XIAS

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4 SCIENCE & TECH

PRELIMS 2026

IAS

COVERAGE

JUNE 2025 TO FEB2026

This file has month wise CA in compiled format.

All memory tricks , static value addition is done by expert faculty ANKITA MAAM in classes on youtube. DO NOT MISS THEM .

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TOPICS COVERED-

- **Core-Mantle Connectivity** – Precious metals like gold, platinum, and ruthenium leak from Earth's core to surface via mantle plumes, showing the core is not geochemically isolated.
- **Tardigrades Aboard Axiom-4 Mission** – India's Shubhanshu Shukla pilots Axiom-4 carrying tardigrades to study survival in space for Gaganyaan prep.
- **Stratospheric Aerosol Injection (SAI)** – Geoengineering method spraying reflective aerosols into the stratosphere to temporarily cool Earth.
- **Internet of Things (IoT) Revolution** – Networked smart devices transforming homes, cities, industries, with challenges in cybersecurity and interoperability.
- **India's First Gene-Edited Sheep** – CRISPR-Cas9 used to edit myostatin gene, increasing muscle mass by 30% without foreign DNA.
- **World's First Gene-Edited Rice (India)** – CRISPR-edited DRR Dhan 100 & Pusa DST Rice 1 are climate-resilient, high-yield, non-GM rice varieties.
- **SHUKR Gene in Flowering Plants** – Gene regulates pollen viability, explaining rapid flowering plant diversification (Darwin's "Abominable Mystery").
- **Thermophilic Bacteria** – Heat-loving bacteria from Rajgir hot springs producing antibiotics and industrially useful enzymes.
- **Nanozymes** – Artificial nanomaterials mimicking enzymes, used to prevent blood clotting and treat PTE/COVID complications.
- **Andromeda Galaxy** – Closest major galactic neighbor (M31), approaching Milky Way at 110 km/s, likely to merge in 4–5 billion years.
- **INS Arnala – India's First ASW-SWC** – Indigenous anti-submarine warfare shallow-water craft boosting coastal and subsurface defence.
- **AI-Enabled Piezo-Photocatalytic Water Purification** – INST Mohali developed AI-assisted, biodegradable system removing industrial dyes from wastewater.
- **Solar-Driven PEC Device for Green Hydrogen** – CeNS Bengaluru's solar device splits water using abundant materials for sustainable hydrogen production.
- **Science & Technology Clusters** – India's regional tech consortiums enabling quantum communication, AR/VR platforms, and emerging tech solutions.
- **Folate (Vitamin B9)** – Water-soluble vitamin essential for DNA/RNA synthesis, RBC formation, CNS development, and preventing birth defects.
- **Fiber Optic Drones** – Tethered drones using glass fiber cables for fast, jam-resistant, long-range operations.
- **DHRUVA – Digital Hub for Reference and Unique Virtual Address** – Provides unique digital addresses for homes to aid governance, logistics, and e-commerce.
- **HIV Prevention Drug – Lenacapavir** – Long-acting antiretroviral for pre-exposure prophylaxis to prevent HIV infection.
- **First Pangenome of Asian Rice** – Integrates cultivated & wild rice genomes, aiding breeding for high-yield and climate-resilient varieties.

- **Indian Yak Genome Sequencing** – Chromosome-level genome decoding for cold tolerance, disease resistance, and milk production.
- **Hillchol – Oral Cholera Vaccine** – Bharat Biotech's effective oral vaccine against Ogawa and Inaba strains, supporting epidemic preparedness.
- **Operation Sindoor – Key Defence Technologies** – India employed advanced indigenous and imported missiles & loitering munitions to target PoK terrorists.
- **AMCA – Advanced Medium Combat Aircraft** – India's 5th-gen stealth fighter with multirole capabilities, indigenous design, and advanced weaponry.

SCIENCE AND TECHNOLOGY

SOURCE – DRISHTI MONTHLY

Core-Mantle Connectivity

Recent Context -:

German research reveals precious metals like gold, platinum, and ruthenium leak from Earth's core to surface via mantle plumes, challenging the belief that the core is geochemically isolated.

About -:

1. **Discovery:** Ruthenium-100 isotope in Hawaiian volcanic rocks indicates core material reaches surface via mantle plumes.
2. **Core Metals:** Core holds 99.999% of Earth's gold and other siderophile elements (Pt, Ir, Ru).
3. **Mantle Extent:** 83% of Earth's volume, from Moho discontinuity (~7–35 km) to core boundary at 2,900 km.
4. **Mantle Composition:** Silicate rocks (olivine, garnet, pyroxene), ~45% oxygen, 21% silicon, 23% magnesium.
5. **Core Structure:** Outer core (liquid iron-nickel, 4,000–6,000°C) drives geodynamo; inner core (solid iron-nickel, 5,000–7,000°C) rotates slightly faster than surface.
6. **Asthenosphere:** Ductile upper mantle (80–200 km depth), source of magma, enables tectonic plate movement.
7. **Seismicity:** Earthquakes occur in mantle subduction zones up to 670 km depth.

Tardigrades Aboard Axiom-4 Mission to Test Space Resilience

Recent Context -:

Indian astronaut Shubhanshu Shukla will pilot Axiom-4 to the ISS, carrying tardigrades for ISRO experiments to study survival of life in extreme space conditions, aiding future Gaganyaan mission.

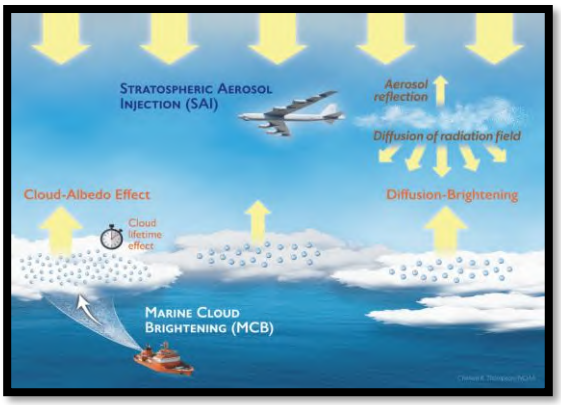
About -:

1. **Axiom-4 Mission:** 4th private flight to ISS by Axiom Space using SpaceX Crew Dragon; 14-day stay with international crew (USA, India, Poland, Hungary).
2. **Historic Milestone:** Shubhanshu Shukla — 2nd Indian in space after Rakesh Sharma (1984), 1st Indian aboard ISS.
3. **Key Experiments:** Tardigrade resilience in microgravity, crop growth (moong dal), cyanobacteria studies, screen-use effects in zero-G.
4. **Tardigrade Facts:** Microscopic (~0.5 mm), eight-legged, survive −272.95°C to 150°C, extreme radiation, vacuum, high pressures, revived after 30 years frozen.
5. **Survival Mechanisms:** Cryptobiosis, anhydrobiosis (tun state), CAHS proteins forming protective cell gel.
6. **Significance for India:** Strengthens ISRO-NASA collaboration, trains crew for Gaganyaan 2027, boosts astrobiology research.
7. **Zero-G Indicator:** Swan plushie named *Joy*; symbolic cue for entering weightlessness.

Stratospheric Aerosol Injection (SAI)

Recent Context -:

Scientists are assessing Stratospheric Aerosol Injection, a geoengineering method inspired by volcanic eruptions, to reflect sunlight, cool the Earth, and provide a temporary, cost-effective climate change mitigation strategy.



About -:

1. **Definition:** SAI — solar geoengineering technique to reflect sunlight back into space,

reducing heat absorption and cooling the planet.

2. **Inspiration:** Modeled after 1991 Mount Pinatubo eruption, which injected sulfate aerosols into the stratosphere, lowering global temperatures by ~0.5°C.
3. **Mechanism:** Releases reflective particles (sulfate aerosols, calcium carbonate) into stratosphere (10–50 km), increasing Earth's albedo.
4. **Longevity:** Stratospheric particles persist for months–years, unlike lower atmosphere particles which rain out quickly.
5. **Regional Impact:** Cooling more effective in polar regions; weaker in tropics despite higher warming levels.
6. **Environmental Risks:** Ozone layer damage, acid rain, altered precipitation patterns, monsoon disruption, uneven cooling.
7. **Limitation:** Only masks warming; doesn't reduce CO_2; may affect methane life span, ice formation, and cloud microphysics.

SOURCE-THE HINDU

Internet of Things (IoT) Revolution and Smart Future

Recent Context -:

IoT is transforming homes, cities, healthcare, transport, and industries through interconnected smart devices, but challenges such as cybersecurity threats, interoperability issues, and infrastructure demands remain critical for sustainable adoption.

About -:

1. **Definition:** IoT — network of physical devices with sensors, software, and connectivity to collect, exchange, and act on data.
2. **Key Features:** Connectivity, automation, remote monitoring, interoperability, scalability, AI-driven analytics, personalization.
3. **Major Components:** Sensors & actuators, connectivity protocols (Wi-Fi, Bluetooth, 5G), IoT gateways, cloud computing, user interfaces.
4. **Applications:** Smart cities, smart homes, healthcare, transport, industrial safety, agriculture, and food supply monitoring.
5. **Example Initiatives:** Jaipur Smart City, Google Nest Thermostat, Tesla Autopilot, Siemens IoT fire safety, Fyllo precision farming.
6. **Risks:** Cybersecurity vulnerabilities, unauthorized access, privacy breaches, lack of standardization, AI-powered cyber threats.
7. **Data Impact:** IoT generates ~73 zettabytes/year, requiring advanced cloud/edge infrastructure and energy-efficient solutions.

India's First Gene-Edited Sheep

Recent Context :

A university in Kashmir created India's **first gene-edited sheep** using **CRISPR-Cas9**, editing the **myostatin gene** to increase muscle mass by 30%, similar to European Texel sheep.

ABOUT:

1. **Technology:** CRISPR-Cas9 enables precise gene editing **without foreign DNA**.
2. **Target gene:** Myostatin gene—regulates muscle growth; editing increases meat yield.
3. **Applications:** Animal biotechnology: meat, milk, wool, disease-resistant livestock.
4. **Difference from crossbreeding:** Crossbreeding is slow; gene editing is faster, precise.
5. **Difference from GM:** No foreign DNA is inserted; unlike GM organisms.
6. **Regulation:** Complies with India's biotech norms; more acceptable to regulators.
7. **Significance:** Boosts livestock productivity, reduces dependency on imports, enhances food security.

India Produces World's First Gene-Edited Rice

Recent Context :

Scientists developed **climate-resilient rice varieties** 'DRR Dhan 100 (Kamala)' and 'Pusa DST Rice 1' using **CRISPR-Cas9 SDN-1 & SDN-2**, improving yield, drought tolerance, and reducing irrigation needs.

ABOUT:

1. **Genome editing:** SDN-1 & SDN-2 use native genome; SDN-3 involves foreign DNA (GM crop).
2. **Varieties enhanced:** Samba Mahsuri & MTU1010; better **stress tolerance, yield, climate adaptability**.
3. **Benefits:** 25% more yield, water-saving, 20% reduction in GHG emissions.
4. **Non-GM:** No foreign DNA; avoids GMO apprehensions.
5. **Regulation:** Under **EPA, 1986**; gene editing encouraged with amendments.
6. **Scientific significance:** Supports precision breeding, faster crop improvement.
7. **Global first:** India is the **first country to develop gene-edited rice varieties**.

SHUKR Gene in Flowering Plants

Recent Context -:

The SHUKR gene, discovered in Arabidopsis thaliana, plays a key role in pollen viability and may help explain Darwin's "Abominable Mystery" of rapid flowering plant diversification.

About -:

1. **Discovery:** Found in flowering plants like *Arabidopsis thaliana*.
2. **Evolutionary Origin:** Appeared ~125 million years ago in eudicots (¾ of all flowering plants).
3. **Function:** Produces viable pollen during the sporophyte phase for reproduction.
4. **Genetic Mechanism:** Controls F-box genes, replacing old proteins to aid pollen growth.
5. **Adaptation Role:** Enables survival under heat, cold, and drought.
6. **Darwin's "Abominable Mystery":** Rapid diversification of flowering plants contrasted with gradual evolution; SHUKR gene offers a molecular explanation.
7. **Significance:** Links plant reproductive success with environmental adaptability over evolutionary timescales.

Thermophilic Bacteria

Recent Context -:

Researchers have discovered antibiotic-producing thermophilic bacteria in Rajgir hot spring, Nalanda, Bihar, highlighting their potential in medicine, biotechnology, and industrial processes.

About -:

1. **Definition:** Also called *thermophiles*; thrive in high-temperature environments like hot springs, deep-sea vents, and compost piles.
2. **Ecological Niche:** Survive in mineral-rich, low-competition habitats.
3. **Antibiotic Production:** Produce antibiotics to outcompete other microorganisms.
4. **Industrial Uses:** Applied in medicine production, PCR testing, waste decomposition, and biofuel generation.
5. **Key Examples:**
   - *Thermus aquaticus* – source of Taq polymerase in PCR.
   - *Actinobacteria* – known for antibiotic production.
   - *Sulfolobus acidocaldarius* – thrives in acidic hot springs.
6. **Recent Discovery:** Antibiotic-producing thermophiles found in Rajgir hot spring, Bihar.
7. **Significance:** Useful for developing heat-stable enzymes and novel antibiotics.

Nanozymes

Recent Context -:

Researchers have developed an artificial metal-based nanozyme to prevent blood clotting, offering potential treatment for pulmonary thromboembolism (PTE) and COVID-19-related complications.

About -:

1. **Definition:** Nanomaterials exhibiting enzyme-like properties, mimicking natural enzyme activity.
2. **Types:** Metallic, metal oxide-based, carbon-based, and other nanomaterial compositions.
3. **Advantages:** Recyclable, cost-effective, and easy to manufacture compared to natural enzymes.
4. **Applications:** Diagnostic medicine, targeted drug delivery, biosensing, and treating ROS-related neurological disorders.

5. **Mechanism:** Accelerate specific biochemical reactions similar to natural enzymes.
6. **Recent Research:** Artificial metal-based nanozyme created to prevent haemostasis (blood clot formation).
7. **Health Relevance:** Potential treatment for conditions like PTE and COVID-19 complications involving clotting.

Andromeda Galaxy

Recent Context -:

The Andromeda Galaxy (M31), our closest major galactic neighbor, is approaching the Milky Way at 110 km/s, potentially merging in about 4–5 billion years.

About -:

1. **Other Name:** Also known as Messier 31 (M31).
2. **Distance:** Approximately 2.5 million light-years from Earth.
3. **Type:** Barred spiral galaxy, similar in structure to the Milky Way.
4. **Motion:** Moving towards the Milky Way at ~110 km/s.
5. **Future Event:** Expected to merge with the Milky Way in billions of years.
6. **Structure Feature:** Contains a central bar-like structure formed by stars.
7. **Astronomical Significance:** Nearest major galaxy, important for studying galactic formation and evolution.

SOURCE-PIB

INS Arnala – India's First Anti-Submarine Warfare Shallow Water Craft (ASW-SWC)

Recent Context -:

INS Arnala, the first indigenously built ASW-SWC under Aatmanirbhar Bharat, will be commissioned on 18 June 2025, boosting India's coastal defence and subsurface surveillance capabilities.

About -:

1. **Commissioning Date & Location:** 18 June 2025, Naval Dockyard, Visakhapatnam.
2. **Series:** First in a series of 16 ASW-SWC class ships for the Indian Navy.
3. **Builder:** Garden Reach Shipbuilders & Engineers (GRSE), Kolkata, in PPP with L&T Shipbuilders.
4. **Indigenous Content:** Over 80%, involving BEL, L&T, Mahindra Defence, MEIL, and 55+ MSMEs.
5. **Technical Specs:** Length – 77.6 m; Displacement – ~1490 tonnes; Diesel Engine–Waterjet propulsion.
6. **Capabilities:** Subsurface surveillance, ASW operations, SAR, Low-Intensity Maritime Operations.

7. **Heritage Link:** Named after Arnala Fort, Maharashtra, with historical maritime significance.

AI-Enabled Piezo-Photocatalytic Water Purification System – INST Mohali

Recent Context -:

INST Mohali, under DST, developed a biodegradable, low-cost water purification system using sunlight, vibrations, and AI to remove toxic industrial dyes like Methylene Blue and Congo Red from wastewater.

About -:

1. **Developer:** Institute of Nano Science and Technology (INST), Mohali under Department of Science & Technology (DST).
2. **Core Material:** 3D-printed **Polylactic Acid (PLA)** scaffold – biodegradable polymer.
3. **Catalyst: Bismuth Ferrite ($BiFeO_3$)** – enables *piezo-photocatalysis*.
4. **Working Principle:**

- **Photocatalysis:** Sunlight activates $BiFeO_3$ to degrade pollutants.
- **Piezocatalysis:** Mechanical vibrations trigger catalyst activity, even on cloudy days.

5. **AI Role:** Machine learning (Artificial Neural Networks) predicts performance with 99% accuracy for real-world optimization.
6. **Performance:** Removes **98.9% Congo Red** & **74.3% Methylene Blue** without hazardous chemicals.
7. **Sustainability:** Supports **SDG 6, 9, 12, 13**; scalable for textile, pharma industries, and rural water purification.

Solar-Driven Photoelectrochemical (PEC) Device for Green Hydrogen – CeNS Bengaluru

Recent Context -:

CeNS Bengaluru scientists developed a next-generation PEC solar device using earth-abundant materials to split water into hydrogen and oxygen directly, enabling clean, affordable, fossil-fuel-free green hydrogen production at scale.

About -:

1. **Institution:** Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru under DST.
2. **Technology: n-i-p heterojunction** – n-type TiO_2, intrinsic Si, p-type NiO.
3. **Fabrication:** Magnetron sputtering – scalable, industry-ready process.
4. **Performance:** 600 mV surface photovoltage, low onset potential (~0.11 V_RHE), stable for 10+ hrs with only 4% degradation.
5. **Advantages:** Direct solar-to-hydrogen conversion, no rare or toxic materials, low voltage requirement.
6. **Significance:** Supports **India's Green Hydrogen Mission**, net-zero by 2070; potential for home, industrial, and mobility applications.
7. **Publication:** Featured in *Journal of Materials Chemistry A* (Royal Society of Chemistry).

SOURCE- VISION MONTHLY

Science and Technology (S&T) Clusters – Emerging Tech & Quantum Communication Developments

Recent Context -:

The 2024–25 S&T Clusters Report showcased initiatives like Kalaanubhav.in, India's ranking in Harvard's Critical and Emerging Technologies Index, and DRDO–IIT Delhi's milestone in quantum entanglement-based secure communication.

About -:

1. **S&T Clusters Initiative:** Launched 2020 on PM-STIAC recommendation; consortium model for regional, demand-driven tech solutions; nodal agency – **Office of the PSA** under Cabinet Secretary.
2. **Kalaanubhav.in:** AR/VR-enabled artisan marketplace under S&T Clusters.
3. **Critical & Emerging Technologies Index:** Published by **Harvard Kennedy School**; assesses 25 countries in AI, biotech, semiconductors, space, quantum tech using 6 criteria (incl. GDP contribution, supply chain risk).
4. **India's Performance:** Lags behind US, China, Europe; weakest in semiconductor technology.
5. **Quantum Communication Breakthrough:** DRDO & IIT Delhi demonstrated **free-space quantum secure communication** over ~1 km with QBER < 7%.
6. **Previous Record:** ISRO achieved 300 m free-space QKD in 2021.
7. **QKD Basics:** Uses quantum entanglement & cryptography for hack-proof data transfer; key for quantum internet & cybersecurity.

Folate (Vitamin B9)

Recent Context -:

Folate, the natural form of vitamin B9, is vital for DNA/RNA synthesis, RBC production, and nervous system development; deficiency leads to anaemia and developmental issues.

About -:

1. **Nature:** Water-soluble vitamin; naturally occurring form of vitamin B9 (different from synthetic folic acid).
2. **Sources:** Green leafy vegetables (spinach, fenugreek), legumes, citrus fruits, nuts, whole grains, fortified cereals.
3. **Functions:** DNA/RNA synthesis & repair, RBC production, oxygen transport, CNS development in early life.
4. **Deficiency:** Causes anaemia, neural tube defects in foetus, developmental delays.
5. **Medical Uses:** Folate supplements used to prevent/treat deficiencies of B6, B9, and B12.
6. **Special Needs:** Pregnant women require higher folate to prevent birth defects.
7. **Properties:** Recyclable in the body but must be replenished via diet due to water-solubility.

FIBER OPTIC DRONES

- **Definition:** Drones tethered to operator via fiber optic cables (up to 20 km), replacing radio links.
- **Material:** Cable made of glass fibers thinner than human hair.
- **Advantages:**
  - Faster speeds & longer distances.
  - Immune to jamming & interception by Electronic Warfare (EW).
- **Limitation:** Fiber supports a single communication channel at one time.
- **Recent Context:** Used in Russia–Ukraine war for EW-resistant operations.

DHRUVA – Digital Hub for Reference and Unique Virtual Address

- **Nodal Agency:** Department of Posts (DoP).
- **Nature:** Digital Public Infrastructure (DPI) for unique digital address to every home.
- **Aim:** Foundational public infrastructure for governance, service delivery & e-commerce.
- **Two Layers:**
  1. **DIGIPIN** – 10-digit alphanumeric code for 4×4 m grids using lat-long coordinates.
  2. **Digital Address Layer** – Consent-based, user-friendly labels linked to DIGIPIN.
- **Benefits:**
  - Citizens: Better scheme delivery, emergency response.
  - Private sector: Accurate logistics, banking KYC.
  - Governance: Urban planning, targeted welfare delivery.
- **Features:** Privacy, interoperability, scalability, transparency.

INDIA'S FIRST GENE-EDITED SHEEP

- **Developed by:** Kashmir University + ICAR.
- **Technology:** CRISPR-Cas9 (cut-and-paste DNA editing).
- **Gene Targeted:** Myostatin gene → 30% muscle growth boost.
- **Note:** No foreign DNA inserted → different from transgenic.
- **Earlier:** NDRI developed gene-edited buffalo embryo.
- **Ethical Concerns:**
  - Designer animals/humans.
  - Risk of eugenics, discrimination.
  - Off-target mutations, mosaicism.
  - Animal welfare issues.
- **Global Context:** UNESCO's International Bioethics Committee studying genome editing.

HIV PREVENTION DRUG – LENACAPAVIR

- **Approved by:** US FDA; WHO prequalification expected.
- **Use:** Long-acting HIV prevention (PrEP – Pre-Exposure Prophylaxis).
- **WHO Current PrEP Options:** Oral PrEP, dapivirine vaginal ring, CAB-LA injection.
- **Mechanism:** Antiretroviral → prevents HIV from infecting immune cells.
- **About HIV:**
  - Attacks CD4 T cells → weakens immunity.

- Transmitted via blood, semen, vaginal fluids, breast milk, mother-to-child.
- Untreated HIV → AIDS.

- **India Context:** 2.5 million people living with HIV (HIV Estimations 2023).

SOURCE – INDIAN EXPRESS

First Pangenome of Asian Rice

Recent Context :

International team assembled the **first pangenome of Asian rice**, integrating **144 cultivated and wild varieties**, revealing 28,907 core genes and 13,728 wild-rice-specific genes.

ABOUT:

1. **Pangenome:** Entire gene set of a species; core + accessory genes.
2. **Technology used:** PacBio HiFi sequencing & bioinformatics for assembly.
3. **Findings:** 69,531 genes; 20% unique to wild rice.
4. **Evolutionary insight:** Supports Or-IIIa wild rice as ancestor of japonica rice.
5. **Applications:** Develop high-yield, disease-tolerant, region-specific rice cultivars.
6. **Climate resilience:** Helps breed varieties suited to **rapid environmental changes**.
7. **Significance:** Preserves genetic diversity; aids sustainable agriculture and breeding.

Indian Yak Genome Sequencing

Recent Context :

ICAR scientists assembled the **first chromosome-level genome of Indian Yak**, decoding its genes for **cold tolerance, disease resistance, and milk production**, enabling conservation and breeding programs.

ABOUT:

1. **Genome sequencing:** Reading DNA base by base to map gene locations.
2. **Technology:** Long-read sequencing (LRS) enables longer DNA reads than traditional methods.
3. **Significance:** Identifies genetic markers for **cold tolerance, disease resistance, milk yield**.
4. **Applications:** Precision yak breeding, conservation, and livestock improvement.
5. **Comparative genomics:** Enables **allele mining** from other bovines for useful traits.
6. **Biodiversity impact:** Supports **Himalayan yak conservation**, sustaining local livelihoods.
7. **Scientific leap:** Advances understanding of high-altitude bovine genetics.

Hillchol – Oral Cholera Vaccine

Recent Context:

Bharat Biotech's **Hillchol vaccine** completed Phase III trials, effective against **Ogawa and Inaba serotypes** of *Vibrio cholerae O1*.

Key Points:

1. **Disease:** Cholera—acute diarrhoeal infection; transmitted via contaminated water/food.
2. **Global Burden:** ~2.86 million cases/year; 95,000 deaths.
3. **Vaccine Technology:** Oral, single stable O1 Hikojima strain; cost-effective for LMICs.
4. **Advantages:** Easy mass administration, affordable, stable storage, dual serotype coverage.
5. **Public Health Significance:** Supports cholera outbreak prevention and eradication efforts.
6. **Phase III Trials:** Demonstrated efficacy and safety for widespread use.
7. **Relevance to India:** Strengthens immunization capacity and epidemic preparedness.

Operation Sindoor – Key Defence Technologies

Recent Context:

India used **indigenous & advanced weapons** during Operation Sindoor to target terrorist infrastructure in PoK.

Key Technologies:

1. **Akashteer:** AI-powered mobile air defence system, integrates radars, NAVIC GPS; intercepts drones, missiles.
2. **Akash Missile System:** Medium-range SAM (25–45 km), supersonic, multiple variants.
3. **S-400:** Russian SAM, 400 km range, multi-layered defence.
4. **BrahMos:** Supersonic cruise missile, Mach 3, 450 km range.

