target with a single vaccine.
- Antigenic Variation: Plasmodium changes surface proteins to evade immune responses, reducing vaccine effectiveness.
- Intracellular Nature: Malaria parasites hide inside liver and red blood cells, making them difficult for the immune system to target.
- Lack of Animal Models: Human malaria doesn't replicate well in animals, making research harder compared to viral vaccines, which benefit from better animal models.

17. EINSTEIN RING

- The European Space Agency's (ESA) Euclid telescope has discovered a rare Einstein ring around a galaxy 590 million light-years from Earth. The photos, taken in September 2023 and released recently, show a bright ball of light with a surrounding cloudy ring.
- **Key Points:**
- Einstein ring: A ring of light formed by gravitational lensing, caused by a massive celestial body like a galaxy distorting the light of a more distant galaxy.
- Gravitational lensing: A phenomenon where a galaxy or galaxy cluster's gravitational field bends and amplifies light from distant objects along the same line of sight. The object causing the lensing is called the gravitational lens.
- ➤ Named after Albert Einstein, who predicted that light could bend around cosmic objects, the first Einstein ring was discovered in 1987. Since then, more have been found.

- Observation: Einstein rings are not visible to the naked eye and can only be seen using space telescopes like Euclid.
- Why Study Einstein Rings?
- Dark Matter Investigation: Einstein rings help detect dark matter, which is undetectable by light but exerts gravitational effects. They provide indirect evidence of dark matter, which makes up 85% of the universe's mass.
- > **Distant Galaxies**: They allow scientists to study distant galaxies that would otherwise be invisible.
- Cosmic Expansion: These rings provide insights into the expansion of the universe, as the space between galaxies stretches.

18. JAGADISH CHANDRA BOSE

- Jagadish Chandra Bose was a pioneering Indian scientist known for his contributions to biophysics, plant physiology, and radio science. His work laid the foundation for wireless communication and demonstrated that plants have life.
- **Rey Contributions:**
- Radio Science:
- ➢ Bose was a pioneer in wireless communication, independently developing radio wave technology around the same time as Guglielmo Marconi.
- > In **1895**, he transmitted radio waves over 75 feet, two years before Marconi's first wireless transmission.
- > He invented the **coherer**, a device to detect radio waves, crucial for modern wireless communication.
- Plant Physiology:
- Bose demonstrated that plants respond to external stimuli like humans, such as light, temperature, and chemicals.
- > He invented the **Crescograph** to measure plant growth and responses to stimuli.
- > His studies on **tropism** and plant movement advanced understanding in plant physiology.
- Material Science:
- Bose researched metal fatigue and responses of inorganic substances, contributing to early studies on semiconductors.
- **Recognition and Legacy:**
- Bose Institute (1917): Founded India's first interdisciplinary research institute in plant sciences and physics.
- > Fellow of the Royal Society (1920): One of the first Indian scientists to receive this honor.
- Bose was also a science fiction writer, penning Niruddesher Kahini, one of the earliest Bengali science fiction works.
- His discoveries were largely unrecognized at the time, as he didn't patent many of them, believing in open research.
- His work in radio waves played a key role in the development of wireless communication and is foundational in modern physics.

19. DISTRIBUTED DENIAL OF SERVICE (DDOS) ATTACK

- > A **DDoS (Distributed Denial of Service)** attack aims to disrupt the normal functioning of a targeted server, service, or network by flooding it with excessive traffic.
- Unlike a DoS attack, which originates from a single source, a DDoS attack uses multiple compromised systems, called a botnet, to generate the traffic.
- These attacks can overload bandwidth, exploit weaknesses in network protocols, or target vulnerabilities in applications or services.
- While DDoS attacks don't steal data, they can act as distractions for other cyberattacks, like data breaches. Recently, the Kaveri 2.0 portal, used for property registrations, faced performance issues due to fake accounts created and used to overload the system.

- The attack involved 62 email accounts and 14 IP addresses, demonstrating its distributed nature.
- **Mitigation Methods:**
- > Advanced Traffic Filtering: Helps distinguish between legitimate and malicious traffic, preventing overload.
- **Rate Limiting**: Controls the number of requests per user within a given time to avoid system saturation.
- > Bot Detection: Tools like CAPTCHA and behavioral analysis can identify and block bots.
- Robust Authentication & Security Audits: Strengthen online services against unauthorized access and vulnerabilities.