5. **HAMMER & SCALP:** Precision-guided air-to-ground cruise missiles.
6. **Meteor:** BVRAAM air-to-air missile, largest "No Escape Zone."
7. **Loitering Munitions & Anti-Drone Systems:** SkyStriker, Harop, D-4 for surveillance and precision strikes.

Significance: Enhances **India's aerial strike and defensive capabilities**, showcasing indigenous tech integration (DRDO, ISRO, HAL).

AMCA – Advanced Medium Combat Aircraft

Recent Context:

India's **fifth-generation stealth fighter aircraft** program approved, with HAL and private sector participation; prototype expected by 2035.

Key Points:

1. **Type:** 5th-generation multirole stealth fighter; twin-engine, 25-tonne, Mach 2.15.
2. **Capabilities:** Air-to-air, air-to-ground, SEAD, electronic warfare, "first look, first kill."
3. **Weapons:** BrahMos-NG, Astra, Rudram, anti-tank missiles, laser-guided bombs.
4. **Engines:** Mk1—GE-F414 (98 kN); Mk2—110 kN indigenous collaboration.
5. **Stealth Features:** Radar-absorbing coating, reduced IR signature, internal fuel tank.
6. **Strategic Significance:** Fills IAF gaps; counters China and Pakistan's advanced fighters; elevates India to global 5th-gen fighter club.
7. **Indigenous Development:** Designed by ADA, manufactured by HAL + private firms.

TOPICS COVERED-

- **Nuclear Technology in the Wake of US Attack on Iran** – Global nuclear concerns heightened due to US–Iran conflict.
- **Duality in Magnetic Material (CrSb in Altermagnets)** – Chromium antimonide exhibits novel direction-dependent magnetic properties.
- **NISAR Satellite** – NASA–ISRO collaboration for Earth observation using synthetic aperture radar.
- **Black Hole Merger (GW231123)** – Detection of gravitational waves from merging black holes.
- **Bluetooth Mesh Networking (BitChat App)** – Enables decentralized communication between devices via mesh technology.
- **AI Alliance Network (AIANET)** – Platform promoting collaborative AI research and applications.
- **WHO "3 by 35" Initiative** – Global target to eliminate hearing loss by 2035.
- **WHO–UNICEF Immunization Data 2024** – Monitoring vaccination coverage and gaps globally.
- **Phenome India National Biobank** – Repository linking phenotypic and genomic data for research purposes.
- **CRIB Blood Group** – New classification improving transfusion safety and biomedical research.
- **Fungus-Fighting Pineapple** – Bioactive compounds in pineapple targeting fungal infections.
- **Nuclear Medicine using Radioactive Iodine (RAI)** – Diagnosis and treatment of thyroid disorders.
- **Gujarat Tribal Genome Sequencing Project** – Mapping tribal genomes to gain health insights.
- **Optical Atomic Clock** – Ultra-precise timekeeping, applicable in navigation and physics experiments.
- **Extended Range Anti-Submarine Rocket (ERASR)** – Advanced naval weapon for submarine engagement.
- **Advanced Towed Artillery Gun System (ATAGS)** – Indigenous long-range artillery enhancing defense capability.
- **Accelerator Mass Spectrometry (AMS) Dating** – Technique for precise radiocarbon and isotope dating.
- **Research Development and Innovation (RDI) Scheme** – Government initiative promoting scientific innovation.
- **Altermagnet (Chromium Antimonide - CrSb)** – Material with direction-dependent magnetic behavior.
- **Star HOPS315 (Planet Formation Discovery)** – Observation revealing early-stage planet formation.
- **Vera C. Rubin Observatory** – Telescope mapping dynamic universe and dark matter studies.
- **GOSAT-GW Satellite** – Monitors greenhouse gases and tracks climate change globally.
- **AI-Driven Dynamic Targeting Technology** – Military and industrial precision targeting using AI.
- **Kerala's KITE AI Initiative** – State program integrating AI into education and governance.
- **AI Appreciation Day** – Promoting awareness and ethical use of artificial intelligence.
- **Quantum Noise Discovery (RRI)** – Insights into quantum fluctuations for precision measurement.
- **India's First Indigenous Dengue Vaccine** – Tetravalent vaccine covering all dengue serotypes.
- **Japonica Rice Gene-Editing (NIPGR)** – Genetic modification improving yield and resilience.
- **Dark Web** – Hidden networks facilitating anonymous communication.
- **India's First National Biobank** – Centralized repository for biological samples advancing health research.
- **Empowering States Through Science (NITI Aayog Report on SSTCs)** – Promotes state-level science and technology centres.
- **Blocking of AI Web Crawler** – Restricting automated AI data collection for privacy and security.

- **BHARAT-FIRST: Guiding India Towards Innovation-Driven Future** – Strategy to foster indigenous R&D and innovation.
- **AI Shortcuts and the Collapse of Educational Purpose** – Risks of over-reliance on AI in learning environments.
- **Firms Must Lead India's Innovation Growth Path** – Encouraging private sector-driven R&D.
- **European Union Plans Age Checks for Safety** – Regulatory measures to protect minors online.
- **ICMR Develops New Malaria Vaccine with Promising Results** – Multistage vaccine targeting *Plasmodium falciparum*.
- **NISAR Satellite Enhances Global Earth Observation Efforts** – Advanced radar imaging for environmental monitoring.

SCIENCE AND TECHNOLOGY

SOURCE – INDIAN EXPRESS

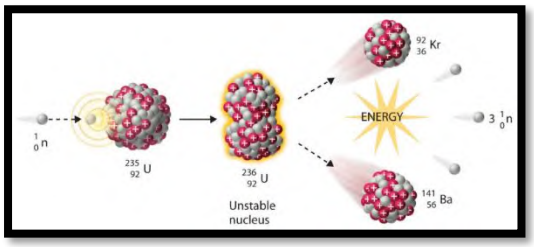
Understanding Nuclear Technology in the Wake of US Attack on Iran

Recent Context -

The US attack on Iran's Fordow nuclear facility reignited debates on nuclear technology's dual-use nature, highlighting its role in energy security, healthcare, agriculture, military strategy, and global non-proliferation frameworks.

About -

1. **Nuclear Reactions:** Fission = splitting of heavy nuclei (Uranium-235, Plutonium-239). Fusion = combining light nuclei (Hydrogen isotopes) into heavier nuclei, releasing massive energy.
2. **Civilian Uses:** Nuclear power plants for electricity, desalination, district heating; agriculture via irradiation, pest control (Sterile Insect Technique); healthcare through radiotherapy & diagnostics.
3. **International Frameworks:** IAEA safeguards, NPT (1968), CTBT (1996), Nuclear Suppliers Group (NSG), and export controls regulate technology use and prevent proliferation.
4. **India's 3-Stage Nuclear Programme:** Stage I – PHWRs with natural uranium, Stage II – Fast Breeder Reactors with plutonium, Stage III – Thorium-based advanced reactors.
5. **Indian Regulation:** Atomic Energy Act (1962), Department of Atomic Energy (1954), Atomic Energy Commission, and Civil Liability for Nuclear Damage Act (2010) ensure governance, safety, and accountability.



SOURCE – PIB

Duality in Magnetic Material (CrSb in Altermagnets) – Scientific Breakthrough

Recent Context -

Scientists discovered duality in Chromium Antimonide (CrSb), an *altermagnet* material showing both n-type and p-type conduction depending on direction, with huge potential in spintronics, semiconductors, and sustainable electronics.

About -

1. **Altermagnets:** Hybrid class combining ferromagnets (external magnetism) & antiferromagnets (internal cancellation); non-magnetic outside but show strong internal spin — ideal for spintronics.
2. **CrSb Properties:** Metallic conductor, works above 60°C, record-high spin splitting (30× room temp).
3. **DDCP (Direction-Dependent Conduction Polarity):** CrSb shows n-type (electrons) in-plane & p-type (holes) out-of-plane — unique duality.
4. **Tech Simplification:** Removes need for doping/heterostructures in devices like solar cells & thermoelectrics.
5. **Spintronics Application:** Enables low-power, faster electronics using electron spin instead of charge flow.
6. **Environmental Edge:** Composed of abundant, non-toxic elements → eco-friendly manufacturing.
7. **Policy Relevance:** Supports Make in India, indigenous R&D, and India's green-tech leadership ambitions.

SOURCE – VISION MONTHLY

NISAR (NASA–ISRO Synthetic Aperture Radar) Satellite

Recent Context -

NISAR, a joint NASA–ISRO Earth observation satellite, was launched aboard GSLV-F16 from Sriharikota. It integrates L-band and S-band SAR, offering unprecedented global data for climate, land, and disaster monitoring.

About -

1. **Joint Mission:** NASA (L-band radar, antenna, GPS, telecom) + ISRO (S-band radar, spacecraft bus, GSLV-F16).
2. **Unique Orbit:** First GSLV launch into **743 km Sun-Synchronous Orbit (SSO)**.
3. **SAR Technology:** Dual-band **Synthetic Aperture Radar (L & S band)**; penetrates canopy, soil, ice.
4. **SweepSAR Technique:** Enables **high-resolution, wide-swath imaging** across terrain.
5. **Antenna: 12-metre unfurlable reflector**; resolution equivalent to 20 km ground antenna.
6. **Mission Cycle:** Revisits Earth every **12 days** for land-change monitoring.
7. **Open-Data Policy:** Free data for global scientific community, aiding developing nations in disaster/climate studies.

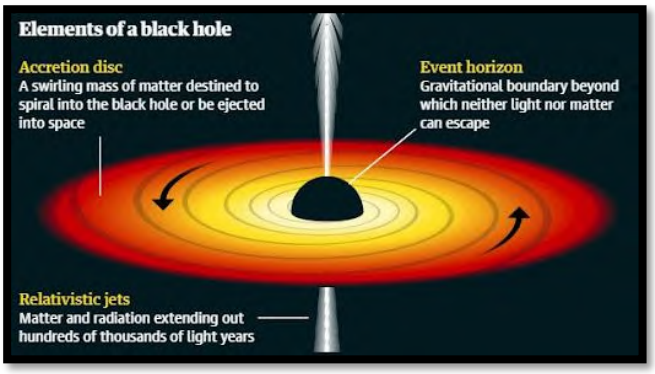
Black Hole Merger (GW231123)

Recent Context -

The LVK network (LIGO–Virgo–KAGRA) detected the merger of two massive black holes (140 & 100 solar masses), forming a 225 solar mass black hole — the largest observed merger.

About -

1. Event name: **GW231123** (gravitational wave detection).
2. Detectors: **LIGO (USA), Virgo (Italy), KAGRA (Japan); LIGO-India upcoming in Maharashtra**.
3. Result: Formation of an **intermediate-mass black hole (225 solar masses)**.
4. Predicted by **Einstein (1915), confirmed experimentally in 2015**.
5. Significance: Offers insights into **hierarchical mergers → supermassive black hole formation**.
6. Gravitational waves → tool for probing **dark matter & dark energy**.
7. **Types of black holes:** stellar, supermassive, intermediate, primordial.



Bluetooth Mesh Networking (BitChat App)

Recent Context -

Twitter co-founder introduced **BitChat**, a peer-to-peer encrypted messaging app that uses **Bluetooth Low Energy Mesh Networking** — enabling communication without servers, SIM cards, or mobile networks, ensuring privacy and resilience.

About -

1. **Mesh topology** → multi-hop communication, data relayed device-to-device.
2. **Bluetooth Low Energy (BLE)** used for low-power, short-range networking.
3. **No central server** → data stored only on devices, deleted soon.
4. **End-to-end encryption** + anonymity (no email/phone registration).
5. Works even if one node fails → resilient communication.
6. **Limitations:** high latency, complex management, low data transfer rate.
7. Applications in **disaster zones, military ops, privacy-focused communication**.

AI Alliance Network (AIANET)

Recent Context -

Digital India Foundation opposed Pakistan's AI Technology Centre (AITeC) joining AIANET, citing security and misuse concerns. AIANET is a voluntary global platform to accelerate AI development and collaboration.

About -

1. AIANET = **informal, voluntary global AI network**.
2. Aim → accelerate **AI for sustainable prosperity & socio-economic growth**.
3. Members → 17, including India.

4. Administered by **AI Alliance Russia**.
5. Functions → **knowledge exchange, policy dialogues, expertise sharing**.
6. DIF (India) → **founding member**, promotes digital inclusion.
7. Current issue → **Pakistan's membership application contested**.

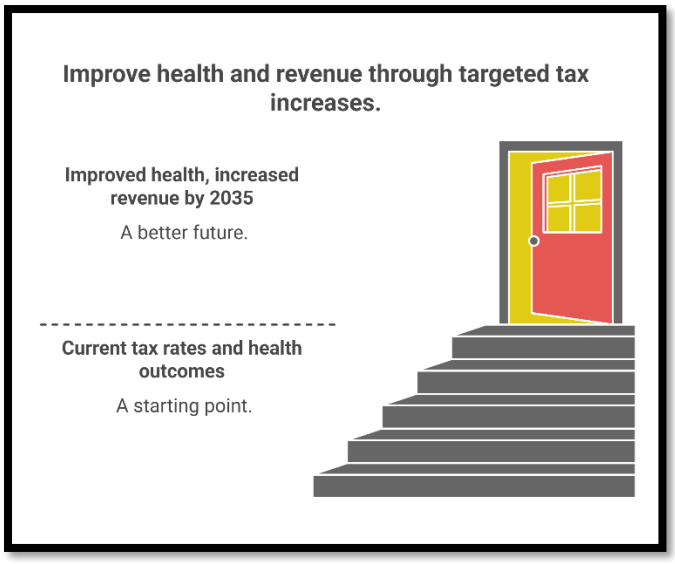
WHO "3 by 35" Initiative

Recent Context -

WHO launched the "3 by 35" initiative to raise taxes by 50% on tobacco, alcohol, and sugary drinks by 2035, aiming at better health outcomes and revenue generation.

About -

1. Products targeted → **tobacco, alcohol, sugary drinks**.
2. Goal → **50% price increase via health taxes by 2035**.
3. Potential revenue → **US $1 trillion in a decade**.
4. NCDs → cause **>75% global deaths**.
5. Supported by **governments, civil society, academia, development partners**.
6. India: Aerated drinks taxed **28% GST + 12% cess**.
7. WHO → calls **health taxes most cost-effective NCD tool**.



WHO–UNICEF Immunization Data 2024

Recent Context -

WHO-UNICEF 2024 data shows India reduced zero-dose children by 43% (1.6m → 0.9m). Globally, 89% infants received at least one DTP vaccine dose, showing progress in immunization.

About -

1. WHO-UNICEF dataset = **largest global immunization database**.
2. Global: **89% infants received ≥1 DTP vaccine in 2024**.
3. India: **Zero-dose children fell 43% (2023–24)**.
4. **Universal Immunization Programme (UIP, 1985)** → covers 12 diseases.
5. UIP achievements → **Polio-free (2014), Neonatal tetanus eliminated (2015)**.
6. Key campaigns → **Mission Indradhanush, IMI 5.0, U-WIN Portal**.
7. Diseases covered → **9 nationwide, 3 region-specific**.

Phenome India National Biobank

Recent Context -

CSIR-IGIB inaugurated India's National Biobank under the Phenome India Project to build a health database, enabling AI-driven diagnostics, early disease detection, and personalized medicine research for diverse populations.

About -

1. Based on **UK Biobank model**, adapted for India.
2. Launched under **Phenome India-CSIR Health Cohort Knowledgebase (PI-CheCK, 2023)**.
3. Coverage → **10,000 individuals' genomic, lifestyle, clinical data**.
4. Purpose → **precision medicine, early diagnosis, therapeutic targeting**.
5. Supports fight vs **diabetes, cancer, CVD, rare genetic disorders**.
6. Generates **high-resolution AI-powered biomedical data**.
7. **Phenome = full set of phenotypes** (traits shaped by genes + environment).

SOURCE – INSIGHTS

CRIB Blood Group

Recent Context -

A new human blood group **CRIB (Cromer India**

Bengaluru) has been discovered at Rotary Bangalore TTK Blood Centre, officially recognised by the **International Blood Group Reference Laboratory (IBGRL), UK**.

About -

1. **CRIB = Cromer India Bengaluru**, first globally reported blood group antigen.
2. Identified in a **38-year-old South Indian woman**.
3. Discovered within **Cromer blood group system (CR)**.
4. Cromer antigens located on **DAF (Decay Accelerating Factor) protein**.
5. Detection → panreactive blood, incompatible with all tested types.
6. Recognised by **International Society of Blood Transfusion (ISBT) nomenclature**.
7. Highlights need for **rare donor registries & immunogenetics research**.

Fungus-Fighting Pineapple

Recent Context -

Researchers at **Bose Institute (DST)** developed a **genetically modified pineapple** resistant to **Fusariosis**, a devastating fungal disease, by overexpressing the **AcSERK3 gene**, enhancing natural defence and reducing dependence on fungicides.

About -

1. Target disease → **Fusariosis**, caused by *Fusarium moniliforme*.
2. Causes **stem warping, leaf blackening, fruit rot** in pineapples.
3. Developed via **Agrobacterium-mediated transformation**.
4. Gene used → **AcSERK3**, enhances stress tolerance.
5. Benefits → **multi-fungal resistance, low gene-deletion risk**.
6. First case of **overexpressing inherent pineapple gene** for resistance.
7. Promotes **sustainable agriculture by cutting fungicide use**.

Nuclear Medicine using Radioactive Iodine (RAI)

Recent Context -

Radioactive Iodine Therapy (^{131}I) is increasingly used in India as a **non-invasive, cost-effective treatment** for **thyroid disorders and cancers**, combining diagnostics and therapy under nuclear medicine's **theranostic approach**.

About -

1. Uses **Iodine-131 isotope**, discovered in **1938 (Seaborg, Livingood)**.
2. First proposed in **1936 by Saul Hertz**.
3. Works by **thyroid-specific iodine absorption → cell destruction**.
4. Emits **beta particles (therapy) + gamma rays (imaging)**.
5. Contraindicated in **pregnancy & lactation**.
6. Key applications → **Graves' disease, toxic goitre, thyroid cancers**.
7. **Safe, affordable, minimally invasive**; widely available in Indian hospitals

Gujarat Tribal Genome Sequencing Project

Recent Context -

Gujarat became the **first Indian state** to launch a **Tribal Genome Sequencing Project** to build a genetic reference database, aiming at precision medicine and better healthcare access for tribal populations.

About -

1. First state-level **genomic initiative in India**.
2. Implemented by **Gujarat Biotechnology Research Centre (GBRC)**.
3. **2,000 tribal genomes** sequenced across **17 districts**.
4. Targets disorders: **Sickle cell anaemia, thalassemia, hereditary cancers**.
5. Focus on **natural immunity markers**.
6. Involves **tribal community consultation & awareness**.
7. Serves as a **model for other states** in genomic policy.

Optical Atomic Clock

Recent Context -

An international team of scientists achieved the **largest optical atomic clock comparison across three continents**, moving closer to redefining the **SI unit of time – the second**.

About -

1. Uses **light waves (optical frequency)**, unlike caesium microwave clocks.
2. Elements: **Strontium-87, Ytterbium-171, Indium-115 ions**.
3. Accuracy up to **10^{-18} seconds**.
4. Stability → loses 1 sec in **15 billion years**.
5. Supports **GPS, space navigation, climate science**.
6. Participating nations: **Germany, France, Japan, UK, Italy, Finland**.
7. Expected to redefine SI **second by 2030**.

Extended Range Anti-Submarine Rocket (ERASR)

Recent Context -

India successfully tested the **Extended Range Anti-Submarine Rocket (ERASR)** from **INS Kavaratti**, developed by **DRDO**, boosting naval underwater strike capability and reducing dependence on imported defence systems.

About -

1. Developed by **DRDO**.
2. **Twin rocket motor system** → short & long range.
3. Uses **indigenous electronic time fuze**.
4. Tested with **17 rockets** from INS Kavaratti.
5. Enhances **Anti-Submarine Warfare (ASW)** capability.
6. Compatible with **Indigenous Rocket Launchers (IRLs)**.
7. Promotes **Atmanirbharta in defence**.

Advanced Towed Artillery Gun System (ATAGS)

Recent Context -

The Indian Army is set to induct its first regiment of **indigenous ATAGS artillery guns**, a **155mm/52 calibre system**, after successful trials, strengthening artillery modernization and defence self-reliance.

About -

1. Developed by **DRDO + Tata + Bharat Forge**.
2. Calibre: **155mm/52**, firing range up to **48 km**.
3. **Deployment time: 90 seconds**.
4. Firing modes: **Burst, Intense, Sustained**.
5. Uses **electric drive system** (not hydraulic).
6. Over **80% indigenous components**.
7. Enables **"shoot and scoot" tactics** with MGS variant.

Accelerator Mass Spectrometry (AMS) Dating

Recent Context -

Tamil Nadu State Department of Archaeology sent **23 charcoal samples from 7 excavation sites** for AMS Dating to a U.S. lab, aiming at precise age estimation of ancient artefacts.

About -

1. AMS → precise **radiocarbon dating** technique.
2. Counts **C-14 atoms directly**, unlike conventional decay-based radiometry.
3. Works with **tiny samples (~20 mg)**.
4. Sample → converted to graphite, ionized, accelerated.
5. Isotopes separated by **magnetic fields**.
6. Applications → Archaeology, geology, oceanography, biomedical, climate science.
7. Advantage → **Non-destructive, high precision, fast results**.

Research Development and Innovation (RDI) Scheme

Recent Context -

Union Cabinet approved the **₹1 lakh crore RDI Scheme** to scale up private sector R&D investment, boost deep-tech innovation, and strengthen India's **strategic technology self-reliance** through affordable long-term financing.

About -

1. Nodal Ministry → **DST**; oversight by **ANRF (PM chaired)**.
2. **Corpus: ₹1 lakh crore**.
3. Financing → **Two-tiered system** (ANRF fund → 2nd-level fund managers).
4. Provides **low/nil interest loans**.

5. Creates **Deep-Tech Fund of Funds** (AI, quantum, semiconductors, biotech).
6. Supports **critical tech acquisition & domestic R&D**.
7. Promotes **Atmanirbharta + sunrise sector innovation**.

Altermagnet (Chromium Antimonide - CrSb)

Recent Context -

Scientists at **S.N. Bose National Centre** discovered **direction-dependent conduction polarity (DDCP)** in CrSb, a rare altermagnet, enabling both **p-type and n-type conduction** in a single crystal.

About -

1. Altermagnets → mix of **antiferromagnet + ferromagnet traits**.
2. Exhibit **zero net external magnetization**.
3. Show **high spin splitting** (30× room temperature).
4. **CrSb** conducts as **n-type along layers**, **p-type across layers**.
5. **Thermally stable** → survives 2× room temperature.
6. Applications: Spintronics, compact electronics, thermoelectric systems.
7. Non-toxic, earth-abundant → supports **green electronics**.

Star HOPS315 (Planet Formation Discovery)

Recent Context -

Using **JWST & ALMA**, astronomers observed **rock vapour condensing into solid crystals** around HOPS315, a young protostar in Orion, providing **first direct evidence of rocky planet formation**.

About -

1. Protostar in **Orion molecular cloud**.
2. Unique **tilted disc** → rare view of inner disc.
3. JWST detected **SiO gas & crystalline silicates** near 2 AU.
4. Rock vapour crystallized into **forsterite, enstatite, silica**.
5. Matches **chondritic meteorites** from early Earth.
6. Shows **genesis of rocky planets**.
7. First-ever **direct observational proof** of rock-to-crystal transition.

Vera C. Rubin Observatory

Recent Context -

The Vera C. Rubin Observatory in Chile released its **first test images**, demonstrating capacity to scan the sky rapidly, detect millions of celestial events nightly, and advance dark matter/dark energy studies.

About -

1. Location → Cerro Pachón, Chile (8,684 ft).
2. Partners → **NSF + DOE (USA)**.
3. Camera → **3,200 MP**, size of car, detects faint light.
4. Can map **entire southern sky every 3 days**.
5. Fastest slewing telescope (5 sec target switch).
6. Data → 20 TB/day, 10 million alerts nightly.
7. Goals → Dark matter/energy study, NEO tracking, public data access.

GOSAT-GW Satellite

Recent Context -

Japan launched the **GOSAT-GW satellite** aboard its **final H-2A rocket**, enhancing global monitoring of greenhouse gases and water cycles, and supporting international climate policy frameworks like the Paris Agreement.

About -

1. Full form → **Global Observing Satellite for Greenhouse gases & Water cycle**.
2. Developer → JAXA + Mitsubishi Heavy Industries.
3. Launched by → **H-2A rocket (50th & final mission)**.
4. Dual mission → **Greenhouse gases + Hydrological cycle**.
5. Provides real-time global data (open access).
6. Supports **NOAA, Paris Agreement**, global stakeholders.
7. Successor → will transition to new **H3 rocket**.

AI-Driven Dynamic Targeting Technology

Recent Context -

NASA's JPL tested **AI Dynamic Targeting**, enabling Earth-observing satellites to autonomously avoid clouds and focus on high-value events (wildfires, storms, volcanoes) in real time, boosting climate monitoring and disaster readiness.

About -

1. Developed by → NASA JPL, with Open Cosmos + Ubotica.
2. Works via **Lookahead Sensor + onboard AI**.
3. Decisions in **<90 seconds** for cloud-free imaging.
4. **Pivot-and-shoot** mechanism improves usable data.
5. Scalable to **CubeSats and constellations**.
6. Enhances **climate event & disaster monitoring**.
7. Reduces ground control dependence + bandwidth load.

Kerala's KITE AI Initiative

Recent Context -

Kerala's **KITE initiative** gained global recognition (UNICEF best practice) for integrating **ethical AI in schools**, ensuring student data sovereignty, FOSS adoption, and mass teacher training in responsible AI use.

About -

1. KITE → **Kerala Infrastructure & Technology for Education**.
2. State initiative under Kerala's Education Dept.
3. Focus → **ethical, transparent, open-source AI** in schools.
4. Trained **80,000+ teachers** in AI & bias detection.
5. Uses **FOSS across 15,000+ schools**.
6. Samagra Plus → Kerala's own **RAG-based AI engine**.
7. **Little KITEs IT Clubs** → robotics + AI learning for students.