20. INDIRECT PROMPT INJECTION ATTACKS

- Indirect prompt injection attacks are a significant security concern in generative AI systems, especially those using large language models (LLMs).
- 2 Unlike direct prompt injections, where malicious commands are input directly, indirect prompt injections embed harmful instructions within external data sources accessed by the AI.
- This can cause the AI to perform unintended actions, compromising data integrity and user trust.
- > Mechanism of Indirect Prompt Injection Attacks:
- Embedding Malicious Instructions: Attackers hide harmful commands in external data like emails, documents, or web content. For example, a malicious prompt in an email could instruct the AI to leak sensitive information or perform unauthorized actions.
- Exploitation Through Data Access: When the AI processes this tainted data, it unknowingly executes the malicious instructions, as it cannot distinguish between legitimate data and harmful commands.
- > Potential Risks:
- Data Exfiltration: The AI could be manipulated to extract and send confidential information to unauthorized entities.
- Propagation of Malicious Content: Al-generated content might unknowingly spread harmful instructions embedded in the source material.
- Unauthorized Actions: AI systems with integrations might perform actions beyond their scope, like sending unauthorized emails or accessing restricted data.
- > Mitigation Strategies:
- Input Validation and Sanitization: Implement checks to detect and neutralize hidden commands within external data.
- Contextual Differentiation: Improve the AI's ability to distinguish between regular data and executable instructions to prevent unintended command execution.
- Restricting External Data Access: Limit the AI's interaction with untrusted data sources to reduce exposure to threats.
- Human Oversight: Include human review for AI outputs, especially with sensitive information, to catch anomalies.

21. PROJECT WATERWORTH

- Project Waterworth is Meta's initiative to create the world's longest undersea cable system, spanning over 50,000 kilometers, surpassing Earth's circumference.
- The cable will enhance connectivity between key regions, including the US, India, Brazil, and South Africa. It will be the longest 24-fibre-pair system, offering higher capacity to support Meta's AI projects, which include Facebook, Instagram, and WhatsApp.
- Meta plans to lay the cable up to 7,000 meters deep and use enhanced burial techniques in high-risk areas, such as near coasts, to avoid damage from ship anchors and other hazards.
- By using advanced machine learning models, Project Waterworth aims to predict and prevent disruptions, strengthening the resilience of subsea networks.

22. EXPERIMENTAL ADVANCED SUPERCONDUCTING TOKAMAK (EAST)

- Recently, Chinese scientists reported maintaining plasma at 100 million degrees Celsius for 1,066 seconds in the Experimental Advanced Superconducting Tokamak (EAST).
- Nuclear fusion, unlike fission, doesn't produce harmful radioactive waste, making it a key technological goal. However, there are challenges such as the energy required to sustain a fusion reaction and the tritium problem.

The Tritium Problem:

- Isotropy Fusion requires deuterium and tritium. Deuterium is abundant in seawater, but tritium is rare and difficult to produce.
- Deuterium-tritium fusion is more efficient than deuterium-deuterium fusion because tritium's extra neutron helps overcome repulsion between protons.
- The fusion of deuterium and tritium creates non-radioactive helium, a neutron, and significant energy (17.6 MeV).

Problem: The Temperature Problem:

- To fuse, nuclei must overcome repulsion and come within 1 femtometer of each other. This requires high temperatures to give them enough energy to get close enough for the strong nuclear force to act.
- Tokamaks, like EAST, use magnetic fields to confine the plasma and allow fusion.

Importance of EAST:

- EAST isn't yet producing electricity or achieving "ignition" (self-sustaining fusion), but it is a critical testbed for ITER, an international project working on a tokamak that aims to sustain fusion reactions producing more energy than required.
- EAST's progress is crucial for ITER's future, especially amid concerns over delays and cost overruns, with ITER being labeled as the most expensive science experiment in history.

23. EVO 2

- Evo 2 is a biological foundation model that integrates information across long genomic sequences while detecting single-nucleotide changes.
- With 40 billion parameters, it is the largest AI model for biology, understanding the genetic code across all domains of life.
- Evo 2 models and designs genetic codes for bacteria, archaea, viruses, plants, and humans.
- It is freely available to researchers through Nvidia's BioNeMo platform.
- The model is trained on over 9.3 trillion nucleotides from 128,000 genomes across the tree of life.
- Evo 2's scale matches that of the most powerful generative AI large language models.
- Rey Features:
- Genomic Understanding: Evo 2 identifies genetic patterns across species, a task that would take human researchers years.
- > **Disease Prediction:** It can accurately predict disease-causing mutations in human genes.
- ➤ Genome Design: It designs entire genomes, such as those of simple bacteria.
- > **Open Source:** Code, training data, and model weights are publicly available on Arc Institute's GitHub.
- **Applications:**
- ➤ Research Acceleration: Evo 2 speeds up genomic research and analysis.
- Interdisciplinary Collaboration: It connects researchers from Stanford University, UC Berkeley, and UC San Francisco.
- User-Friendly Interface: Evo Designer allows researchers to easily generate and annotate DNA sequences.
- Significance:

- > Generative Biology: Evo 2 marks a breakthrough in enabling machines to read, write, and think in nucleotide language.
- > Open Science: Its open-source nature encourages transparency and collaboration in the scientific community.



24. MAJORANA 1

? Microsoft has introduced a new chip called Majorana 1, claiming that quantum computing is now "years, not decades" away. This announcement puts Microsoft alongside Google and IBM, who also predict that a breakthrough in computing technology is imminent. ?

Majorana 1 Chip:

 \succ Quantum Computing: Majorana 1 brings quantum computing closer by utilizing Majorana particles, theorized over 80 years ago but never before observed. These particles are their own anti-particles and exist in a topological state, unlike traditional matter states.

Topological Qubits: The chip integrates eight topological qubits, \triangleright

- which are more stable and less error-prone than traditional gubits.
- > Topological Conductors: It uses topoconductors to control and observe Majorana particles, improving qubit reliability and scalability.
- **Compact Design:** Despite its small size (about the size of a sticky note), Majorana 1 is powerful enough to pave the way for quantum systems with a million qubits.
- Applications:
- > Industrial Problems: Majorana 1 is designed to address large-scale problems in fields like medicine, pollution control, and materials science.
- > Future Potential: Microsoft aims for this chip to lead to scalable quantum systems capable of solving complex challenges.
- Significance:
- > Quantum Leap: Majorana 1 represents a major advancement in quantum computing, with the potential to revolutionize industries.
- Error Resistance: The use of Majorana fermions ensures the chip is highly stable and resistant to errors, a major hurdle in quantum computing.

25. SELENIUM

- > Incidents of sudden hair loss in Buldhana district of Maharashtra have been linked to high selenium levels in wheat from **Punjab** and **Haryana**, supplied by local ration shops. This connection was revealed in a medical expert's report.
- > Context: Between December 2024 and January 2025, 279 people in 18 villages of Buldhana reported sudden hair loss, or acute onset alopecia totalis, prompting authorities to investigate.
- > Learning Corner:
- > Selenium (Se) is a nonmetal element found in various forms, including a gray metallic one, useful in photocells and light meters.
- > It is primarily obtained from copper refining and is used in glassmaking, pigments, and electronics. Biologically, selenium is essential for thyroid hormone metabolism, DNA synthesis, and protecting against oxidative damage and infection.
- It naturally occurs in soil, water, and some foods. Rich dietary sources include Brazil nuts, fish, poultry, and grains.
- While necessary in small amounts, excessive selenium intake can cause toxicity.

26. PUNCH MISSION



☑ NASA is preparing for its first-of-its-kind solar mission, the Polarimetry to Unify the Corona and Heliosphere (PUNCH), to study the solar atmosphere, solar winds, and Coronal Mass Ejections (CMEs) that affect space weather. The mission will launch on February 28 via SpaceX.

PUNCH is designed to study the Sun's outer atmosphere (corona) and its expansion into the solar wind.

The mission's goal is to understand how the solar corona becomes solar wind and how solar events, like CMEs, spread through space.

The spacecraft consists of four suitcase-sized satellites working together to create continuous 3D images of the corona and inner heliosphere.

Scientific objectives include:

- Mapping the Solar Wind: Tracking charged particles from the Sun to understand their behavior.
- Studying Solar Transients: Observing CMEs and dynamic events to learn their structure and impact on planets.
- Enhancing Space Weather Prediction: Providing data to improve predictions of space weather that affect Earth's satellites and systems.
- The satellites will be in a Sun-synchronous low Earth orbit for continuous observation.
- After a 90-day commissioning phase, the mission will last at least two years.



? NASA will launch its SPHEREx space telescope on February 28 aboard a SpaceX Falcon 9 rocket from Vandenberg Space Force Base in California. This two-year mission will study the formation of the universe, the growth of galaxies, and the location of water and life-forming molecules in the Milky Way.

 Key Features of SPHEREx:
 Mapping the Universe:
 SPHEREx will map the universe in both optical and infrared light. While optical light is visible to the human eye, infrared light

provides key information about distant space, star formation, and galactic structures.

- Infrared Observation: Similar to the James Webb Space Telescope (JWST), SPHEREx will observe in infrared, but unlike JWST, it will image the entire sky from Earth.
- ➤ Scientific Goals:
- Cosmic Inflation: SPHEREx will measure cosmic inflation, a phase 14 billion years ago when the universe expanded faster than light.

- ➤ Mapping Galaxies: The telescope will create 3D maps of about 450 million galaxies across cosmic history.
- Biogenic Molecules: SPHEREx will identify water and key molecules (carbon, hydrogen, oxygen) in the Milky Way and nearby systems. These molecules, frozen in ice, could offer clues about life's origins.