AI Appreciation Day

Recent Context -

India observed **AI Appreciation Day (July 16, 2024)** to highlight rapid progress in AI across healthcare, education, agriculture, and governance, while emphasizing ethical, inclusive, and responsible AI development.

About -

1. Celebrated on **July 16 every year** (globally).
2. Recognizes AI's transformative role in society.
3. Linked with **Digital India (2015), National AI Strategy (2018)**.
4. Applications → healthcare, farming, governance, education.
5. Promotes **ethical & responsible AI** use.
6. Encourages **youth skilling in AI**.
7. Boosts India's digital economy + global AI hub status.

Quantum Noise Discovery (RRI)

Recent Context -

Indian scientists at **Raman Research Institute** found that **quantum noise**, earlier seen as destructive, can actually **generate or revive entanglement**, offering

resilience for future quantum communication and computing systems.

About -

1. Quantum noise → random disturbances in quantum systems.
2. Arises from **Heisenberg's Uncertainty Principle**.
3. Leads to **decoherence** in entangled states.
4. Can be modeled via amplitude/phase damping.
5. Discovery → **noise may enhance entanglement**.
6. Application → **quantum cryptography & error correction**.
7. Applies to **photons, neutrons, trapped ions**.

India's First Indigenous Dengue Vaccine

Recent Context -

India began **Phase 3 trials** of its indigenous dengue vaccine **DengiAll**, developed by Panacea Biotec with ICMR support, targeting protection against all four dengue serotypes across 20 trial centers.

About -

1. Vaccine name → **DengiAll** (tetravalent).
2. Derived from **NIH TV003/TV005 strain**.
3. Developer → **Panacea Biotec + ICMR**.
4. Two-dose, live-attenuated vaccine.
5. Trials at **20 centers** (Delhi, Pune, Hyderabad).
6. Phase 1 & 2 successful (2018–19).
7. Significance → protects children, reduces reinfections.

Japonica Rice Gene-Editing (NIPGR)

Recent Context -

NIPGR scientists used **CRISPR-Cas9 gene-editing** to enhance phosphate uptake in **japonica rice**, boosting yields by 20–40% with reduced fertilizer use, offering eco-friendly agriculture and reduced DAP import reliance.

About -

1. Japonica rice → short-grain, high-starch, East Asia variety.
2. Developed using **CRISPR-Cas9**.
3. Target gene → **OsPHO1;2** transporter.
4. Removed binding site of repressor **OsWRKY6**.
5. Yield → +20% (full phosphate), +40% (low phosphate).
6. No foreign DNA retained.
7. Significance → reduces **DAP imports (~4.5 MT/year)**.

Dark Web

Recent Context -

A Kerala engineer was arrested as a **Level-4 darknet vendor**, selling LSD and ketamine via the **dark web** using cryptocurrency, highlighting rising cybercrime challenges in India.

About -

1. Dark web → hidden internet, needs **Tor browser**.
2. Uses "**.onion**" domains.
3. Ensures anonymity & encryption.
4. Hosts legal + illegal marketplaces.
5. Used by **journalists & activists** in authoritarian regimes.
6. Facilitates **cybercrime & illicit trade**.
7. Level-4 vendor → high-tier, trusted darknet seller.

India's First National Biobank

Recent Context -

Union Minister inaugurated **India's first National Biobank** at CSIR-IGIB, Delhi, under **Phenome India initiative**, to create a genomic and clinical database enabling personalized medicine and indigenous genomic research.

About -

1. Developed by **CSIR-IGIB, Delhi**.
2. Part of **Phenome India longitudinal study**.
3. Collects genomic + lifestyle + clinical data.
4. Inspired by **UK Biobank**.
5. Coverage → **10,000+ individuals nationwide**.
6. Supports AI-driven diagnostics & therapies.
7. Significance → personalized medicine, rare disease research.

SOURCE – DRISHTI

Empowering States Through Science (NITI Aayog Report on SSTCs)

Recent Context -

NITI Aayog's report *"A Roadmap for Strengthening*

State Science and Technology (S&T) Councils" calls for reforms in funding, governance, and leadership of SSTCs to boost decentralised science-led development.

About -

1. **State S&T Councils (SSTCs):** Created in 1971 under C. Subramaniam; first in Karnataka, Kerala, UP, WB.
2. Supported by **DST under SSTP** with variable state funding.
3. Roles → promote grassroots innovation, agriculture, renewable energy, disaster management, biotech.
4. Challenges → overdependence on DST grants, weak industry linkages, poor R&D output, leadership by bureaucrats.
5. **State R&D spending:** only 6.7% vs Centre's 44%; some states cut budgets recently.
6. **Reforms by NITI:** full-time scientists as heads, performance-based funding, STI info cells, innovation hubs.
7. **Success stories → Kerala (women scientists return scheme), Tamil Nadu (patents & GI leader), Punjab (paddy straw mgmt), Mizoram (Innovation Facility Centre), Manipur (aromatic plants).**

Blocking of AI Web Crawler

Recent Context -

Major US and UK publishers have blocked AI web crawlers like GPTBot and Amazonbot, raising global debates on copyright, consent-based safeguards, ethical AI use, and India's need for regulation.

About -

1. **AI Web Crawler:** Automated bot that scans web data → used for **LLM training** (GPTBot, Amazonbot, GoogleOther) or **live retrieval** (Bing, ChatGPT).
2. **India's Gap:** Copyright Act, 1957 not equipped for AI-specific cases (training data, derivative outputs).
3. **Concerns:** Unauthorized scraping, lack of compensation, unclear "fair use," no non-personal data law.
4. **Ethical Risks:** Biased/unvetted training data → misinformation, harmful outputs, weak public trust.
5. **Global Example:** EU AI Act (2024) regulates copyrighted data; US publishers pursuing licensing/legal action.
6. **India's Path Forward:** MeitY & I&B to define "unauthorised scraping," build consent-based AI licensing framework.
7. **Safeguards:** AI bot-blocking tools (via Cloudflare-like platforms) to empower Indian publishers.

SOURCE – THE HINDU

BHARAT-FIRST: Guiding India Towards Innovation-Driven Future

Recent Context -

India's ₹71 trillion R&D push in sunrise sectors signals ambition for technological leadership. To ensure long-term impact, experts propose **BHARAT-FIRST**, an independent foresight institute for strategic STI governance.

About -

1. **BHARAT-FIRST:** *Foresight Institute for Research in Science & Technology* → an independent, non-partisan STI think tank.
2. **Need:** To keep pace with disruptive tech (AI, quantum, clean energy, biotech) & avoid obsolete investments.
3. **Global Models:** Germany's Fraunhofer, USA's RAND & Brookings, Finland's SITRA → foresight institutions guiding policy.
4. **Mission:** Curate open datasets, foresight reports, stakeholder dialogues; align STI with national development & societal goals.
5. **Role:** Back national tech missions (AI Mission, Deep Tech Fund), reduce duplication, enable anticipatory innovation.
6. **Global Relevance:** Boost tech diplomacy, support Global South, strengthen South–South cooperation in digital & STI governance.
7. **Design:** 20–50 year horizon focus; led by CEO; funded by CSR/philanthropy; include academia, industry, civil society.

AI Shortcuts and the Collapse of Educational Purpose

Recent Context -

With rising use of AI-generated lesson plans, lectures, and assignments, experts warn that outsourcing thinking undermines education's purpose—shifting focus from active intellectual struggle to passive consumption.

About -

1. **Issue:** Teachers & students increasingly rely on AI (e.g., ChatGPT) for lesson plans, lectures, and assignments.
2. **Core Concern:** Outsourcing thinking erodes reflection, adaptability, and creativity—the essence of education.
3. **Teaching Impact:** Pre-designed AI lesson plans limit improvisation and responsiveness in dynamic classroom settings.
4. **Student Impact:** AI-generated essays/problem sets undermine critical thinking and intellectual effort.
5. **Assessment Challenge:** Take-home assignments lose value; AI makes traditional evaluation methods obsolete.
6. **Way Forward:** Return to supervised exams, oral tests, and live assessments for authentic evaluation.
7. **Principle:** AI should remain a supportive tool, not a replacement for human thought—struggle is central to real learning.

Firms Must Lead India's Innovation Growth Path

Recent Context -

The Union Cabinet approved a ₹1 trillion Research, Development & Innovation (RDI) scheme with ₹20,000 crore this year to boost industry-led R&D and correct India's low private innovation investment.

About -

1. **Scheme:** ₹1 trillion RDI scheme; ₹20,000 crore allocated in Budget 2025–26.
2. **Problem:** Indian firms invest only 0.3% of GDP in R&D vs 1.5% global average.
3. **Core Idea:** Innovation mainly firm-driven; public research supports but doesn't replace firm-level R&D.
4. **Target Firms:** Should focus on R&D-intensive sectors—pharma, auto, defence, chemicals—already investing at least half of global peers.
5. **Eligible Pool:** Top 300 Indian R&D investors (₹16–297 crore annual R&D spend).
6. **Performance Incentives:** Firms must expand R&D staff by 50% in a year for further funding tranches.
7. **Evaluation:** TRL-based metrics (focusing on TRL 4–6) to bridge academic research and commercialization.

European Union Plans Age Checks for Safety

Recent Context -

The European Commission proposed an **age verification app** under the **Digital Services Act (DSA)** to prevent minors' access to harmful online content while balancing child safety with adult privacy concerns.

About -

1. **Legal Basis:** Proposal under EU's **Digital Services Act (DSA)** for safer online spaces.
2. **Technology:** App built on **European Digital Identity Wallet (eID)** standards; rollout by 2026.
3. **Pilot Trials:** Denmark, France, and Spain to test national versions; includes "**zero-knowledge proof**" for privacy.
4. **France's Push:** Advocates **social media ban below 15 years**; among first to trial prototype app.
5. **Industry Opposition:** Adult content firms (e.g., Pornhub-owner Aylo) resist website-level checks, suggest device-level verification by tech giants.
6. **Privacy Concerns:** Risks of data misuse, tracking, and monetisation; Commission assures data security via **open-source specifications**.
7. **Judicial Developments:** France's top court upheld mandate; legality under EU law remains contested.

ICMR Develops New Malaria Vaccine with Promising Results

Recent Context -

ICMR has developed a new malaria vaccine candidate, **AdFalciVax**, targeting ***Plasmodium falciparum***. It shows >90% efficacy in animal trials and aims to provide long-lasting protection while preventing disease transmission.

About -

1. **Disease Burden:** Malaria causes ~4 lakh deaths annually; Africa worst affected. India reported only 83 official deaths in 2022, but WHO estimates ~5,500.
2. **Existing Vaccines:** RTS,S and R21 approved earlier; ~75% efficacy only.
3. **AdFalciVax Mechanism:** Chimeric recombinant vaccine; targets **CSP** (individual protection) and **Pro6C** (community-level transmission block).
4. **Efficacy:** Animal trials show >90% protection; 3 doses may give decade-long immunity.
5. **Adjuvant Used: Alum-based**, safer than AS01 or Matrix M; stable at room temperature for 9 months, reducing cold chain dependency.
6. **ICMR's Role:** Technology owner; seeks private partners for human trials & production; IP shared.
7. **Revenue Model:** ICMR to earn **2% royalty** on vaccine sales; joint authorship in publications.

NISAR Satellite Enhances Global Earth Observation Efforts

Context -

India and the US jointly develop NISAR, the first dual-band radar satellite. It provides all-weather, high-resolution Earth observation, supporting climate, geophysical, and ecological research for global policymaking.

About -

1. **Dual-Band SAR:** L-band penetrates vegetation/ice/sand; S-band captures broader features like crops and water bodies.
2. **All-Weather Observation:** Operates through clouds, rain, fog, and darkness for uninterrupted monitoring.
3. **Advanced Antenna:** 12-metre antenna simulates 20-km ground radar for exceptional surface resolution.
4. **NASA-ISRO Partnership:** NASA provides L-band SAR, ISRO provides S-band radar and launch; total budget ~$1.25 billion.
5. **Synthetic Aperture Radar (SAR):** Uses microwave reflections to determine distance, movement, and composition of objects.
6. **Scientific Applications:** Climate change, volcanic activity, surface deformation, biomass monitoring, crop cycles.
7. **Strategic Significance:** Strengthens US-India space collaboration; supports global environmental and geological policymaking.

TOPICS COVERED-

1. **HOW DO GLP-1 DRUGS WORK?**
   GLP-1 drugs mimic the incretin hormone to regulate blood sugar, appetite, and digestion.
2. **INDIA'S FIRST TRIBAL GENOME SEQUENCING PROJECT**
   Sequences genomes of tribal populations to identify health risks and enable personalised healthcare.
3. **CONFINED FIELD TRIALS OF GM MAIZE**
   Tests genetically modified maize for insect resistance and herbicide tolerance under controlled conditions.
4. **STEM CELL THERAPY 'ZIMISLECEL' IN TYPE-1 DIABETES**
   Transplants stem cell-derived islets to restore insulin production in Type-1 Diabetes patients.
5. **MOLECULAR IMAGING – CALTECH'S ANGSTROM-SCALE MICROSCOPE**
   Achieves real-time, non-invasive imaging of molecules at angstrom-level resolution.
6. **AXIOM-4 MISSION – INDIA'S PARTICIPATION**
   First Indian astronaut flies private mission to ISS for space biology and technology experiments.
7. **DRDO'S PHOTONIC RADAR**
   Next-gen radar using light-based photonic circuits for high-resolution, jam-proof detection.
8. **HAM RADIO – SPACE & EARTH COMMUNICATION**
   Amateur radio enables educational, emergency, and space communication applications.
9. **PARAM-1 – INDIA'S FOUNDATIONAL LLM**
   India's first bilingual open-source AI model for local applications in Hindi and English.
10. **INDIA'S 1st PRIVATE TEST FACILITY FOR HEAVY WATER UPGRADE**
    Tests and upgrades heavy water for nuclear reactors, reducing production timelines.
11. **CLIMATE-SMART FABRICS**
    Adaptive textiles providing thermal comfort, UV protection, and wearable health monitoring.
12. **VITAMIN D DEFICIENCY & NEURODEVELOPMENTAL ISSUES**
    Low neonatal Vitamin D is linked to ADHD, autism, and schizophrenia risks.
13. **PRALAY MISSILE SYSTEM**
    Short-range missile with manoeuvrable re-entry vehicle for precision battlefield strikes.
14. **AKASH PRIME AIR DEFENCE SYSTEM**
    Medium-range mobile SAM for high-altitude air defence and drone/aircraft interception.
15. **INS NISTAR – India's First Indigenous Diving Support Vessel (DSV)**
    Supports submarine rescue and deep-sea operations with advanced saturation diving.
16. **APACHE AH-64E HELICOPTERS**
    Advanced attack helicopters enhancing India's close air support and anti-tank capabilities.
17. **PATRIOT MISSILE DEFENCE SYSTEM**
    Mobile surface-to-air system intercepting aircraft and missiles with high accuracy.
18. **SPACE PROGRAMME OF INDIA**
    Supports governance, disaster management, agriculture, and strategic technological advancement.

19. **INDIA'S FIRST COMMERCIAL EARTH OBSERVATION (EO) SATELLITE CONSTELLATION**
    Private-public EO satellites for climate, agriculture, security, and geospatial intelligence.
20. **ISRO INAUGURATES HOPE ANALOG MISSION (LADAKH)**
    Simulates Moon/Mars conditions for astronaut training and astrobiology experiments.
21. **ISRO'S LUNAR MODULE LAUNCH VEHICLE (LMLV) BY 2035**
    Heaviest rocket to support India's first human lunar mission.
22. **EU AI CODE OF PRACTICE ON GPAI**
    Voluntary guidelines by major tech firms on AI transparency, safety, and accountability.
23. **BRAIN-COMPUTER INTERFACE (BCI)**
    Technology enabling direct thought-to-device communication with privacy safeguards.
24. **ANNUAL FASTAG PASSES**
    One-time RFID toll payment valid for a year, simplifying travel and reducing congestion.
25. **SHRESTH INITIATIVE**
    Benchmarks state drug regulators to ensure uniform quality, licensing, and safety.
26. **ARTIFICIAL INTELLIGENCE (AI) SOVEREIGNTY**
    Developing indigenous AI to secure national security, economic growth, and language inclusion.
27. **NEED FOR NATIONAL SPACE LAW (INDIA)**
    Calls for legal framework to regulate private, commercial, and international space activities.
28. **BHARATIYA ANTARIKSH STATION (BAS)**
    India's planned space station supporting long-duration missions and research by 2035.
29. **SEMICONDUCTOR INDUSTRY IN INDIA**
    Expansion of semiconductor projects to reduce import dependence and strengthen global footprint.
30. **INDIA'S ENERGY LANDSCAPE & ELECTRICITY SECURITY**
    Diversifies energy mix with renewables, nuclear, and EV integration for grid security.
31. **AI IN INDIA'S IT SECTOR**
    AI adoption transforming productivity, automation, and innovation in IT services.
32. **SUSTAINABLE AVIATION FUEL (SAF)**
    Biofuel from renewable sources reducing aviation emissions and enhancing energy security.
33. **HEPATITIS D VIRUS**
    Carcinogenic virus requiring HBV, targeted for elimination through national programs.
34. **BIOFORTIFIED POTATOES**
    Iron-rich crops addressing anemia and improving child nutrition in India.
35. **ZOONOTIC DISEASES**
    Animal-to-human diseases controlled via One Health Programme and vaccination drives.
36. **INDIA'S FIRST PRIVATE HEAVY WATER TESTING FACILITY**
    Tests and upgrades heavy water for safer nuclear reactor operations.
37. **ISRO LVM3 LAUNCH VEHICLE WITH SEMI-CRYOGENIC STAGE**
    Enhances payload capacity and reduces launch costs for heavy-lift missions.
38. **MYCORRHIZAL FUNGI CONSERVATION (SPUN Atlas)**
    Maps fungal biodiversity critical for soil health, carbon sequestration, and agriculture.
39. **ISRO'S NATIONAL SPACE MEET 2.0 – WHY SPACE MATTERS FOR VIKSIT BHARAT**
    Highlights space applications for governance, startups, and societal development.
40. **Rare Blood Group – CRIB**
    Newly discovered blood group in India, advancing transfusion medicine.

41. **Ending Leprosy Stigma**
    Supreme Court urges law reforms and social inclusion for persons affected by leprosy.
42. **Deep-Brain Stimulation (DBS)**
    Implanted electrodes modulate brain activity to treat movement and psychiatric disorders.
43. **Test Facility for Heavy Water**
    Private facility upgrades heavy water to support India's PHWR operations.
44. **India's First Hydrogen-Powered Coach**
    Demonstrates hydrogen fuel cell trains for sustainable rail transport.
45. **India's Moon Landing Mission (2040)**
    Indigenous lunar mission to demonstrate human exploration beyond Earth.
46. **Why India Needs a National Space Law**
    Ensures legal clarity, safety, and FDI support for private and commercial space activities.
47. **India's Private Space Talent Crisis**
    Shortage of skilled engineers threatens competitiveness in private space sector.
48. **Satellite Internet**
    Global internet access via satellites for remote connectivity and disaster resilience.
49. **AI and the Restructuring of India's Infotech Sector**
    AI adoption shifts India's IT sector from manpower-heavy to high-value, efficient services.

SCIENCE AND TECHNOLOGY

SOURCE – THE HINDU

HOW DO GLP-1 DRUGS WORK?

Recent Context :

In 2025, **Semaglutide (Novo Nordisk)** and **Tirzepatide (Eli Lilly)** became available in India, revolutionising treatment of **diabetes** and **obesity**, with proven benefits in weight reduction and metabolic control.

ABOUT-

1. **GLP-1 (Glucagon-like peptide-1)** – an **incretin hormone** secreted from **small intestine and hindbrain** after meals.
2. **Function:** Increases **insulin**, decreases **glucagon**, regulates **blood sugar**.
3. **GLP-1 Receptor Agonists (RA):** Drugs mimicking incretin; regulate appetite & digestion.
4. **Semaglutide:** Weekly injection/ oral form; mimics GLP-1.
5. **Tirzepatide:** Mimics both **GLP-1 and GIP** hormones.
6. **Utility:** Weight loss (15–20%), **diabetes management**, potential in **Alzheimer's, CVD, NAFLD, sleep apnoea**.
7. **Side Effects:** Common – nausea, diarrhoea; Rare – **pancreatitis, thyroid carcinoma risk**.

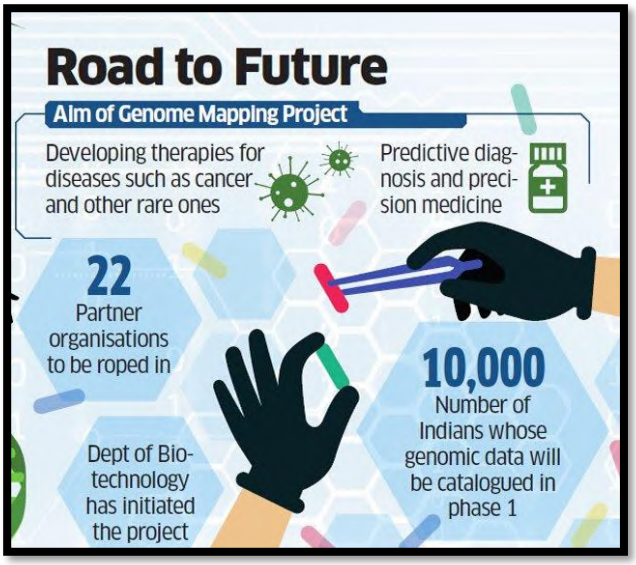
Topic: INDIA'S FIRST TRIBAL GENOME SEQUENCING PROJECT

Recent Context :

In 2025, **Gujarat** launched India's first **tribal genome sequencing project** to create a **reference genome database**, focusing on health risks and personalised healthcare for **tribal communities** across 17 districts.

ABOUT-

1. **Genome = complete DNA** set; 23 chromosome pairs.
2. **Whole-Genome Sequencing (WGS):** Determines order of **nucleotide bases**.
3. Gujarat project will sequence **2000 tribal individuals**.
4. Significance: Detects **genetic disorders** like **sickle cell anaemia, thalassemia, G6PD deficiency**.
5. **Applications:** Disease diagnosis, personalised drug development, prenatal screening.
6. **Forensics & Evolutionary Biology:** Used in **criminal cases**, **ancestry studies**.
7. **Agriculture Use:** Identifying genes for **crop/livestock traits**.



Topic: CONFINED FIELD TRIALS OF GM MAIZE

Recent Context :

In 2025, **Punjab Agricultural University (PAU)** began **confined field trials** of genetically modified (GM) maize with **BT (insect-resistant)** and **HT (herbicide-tolerant)** traits, approved by **RCGM** and Punjab Govt.

ABOUT-

1. **GM Crops:** Plants with **DNA altered** via genetic engineering.
2. Example: **BT Cotton** (gene from *Bacillus thuringiensis*).
3. GM Maize traits: **Herbicide-tolerant (Glyphosate-K salt)**, **Insect-resistant (stem borer, fall armyworm)**.
4. **Field trials:** BRL-I (≤1 acre, RCGM), BRL-II (≤2.5 acres, GEAC).
5. **GEAC (MoEFCC):** Regulates GM crop clearance.
6. **Criticism:** Risks of **gene flow, ecological damage, glyphosate ban in Punjab**.
7. **Regulation:** Governed under **1989 Rules** (EPA 1986).

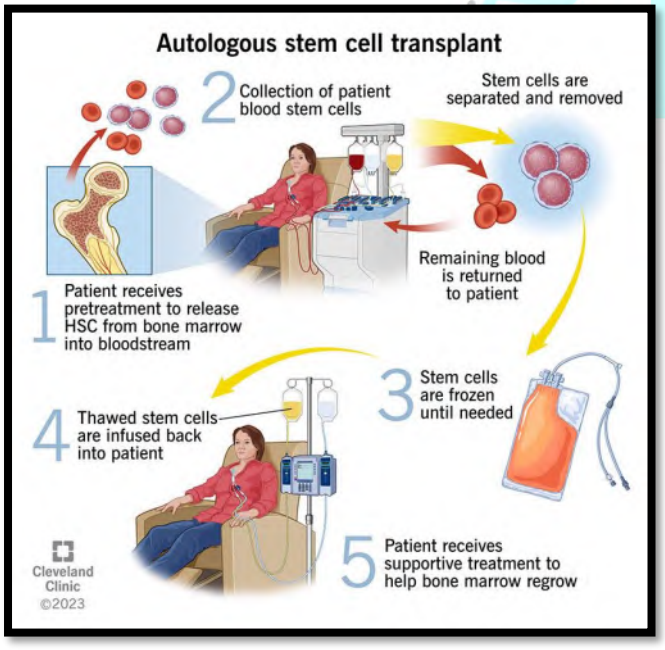
Topic: STEM CELL THERAPY 'ZIMISLECEL' IN TYPE-1 DIABETES

Recent Context :

In 2025, trials of **Zimislecel**, a **stem cell-derived islet therapy**, showed promise in **Type-1 Diabetes**, restoring insulin production by transplanting lab-grown islets into the liver of patients.

ABOUT-

1. **Type-1 Diabetes:** Autoimmune destruction of **pancreatic islet cells**; lifelong insulin dependence.
2. **Zimislecel:** Allogeneic **stem cell-derived islet therapy**, infused into **liver**.
3. Function: Restores **insulin secretion**, stabilises **blood sugar**, prevents **hypoglycaemia**.
4. **Stem Cells:** Undifferentiated, **self-renewing**, can form specialised cells.
5. Types: **Totipotent, Pluripotent, Multipotent, Unipotent**.
6. Source: **Pluripotent stem cells** matured into functional islets.
7. Challenges: **Cost**, **lifelong immunosuppression** side effects.



MOLECULAR IMAGING – CALTECH'S ANGSTROM-SCALE MICROSCOPE

Recent Context :

In 2025, **Caltech scientists** developed an **angstrom-scale microscope** using **Brownian motion and ultrafast lasers**, achieving **non-invasive, real-time molecular imaging**, revolutionising **biomedical research, nanomaterials, and drug design**.

ABOUT-

1. **Brownian Motion:** Random motion of particles due to collisions; slower for massive particles, faster for small ones.
2. **Conventional Microscopes:** Use visible light; **invasive**, limited resolution (~hundreds of nanometres).
3. **Breakthrough Technique:** Uses **light-matter interactions** + **Brownian motion** to indirectly detect molecules.
4. Resolution: Detects at **angstrom scale (10^{-10} m)**, surpassing previous limits.
5. **Benefits: Non-invasive**, real-time imaging, estimates **molecular size** via light disturbance.
6. **Applications:** Early **disease detection**, **drug delivery**, **nanomaterial fabrication**, efficient electronics.
7. **Significance:** First imaging system to resolve individual molecular motion in **real-time**.

Topic: AXIOM-4 MISSION – INDIA'S PARTICIPATION

Recent Context :

In June 2025, **Group Captain Shubhanshu Shukla** became the **first Indian astronaut** to fly on a **private space mission (Axiom-4)** to the ISS, conducting **ISRO's space biology and technology experiments**.

ABOUT-

1. **Axiom-4:** Private mission by **Axiom Space** aboard **SpaceX Dragon**; 18-day ISS stay.
2. Indian Experiments: **Myogenesis study, plant growth (moong, methi), microalgae, tardigrades, human-tech interactions, cerebral hemodynamics**.
3. **Myogenesis:** Muscle loss study in microgravity; helps space & Earth therapies.
4. **Food Experiments:** Plant growth + microalgae for **sustainable space nutrition**.
5. **Tardigrades:** Survival study in extreme conditions → insights into **radiation resistance**.
6. Lessons for **Gaganyaan:** Crew training, operational flows, re-entry, astronaut selection.

7. **Significance:** Boosts **international collaboration**, private-sector role, and STEM inspiration.

Topic: DRDO'S PHOTONIC RADAR

Recent Context :

In 2025, **DRDO** unveiled a **photonic radar prototype**, placing India among the **first four nations** (after US, China, Israel) to develop **next-generation radar** using **light-based photonic circuits**.

ABOUT-

1. **Radar:** Uses radio waves to detect distance, velocity, characteristics of objects.
2. **Photonic Radar:** Uses **lasers & optical fibres** instead of electronic oscillators.
3. **Frequency Range:** Can reach **100 GHz–THz**, beyond conventional radar (≤40 GHz).
4. **Advantages:** High-resolution 3D imaging, stealth detection, **jam-proof**, lighter weight.
5. Applications: **Military, satellites, drones, medicine, space tracking, weather monitoring**.
6. **Challenge:** India lacks **PIC (Photonic Integrated Circuit) fabrication**, faces export restrictions.
7. Related Technologies: **Quantum radar, Terahertz radar** emerging globally.

Topic: HAM RADIO – SPACE & EARTH COMMUNICATION

Recent Context :

In 2025, Indian astronaut **Shubhanshu Shukla** used **HAM radio** aboard the ISS to interact with Indian students, showcasing its relevance as an **educational and emergency communication tool**.

ABOUT-

1. **Ham Radio (Amateur Radio):** Licensed radio communication using dedicated frequencies.
2. Uses: **Education, emergency SOS communication, global & space contact**.
3. First space use: **1983 Shuttle mission**; ISS uses **ARISS system**.
4. In India: Licenses issued by **MeitY**; allowed above age **12**.
5. Safety: Radio outages scheduled during **docking** to avoid interference.
6. Role in Disasters: Vital in **Bhuj earthquake (2001), Tsunami (2004), Uttarakhand floods (2013)**.
7. **Significance:** Alternate, resilient mode when **telecom networks fail**.

Topic: PARAM-1 – INDIA'S FOUNDATIONAL LLM

Recent Context :

In 2025, **BharatGen** launched **PARAM-1**, a **2.9B parameter bilingual foundational LLM**, India's first open-source **Hindi-English AI model**, trained on **government, cultural, and educational data** for local applications.

ABOUT-

1. **Foundational AI:** Large models trained on huge datasets → multiple applications.
2. **LLMs:** ≥1B parameters (e.g., ChatGPT, Gemini); **SLMs** (<1B) are smaller, use-specific.

3. **PARAM-1: 2.9B parameters**, bilingual (Hindi-English).
4. **Training Data:** 25% Hindi, rest curated English sources.
5. **Script-aware Tokeniser:** Handles **Indic scripts** better than standard English tokenisers.
6. Evaluation: Benchmarked on **MMLU, ARC, MILU, SANSKRITI**.
7. Limitation: Supports only **Hindi & English** → excludes wider **linguistic diversity** of India.

INDIA'S 1st PRIVATE TEST FACILITY FOR HEAVY WATER UPGRADE

Recent Context :

In 2025, **TEMA India** inaugurated India's **first private test facility** for **heavy water upgrade** at Palghar, Maharashtra, under **BARC technology transfer**, to speed up **PHWR operationalisation**.

ABOUT-

1. **Heavy Water (D_2O):** Water with **deuterium isotope** of hydrogen; acts as **coolant and moderator** in PHWR.
2. **Requirement:** Must be **99.9% pure**; gets contaminated over time → needs **distillation upgrade**.
3. **Earlier System:** Equipment assembled & tested **centrally by BARC** (7–8 years).
4. **New Facility (TEMA India):** Manufactures & tests **distillation columns**, decentralising process → reduces timeline by **1–2 years**.
5. **Application:** First deployment at **Rawatbhata Nuclear Power Plant (RAPP-8), Rajasthan** (to go critical Dec 2025).
6. **PHWR (Pressurised Heavy Water Reactor):** Uses **natural uranium** fuel, **heavy water** as moderator & coolant; advantages – less waste, lower operating pressure.
7. **India's Nuclear Targets:** Current – **8780 MW (24 reactors)**; By 2032 – **22.4 GW**; By 2047 – **100 GW**.

Topic: CLIMATE-SMART FABRICS

Recent Context :

India faces **record-breaking heatwaves**, but current **Heat Wave Action Plans** lack long-term interventions. **Climate-smart fabrics** are proposed as adaptive clothing for **thermal comfort, UV protection, and health safety**.

ABOUT-

1. **Smart Textiles:** Fabrics that **adapt to environment** via **sensors, PCMs, conductive fibres**.
2. **Thermal Regulation: Phase Change Materials** absorb excess heat & release when cool.
3. **Moisture-Wicking:** Pulls sweat, aids faster **evaporation**.
4. **Infrared Transparent Textiles:** Radiate body heat outward.
5. **Key Technologies: Nanotech coatings (e.g., graphene clothing), embedded electronics, Bluetooth/NFC, flexible solar/batteries**.
6. **Applications: Heatwave protection, wearable health monitors, protective uniforms**.
7. **Way Forward:** Integrate into **Heat Action Plans**, prioritise under **₹1 lakh crore RDI Scheme** for **mass production**.

Topic: VITAMIN D DEFICIENCY & NEURODEVELOPMENTAL ISSUES

Recent Context :

A major study (2025) linked **low neonatal Vitamin D levels** with higher risks of **schizophrenia, ADHD, and autism**, highlighting India's widespread **maternal-infant deficiency problem**.

ABOUT-

1. **Vitamin D:** Fat-soluble vitamin; synthesised in **skin via sunlight (UV-B)** exposure.
2. **Role:** Crucial for **bone health, brain development, immune regulation**.
3. **India's Deficiency:** ~74% infants, 85% mothers deficient; half severely deficient.
4. **Correlation:** Maternal deficiency strongly linked to **infant deficiency**.
5. **Neurodevelopmental Impact:** Deficiency associated with **ADHD, autism, schizophrenia risk**.
6. **Prevention: Timely maternal supplementation** improves both maternal & neonatal levels.

7. **Other Risks:** Rickets, osteomalacia, poor immunity, higher **infection vulnerability**.

SOURCE – INDIAN EXPRESS

PRALAY MISSILE SYSTEM

Recent Context :

In 2025, DRDO successfully conducted two flight tests of **Pralay**, a short-range surface-to-surface missile, from Dr. APJ Abdul Kalam Island, Odisha, validating precision strike and manoeuvrability features.

ABOUT-

1. Developed by **DRDO** for **tactical battlefield use**; designed for the Indian Army.
2. **Range:** 150–500 km; **Weight:** ~5 tonnes.
3. **Propulsion:** Two-stage solid-propellant rocket with **MaRV (Manoeuvrable Re-entry Vehicle)**.
4. **Trajectory:** Quasi-ballistic, low altitude → evades early detection.
5. **Guidance:** Inertial navigation system + integrated avionics → real-time correction.
6. Launches from **8×8 BEML Tatra Transporter Erector Launcher** → high mobility.
7. Significance: Fills conventional ballistic gap; precision strikes on **radar, C2 centres, airfields**; enhances tactical deterrence.

AKASH PRIME AIR DEFENCE SYSTEM

Recent Context :

In 2025, the Indian Army successfully tested **Akash Prime** in Ladakh at 15,000 feet, validating improved **high-altitude air defence capability**.

ABOUT-

1. Developed by **DRDO**; medium-range **mobile SAM**.
2. Neutralises **aircraft, drones, cruise missiles, air-to-surface missiles**.
3. **Range:** 25–45 km; **Altitude:** up to 20 km.
4. **Propulsion:** Integrated ramjet-rocket engine; speed Mach 1.8–2.5.
5. **Warhead:** 60 kg HE-fragmented with proximity fuse.
6. **Akash Prime upgrade: Indigenous RF seeker** → better accuracy in extreme weather/high altitude.
7. Significance: Enhances **air defence in border regions**, integrated with **IACCS** for real-time threat response.

INS NISTAR – India's First Indigenous Diving Support Vessel (DSV)

Recent Context :

In 2025, the Indian Navy commissioned **INS Nistar** at Visakhapatnam – India's first indigenously designed Diving Support Vessel, enhancing submarine rescue and deep-sea operations.

ABOUT-

1. Built by **Hindustan Shipyard Ltd**.
2. **Displacement:** 10,500 tonnes; **Length:** 118 m.
3. Equipped for **saturation diving** up to 300 m.
4. Mothership for **Deep Submergence Rescue Vehicle (DSRV)**.
5. Sister ship **Nipun** (launched 2022) to follow.
6. Enhances **deep-sea diving + submarine rescue** capability.
7. Significance: Boosts India's role as **net security provider in IOR**.

APACHE AH-64E HELICOPTERS

Recent Context :

In 2025, the Indian Army received its first **Apache AH-64E attack helicopters** from the US at Hindon Airbase, strengthening close air support and tank-busting capabilities.

ABOUT-

1. Built by **Boeing (USA)**; world's most advanced attack helicopter.
2. Armament: **Hellfire missiles, Hydra rockets, Stinger AAMs, 30 mm cannon**.
3. Radar: **Longbow fire-control radar** – tracks 128 targets, engages 16 simultaneously.
4. Features: Advanced digital connectivity, UAV control, composite rotor blades.
5. Speed & Agility: Optimised for high-altitude and all-weather combat.
6. Indian Army contract: **6 helicopters (2020 deal)**; IAF already operates **22 Apaches**.
7. Significance: Enhances **close support, armoured warfare, anti-tank ops**, especially along borders.

PATRIOT MISSILE DEFENCE SYSTEM

Recent Context :

In 2025, Germany considered funding **US-made Patriot systems** for Ukraine; meanwhile, the US transferred 90 Patriot interceptors from Israel to Ukraine amid Russian attacks.

ABOUT-

1. Developed by **USA**; stands for *Phased Array Tracking Radar for Intercept on Target*.
2. Mobile **surface-to-air missile defence system**.
3. Detects, tracks, intercepts **aircraft, missiles, drones**.
4. **PAC-2 variant:** blast-fragmentation warhead; **PAC-3:** hit-to-kill accuracy.
5. **Radar range:** >150 km (NATO data).
6. Used in **19 countries** (US, Japan, Germany, Saudi Arabia, Ukraine, etc.).
7. Cost: 1 battery > $1 billion; 1 interceptor ≈ $4 million.

SPACE PROGRAMME OF INDIA

Recent Context :

In 2025, Lok Sabha held a special discussion on the **Critical Role of India's Space Programme for Viksit Bharat@2047**, highlighting astronaut **Subhanshu Shukla's ISS mission** and space technology's developmental impact.

ABOUT-

1. **Subhanshu Shukla** – India's first astronaut aboard **ISS (Axiom-4 Mission)**; second Indian in space after **Rakesh Sharma (1984)**.
2. **Agriculture:** INSAT-3D/3DR (weather), Resourcesat (crop monitoring, yield estimation).
3. **Infrastructure:** PM Gati Shakti uses ISRO imagery & spatial data integration.
4. **Disaster Management:** ISRO's **DMS Programme** – real-time monitoring, early warning, post-disaster assessment.
5. **Strategic Tech:** NavIC (indigenous navigation), GSAT-7/RISAT (defence comms), Mission Shakti (2019 ASAT).
6. **Global Role:** South Asia Satellite (2017), NISAR with NASA, UNNATI training programme, COSPAS-SARSAT (search & rescue).
7. **Policy Push: India Space Policy 2023**, IN-SPACe (private facilitation), NSIL (commercial arm), FDI liberalisation (100%), 300+ startups fueling innovation.

INDIA'S FIRST COMMERCIAL EARTH OBSERVATION (EO) SATELLITE CONSTELLATION

Recent Context :

In 2025, **PixxelSpace-led consortium** won the IN-SPACe proposal to build **India's first indigenous commercial EO satellite system**, investing ₹1,200 crore under a PPP "zero-cost" model.

ABOUT-

1. Consortium: **PixxelSpace India**, Piersight Space, Satsure Analytics, Dhruva Space.
2. Model: **Public-Private Partnership (EO-PPP)** – private sector builds/operates; govt provides policy/strategic support.

3. Constellation: **12 EO satellites** in 5 years; sensors include **panchromatic, multispectral, hyperspectral, SAR**.
4. Applications: Climate monitoring, disaster mgmt, agriculture, security, geospatial intelligence.
5. EO Satellites = Earth remote sensing satellites → collect physical, chemical, biological & human system data.
6. Significance: Boosts **space economy ($8.4B → $44B by 2033)**, Atmanirbhar Bharat, job creation, global competitiveness.
7. Challenges: No comprehensive **national space law**, regulatory overlaps, tech bottlenecks, import dependence, weak upstream sector.

SOURCE – VISION MONTHLY

ISRO INAUGURATES HOPE ANALOG MISSION (LADAKH)

Recent Context :

In 2025, ISRO inaugurated the **HOPE Mission** at **Tso Kar Valley, Ladakh**, simulating Moon/Mars-like conditions to prepare astronauts, test survival protocols, and conduct **astrobiology and health experiments**.

ABOUT-

1. **HOPE = Himalayan Outpost for Planetary Exploration**.
2. Modules: **Habitat Module (crew)** + **Utility Module (operations)**, seamlessly integrated.
3. Led by **ISRO HSFC** with academia + industry partners.
4. Research areas: **epigenetics, genomics, physiology, psychology, microbial analysis**.
5. Valley chosen: **High UV, low pressure, extreme cold, saline permafrost** (Mars-analogue).
6. Global analogues: **MDRS (USA), Flashline Station (Canada), BIOS-3 (Russia)**.
7. Aims: Prepare for **long-term interplanetary missions**, validate **health & surface operation protocols**.

TOPIC: ISRO'S LUNAR MODULE LAUNCH VEHICLE (LMLV) BY 2035

Recent Context :

ISRO announced plans to build the **LMLV**, its heaviest-ever rocket, by **2035**, to support **India's first human mission to the Moon (2040 target)**.

ABOUT-

1. LMLV = **Improved NGLV** (Next-Gen Launch Vehicle).
2. Size: **40-storey tall**.
3. Payload: **80 tonnes to LEO, 27 tonnes to Moon**.
4. Propulsion: 3 stages → **liquid (1st & 2nd)** + **cryogenic (3rd)**.
5. Purpose: **Human lunar missions, deep space exploration**.
6. Other launch vehicles:
   - **PSLV** – Chandrayaan-1, MOM.
   - **GSLV** – comm. satellites (~2t).
   - **LVM3** – Chandrayaan-2, 3, Gaganyaan (~10t LEO).
   - **SSLV** – small payloads (10–500 kg).
7. Strategic role: Proposed use in **Bharatiya Antariksh Station (BAS)** programme.

TOPIC: EU AI CODE OF PRACTICE ON GPAI

Recent Context :

26 major tech firms (Google, Amazon, Microsoft) signed the **EU AI Code of Practice on General-Purpose AI**, a voluntary step before the binding **EU AI Act** takes effect.

ABOUT-

1. Code covers **Transparency, Copyright, Safety & Security**.
2. Voluntary, but eases **compliance with EU AI Act**.
3. **EU AI Act** = world's **1st comprehensive AI law** (risk-based).
4. Inspired by **GDPR model** → likely global benchmark.
5. Penalties: Up to **7% of global turnover** for non-compliance.
6. Concerns: **Legal uncertainty, excessive scope, regulatory burden**.
7. Significance: Balances **innovation, accountability, safety, competitiveness**.

TOPIC: BRAIN-COMPUTER INTERFACE (BCI)

Recent Context :

Stanford developed a **password-protected Brain-Computer Interface** to ensure privacy in thought-to-device communication, addressing risks like **brain tapping, hacking, and mind control**.

ABOUT-

1. **BCI = brain-to-device communication** bypassing muscles.
2. Tech: Neural signals → processing → commands → feedback loop.
3. Types: **Invasive implants** & **non-invasive wearables**.
4. Applications:
   - **Medical** – restore mobility, speech.
   - **Wellness** – mental health feedback.
   - **Gaming/Industry** – immersive tech.
   - **Cognition** – memory, attention boost.
5. Concerns: **Cybersecurity, privacy, cognitive liberty, health impacts**.
6. Way forward: **Robust laws, neurorights, consent frameworks**.
7. Emerging concept: **"Neurorights"** – protect freedom of thought & mental privacy.

TOPIC: ANNUAL FASTAG PASSES

Recent Context :

MoRTH introduced **FASTag Annual Pass**, enabling one-time fee (₹3,000 or 200 crossings), eliminating frequent recharges for toll payments.

ABOUT-

1. **FASTag** = RFID-based toll payment.
2. Managed by **NPCI & NHAI**.
3. Works via **tags + readers**, using radio waves.
4. Pass: Valid **1 year**, unlimited up to **200 tolls**.
5. Benefits: **Cashless, faster, less congestion**.
6. Tech type: **Short-range RFID**.
7. Supports **Digital India, e-payments** ecosystem.

TOPIC: SHRESTH INITIATIVE

Recent Context :

Union Health Ministry launched **SHRESTH Index**, benchmarking state drug regulatory systems to ensure **uniform drug quality, licensing, and safety standards**.

ABOUT-

1. Full form: **State Health Regulatory Excellence Index**.
2. Proposed by **CDSCO (Central Drugs Standard Control Org.)**.
3. Aim: Strengthen **state drug regulatory authorities**.
4. Themes (5): **HR, Infrastructure, Licensing, Surveillance, Responsiveness**.
5. Improves **transparency, accountability, interstate performance comparison**.
6. Links to **drug safety, consumer health, pharma exports**.
7. Supports India's status as **"pharmacy of the world"**.

ARTIFICIAL INTELLIGENCE (AI) SOVEREIGNTY

Recent Context :

In his Independence Day speech (2025), the PM stressed **technological sovereignty**, highlighting **AI, cybersecurity, deep tech, and indigenous systems** as pillars of national security, economic growth, and cultural identity.

ABOUT-

1. **Sovereign AI = Nation's ability to design, train, and deploy AI independently**, free from reliance on foreign tech.
2. Need: Ensures **national security, defence, border surveillance, cyber-resilience**; prevents vulnerability to **sanctions/export controls**.
3. Economic value: AI projected to add **trillions to global GDP by 2030**; sovereign AI enables **domestic capture** of this growth.

4. Social inclusion: **Localized AI** → 22+ languages, Indic tools (e.g., **AI4Bharat's IndicTrans2**).
5. Challenges: **Chip manufacturing deficit, high R&D costs, weak datasets, poor funding, regulatory gaps, energy demands**.
6. Global models: **EU AI Act (risk-based), US (sectoral), China (state-led), UNESCO AI Ethics (2021)**.

TOPIC: NEED FOR NATIONAL SPACE LAW (INDIA)

Recent Context :

On **National Space Day (Aug 23, 2025)**, experts urged a **National Space Law** to align with **international treaties** and regulate India's growing **private space industry**.

ABOUT-

1. India currently relies on **policies, guidelines, executive orders** (e.g., **Space Policy 2023, IN-SPACe NPG 2024**), not law.
2. International obligation: **Outer Space Treaty (1967)** – principles of **peaceful use, non-appropriation, liability, cooperation**.
3. Domestic gaps: **Unclear licensing, FDI ambiguity, IP risks, liability for startups, no debris law**.
4. IN-SPACe: India's commercial space regulator, but **lacks statutory authority** → decisions can be challenged.
5. Global practice: **US, Japan, Luxembourg** have **space laws** regulating private firms, liability, and space resource use.
6. Industry concern: Without legal clarity, India risks **losing FDI, innovation, and global competitiveness** in space commerce.
7. Way forward: **Comprehensive Space Activities Law**, statutory **IN-SPACe**, **insurance frameworks**, **liberalised FDI**, **IP protection**, and **legally binding sustainability norms**.

SOURCE – DRISHTI MONTHLY

BHARATIYA ANTARIKSH STATION (BAS)

Recent Context :

India plans a **fully operational Bharatiya Antariksh Station (BAS) by 2035**, supporting long-duration human space missions, microgravity research, and international collaboration, ahead of the vision of **Viksit Bharat 2047**.

ABOUT-

1. **BAS**: Planned Indian **space station**, orbiting 400–450 km above Earth, similar to **ISS**.
2. **Modules**: 5 modules built in phases; **Base Module** by 2028, full operation by 2035.
3. **Significance**: Boosts **India's global space stature**, supports **biotech & material science research**, and long-duration **human space missions**.
4. **International collaboration**: Provides platform for joint research with countries in **microgravity experiments**.
5. **Earth observation**: Enhances **disaster monitoring** and strengthens **space economy**.
6. **STEM impact**: Inspires **youth engagement**, talent development in **science & technology**.
7. **Comparison**: ISS is the **largest habitable satellite**, a joint venture of **NASA, Roscosmos, ESA, JAXA**, hosting **3,000+ experiments** from 108+ countries.

TOPIC: SEMICONDUCTOR INDUSTRY IN INDIA

Recent Context :

The **Union Cabinet approved 4 new semiconductor projects** under the **India Semiconductor Mission**, raising the total to 10, aiming to reduce **import dependence** and strengthen India's **global semiconductor footprint**.

ABOUT-

1. **India Semiconductor Mission (ISM, 2021)**: Promotes **fabs, ATMP/OSAT units, design startups**, and **indigenous IP creation**.
2. **Projects**: 10 projects across **6 states**, including Odisha, Punjab, Andhra Pradesh.
3. **Market trends**: **Consumption USD 52 bn → 103.4 bn** by 2030; **mobile, IT, industrial electronics** drive 70% demand.
4. **Challenges**: High **fab costs**, **skilled workforce gap**, **imported components**, and global competition from **Taiwan, South Korea, China, Japan, US**.

5. **Government schemes**: **Fabs Scheme, Display Fabs Scheme, ATMP/OSAT Scheme, Design Linked Incentive**.
6. **Way forward**: Boost **R&D, indigenous IP, startup ecosystem**, **skilling programs**, and **chip diplomacy** for niche tech.
7. **Strategic relevance**: Supports **5G, AI, digital devices**, and **reduces import dependency** for critical electronics.

TOPIC: INDIA'S ENERGY LANDSCAPE & ELECTRICITY SECURITY

Recent Context :

Global and Indian electricity demand is rising, driven by **EVs, heatwaves, data centers**; India aims to expand **renewables, nuclear energy**, and ensure **electricity security** and **grid stability**.

ABOUT-

1. **Installed capacity**: **484.82 GW** – 49.92% thermal, 38.08% renewables, 10.19% large hydro.
2. **Renewables**: Solar 47.06%, wind 21.78%, hydro 20.35%, bio 4.92%.
3. **Energy schemes**: **PM-KUSUM, PM-Surya Ghar, Solar Parks, PLI, National Bioenergy Programme, Green Hydrogen Mission**.
4. **Electricity security**: Blackouts highlight need for **robust grid, flexible resources**.
5. **EV penetration**: India's share 0.23% (2016) → 7.6% (2024), target 30% by 2030 (**EV30@30 campaign**).
6. **Government initiatives**: **FAME-II, PM E-DRIVE, National Programme on Advanced Chemistry Cell Battery Storage**.
7. **Challenges & Way forward**: **Financing e-buses, charging infra, awareness**, and focus on **ZEV adoption, battery leasing, city-specific EV plans**.

TOPIC: AI IN INDIA'S IT SECTOR

Recent Context :

India's **USD 280 billion IT sector** is being transformed by **AI**, enhancing productivity and automation, but facing **skill gaps, workforce displacement, ethical concerns**, and need for **AI infrastructure and regulation**.

ABOUT-

1. **Applications**: **Productivity & automation** (GitHub Copilot, UiPath), **cybersecurity**, **data management**, **predictive maintenance**.
2. **Workforce impact**: **Routine jobs automated**; 85 million jobs at risk globally by 2025 (WEF).
3. **Challenges**: **Skill gap, legacy infra, AI ethics, data privacy, regulatory ambiguity, reliance on foreign cloud**.
4. **Way forward**: **Nationwide AI skilling missions**, build **high-performance GPU data centers**, access **AIKosh datasets**.
5. **PPP promotion**: Support **deep-tech AI startups**, allocate **Rs 10,000 crore Fund of Funds**, and encourage IT firms as **global AI partners**.
6. **Ethical AI**: Ensure **Explainable AI (XAI)**, **bias mitigation**, and compliance with **GDPR/DPDP**.
7. **Strategic relevance**: Enhances **India's AI leadership**, global competitiveness, and IT sector transformation.

SUSTAINABLE AVIATION FUEL (SAF)

Recent Context :

Indian Oil Corporation (IOC) will start India's first **commercial SAF plant** from **used cooking oil**, aligned with **ISCC-CORSIA standards**, supporting aviation decarbonisation and the **Net Zero 2070 roadmap**.

ABOUT-

1. **Definition**: SAF is a **biofuel** from sustainable feedstocks, chemically similar to **conventional jet fuel**, usable in existing **aircraft engines** without modification.
2. **Environmental impact**: Reduces **GHG emissions by ~80%**, contributing >60% to **aviation decarbonisation**.
3. **Blending**: Supports **up to 50% fuel blends** with conventional jet fuel.
4. **Challenges**: High cost (2–3x conventional fuel), **infrastructure gaps**, and **scattered/seasonal feedstock supply**.
5. **ISCC for CORSIA**: Ensures compliance with **ICAO's Carbon Offsetting and Reduction**

Scheme; mandatory from **2027 for international flights**.

6. **India's roadmap**: **1% SAF blending** in international flights by 2027, 2% by 2028; domestic mandate post-2027.
7. **Strategic relevance**: Enhances **energy security**, reduces **carbon footprint**, and positions India in **sustainable aviation leadership**.

TOPIC: HEPATITIS D VIRUS

Recent Context :

WHO reclassified Hepatitis D Virus (HDV) as carcinogenic, highlighting its dependency on **Hepatitis B Virus (HBV)**, with India targeting elimination through **National Viral Hepatitis Control Program by 2030**.

ABOUT-

1. **Definition**: **Defective virus** requiring **HBV** for infection and replication.
2. **Health impact**: Causes **liver inflammation, jaundice, fatigue**, and increased **risk of liver cancer**.
3. **Prevalence**: Underreported in India, especially among **intravenous drug users** and **chronic HBV patients**.
4. **Transmission**: Only via **infected blood** (with HBV), unlike Hepatitis A/E (**contaminated food/water**) and B/C (**blood/body fluids**).
5. **Vaccine**: No direct vaccine for HDV; **HBV vaccine** provides indirect protection.
6. **Treatment**: Managed with **interferon therapy**; other antivirals ineffective without HBV control.
7. **Global & national strategy**: WHO aims to **reduce infections by 90%** and deaths by 65% (2022–2030); India targets **elimination by 2030** under **UIP and National Viral Hepatitis Control Program**.

BIOFORTIFIED POTATOES

Recent Context :

International Potato Center (CIP) to introduce **iron-rich biofortified potatoes** in India, setting up a **South Asia Regional Centre in Agra**, addressing **iron deficiency anemia** and promoting **child nutrition**.

ABOUT-

1. **Definition**: Biofortified crops have **enhanced micronutrient content** like **iron, zinc, vitamin A, and C**.
2. **Varieties**: Biofortified **potatoes** (iron-rich) and **sweet potatoes** (beta-carotene) improve nutrition.
3. **Cultivation areas**: **Odisha, West Bengal, Karnataka, Assam**.
4. **Significance**: Prevents **iron deficiency anemia**, **night blindness**, boosts **immunity** and **growth in children**.
5. **ICAR-CTCRI contribution**: Developed **SP-95/4**, a **beta-carotene rich high-yield variety** for tribal communities.
6. **Other fortified crops**: Iron—rice, beans; Zinc—wheat, maize; Provitamin A—maize, cassava; Protein—sorghum, cassava.
7. **Global relevance**: Enhances **food security** and **micronutrient sufficiency**, aligning with **SDG 2: Zero Hunger**.

TOPIC: ZOONOTIC DISEASES

Recent Context :

A global study identifies **9% of Earth's land at high zoonotic disease risk**; India strengthens **One Health Programme, National Animal Disease Control**, tackling **FMD, brucellosis, and rabies**.

ABOUT-

1. **Definition**: Diseases transmitted from **animals to humans**, caused by **bacteria, viruses, parasites, fungi** (e.g., Nipah, Covid-19, Ebola).
2. **Global burden**: **2.5 bn cases**, **2.7 mn deaths** annually; high-risk regions: **Latin America, Oceania, Asia, Africa**.
3. **Global initiatives**: **ZODIAC (IAEA), G20 Pandemic Fund, World Zoonoses Day (6th July)**.
4. **India's initiatives**: **National One Health Programme (2013), National Animal Disease Control Programme, Rabies vaccination (ASCAD)**.
5. **Key diseases in India**: **FMD, brucellosis, rabies**, with mass **vaccination programs**.
6. **Significance**: Early detection and control prevent **pandemics** and **economic losses in agriculture and health**.
7. **Preparedness**: Combines **epidemic risk index** with country capacity for **prevention and response**.

TOPIC: INDIA'S FIRST PRIVATE HEAVY WATER TESTING FACILITY

Recent Context :

TEMA India sets up India's first **private heavy water testing facility**, collaborating with **BARC**, enhancing **public-private partnership** and supporting **safe nuclear reactor operations**.

ABOUT-

1. **Heavy Water (D_2O)**: Contains **2 deuterium atoms + 1 oxygen atom**, non-radioactive, used as **coolant and moderator** in **nuclear reactors**.
2. **Deuterium**: Heavier stable **isotope of hydrogen**, found in water and hydrocarbons.
3. **Purity requirement**: Must be **≥99.9% pure** for reactor safety and efficiency.
4. **Use in reactors**: Supports **construction, refueling**, and ensures **efficient nuclear fission**.
5. **Upgrading**: Restores depleted heavy water via **distillation**, maintaining **operational efficiency**.
6. **Significance of private facility**: Enhances **public-private collaboration**, reduces **dependence on BARC**, and strengthens **nuclear infrastructure**.
7. **Global relevance**: Critical for **civil nuclear energy**, **research reactors**, and **nuclear fuel cycle management**.

TOPIC: ISRO LVM3 LAUNCH VEHICLE WITH SEMI-CRYOGENIC STAGE

Recent Context :

ISRO plans **first flight of LVM3 with semi-cryogenic stage in Q1 2027**, enhancing **payload capacity, reducing launch costs**, and supporting **future heavy-lift satellite and lunar missions**.

ABOUT-

1. **Definition**: **LVM3 (GSLV Mk III)** is ISRO's **heavy-lift, 3-stage launch vehicle**.
2. **Stages**: First—**S200 solid boosters**; Second—**L110/SC120 liquid/semi-cryogenic stage**; Third—**C25 cryogenic stage (CE20 engine)**.
3. **Propellants**: Semi-cryogenic stage uses **refined kerosene (RP-1) + LOX**; cryogenic stage uses **LH_2 + LOX**.
4. **Payload capacity**: Enhanced **GTO payload ~5,200 kg, reduces launch costs ~25%**.
5. **Environmental impact**: Semi-cryogenic stage improves **fuel efficiency and reduces emissions**.
6. **Key missions**: **CARE (2014), GSAT-19/29, Chandrayaan-2/3, OneWeb India-1/2**.
7. **Strategic relevance**: Boosts India's **heavy-lift capability**, enabling **satellite deployment, space station, and interplanetary missions**.

TOPIC: MYCORRHIZAL FUNGI CONSERVATION (SPUN Atlas)

Recent Context :

SPUN launched Underground Atlas, revealing **>90% of mycorrhizal fungi hotspots outside protected areas**, emphasizing their **role in nutrient absorption, carbon sequestration**, and importance for **global soil biodiversity**.

ABOUT-

1. **Definition**: Symbiotic fungi forming **mutualistic relationships with ~80% of plants**, aiding **nutrient absorption** (e.g., phosphorus).
2. **Carbon sequestration**: Store **~1/3 of global fossil fuel emissions** via plant root interaction.
3. **Types**: **AM fungi** penetrate roots (crops, grasses); **EcM fungi** wrap roots (forest trees).
4. **Hotspots**: **AM**—Brazil, Southeast Asia, West Africa; **EcM**—Canada, Siberia, Central Europe, Western US.
5. **Global initiatives**: **FAO GLOBSOB**, launched at **COP15 CBD**, tracks **soil biodiversity**.
6. **Conservation gaps**: Majority of **fungi biodiversity lies outside protected areas**, risking habitat loss.
7. **Significance**: Supports **agriculture, forest ecosystems, soil health**, and **climate mitigation efforts**.

SOURCE – PIB

ISRO'S NATIONAL SPACE MEET 2.0 – WHY SPACE MATTERS FOR VIKSIT BHARAT

Recent Context :

ISRO's National Space Meet 2.0, on **2nd National Space Day**, highlighted **space applications in governance, agriculture, health, disaster management**, and **roadmap for Viksit Bharat 2047**, integrating **startups and private sector**.

ABOUT-

1. **Purpose**: Space as **applied infrastructure**, supporting **governance, livelihoods, environment, disaster response**, not just prestige.
2. **Foundational Role**: **Satellites + space tech** underpin **agriculture, weather, telecom, navigation, education, healthcare**.
3. **Participants**: **60+ ministries, states/UTs, industry, academia, startups, experts, citizens** collaborated for **whole-of-government, whole-of-nation approach**.
4. **Roadmap Targets**: **119 satellites by 2040** for **EO, SATNAV, SATCOM**, with **government-led societal applications** and **PPP-led commercial satellites**.
5. **Technology Agenda**: Integration of **AI, quantum computing, big data**, autonomous constellations, next-gen instruments, and **advanced launchers**.
6. **Startup & Private Sector Role**: Space ecosystem grew from **2 (2014) → 350+ (2025)** startups; **PPP** supports innovation to execution.

Rare Blood Group – CRIB

Recent Context :

A **38-year-old woman from Kolar** discovered a **never-before-seen blood group**, officially named **CRIB**, validated internationally, marking a **global milestone in transfusion medicine** under the **Cromer blood group system**.

ABOUT-

1. **Discovery Location**: **Rotary Bangalore TTK Blood Centre**, India; confirmed by **IBGRL, UK**.
2. **Nomenclature**: **CRIB = CR (Cromer system) + IB (India, Bengaluru)**, first globally to present with this antigen.
3. **Cromer Blood Group**: Comprises **20+ antigens** on **DAF/CD55 protein**; Cr^a is most common.
4. **Definition of Rare Blood Groups**: Individuals lacking **high-frequency antigens**, complicating transfusions.
5. **Global Examples**: **Rh null**, **Bombay Blood Group (hh)**, **D-**, **In b Negative**, **Gwada Negative**, **CRIB**.
6. **ISBT Role**: **International Society of Blood Transfusion (1935)** promotes safe blood transfusions, ethical guidelines, and global collaboration.
7. **Significance**: Enhances **transfusion safety**, supports **rare donor registries**, and aids **global hematology research**.

TOPIC: Ending Leprosy Stigma

Recent Context :

Supreme Court urged **States and Centre** to **amend discriminatory laws** against persons affected by **leprosy**, emphasizing **social inclusion, legal reforms**, and **public awareness** by **October 2025**.

ABOUT-

1. **Legal Action**: Court advised **special Assembly sessions/ordinances** to remove outdated provisions in **145+ laws**.
2. **Health Aspect**: Leprosy caused by **Mycobacterium leprae**, spreads via **prolonged close contact**, curable with **MDT (dapsone, rifampicin, clofazimine)**.
3. **Historical Stigma**: Myths associating leprosy with **impurity or divine punishment** caused **discrimination**.
4. **Social Barriers**: Exclusion from **education, workplaces, public transport**, despite cure.
5. **Legal Discrimination**: Bars in **public office, elections, marriage/divorce**; example: **Orissa Municipal Corporation Act, 2003**.
6. **Supreme Court Directive**: States accountable; NHRC may **submit findings**; deadline: **October 2025**.
7. **Policy Significance**: Promotes **human rights, social inclusion, and health-based reforms**.

TOPIC: Deep-Brain Stimulation (DBS)

Recent Context :

DBS uses **implanted electrodes** to modulate **brain activity**, treating **Parkinson's, tremors, OCD**, with over **1.6 lakh patients worldwide**, expanding into **neuropsychiatric and cognitive disorders**.

ABOUT-

1. **Procedure**: Electrodes implanted in **specific brain regions**, connected to **pacemaker-like device** under chest skin.
2. **Mechanism**: Modulates **neural circuits**, correcting abnormal **electrical activity**.
3. **Primary Use**: Treats **movement disorders**, e.g., **Parkinson's disease, essential tremor, dystonia**.
4. **Psychiatric Applications**: Approved for **OCD**, studied for **depression, epilepsy**.
5. **Global Reach**: Over **1.6 lakh patients** treated worldwide.
6. **Adjustable Settings**: Clinicians/patients can modify **stimulation intensity/frequency**.
7. **Significance**: Provides **non-pharmacological intervention** when medications fail, advancing **neuromodulation therapy**

TOPIC: Test Facility for Heavy Water

Recent Context :

TEMA India inaugurated **India's first private heavy water test facility** in **Palghar, Maharashtra**, using **BARC technology transfer**, enhancing **nuclear fuel security** and supporting **PHWR operations**.

ABOUT-

1. **Heavy Water (D_2O)**: **Deuterium oxide**, hydrogen replaced by **deuterium**, non-radioactive.
2. **Applications**: Acts as **coolant and moderator** in **Pressurised Heavy Water Reactors (PHWRs)**.
3. **Purity Requirement**: Must be **99.9% pure** for efficient operation.
4. **Strategic Importance**: Enables **use of natural uranium**, reducing dependency on enriched uranium.
5. **Technology Transfer**: Facility licensed from **BARC**, ensures compliance with **national nuclear standards**.
6. **Heavy Water Board (HWB)**: Under **DAE**, manages **production and quality control**.
7. **Significance**: Supports **India's civilian nuclear program**, energy security, and **non-proliferation commitments**.

SOURCE – INSIGHTS MONTHLY

India's First Hydrogen-Powered Coach

Recent Context :

Indian Railways tested **hydrogen-powered train** at **ICF Chennai**, with **hydrogen fuel cell traction system**, 10 coaches, reducing **GHG emissions** and advancing **renewable energy integration** in transport.

ABOUT-

1. **Development**: By **RDSO and ICF Chennai**; 10 coaches, 2,600+ passengers.
2. **Fuel System**: **Hydrogen fuel cells** generate electricity for traction motors.
3. **Hydrogen Facility**: **3,000-kg fuelling station at Jind, Haryana**.
4. **Energy Storage**: Battery stores **excess/regenerative energy**.
5. **Safety**: Includes **pressure relief valves, leak/flame detection, ventilation systems**.

6. **Environmental Significance**: Reduces **greenhouse gas emissions**, promotes **renewable energy usage**.
7. **Innovation**: Demonstrates **sustainable rail mobility**, aligning with **India's clean energy goals**.

TOPIC: India's Moon Landing Mission (2040)

Recent Context :

Union Minister **Jitendra Singh** announced **Indian astronaut Moon landing by 2040**, following **Gaganyaan and Vyommitra missions**, contributing to **Viksit Bharat 2047** vision, enhancing **space self-reliance and global stature**.

ABOUT-

1. **Objective**: Demonstrate **human exploration beyond Earth orbit**.
2. **Self-Reliance**: Uses **indigenous launch vehicles, life-support systems, lunar tech**.
3. **Significance**: Integrates **scientific, economic, security dimensions**.
4. **Vyommitra Mission (2026)**: **Uncrewed test of humanoid robot** in spaceflight systems.
5. **Gaganyaan Mission (2027)**: India's **first crewed human spaceflight** to Low Earth Orbit.
6. **Bharat Antariksh Station (2035)**: **India's own space station**, enables **long-duration experiments**.
7. **Vision 2047**: Achieve **independent lunar exploration**, strengthening **global space leadership**.

Why India Needs a National Space Law

Recent Context :

India prepares for its **second National Space Day** amid **Chandrayaan-3 follow-ups and Gaganyaan**, but lacks a **comprehensive space law** to regulate private, commercial, and international obligations.

ABOUT-

1. **Definition**: **Space law** governs exploration, commercialisation, safety, liability, and peaceful use, balancing **international treaty obligations** with domestic regulation.
2. **OST 1967 Principles**: **Common heritage, peaceful use, state responsibility, liability for damages, international cooperation**.
3. **Importance**: Provides **legal clarity, predictable licensing, safety standards**, and **debris management**.
4. **Private Sector & FDI**: Clear rules on **IP, insurance, licensing** attract **investments** and prevent **startups from relocating**.
5. **Current Status**: **IN-SPACe norms, Indian Space Policy 2023**, but lacks **statutory authority**, creating regulatory uncertainty.
6. **Challenges**: **Fragmented approvals, liability risks, limited FDI, weak IP protection**, and regulatory overlaps among ministries.

TOPIC: India's Private Space Talent Crisis

Recent Context :

India's **private space startups** face a shortage of **highly skilled engineers and scientists** in **rocketry, propulsion, sensors, photonics**, affecting **competitiveness** and growth in the $9 billion space economy target.

ABOUT-

1. **Talent Gap**: Only **8,000 aerospace engineers graduate annually**, 0.5% of all engineers; reliance on **lateral hires** and long **on-job training**.
2. **Sector Significance**: Drives **innovation, economic growth, employment creation**, and **global competitiveness** in launch and satellite services.
3. **Academic Limitation**: Few institutes offer **deep specialization in cryogenics, photonics, optical engineering**.
4. **Brain Drain**: Skilled graduates seek **higher-paying overseas jobs**, reducing India's talent pool.

5. **Government Initiatives**: **IN-SPACe–AICTE collaboration, short-term certification courses, Make in India incentives**, liberalised **FDI norms**.
6. **Significance**: Building a **robust, skilled workforce** is critical for **private sector-led space growth**.

TOPIC: Satellite Internet

Recent Context :

Starlink, Elon Musk's **satellite internet**, plans to enter India, offering **connectivity to remote areas**, **disaster resilience**, **strategic communications**, and advancing **digital inclusion and national security**.

ABOUT-

1. **Definition**: Internet delivered via **satellites**, ground stations, and user terminals; bypasses terrestrial fiber/cables.
2. **Need**: Bridges **digital divide, disaster resilience, on-the-move connectivity**, and supports **defence and e-governance**.
3. **Key Features**: **Global coverage, dual-use technology, rapid deployment, resilience, mega-constellations** for redundancy and low latency.
4. **Orbit Types**: **GEO (~35,786 km, high latency), MEO (2,000–35,786 km, balanced), LEO (<2,000 km, low latency)**.
5. **Data Flow**: Signals travel **user terminal → satellite → ground station → internet backbone**, with **automatic handover** for uninterrupted service.
6. **Applications**: Civilian broadband, **smart agriculture, disaster management, defence communications, transport, healthcare**, and space economy support.

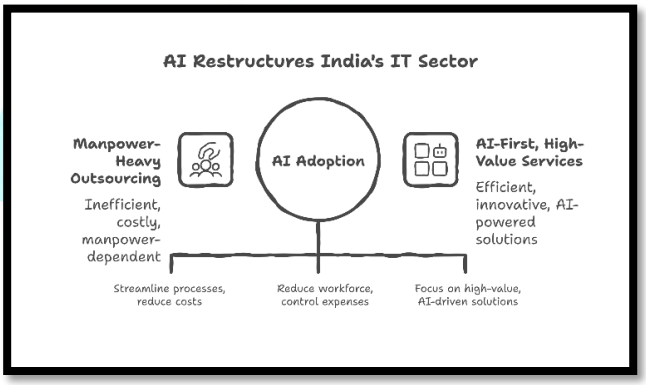
TOPIC: AI and the Restructuring of India's Infotech Sector

Recent Context :

India's IT sector is **restructuring under AI adoption**, with **efficiency-driven operations**, TCS hiring freezes, and a shift from **manpower-heavy outsourcing to AI-first, high-value services**.

ABOUT-

1. **Drivers**: AI boosts **productivity, efficiency, cost optimisation**, and transforms **traditional outsourcing models**.
2. **Opportunities**: Global AI adoption partner, **sector-specific solutions**, **data governance expertise**, and innovation hubs.
3. **Challenges**: Workforce **displacement, skill shortages, resistance to cultural shift**, and **infrastructure gaps**.
4. **Policy Role**: **National AI Mission, Digital India, data governance, higher education reforms, AI startup incentives**.
5. **Workforce Strategy**: **Reskilling programs** for AI roles, ethical AI leadership, and **promoting IP creation**.
6. **Sectoral Shift**: From **scale-driven services to value-driven, AI-first solutions** for global clients.
7. **Significance**: Positions India as a **global hub for AI adoption**, innovation, and ethical technology leadership.

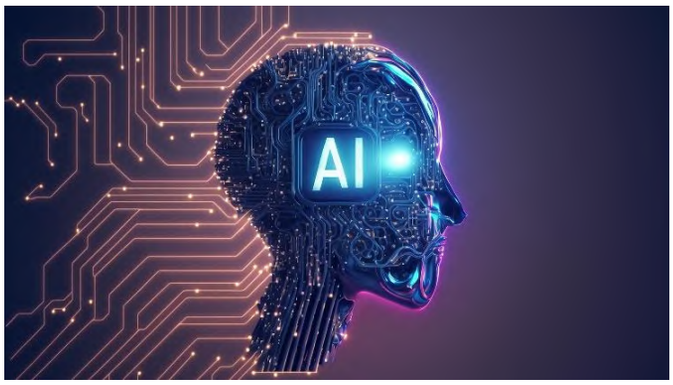


SCIENCE AND TECHNOLOGY

SOURCE: VISION MONTHLY

ARTIFICIAL INTELLIGENCE & HEALTHCARE

Recent Update: India joined the **Health AI Global Regulatory Network (GRN)** to strengthen oversight of AI in healthcare.



About:

1. HealthAI, a **Geneva-based non-profit**, promotes **Responsible AI** in health through global regulatory cooperation.
2. GRN members access a **Global Public Repository** of registered AI health solutions.
3. **ICMR-NIRDHDS** and **IndiaAI** will collaborate with nations like the **UK and Singapore** under GRN.
4. Supports **IndiaAI Strategy** under **MeitY**, fostering an inclusive AI ecosystem.
5. Aims to position **India as a leader in AI innovation** and ethical AI regulation.

ONCOLYTIC & PERSONALIZED MRNA VACCINES

Recent Update: Russia is developing **oncolytic vaccine Enteromix** and **personalized mRNA vaccines** for cancer treatment.

About Oncolytic Vaccine (Enteromix):

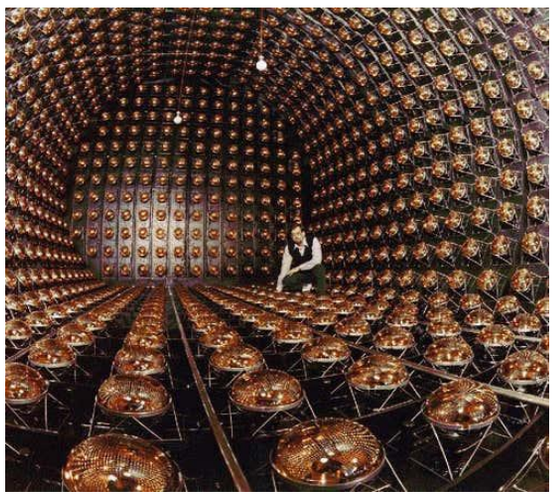
1. Uses **oncolytic viruses (OVs)** to destroy cancer cells and activate immune response.
2. Based on **four non-pathogenic viruses**, showing **100% success in preclinical trials**.
3. Targets **colorectal cancer**, with progress on **glioblastoma** and **melanoma**.

About Personalized mRNA Vaccines:

4. Developed from **genetic analysis** of each patient's tumor.
5. **mRNA** instructs cells to produce tumor-specific proteins, training immunity.
6. Works through **lipid nanoparticle delivery** triggering **antibodies and T-cell** response.
7. Based on the same technology used in **COVID-19 vaccines**.

WORLD'S LARGEST NEUTRINO DETECTOR ACTIVATED

Recent Update: China activated the **Jiangmen Underground Neutrino Observatory (JUNO)**.



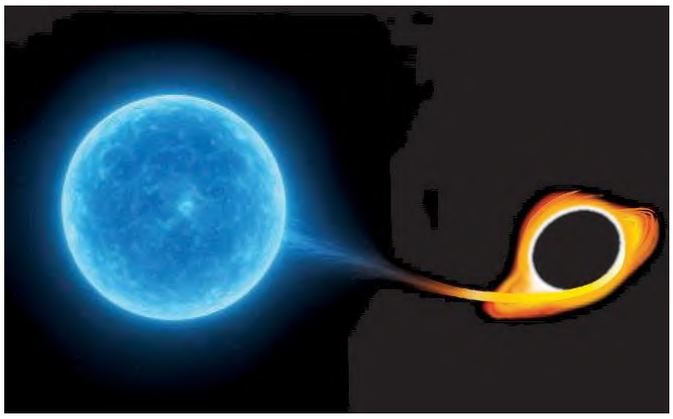
About:

1. Located **700 meters underground** to shield from cosmic particles like **muons**.
2. Aims to determine **mass hierarchy** among **electron, muon, and tau neutrinos**.
3. Measures **neutrino oscillation frequency**, revealing particle behavior.
4. **Neutrinos** are subatomic "**ghost particles**" — chargeless, nearly massless, and abundant.
5. Travel almost at the **speed of light**, unaffected by magnetic fields.

EXTREME NUCLEAR TRANSIENTS (ENTS)

Recent Update: Astronomers identified a new

class of cosmic events called **Extreme Nuclear Transients (ENTs)**.

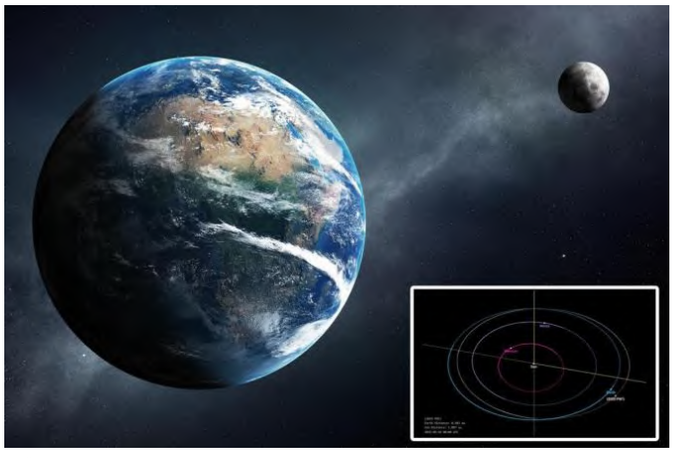


About:

1. Occur when **massive stars (≥3 solar masses)** are torn apart by **supermassive black holes**.
2. **Tidal forces** stretch stars into **spaghetti-like structures**, releasing energy bursts.
3. Represent a new window into **black hole-star interactions** and **galactic evolution**.

QUASI-MOON 2025 PN7

Recent Update: Astronomers discovered a new **quasi-moon**, named **2025 PN7**, orbiting near Earth for 60 years.



About:

1. **Quasi-moon** appears to orbit Earth but actually orbits the **Sun** in sync with Earth.
2. Influenced mainly by **solar gravity**, not Earth's.
3. **Not a true satellite**, unlike the Moon.
4. Around **six quasi-moons** of Earth are currently known.

INDIA'S LARGEST LITHIUM-ION BATTERY PLANT

Recent Update: India inaugurated its **largest Li-ion battery manufacturing plant** in **Haryana**.

About:

1. Expected to produce **20 crore battery packs/year**, meeting **40% of India's demand**.
2. Established under the **Electronics Manufacturing Cluster (EMC) scheme**.
3. **Li-ion batteries** use lithium ions moving between **graphite anode** and **metal oxide cathode**.
4. Key to **EV ecosystem**, **energy storage**, and **green mobility**.

AYURVEDA AHARA

Recent Update: FSSAI and **Ministry of Ayush** released a definitive list of **Ayurveda Aahara** products.

About:

1. Based on **Food Safety and Standards (Ayurveda Aahara) Regulations, 2022**.
2. Ensures authenticity and **consumer trust** in Ayurvedic food products.
3. Includes traditional items like **Angarkarkati, Krishara, Panaka, Dadhi, and Gulkand**.
4. Drawn from **classical Ayurvedic texts** for dietary relevance.

DRAVYA PORTAL

Recent Update: DRAVYA Portal launched by **Ministry of Ayush** on **National Ayurveda Day (Sept 23, 2025)**.

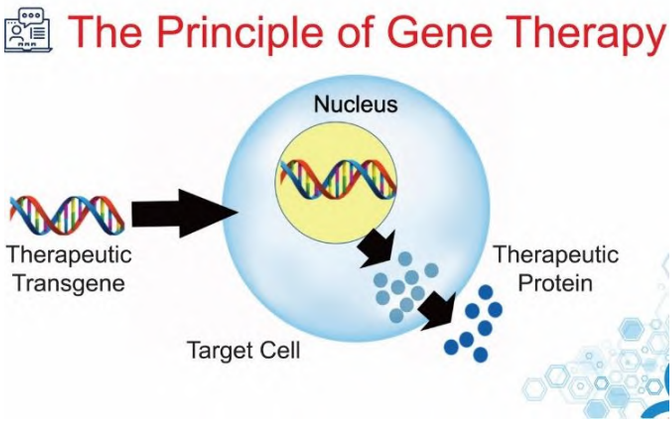
About:

1. Stands for **Digitized Retrieval Application for Versatile Yardstick of AYUSH Substances**.
2. World's **largest database** on Ayurvedic ingredients and products.
3. Integrates data from **classical texts**, **scientific research**, and **field studies**.
4. Promotes **digital access, research, and standardization** of Ayurveda.

SOURCE: INSIGHTS MONTHLY

GENE THERAPY

RECENT UPDATE: The **Indian Council of Medical Research (ICMR)** released a **draft policy** on **Gene Therapy** regulation, aiming to standardize its ethical, scientific, and regulatory oversight.

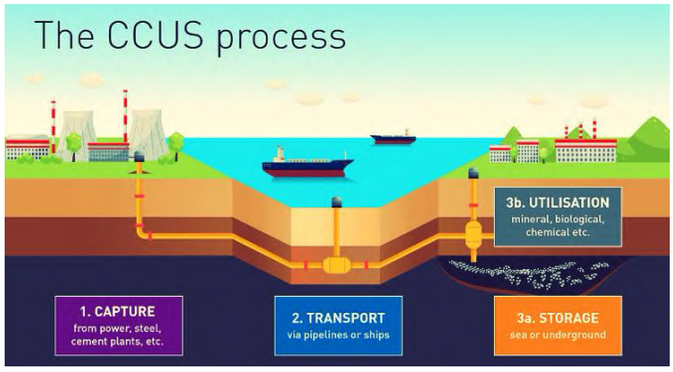


ABOUT:

1. **Definition:** Technique used to **correct defective genes** responsible for disease by introducing healthy genes into a patient's cells.
2. **Types:** Includes **Somatic Gene Therapy** (affects patient only) and **Germline Gene Therapy** (heritable, **banned** in India).
3. **Mechanism:** Uses **vectors** (often modified viruses) to deliver the therapeutic genetic material into the target cells.
4. **Applications:** Treats diseases like **Sickle Cell Anemia (SCA), Hemophilia, and certain cancers**.
5. **Regulation:** Falls under the **National Guidelines for Stem Cell Research (NGSCR)**, regulated by the **Review Committee on Genetic Manipulation (RCGM)**.
6. **Ethical Concerns:** Includes the risk of **unforeseen side effects**, high **treatment costs**, and potential for **genetic enhancement (designer babies)**.
7. **India's Status:** India has seen its **first successful gene therapy trial** for a rare disease, highlighting its potential.
8. **Way Ahead:** Build local capacity by establishing **Centers of Excellence** and promoting **Public-Private Partnerships** for affordable delivery.

CARBON CAPTURE, UTILIZATION AND STORAGE (CCUS)

RECENT UPDATE: India has announced plans to establish **two CCUS hubs** in major industrial clusters (Gujarat/Maharashtra) to achieve net-zero targets.



ABOUT:

1. **Definition:** Process that **captures CO2** emissions from sources like power plants or directly from the atmosphere before release.

1. **Steps:** Involves **Capture, Transport** (via pipeline or ship), and **Storage** (in deep geological formations or depleted oil/gas reservoirs).
2. **Utilization (CCU):** Captured CO2 is used as a resource to create products like **urea, methanol, or building materials**.
3. **India's Targets:** CCUS is crucial for achieving **Net Zero by 2070** and tackling emissions from **Hard-to-Abate sectors** (steel, cement).
4. **NITI Aayog Road Map:** Proposes CCUS capacity of **30 million tonnes (Mt) of CO2 by 2030** and 180 Mt by 2040.
5. **Challenges: High upfront capital cost** (approx. $100-$300/tonne of CO2) and the need for a **long-term regulatory framework**.
6. **Way Ahead:** Provide **fiscal incentives** (tax credits) to industry, create a **CCUS data repository**, and implement **Carbon Pricing**.
7. **Global Example:** The **IEA** views CCUS as essential for achieving climate goals, projecting its capacity must reach **1.2 billion tonnes/year by 2030**.

SOURCE: DRISHTI MONTHLY

NATIONAL QUANTUM MISSION (NQM)

RECENT UPDATE: The **Union Cabinet** approved the **National Quantum Mission (NQM)** with an outlay of **₹6,000 crores** to boost research and development in quantum technologies.

ABOUT:

1. **Objective:** To **seed, nurture, and scale up** scientific and industrial R&D in quantum computing and communications.
2. **Timeframe:** The mission has a duration of **eight years (2023-2031)**.

3. **Technology:** Aims to develop a **50-1000 physical qubit** quantum computer within 8 years.
4. **Applications:** Includes developing **Quantum Key Distribution (QKD)** technology for **hack-proof** communication.
5. **Focus Areas:** Covers **Quantum Computing, Quantum Communication, Quantum Sensing, and Quantum Materials**.
6. **Institutional Setup:** Will establish **four Thematic Hubs (T-Hubs)** in top academic/R&D institutions.
7. **Global Race:** NQM aims to place India among the top **six countries** in quantum technology, alongside the US and China.
8. **Impact:** Revolutionize areas like drug discovery, financial modelling, and **cyberspace security**.

INDIAN SPACE POLICY 2023

RECENT UPDATE: The **Indian Space Policy 2023** was approved, outlining a clear framework for enhanced participation of **Non-Government Entities (NGEs)** in space activities.

ABOUT:

1. **Vision:** To enable a **thriving space ecosystem** by leveraging the private sector's innovation and capacity.
2. **ISRO's New Role:** ISRO will focus on **research, new technology development, human**

spaceflight (Gaganyaan), and sharing its facilities.

3. **Mandate for IN-SPACe:** Serves as the **single-window agency** for authorizing and regulating NGEs' space activities.
4. **New Commercial Arm: NewSpace India Limited (NSIL)** will be the commercial wing, owning and operating assets created by public funds.
5. **Private Sector Scope:** NGEs are allowed to undertake **end-to-end activities** in space, including satellite manufacturing and launch services.
6. **Data Sharing:** Mandates the sharing of high-resolution **remote sensing data** to boost downstream applications.
7. **Challenges:** Requires a **Space Act** to fully legalize and clarify the regulatory and liability framework for NGEs.
8. **International Impact:** Strengthens India's presence in the global space market and boosts space diplomacy.

DATA SECURITY COUNCIL OF INDIA (DSCI) REPORT

RECENT UPDATE: The **DSCI Report (2024)** highlighted the necessity of comprehensive **cybersecurity frameworks** to protect critical infrastructure from rising digital threats.

ABOUT:

1. **DSCI Role:** A **non-profit organization** established by **NASSCOM** to promote data protection and cybersecurity best practices in India.
2. **Core Finding 1:** The need to secure **Operational Technology (OT)** systems used in critical sectors (e.g., power, water).
3. **Core Finding 2: Supply Chain attacks** are a rising vector, emphasizing the need to vet third-party vendors.
4. **Key Challenge:** A severe **Skill Gap** persists, with a shortage of trained cybersecurity professionals.
5. **Legal Framework:** The report supports the **Digital Personal Data Protection Act (DPDP Act)** for data security compliance.
6. **Way Ahead (Government):** Strengthen the mandate of **CERT-In (Indian Computer Emergency Response Team)** and establish a national **Cyber Grid**.
7. **Way Ahead (Industry):** Adopt a **Zero Trust** security model and mandate **Cyber Insurance** for high-risk enterprises.
8. **Policy Support:** Calls for a national strategy to secure India's move towards a **$1 trillion digital economy**.

PROTECTING INDIA'S SATELLITES

RECENT UPDATE: India approved a **₹27,000-crore space defence programme** to deploy **52 surveillance satellites (2026–2032)** and develop **"bodyguard satellites"** for orbital protection.
ABOUT:

1. **Critical Role:** Satellites underpin **communication, NavIC navigation, weather prediction, defence intelligence**, and **internet connectivity**.
2. **Threat Spectrum:** Risks arise from **space debris, collisions, anti-satellite weapons (ASATs)**, **cyber intrusions**, and **solar storms**.
3. **Strategic Value:** Safeguarding satellites protects **national security**, **data integrity**, and **economic resilience** in the digital age.
4. **High Stakes:** Billions invested in satellite infrastructure demand **risk mitigation and space situational awareness (SSA)**.
5. **IS4OM Centre (Bengaluru):** Tracks orbital paths, issues **collision alerts**, and coordinates evasive manoeuvres to prevent space accidents.
6. **Project NETRA:** Builds **radar and telescope network** for indigenous **space debris monitoring** and **collision forecasting**.

7. **Aditya-L1 Mission:** Observes the **Sun** to forecast **solar storms and CMEs**, which can damage satellite electronics.
8. **Future Steps:** Develop **orbital defence satellites**, strengthen **international cooperation (UNCOPUOS)**, and legislate a **National Space Security Policy** for asset protection.

INDIA'S SPACE POLICY AND PRIVATE SECTOR PARTICIPATION

RECENT UPDATE:
The **Indian Space Policy, 2023** entered full operational mode in **2025**, with the **IN-SPACe** clearing over **45 private satellite launch proposals**, marking a new phase of commercialization in India's space sector.

ABOUT:

1. **Objective:** Promote **private participation** in the space economy while maintaining ISRO's strategic leadership.
2. **Institutional Setup:**
    - **IN-SPACe:** Authorizes and supervises private activities.
    - **NSIL:** Manages commercial operations.
    - **ISRO:** Focused on research, deep space exploration, and national missions.
3. **Policy Provisions:** Private entities can **own, operate, and launch satellites**, and access **ISRO infrastructure**.
4. **Economic Potential:** India aims to capture **8% of the global space economy (US$600 billion by 2030)**.
5. **Notable Missions: Chandrayaan-3 (2023)** and **Aditya-L1 (2024)** bolstered India's global reputation.
6. **Private Innovations: Skyroot's Vikram-S** and **Agnikul's Agnibaan** mark India's entry into the **NewSpace era**.
7. **Challenges: Export control issues, funding barriers**, and absence of a **comprehensive space law**.
8. **Way Forward:** Enact **Space Activities Bill**, incentivize **private R&D**, and promote **international collaboration** under **Artemis Accords**.

SOURCE: DOWN TO EARTH

CHIKUNGUNYA

RECENT UPDATE: 240,000+ chikungunya cases reported in 2025, majorly from **Latin America and China**.

ABOUT:

1. Caused by **CHIKV**, an **RNA virus** of the **Alphavirus genus**.
2. Spread by **Aedes aegypti** and **Aedes albopictus**.
3. First identified in **Tanzania (1952)**; now in **110+ countries**.
4. Symptoms: **fever, joint pain, fatigue**.
5. No **specific antiviral**; only symptomatic care.
6. **Climate change** expanding mosquito range.
7. **Vector control and vaccine research** key global priorities.

SOURCE: THE HINDU

2D MATERIALS

RECENT UPDATE: NITI AAYOG'S FRONTIER TECH HUB, in collaboration with **IISc Bengaluru**, released the **4th edition of Future Front Quarterly Insights** titled *"Introduction to 2D*

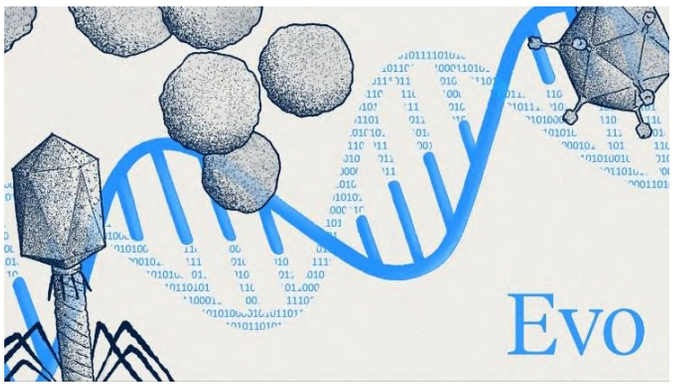
Materials", highlighting their importance and India's need to prioritise them.

ABOUT:

1. **2D Materials** are **super-thin substances**, only **one atom thick**, much thinner than conventional materials — examples include **graphene**, **MoS_2**, and **WS_2**.
2. Their **structure** is flat like a **sheet of paper**, but at the **atomic level**, giving them **unique physical and electronic properties**.
3. They were **discovered in 2004** when scientists **peeled off graphene from graphite** using adhesive tape, a discovery that won the **2010 Nobel Prize in Physics**.
4. **Graphene**, composed of **carbon atoms**, is the **most famous 2D material**, known for its **conductivity and strength**.
5. Other 2D materials include **TMDCs (Transition Metal Dichalcogenides)**, **hexagonal boron nitride (h-BN)**, and emerging **"Xenes"** like **silicene and phosphorene**.
6. These materials show promise in **electronics, sensors, energy storage**, and **quantum computing applications**.

EVO AI MODEL

RECENT UPDATE: Stanford University and the **Arc Institute** have developed **Evo**, an **AI model** that designs **new viruses** to **kill harmful bacteria**, offering new tools against **drug-resistant infections**.



ABOUT:

1. **Evo** is a **foundation model for genomics**, trained on **microbial and viral genetic sequences**.
2. It

   functions like a **"ChatGPT for DNA"**, capable of **predicting, designing, and generating genetic code** for **synthetic biology**.
3. **Developed by**: **Stanford University** and **Arc Institute**.
4. Its **aim** is to **design therapeutic bacteriophages** that can fight **antibiotic-resistant infections**.
5. The model **learned from over 80,000 microbial genomes** and **millions of bacteriophage/plasmid sequences** (about **300 billion nucleotides**).
6. It can **predict DNA mutations**, understand **gene interactions**, and **create novel viral blueprints** for lab testing and validation.
7. **Evo** accelerates research by replacing **slow trial-and-error lab work** with **AI-driven bioengineering**.

MULTI-STAGE MALARIA VACCINE – ADFALCIVAX

RECENT UPDATE: The **Union Government** granted licenses to **five Indian firms** to manufacture and commercialise **AdFalciVax**, India's **first indigenous multi-stage malaria vaccine**.

ABOUT:

1. **AdFalciVax** is a **recombinant chimeric vaccine** developed to **block infection and transmission** of *Plasmodium falciparum*, the **deadliest malaria parasite**.
2. **Developed by**: **ICMR–RMRC (Bhubaneswar)** with support from **ICMR–NIMR** and **NII (New Delhi)**.

3. It aims to **prevent infection** in individuals and **reduce community transmission** to support **malaria elimination goals**.
4. The vaccine **targets the parasite before it enters the bloodstream**, offering **multi-stage protection**.
5. It is **affordable, scalable, and stable**, effective for **over nine months at room temperature**.
6. **Pre-clinical trials** have confirmed its **efficacy and safety**.
7. Represents a **major milestone** in India's **indigenous vaccine innovation**.

HIGH-PERFORMANCE BIOMANUFACTURING PLATFORMS

RECENT UPDATE: The **Department of Biotechnology (DBT)** and **BIRAC** launched **High-Performance Biomanufacturing Platforms** under the **BioE3 Policy** in **New Delhi**.
ABOUT:

1. These platforms form a **national network of bio-foundries** and **biomanufacturing hubs** with **world-class infrastructure**.
2. They aim to **scale bio-based innovations** from the **lab to production**, fostering **green growth**.
3. **Launched by: Union Minister Jitendra Singh**, Minister of State for Science & Technology.
4. **Objective:** To **reduce import dependence**, **accelerate biomanufacturing**, and **build a trillion-dollar bioeconomy** by 2047.
5. Support provided to **start-ups, SMEs, academia, and industry** for innovation and commercialization.
6. Focus areas include **microbial strains, probiotics, bio-based chemicals, cell therapies, mRNA-based medicines**, and **sustainable biofuels**.
7. Aligns with **Atmanirbhar Bharat** and India's **climate commitments**.

WHO MODEL LIST OF ESSENTIAL MEDICINES (EML)

RECENT UPDATE: The **WHO** has added **GLP-1 receptor agonists** like **semaglutide, dulaglutide, liraglutide, and tirzepatide** to its **Essential Medicines List** for treating **type-2 diabetes with obesity and cardiovascular risks**.
ABOUT:

1. The **EML** is a **curated list of medicines** deemed **most effective, safe, and essential** for meeting **priority health needs**.
2. **First published in 1977**, updated **biennially** by the **WHO Expert Committee**.
3. **Children's EML** introduced in **2007**.
4. **Aim:** To **guide nations** in **selecting, procuring, and ensuring equitable access** to essential medicines.
5. Promotes **universal health coverage**, focusing on **affordability and availability**.
6. Based on **evidence of efficacy, safety, and cost-effectiveness**.
7. Acts as a **global benchmark**, used by **150+ countries** to frame their **national medicine lists**, driving **bulk procurement** and **price reduction**.

SOURCE: INDIAN EXPRESS

MPOX (MONKEYPOX)

RECENT UPDATE: The **World Health Organization (WHO)** declared **mpox** is **no longer a Public Health Emergency of International Concern (PHEIC)** due to a **global decline in cases and deaths**.

ABOUT:

1. **Mpox (Monkeypox)** is a **viral zoonotic disease** caused by the **monkeypox virus (MPXV)**.
2. It belongs to the **Orthopoxvirus genus** of the **Poxviridae family**, which also includes **smallpox and cowpox** viruses.
3. **Incubation period:** 5–21 days.
4. **Symptoms:** Fever, headache, back pain, swollen lymph nodes, low energy, and a **rash** that spreads from the **face/genitals to the body**.
5. The rash evolves from **flat sores to blisters and scabs**.
6. Can cause **severe illness** in **children, pregnant women**, and **immunocompromised individuals** (especially **HIV patients**).
7. **WHO monitoring** continues to prevent **resurgence** and track **regional outbreaks**.

ACANTHAMOEBA

RECENT UPDATE: The **Kerala Health Department** raised an alert after studies found **Acanthamoeba** more **widespread in the State's waterbodies** than previously believed.
ABOUT:

1. **Acanthamoeba** is a **microscopic free-living amoeba** found in **water and soil**.
2. It causes **keratitis** — severe **eye infection** leading to **pain, redness, blurred vision**, and **corneal ulcers**.
3. It can also cause **encephalitis**, marked by **headache, fever, seizures**, and often **fatal outcomes**.
4. **Early diagnosis** of keratitis is critical; treated with **antimicrobial eye drops** like **biguanides and diamidines**.
5. In severe cases, **corneal transplants** may be required.
6. **Encephalitis** treatment involves **antifungals, antibiotics**, and **supportive care**, though **survival rates are low**.
7. **Prevention:** Maintain **contact lens hygiene**, **chlorinate wells**, and use **safe water practices**.

CEREBO – INDIGENOUS BRAIN TOOL

RECENT UPDATE: CEREBO, a **hand-held diagnostic device** developed by **ICMR**, **AIIMS Bhopal**, **NIMHANS Bengaluru**, and **Bioscan Research**, has been launched to **detect traumatic brain injuries (TBIs) within a minute**.
ABOUT:

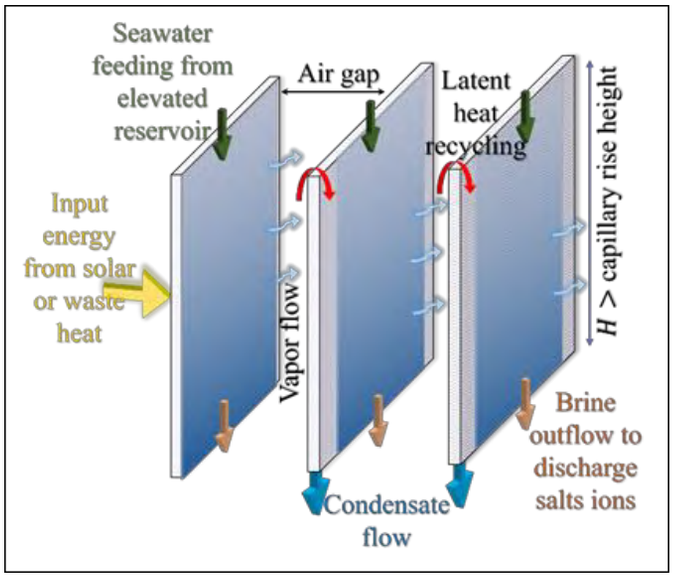
1. Designed as a **low-cost, radiation-free diagnostic tool** for **Traumatic Brain Injuries** in areas with **limited CT/MRI access**.
2. Detects **intracranial bleeding and brain edema** in **under a minute**.
3. **Safe for infants and pregnant women**, usable by **paramedics and unskilled staff**.
4. Provides **colour-coded, easy-to-read results**.
5. **Validated through multi-centre clinical trials** and approved for **emergency and military use**.
6. **Bridges the diagnostic gap** in **rural and underserved regions**.
7. Enables **early detection and triage**, reducing **fatalities and complications**.

SIPHON-POWERED DESALINATION

RECENT UPDATE: IISc Bengaluru researchers developed a **siphon-powered desalination system** that turns **seawater into clean drinking water** efficiently and affordably.

ABOUT:

1. It's a **thermal desalination system** using **siphonage** to continuously **draw, evaporate, and condense seawater** into potable water.
2. **Developed by: Indian Institute of Science (IISc)**, Bengaluru.
3. **Composite siphon** made of **fabric wick and grooved metal surface** draws seawater upward.



4. **Gravity flow** removes salt before crystallization, ensuring durability.
5. Achieves **>6 litres of potable water/m²/hour** under sunlight — several times higher than **solar stills**.
6. Made of **low-cost materials** like **aluminum and fabric**; runs on **solar or waste heat**.
7. **Scalable, off-grid**, and ideal for **villages, coastal areas, and disaster zones**.

BSNL'S SWADESHI 4G NETWORK STACK

RECENT UPDATE: Prime Minister Narendra Modi launched **BSNL's fully indigenous 4G network stack** and commissioned **~98,000 mobile towers**, marking a **milestone in self-reliant telecom infrastructure**.

ABOUT:

1. **BSNL's 4G stack** is **entirely indigenous**, with **hardware and software made in India**.
2. It is a **cloud-native, scalable architecture** capable of **rapid expansion and upgrades**.
3. **Future-ready design:** Built for **5G compatibility** and **6G preparedness**.
4. Supports **digital payments, telemedicine, e-governance, education, and precision farming**.
5. Enhances **strategic autonomy** by reducing **foreign dependence** in telecom infrastructure.
6. Generates **employment**, strengthens **local manufacturing**, and boosts **Indian R&D**.
7. Positions India as the **fifth country globally** to develop and deploy its **own telecom stack**.

TOPICS COVERED-

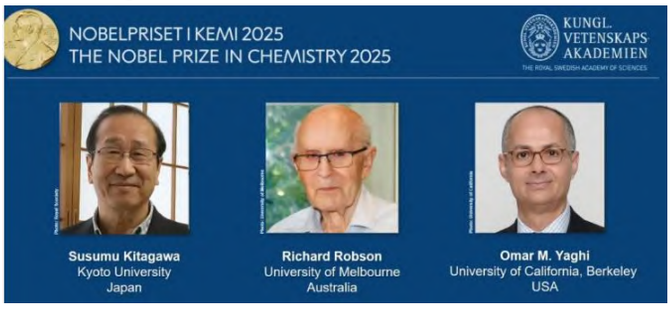
1. **Nobel Prize in Chemistry 2025 — MOFs, porous materials, gas storage**
2. **Nobel Prize in Physics 2025 — quantum tunnelling, superconducting circuits, macroscopic quantisation**
3. **Astrosat — multi-wavelength, X-ray astronomy, UV imaging**
4. **Non-Communicable Diseases (NCDs) — DALYs, lifestyle diseases, pollution link**
5. **Antimicrobial Resistance (AMR) — superbugs, GLASS, rising resistance**
6. **Mahi Banswara Atomic Project — 700 MWe PHWRs, NPCIL–NTPC, fleet mode**
7. **Indigenous 4G (5G-ready) Network — BSNL, C-DOT stack, telecom self-reliance**
8. **RDI Scheme – ANRF Special Purpose Fund — ₹1 lakh crore fund, TRL 4+, deep-tech innovation**
9. **Production Gap Report 2025 — fossil overproduction, Paris misalignment, carbon lock-in**
10. **Cold Desert Biosphere Reserve (WNBR) — Spiti–Lahaul, snow leopard, high-altitude desert**
11. **Gendered & Regional Cancer Variations — Northeast hotspot, breast/oral cancers, lifestyle risks**
12. **Renewable Energy Transmission Trap — curtailments, TGNA, grid congestion**
13. **India's Biotech Surge — deep-tech startups, BioE3, AI-driven R&D**
14. **SMRs for AI Data Centres — modular reactors, baseload power, AI energy demand**
15. **AI in Robotics — healthcare automation, precision farming, industrial robots**
16. **Benzene — aromatic hydrocarbon, carcinogen, industrial chemical**
17. **MAM01 Monoclonal Antibody — malaria prevention, CSP-binding, passive immunity**
18. **DRAVYA Portal — Ayush repository, AI-ready data, medicinal substances**
19. **MAHA MedTech Mission — medical devices, innovation funding, diagnostics**
20. **PM–ABHIM — health infrastructure, surveillance network, pandemic readiness**
21. **Polio — OPV/IPV, cross-border risk, eradication status**
22. **Amoebic Meningoencephalitis — Naegleria fowleri, fatal infection, water exposure**
23. **PM-JAY — ₹5 lakh coverage, cashless schemes, portability**
24. **SPARK–4.0 — Ayurveda research, studentship, CCRAS initiative**
25. **Schedule M Norms — GMP standards, pharma quality, compliance**
26. **Compressive Asphyxia — crowd crush, hypoxia, stampede deaths**
27. **Quantum Echoes Algorithm — quantum advantage, OTOCs, time reversal**
28. **Certified Quantum Randomness (One Qubit) — RRI, LGI tests, secure encryption**
29. **India Mobile Congress 2025 — 5G/6G, semiconductors, digital innovation**
30. **SARAL Tool — research simplification, AI summaries, ANRF**
31. **GSAT-7R Satellite — military communication, anti-jamming, LVM-3**
32. **Comets in the News — SWAN, Lemmon, long-period comets**
33. **CHACE-2 Payload — lunar exosphere, mass spectrometry, CME impact**
34. **Chiron — centaur object, rings, comet–asteroid hybrid**
35. **Crew Escape System (CES) — launch safety, LVM-3, astronaut protection**
36. **Defence Procurement Manual 2025 — revenue procurement, MSMEs, transparency**
37. **INS Vikrant — aircraft carrier, blue-water capability, indigenous build**

38. **Saksham Counter-UAS Grid — drone defence, AI-driven C2, Army Air Defence**
39. **IndiaAI Mission — compute GPUs, datasets (AIKosh), LMMs**
40. **Fusion Power Roadmap (SST-Bharat) — tokamak, plasma confinement, Q-value**
41. **Safe & Trusted AI Ecosystem — deepfake detection, AI bias, AI security**
42. **Desert Soilification Technology — sand binding, water retention, arid farming**
43. **Siphon-Powered Desalination — thermal siphon, high output, low-cost design**
44. **Quantum Digital Security Breakthrough — true randomness, encryption, cloud quantum**
45. **James Webb Space Telescope (JWST) — early galaxies, infrared imaging, L2 orbit**
46. **Protein Language Models (PLMs) — antigen design, protein folding, AI biology**
47. **Acanthamoeba — keratitis, contact-lens risk, environmental amoeba**
48. **CLAMP Programme — paleoclimate, leaf morphology, monsoon evolution**
49. **SPIN90 Protein — actin regulation, cell motility, wound healing**
50. **Extreme Nuclear Transients (ENTs) — black holes, star disruption, cosmic explosions**
51. **Biosignatures on Mars — Jezero Crater, organics, exosphere chemistry**
52. **Aquamonitrix — nitrate detection, portable analyser, water quality**
53. **AI-Designed Viral Genome — bacteriophage ΦX174, synthetic biology, genome engineering**
54. **Indigenous 7 nm Processor — semiconductor design, SHAKTI initiative, advanced node**
55. **Direct Broadcast Network (DBNet) — LEO satellites, weather prediction, real-time data**
56. **Jarosite Discovery (Kutch) — iron sulphate mineral, Mars analogue, paleoenvironment**
57. **TPCR 2025 — defence capability roadmap, AI warfare, industry alignment**
58. **International Earth Sciences Olympiad (IESO) — geoscience knowledge, global competition, MoES**
59. **Gaganyaan Analog Experiments (Gyanex) — space medicine, confinement study, astronaut training**
60. **Manganese — steel alloys, battery materials, Odisha deposits**
61. **Smog — photochemical smog, inversion layer, TiO_2 coatings**
62. **Supercomputer – AIRAWAT PSAI — AI compute, NSM, HPC servers**
63. **Cancer Dimensions (Updated) — AAIR, lifestyle variation, screening gaps**
64. **Transmission Trap (Updated) — curtailment losses, HVDC need, forecasting errors**
65. **H3N2 Influenza Surge — seasonal flu, high-risk groups, genome sequencing**
66. **India's Carb-Heavy Diet & Diabetes — refined grains, insulin resistance, obesity**
67. **India Achieves 500 GW Capacity — renewables milestone, solar–wind share, COP26 target**

SOURCE: VISION MONTHLY

NOBEL PRIZE IN CHEMISTRY 2025

Recent Update: Awarded to **Susumu Kitagawa, Richard Robson, and Omar M. Yaghi** for developing **Metal–Organic Frameworks (MOFs)**.



About

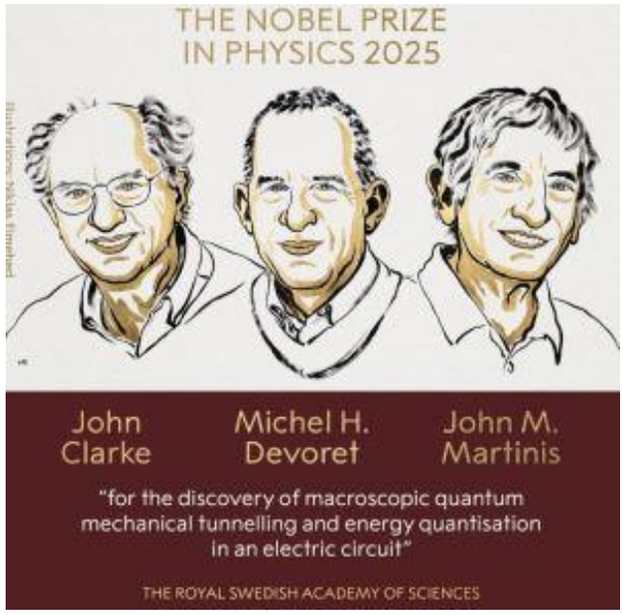
1. **MOF Structure:** Built from **metal ions** and **organic linkers** forming network frameworks.
2. **Porous Design:** Large internal cavities make MOFs extremely porous.
3. **Customisable:** Metals and linkers can be changed to tune pore size and chemistry.
4. **Gas Storage:** Useful for storing **hydrogen, methane, and CO_2**.
5. **Catalysis:** High surface area supports efficient reactions.
6. **Environmental Use:** Applied in water purification and pollutant capture.
7. **Industrial Relevance:** Important for sensors, batteries, and green chemistry.
8. **Scientific Impact:** Revolutionised materials science with modular design.

NOBEL PRIZE IN PHYSICS 2025

Recent Update: Awarded to **John Clarke, Michel H. Devoret, and John M. Martinis** for demonstrating **quantum tunnelling and energy quantisation** in macroscopic circuits.

About

1. **Quantum Basics:** Microscopic particles show wave–particle duality and discrete energy levels.
2. **Energy Quantisation:** Particles occupy fixed energy states, not continuous ranges.
3. **Quantum Tunnelling:** Particles can pass through barriers classical physics forbids.
4. **Scale Question:** Scientists long debated how large a system can still show quantum effects.
5. **Prize Work:** Laureates observed quantised states in superconducting electrical circuits.
6. **Macroscopic Tunnelling:** Demonstrated tunnelling behaviour in large-scale circuit systems.



7. **Quantum Tech Impact:** Foundation for **quantum computing and ultra-sensitive sensors**.
8. **Scientific Bridge:** Connects microscopic quantum rules with real-world engineering.

ASTROSAT

Recent Update: India's first space observatory **completed 10 years** since launch.

About

1. **Mission Goal:** Multi-wavelength study of cosmic objects in **X-ray, UV, and optical** bands.
2. **Launch:** Launched by **PSLV-C30** in 2015.
3. **Orbit:** Operates in a 650 km low Earth orbit.
4. **Spectral Range:** Covers 0.3–100 keV for wide celestial observation.
5. **High-Energy Studies:** Observes neutron stars and black hole binaries.
6. **Magnetic Measurement:** Helps estimate neutron star magnetic fields.
7. **Star Formation:** Studies star-forming regions in and beyond the Milky Way.
8. **Transient Events:** Detects short-lived X-ray sources and performs UV deep surveys.

NON-COMMUNICABLE DISEASES (NCDs)

Recent Update: GBD Report 2025 shows India's disease burden has shifted heavily to **NCDs**.

About

1. **Rising Burden:** NCDs caused **1.80 billion DALYs** in 2023.
2. **Shift from Infectious Diseases:** Better sanitation and vaccination reduced communicable diseases.
3. **Top NCDs:** Heart disease, stroke, and diabetes dominate.
4. **Fastest Growing:** Anxiety, depression, and diabetes increased sharply since 2010.
5. **Lifestyle Factors:** Urbanisation and ageing raise chronic disease risk.
6. **Diet Problems:** High intake of **processed, high-fat, high-sugar foods** increases risk.
7. **Physical Inactivity:** Sedentary living and mechanisation worsen metabolic issues.
8. **Pollution: Air pollution** drives respiratory and cardiovascular NCDs.

ANTIMICROBIAL RESISTANCE (AMR)

Recent Update: WHO released the **Global Antibiotic Resistance Surveillance Report 2025**.

About

1. **High Resistance:** 1 in 6 global infections in 2023 involved resistant bacteria.
2. **Increasing Trend:** 40% of bacteria–drug pairs showed rising resistance.
3. **Superbugs:** Gram-negative bacteria (e.g., **E. coli**) are hardest to treat.
4. **Hotspots:** Highest AMR rates in Southeast Asia and Eastern Mediterranean.
5. **India's Burden:** India, China, Pakistan contributed 41% of bloodstream infection reports.
6. **GLASS Expansion:** AMR surveillance participation quadrupled since 2016.
7. **Definition:** AMR occurs when microbes evolve to withstand antimicrobial drugs.
8. **Global Threat:** Leads to treatment failures and higher mortality.

MAHI BANSWARA RAJASTHAN ATOMIC POWER PROJECT

Recent Update: PM laid foundation stone for **MBRAPP** in Rajasthan.

About

1. **Location:** Banswara district near **River Mahi**.
2. **Capacity:** Four **700 MWe PHWR** units.
3. **Developers:** Jointly by **NPCIL and NTPC** under ASHVINI.
4. **Fleet Mode:** Part of India's initiative to build ten 700 MW reactors with uniform design.
5. **Current Capacity:** India has 24 reactors producing **8180 MW** (2025).
6. **Future Target:** Planned rise to **22,480 MW** by 2031–32.
7. **Energy Share:** Nuclear contributes **3.61%** of electricity generation.
8. **Three-Stage Plan:** India continues Stage-1 PHWRs before moving to FBRs and thorium cycle.

INDIA'S FIRST FULLY INDIGENOUS 4G (5G-READY) NETWORK

Recent Update: BSNL deployed India's first fully indigenous **4G (5G-ready) network** with C-DOT, Tejas, and TCS.

About

1. **Strategic Independence:** Reduces reliance on foreign telecom vendors.
2. **Cloud-Native:** Allows rapid upgrades and smooth transition to 5G/6G.
3. **Digital Inclusion:** Supports remote, tribal, and hilly regions.

4. **Domestic Ecosystem:** Boosts local manufacturing and skilled workforce.
5. **Global Position:** India joins select nations with full indigenous telecom stack.
6. **Fast Rollouts:** Ensures rapid deployment of advanced mobile services.
7. **Economic Impact:** Strengthens Atmanirbhar Bharat and digital growth.
8. **Security:** Enhances cybersecurity through indigenous infrastructure.

RDI SCHEME – ANRF SPECIAL PURPOSE FUND

Recent Update: ANRF approved **Guidelines and Special Purpose Fund (SPF)** for the RDI Scheme.

About

1. **Purpose:** Creates a **₹1 lakh crore RDI Fund** to scale Indian innovation.
2. **Nodal Body:** Implemented through **DST**.
3. **Two-Tier Structure: SPF** + **Second-Level Fund Managers (SLFMs)**.
4. **SLFMs:** Includes AIFs, DFIs, NBFCs, and bodies like **TDB and BIRAC**.
5. **Eligibility:** Supports R&D projects at **TRL 4+**.
6. **Funding:** Up to **50% of assessed project cost**.
7. **Exclusions:** No grants or short-term loans funded.
8. **Goal:** Strengthen national research capability and private-sector innovation.

THE PRODUCTION GAP REPORT 2025

Recent Update: Latest report shows countries plan **far higher fossil fuel production** than compatible with Paris goals.

About

1. **Published By: SEI, IISD, and Climate Analytics**, supported by the UN.
2. **What It Tracks:** Gap between planned fossil fuel production and climate-safe levels.
3. **Coal Misalignment:** Coal output planned for 2030 is **500% above** 1.5°C-aligned levels.
4. **Rising Fossil Fuel Plans:** Governments plan **120% more** fossil fuels by 2030 than Paris allows.
5. **Oil & Gas Increase:** Gas production exceeds 1.5°C limit by **92%**; oil by **31%**.
6. **India Context:** Expanding coal gasification and increasing gas share to 15% in energy mix.
7. **Major Emitters:** China, US, Russia contribute >50% of extraction emissions.
8. **Warning:** Continued investments risk **carbon lock-in** and stranded assets.

COLD DESERT BIOSPHERE RESERVE (CDBR) – WNBR LISTING

Recent Update: CDBR in Himachal Pradesh added to **UNESCO's World Network of Biosphere Reserves (WNBR)**.

About

1. **Location:** Trans-Himalayan region covering **Spiti Division** and parts of **Lahaul**.
2. **Declared:** Recognised as India's **16th biosphere reserve** in 2009.
3. **Landscape:** Glacial valleys, high-altitude deserts, and alpine lakes at 3300–6600 m.
4. **Flora:** Hosts 14 endemic, 68 native, and 62 threatened plant species.
5. **Fauna:** Includes **snow leopard, Himalayan wolf, ibex**, and rare vulture species.
6. **Protected Areas:** Encompasses **Pin Valley NP, Kibber WLS, Chandratal Wetland**.
7. **Importance:** Among world's coldest, driest ecosystems with unique biodiversity.
8. **WNBR Goal:** Facilitates global cooperation and ecological knowledge sharing.

GENDERED & REGIONAL DIMENSIONS OF CANCER IN INDIA

Recent Update: NCRP 2023–24 shows cancer patterns vary sharply by **gender, geography, and lifestyle**.

About

1. **Higher Among Women:** CIR for women (113.3) higher than men (107.4).
2. **Risk Factors:** Delayed childbirth, lifestyle changes, hormonal exposure.
3. **Common Cancers:** Men—oral, lung, prostate; Women—breast, cervical, ovarian.
4. **Male Mortality:** NCD deaths rising faster among men.
5. **Northeast Hotspot:** Aizawl, Papumpare, East Khasi Hills show highest incidence.
6. **Diet Influence:** Smoked/fermented foods linked to digestive cancers.
7. **Rural Trends:** Processed food consumption rising, increasing cancer risk.
8. **Policy Need:** Screening expansion, dietary regulation, rural cancer care strengthening.

SOURCE: THE HINDU

INDIA'S RENEWABLE ENERGY – TRANSMISSION TRAP

Recent Update: Large-scale curtailments caused by **poor transmission planning** and **weak forecasting**.

About

1. **Losses:** ₹700 crore losses due to forced curtailments in 2025.

2. **Affected States:** Rajasthan, Gujarat, Maharashtra, Tamil Nadu.
3. **GNA Gaps:** Many projects operate under **Temporary GNA** with no compensation.
4. **Capacity Mismatch:** Renewable capacity rising faster than grid expansion.
5. **Forecasting Errors:** Demand miscalculations worsen curtailments during monsoon dips.
6. **Investment Impact:** Investor confidence weakening; 2030 targets at risk.
7. **Solution:** Accelerate HVDC lines, install large-scale battery storage, improve forecasting models.
8. **Regulatory Need:** Compensation norms for curtailed TGNA projects.

INDIA'S BIOTECH SURGE AND ITS SCALING CHALLENGES

Recent Update: India's biotech ecosystem expanded from 500 (2018) to 10,000+ startups (2025).

About:

1. **Startup Explosion:** Biotech startups grew 20× due to 94 incubators across 25 states, shifting India toward deep-tech innovation.
2. **Low-Cost R&D:** Affordable research facilities and strong STEM talent enhance India's global biotech competitiveness.
3. **AI Integration:** Startups increasingly use AI for rapid drug discovery, precision diagnostics, and protein modelling.
4. **Vaccine Hub:** India supplies 60% of global immunisation doses, reinforcing its role as the world's vaccine engine.
5. **BioE3 Vision:** The BioE3 Policy (2025) targets a $300-billion bioeconomy by 2030 by unifying biomanufacturing, bioenergy, and biopharma.
6. **BIRAC Support:** BIG, SBIRI and incubator grants strengthened 6,000+ early-stage biotech ventures.
7. **Scaling Issues:** Regulatory delays, limited deep-tech capital, and insufficient GMP-grade manufacturing facilities hinder scale-up.
8. **Competitiveness Need:** Stronger IP protection, skilled workforce, and advanced biofoundries are required to sustain growth.

POWERING THE INTELLIGENCE REVOLUTION: SMRs FOR INDIA'S AI DATA CENTRE BOOM

Recent Update: India to deploy indigenous SMRs under the Nuclear Energy Mission (2025).

About:

1. **Rising Demand:** AI compute, EV adoption, and digital manufacturing sharply increase India's power needs.
2. **Grid Stress:** Transmission constraints and regional shortages challenge continuous power supply for data centres.
3. **Renewable Limits:** Solar–wind intermittency cannot meet 24×7 baseload needs of AI server farms.
4. **SMR Advantage:** SMRs provide continuous, low-carbon power ideal for uninterrupted AI operations.
5. **Modular Deployment:** Compact 1–300 MW units enable installation near consumption hubs, cutting transmission losses.
6. **Safety Features:** Passive cooling and small cores ensure enhanced inherent safety.
7. **India's Targets:** Five SMRs by 2033; part of India's plan to reach 100 GW nuclear capacity by 2047.
8. **Investment Push:** Policy reforms aim to attract $26 billion private investment into next-gen nuclear technologies.

AI IN ROBOTICS — TRANSFORMING HEALTHCARE, AGRICULTURE & INDUSTRY

Recent Update: AI-robotics adoption accelerating across India under Digital India and AI for All.

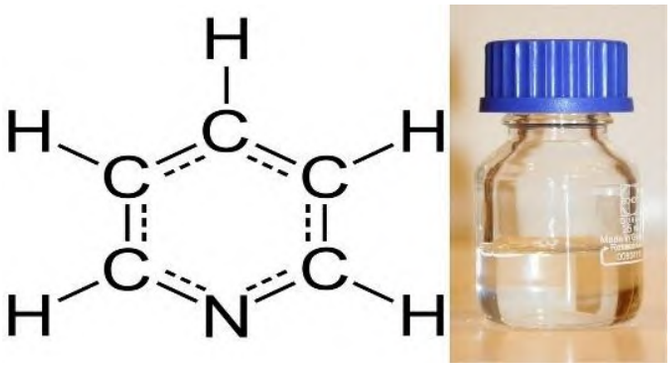
About:

1. **Definition:** AI-equipped robots learn and adapt rather than follow fixed instructions.
2. **Human–Robot Synergy:** Enhances safety, precision, and productivity across multiple sectors.
3. **Robotic Surgery:** AI-assisted systems enable micrometre-level precision, reducing complications and recovery time.
4. **AI Diagnostics:** Algorithms analyse scans, pathology data, and genomes for early disease detection.
5. **Rehabilitation Robotics:** Exoskeletons and robotic limbs restore mobility after injury or paralysis.

6. **Elder Care Robotics:** Assist with routine tasks, reminders, monitoring, and emotional interaction.
7. **Agriculture Automation:** Robots support precision farming, real-time crop monitoring, and autonomous spraying/harvesting.
8. **Industrial Automation:** AI-robots optimize assembly, quality inspection, and predictive maintenance.

BENZENE

Recent Update: Two centuries after discovery, **benzene** remains vital to industry but poses major environmental and health risks.



About:

1. **Definition:** Benzene (C_6H_6) is an aromatic hydrocarbon forming the base of plastics, dyes, detergents, and drugs.
2. **Discovery:** First isolated by **Michael Faraday (1825)**; structure proposed by **August Kekulé (1865)** as a cyclic hexagon.
3. **Aromaticity:** Exceptional chemical stability arises from **delocalised π-electrons**, giving it unique reactivity.
4. **Physical Traits:** A colorless, volatile, sweet-smelling, highly flammable liquid; water-insoluble but mixes with organic solvents.
5. **Industrial Use:** Precursor for **styrene, phenol, cyclohexane, nylon, polystyrene** and other essential chemicals.
6. **Toxicity:** Long-term exposure is linked to **bone-marrow suppression and leukemia**, making it a major occupational hazard.
7. **Environmental Impact:** Found in vehicular emissions, industrial discharge, and cigarette smoke, contributing to urban air pollution.
8. **Regulation:** Strict limits imposed by WHO, OSHA, and Indian pollution standards to curb benzene exposure.

MAM01 (MONOCLONAL ANTIBODY AGAINST MALARIA)

Recent Update: Early clinical trials show **100% protection** at high doses of monoclonal antibody MAM01.

About:

1. **Definition:** MAM01 is a **monoclonal antibody** engineered to neutralise *Plasmodium falciparum* before bloodstream invasion.
2. **Passive Immunisation:** Provides ready-made immunity, unlike vaccines that stimulate active immune response.
3. **Developed By:** University of Maryland's **Center for Vaccine Development & Global Health**.
4. **Target:** Binds to a conserved region of the parasite's **circumsporozoite protein (CSP)** to block liver-cell infection.
5. **Trial Results:** Phase-1 trial (38 adults) showed **dose-dependent protection**, with the highest dose giving complete immunity.
6. **Safety:** No severe adverse reactions recorded, indicating strong safety profile.
7. **Use Case:** Designed for **pregnant women, children**, and high-risk populations in malaria-endemic regions.
8. **Advantage:** Single dose offers **months-long protection**, overcoming limitations of multi-dose malaria vaccines.

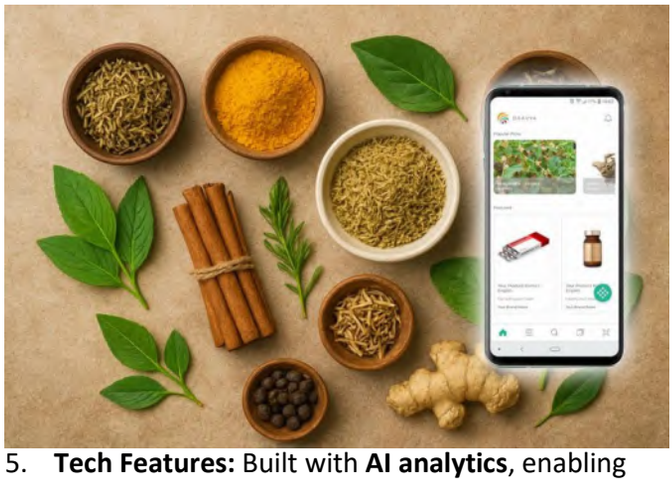
DRAVYA PORTAL

Recent Update: Ministry of Ayush launched **DRAVYA**, digitising 100 key medicinal substances in its first phase.

About:

1. **Definition:** DRAVYA is an **AI-ready digital repository** compiling classical and modern data on Ayush medicinal substances.
2. **Developer:** Created by **CCRAS** under the Ministry of Ayush.
3. **Aim:** To unify scattered traditional knowledge for **evidence-based research** and global accessibility.

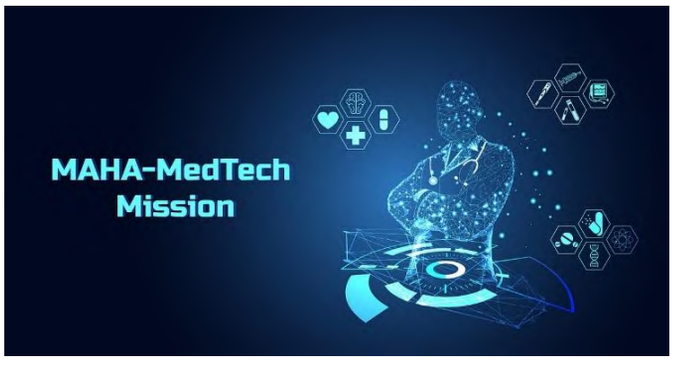
4. **Catalogue:** Includes **100 medicinal substances**, planned for continuous expansion.



5. **Tech Features:** Built with **AI analytics**, enabling research mapping and integration with digital health platforms.
6. **QR-Code Integration:** Supports plant gardens and repositories with authentic, standardised information.
7. **Cross-disciplinary Data:** Includes botany, chemistry, pharmacy, pharmacology, and safety profiles.
8. **Interoperability:** Linked with **Ayush Grid** to support national health digitisation.

MAHA MEDTECH MISSION

Recent Update: ANRF, ICMR & Gates Foundation jointly launched the **MAHA MedTech Mission** to boost domestic medical technology.



About:

1. **Definition:** A national initiative to accelerate innovation and **manufacturing of advanced medical devices** in India.
2. **Objective:** Reduce import dependence and improve access to **affordable, high-quality diagnostics and devices**.
3. **Launch Partners: ANRF, ICMR**, and **Bill & Melinda Gates Foundation**.
4. **Funding:** Offers **₹5–25 crore** per project (up to ₹50 crore in special cases).
5. **Scope:** Covers devices, diagnostics, implants, **AI/ML tools**, robotics, and assistive technologies.

6. **Enabling Systems:** Includes **Patent Mitra**, **MedTech Mitra**, and a national **Clinical Trial Network**.
7. **Selection:** Two-stage process—concept notes (2025) and full proposals.
8. **Impact:** Strengthens India's role in global med-tech manufacturing and innovation.

PM–ABHIM (PRADHAN MANTRI–AYUSHMAN BHARAT HEALTH INFRASTRUCTURE MISSION)

Recent Update: MoHFW reported major progress in **pandemic-ready health infrastructure** under PM-ABHIM

About:

1. **Definition:** A nationwide mission strengthening **public health systems, surveillance, and pandemic preparedness**.
2. **Launch:** Announced in **October 2021** as part of Ayushman Bharat.
3. **Outlay:** ₹64,180 crore under both **Central Sector** and **Centrally Sponsored** components.
4. **Surveillance:** Builds a **real-time, IT-enabled disease surveillance network** across local, state, and national labs.
5. **Integration:** Aligns with **National Health Policy 2017**, NHM, and Ayushman Bharat schemes.
6. **Infrastructure:** Focuses on urban/rural health centres, infectious disease research, and community capacity building.
7. **Goal:** Build a resilient health system capable of managing future epidemics.
8. **Progress:** Multiple centres, labs, and surveillance units nearing operationalisation nationwide.

POLIO

Recent Update: India placed on high alert due to rising polio cases in **Pakistan and Afghanistan**.

About:

1. **Definition:** Polio is a **highly infectious viral disease** targeting the nervous system, often causing paralysis.
2. **Risk Group:** Mainly affects **children under 5**, though unvaccinated adults are also vulnerable.
3. **Symptoms:** Fever, stiffness, limb pain; **1 in 200** cases progress to irreversible paralysis.
4. **Fatality:** 5–10% of paralysed patients die due to respiratory muscle failure.
5. **Vaccines:** Preventable through **OPV** (intestinal immunity) and **IPV** (systemic immunity).
6. **India's Milestone:** Last recorded case in **2011**; certified polio-free in **2014**.
7. **Programmes:** Achieved through **Pulse Polio**, Mission Indradhanush, and robust surveillance.
8. **Current Threat:** Cross-border transmission risk due to endemic neighbouring countries.

SOURCE: INDIAN EXPRESS

AMOEBIC MENINGOENCEPHALITIS

Recent Update: Kerala reported another death, raising 2025 toll to **27 cases**.

About:

1. **Definition:** A rare, fatal brain infection known as **Primary Amebic Meningoencephalitis (PAM)**.
2. **Causative Agent:** Caused by **Naegleria fowleri**, the "brain-eating amoeba."
3. **Transmission:** Not person-to-person; infection occurs when contaminated freshwater enters the **nose**.
4. **Habitat:** Thrives in warm lakes, rivers, hot springs, and poorly chlorinated pools.
5. **Symptoms:** Starts with fever and headache; rapidly progresses to seizures, hallucinations, coma.
6. **Fatality:** Mortality exceeds **95%**, making it one of the deadliest infections known.
7. **Treatment:** Early **amphotericin B**, **miltefosine**, and supportive ICU care offer rare recoveries.
8. **Prevention:** Avoid untreated freshwater, maintain chlorination, use nose clips while swimming.

PRADHAN MANTRI JAN AROGYA YOJANA (PM-JAY)

Recent Update: Chhattisgarh recognised as **best-performing state** for near-zero PM-JAY claim pendency (2025).

About:

1. **Definition:** World's largest **government-funded health assurance scheme** for poor and vulnerable families.
2. **Launch:** Started on **23 September 2018** in Ranchi.
3. **Coverage:** ₹5 lakh annual cover per family; 12 crore families (~55 crore people).
4. **Cashless Care:** Treatment available in all empanelled public and private hospitals nationwide.
5. **Package Count:** Covers **1,929 procedures**, including diagnostics, implants, ICU, surgeries.
6. **Comprehensive Benefits:** Includes pre- and post-hospitalisation care; covers all pre-existing diseases.
7. **Portability:** Benefits accessible anywhere in India.
8. **Governance:** Strengthened by audits, fraud control, and digital claim systems.

SPARK–4.0

Recent Update: CCRAS launched **SPARK-4.0**, supporting 300 BAMS students with research studentships.

About:

1. **Definition:** Studentship Program for Ayurveda Research Ken promoting **research mindset** among BAMS students.
2. **Implementing Body: CCRAS** under Ministry of Ayush.
3. **Aim:** Introduce scientific inquiry and classical-modern integration to young Ayurveda scholars.
4. **Support:** ₹50,000 studentship per participant.
5. **Eligibility:** Students from **NCISM-recognised** colleges.
6. **Structure:** Faculty-guided, short-term independent research projects.

7. **Outcome:** Certification upon completion; builds early-career researchers.
8. **Impact:** Strengthens India's Ayush research pipeline.

SCHEDULE M NORMS

Recent Update: Union Health Ministry ordered strict enforcement after DEG-linked child deaths.

About:

1. **Definition:** Schedule M prescribes **Good Manufacturing Practices (GMP)** for India's pharma industry.
2. **Legal Basis:** Part of the **Drugs and Cosmetics Act, 1940**.
3. **Scope:** Covers facility design, sanitation, equipment, quality control, documentation.
4. **Aim:** Ensure **consistent, safe, and effective** drug production.
5. **Upgraded Rules:** Revised norms demand higher compliance and global-standard manufacturing.
6. **Trigger:** Recent tragedies linked to contaminated syrups exposed regulatory gaps.
7. **Enforcement:** States instructed to verify compliance via inspections and mandatory upgrades.
8. **Outcome Goal:** Improve India's global reputation in pharmaceutical quality.

COMPRESSIVE ASPHYXIA

Recent Update: 41 deaths at a Tamil Nadu rally were caused by **compressive asphyxia**.

About:

1. **Definition:** Mechanical asphyxiation where external chest–abdomen pressure blocks lung expansion.
2. **Cause:** Occurs in **stampedes, crowd crushes**, or heavy weight on the torso.
3. **Crowd Density:** Risk spikes beyond **6–7 people/m²**, restricting diaphragm movement.
4. **Symptoms:** Breathlessness, dizziness, cyanosis, and loss of consciousness.
5. **Physiology:** Leads to **hypoxia**, **hypercapnia**, organ failure, and rapid death.
6. **First Aid:** Immediate removal from crowd pressure.
7. **Medical Care:** CPR, oxygen, airway management, and ventilatory support.
8. **Prevention:** Crowd management, exit planning, and limiting density at events.

QUANTUM ECHOES ALGORITHM

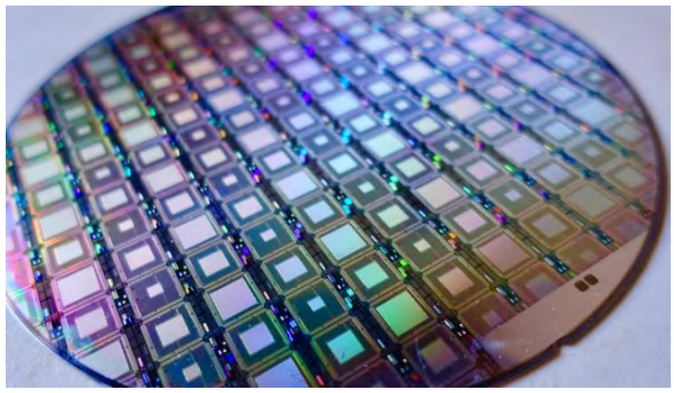
Recent Update: Google's **Willow** processor achieved the first **verifiable quantum advantage** using Quantum Echoes.

About:

1. **Definition:** A quantum algorithm based on **OTOCs** to study information scrambling and time-reversal behaviour.
2. **Developer:** Google Quantum AI team and collaborators.
3. **Aim:** Demonstrate tasks impossible for classical supercomputers.
4. **Method:** Sends a quantum signal, evolves it, then reverses time to generate an **echo** revealing quantum interactions.
5. **Perturbation Test:** Small mid-way disturbances show interference patterns proving genuine quantum behaviour.
6. **Performance:** Ran **13,000× faster** than the world's best supercomputers.
7. **Applications:** Useful in quantum chemistry, material science, and physics modelling.
8. **Significance:** Marks a major milestone in practical quantum computing.

CERTIFIED RANDOMNESS TECHNIQUE USING ONE QUBIT

Recent Update: RRI demonstrated India's first **certified quantum randomness** protocol using a **single qubit** on IBM's cloud quantum computer.



About:

1. A **quantum-based randomness** technique using intrinsic **unpredictability** of quantum mechanics.
2. Produces **truly random numbers** that cannot be replicated by classical systems, ensuring **cryptographic security**.
3. Developed by **Raman Research Institute (RRI)** with **IBM Quantum**.
4. Uses **one qubit** with controlled **single-qubit gate rotations**, making it highly efficient.

5. Validates randomness using **Leggett–Garg Inequality (LGI)** tests, confirming quantum behaviour.
6. Ensures **no-signalling-in-time**, proving randomness is not from external interference.
7. Uses **error mitigation** to remove hardware and classical noise.
8. Strengthens India's progress in **quantum communication** and **secure encryption**.

INDIA MOBILE CONGRESS (IMC) 2025

Recent Update: PM inaugurated **IMC 2025**, highlighting India's strides in **5G–6G, AI, semiconductors**, and digital innovation.

About:

1. Asia's largest **digital communications and tech forum** showcasing national and global innovations.
2. Organised by **DoT** and **COAI** under the **Ministry of Communications**.
3. 2025 theme: **"Innovate to Transform"** focusing on future digital ecosystems.
4. Participation from **150+ countries**, **400+ companies**, and **1.5 lakh visitors**.
5. Displayed **1,600+ new tech use cases** in telecom, AI, cybersecurity, and green tech.
6. Key focus: **5G**, **6G**, **optical networks**, **quantum tech**, and **semiconductors**.
7. Provides a major platform for **startups**, **industry**, and **academia** to showcase solutions.
8. Supports **Digital India** and **Atmanirbhar Bharat** goals in telecom self-reliance.

SARAL TOOL

Recent Update: ANRF launched **SARAL**, an AI tool for simplifying complex research papers into accessible summaries.

About:

1. **AI-based tool** converting scientific research into **easy-to-understand summaries**.
2. Developed by the **Anusandhan National Research Foundation (ANRF)**.
3. Extracts **key insights** using AI and presents them as **text, videos, posters, and podcasts**.
4. Makes scientific knowledge accessible to **students, policymakers, industry**, and the public.
5. Supports creation of an **AI Science & Engineering Open India Stack**.
6. Enhances **research communication** and improves innovation adoption.
7. Helps industries interpret **academic research** more efficiently.
8. Aligns with India's **₹1 lakh crore RDI scheme** to boost national deep-tech capacity.

GSAT-7R SATELLITE

Recent Update: ISRO is set to launch **GSAT-7R (CMS-03)** aboard **LVM-3**, upgrading India's military communication.

About:

1. A next-gen **military communication satellite** replacing **GSAT-7A**.
2. Provides **encrypted, secure, long-range** communication for **Navy, Air Force, and Army**.
3. Key for **network-centric warfare** and **maritime domain awareness**.
4. Operates on **Ku, Ka, and UHF bands** ensuring anti-jamming capability.
5. Covers entire **Indian Ocean Region (IOR)**, East Africa, and Southeast Asia.
6. ISRO's heaviest military communication satellite (**~4,400 kg**).
7. Equipped with **frequency hopping**, **advanced encryption**, and **anti-jamming tech**.
8. Launched via **LVM-3**, India's most powerful operational launcher.

SOURCE: INSIGHTS MONTHLY

COMETS IN THE NEWS

Recent Update: Two rare comets — **C/2025 R2 (SWAN)** and **C/2025 A6 (Lemmon)** — appeared simultaneously in Indian skies.

About:

1. **Comet SWAN** was detected by **SOHO's SWAN instrument**, visible with a faint tail.
2. SWAN will return only after **20,000 years**.

3. **Comet Lemmon** is brighter (magnitude 4.5), visible near **Bootes constellation**.
4. Lemmon will return in **3175**, making it once-in-a-

millennium.
5. Comets consist of **nucleus**, **coma**, and **dust/ion tails** pointing away from the Sun.
6. They are remnants of early **Solar System formation (4.6 billion years)**.
7. May have delivered **water and organic molecules** to early Earth.
8. Named per **IAU rules** — after discoverers or detecting instruments.

CHACE-2 PAYLOAD (CHANDRAYAAN-2)

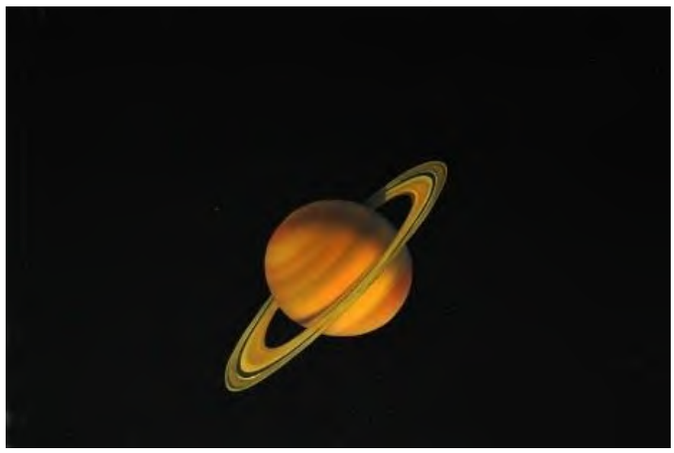
Recent Update: CHACE-2 made the **world's first direct measurement** of a **CME impact on the Moon**.

About:

1. A **neutral gas mass spectrometer** aboard the **Chandrayaan-2 orbiter**.
2. Studies composition and density of the **lunar exosphere**.
3. Measures gases in the **1–300 amu** range including water vapour and noble gases.
4. Successor to **CHACE (CY-1)** and **MENCA (MOM)** instruments.
5. Provides **in-situ data** on exospheric variability.
6. Detects gases like **Argon-40** and maps their distribution.
7. Helps model **surface–exosphere interactions**.
8. Essential for understanding **space weather effects** on the Moon.

CELESTIAL BODY – CHIRON

Recent Update: Astronomers observed **ring formation** around **Chiron**, the first real-time ring evolution seen around a small body.



About:

1. Chiron is a **centaur object** — hybrid of an asteroid and comet.
2. Discovered in **1977**; first-known object in the centaur category.
3. **~200 km** wide with an orbit of **~50 years**.
4. Contains **rock, water ice, and organic materials**.
5. Shows occasional **comet-like outgassing**.
6. Newly discovered system includes **three dense rings** and **one diffuse outer ring**.
7. Rings likely formed from **collision debris** or expelled material.
8. Helps understand **ring dynamics** of small celestial bodies.

CREW ESCAPE SYSTEM (CES) – GAGANYAAN

Recent Update: ISRO validated the **full CES operation** in the latest Gaganyaan safety demonstration.

About:

1. A rapid **astronaut escape mechanism** activated during launch emergencies.
2. Mounted atop **LVM-3**, using **high-burn solid motors**.

3. Triggered automatically by the **IVHM system** when anomalies occur.
4. Generates higher thrust than the rocket to **pull the crew module away instantly**.
5. Enables **multi-stage parachute descent** and safe splashdown.
6. Uses **puller-type** escape configuration used in **Soyuz** and **Saturn-V**.
7. Protects astronauts during **critical ascent phase**.
8. Essential to **human-rate** India's first crewed mission.

DEFENCE PROCUREMENT MANUAL (DPM) 2025

Recent Update: Defence Minister released **DPM-2025**, replacing DPM-2009 to modernize procurement.

About:

1. New manual for **revenue procurement** under the Ministry of Defence.
2. Simplifies processes worth nearly **₹1 lakh crore annually**.
3. Encourages **MSME and startup participation** through relaxed norms.
4. Caps **Liquidated Damages** at **10%**, reducing punitive burden.
5. Allows **long-term assured orders** up to 5 years for indigenous products.
6. Removes outdated **Ordnance Factory Board NOC requirement**.
7. Enhances **transparency, accountability, and speed** in procurement.
8. Supports **Make in India** and India's defence self-sufficiency goals.

INS VIKRANT

Recent Update: PM celebrated Diwali onboard **INS Vikrant**, praising its role in **Operation Sindoor**.

About:

1. India's first **indigenously built aircraft carrier**, constructed by **Cochin Shipyard**.
2. Symbol of India's **naval modernisation** and **Aatmanirbhar Bharat**.
3. Named after the historic carrier from the **1971 Indo-Pak War**.
4. Enhances **blue-water capability** across the Indian Ocean Region.
5. Supports **fighters, helicopters**, and multirole aircraft.
6. Strengthens **maritime deterrence and power projection**.
7. Crucial for **HADR operations** and crisis response.
8. Key asset for India's **Indo-Pacific maritime strategy**.

SAKSHAM COUNTER-UNMANNED AERIAL THREAT GRID

Recent Update: Indian Army began induction of the **AI-driven Saksham Counter-UAS Grid**.

About:

1. A modular **AI-driven C2 system** detecting and neutralising hostile drones.
2. Developed by **BEL** with the **Indian Army Air Defence Corps**.
3. Integrates sensors, radars, drones, and weapons into a **unified air picture**.
4. Uses **AI/ML algorithms** for drone classification and threat prioritisation.
5. Secures **airspace up to 3,000 m** (Air Littoral Zone).
6. Connected to the **Army Data Network**, ensuring secure real-time operations.
7. Interoperable with the **Akashteer Air Defence System** for automated interception.
8. Protects against **surveillance drones, swarm attacks**, and aerial incursions.

INDIAAIMISSION AND ITS ROLE IN FOSTERING A RESPONSIBLE AI ECOSYSTEM IN INDIA

Recent Update: IndiaAI Mission introduced **seven governance pillars** to ensure **safe, trusted, inclusive**

and responsible AI deployment across sectors.

About:

1. **IndiaAI Compute:** Provides subsidised **high-end GPUs at ₹65/hour**, enabling affordable AI training for startups, research labs, and academia.
2. **IndiaAI Application Development Initiative:** Builds **India-specific AI solutions** in **healthcare, agriculture, climate, governance**, and assistive learning.
3. **AIKosh Dataset Platform:** Creates large **curated datasets** from government & private sources to strengthen **model training reliability**.
4. **IndiaAI Foundation Models:** Develops Indian **Large Multimodal Models (LMMs)** using **Indian languages and datasets**, enhancing **AI sovereignty**.
5. **IndiaAI FutureSkills:** Builds a skilled workforce through **AI skilling, certification, and capacity-building programmes**.
6. **IndiaAI Startup Financing:** Financially supports AI startups via the **IndiaAI Startups Global Programme (2025)**.
7. **Safe & Trusted AI:** Ensures ethical AI through **bias mitigation, machine unlearning, privacy-preserving ML, explainability, auditing, and governance testing**.

INDIA'S ROADMAP FOR FUSION POWER

Recent Update: IPR proposed a national roadmap for the **SST-Bharat tokamak**, advancing India's long-term shift towards **fusion energy**.

About:

1. Fusion is the process where **light atoms (H-isotopes)** combine into heavier atoms, releasing **massive clean energy**.
2. Occurs due to **mass defect** where lost mass converts into energy (**$E=mc^2$**).
3. Requires extreme conditions: **100 million°C**, high pressure, and a fully ionised **plasma** state.
4. **Tokamaks** use powerful magnetic fields to confine plasma in a **doughnut-shaped chamber**.
5. Longer plasma confinement brings reactors closer to **self-sustaining fusion**.
6. Fusion efficiency measured by **Q-value**, where **Q>1** means net power generation.
7. Fusion is fundamentally different from **fission**, which splits heavy atoms like uranium.
8. SST-Bharat marks India's first major step toward **steady-state fusion power generation**.

SAFE AND TRUSTED AI ECOSYSTEM IN INDIA

Recent Update: MeitY selected **five pioneering projects** under the **Safe & Trusted AI pillar** focusing on deepfake detection, bias mitigation and AI security.

About:

1. Implemented by **IndiaAI Division (MeitY)**, ensuring ethical & responsible AI.
2. Aim is to **democratise AI benefits** while safeguarding against misuse and algorithmic harm.
3. **Saakshya (IIT Jodhpur & IIT Madras):** Real-time multi-agent **deepfake detection** using RAG.
4. **AI Vishleshak (IIT Mandi):** Enhanced detection of **audio-visual deepfakes & signature forgery**.
5. **IIT Kharagpur:** Tools for **real-time voice deepfake detection**, preventing identity fraud.
6. **Gender Bias Evaluation in Agri-LLMs:** Benchmarks & mitigates **biases affecting women farmers**.
7. **Anvil (IIIT Dharwad):** Pen-testing framework for **LLMs**, strengthening AI system security.
8. Strengthens India's commitment to **safe, unbiased and accountable AI models**.

SOURCE: DRISHTI MONTHLY

DESERT SOILIFICATION TECHNOLOGY

Recent Update: Wheat was successfully grown in **western Rajasthan** using new **desert soilification biotechnology**.

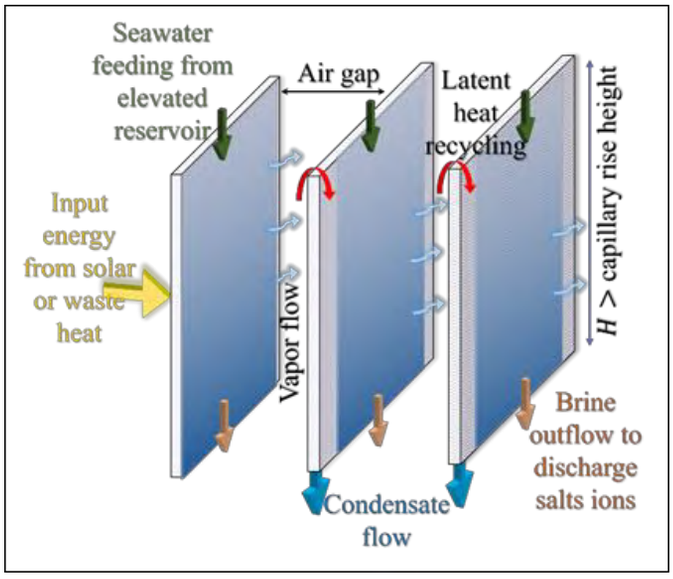
About:

1. Converts **barren desert sand** into soil capable of sustaining crops.
2. Uses **bioformulations & polymers** to bind sand particles and improve **soil structure**.
3. Greatly improves **water retention**, reducing irrigation requirements.
4. Enhances **heat and drought tolerance** of crops like wheat, bajra, guar, chickpea.
5. Produces **54% higher yields** than traditional soils in arid zones.
6. Supports expansion of agriculture in **climate-stressed regions**.

7. Offers scalable, low-cost desert farming solutions for India.
8. Helps achieve **food security** in water-scarce environments.

SIPHON-POWERED DESALINATION

Recent Update: IISc developed a **siphon-based thermal desalination system** producing record-high clean water output.



About:

1. Works on **gravity-driven siphon flow** using a composite wick-metallic siphon.
2. Removes salts before crystallisation, avoiding **clogging** seen in traditional systems.
3. Generates **6+ litres/m²/hour** of potable water under sunlight—far above solar stills.
4. Treats **high-salinity water (up to 20%)** effectively.
5. Uses simple materials (aluminium, fabric), making it **low-cost and scalable**.
6. Can run on **solar or waste heat**, ideal for coastal and rural areas.
7. Reduces energy requirement compared to conventional desalination.
8. Supports India's push for **sustainable water solutions**.

QUANTUM BREAKTHROUGH IN DIGITAL SECURITY

Recent Update: RRI demonstrated the world's first method to generate **true random numbers** using a commercial quantum computer.

About:

1. Major achievement under India's **National Quantum Mission**.
2. Uses **quantum randomness**—impossible to predict or reproduce—to create secure keys.
3. Introduces **time separation**, not spatial separation, enabling simpler setups.
4. Works on single-particle quantum evolution, making it more **practically deployable**.
5. Ensures **hack-proof encryption** for national infrastructure.
6. Provides strong commercial potential for **banking, telecom, cybersecurity**.
7. Establishes India in the global race for **quantum-secure communication**.
8. Key step toward **quantum cryptography deployment**.

JAMES WEBB SPACE TELESCOPE (JWST)

Recent Update: JWST captured new ultra-deep field images refining estimates of **early galaxy formation**.

About:

1. Launched in **2021** by **NASA–ESA–CSA** collaboration.
2. Largest and most powerful **infrared space telescope** ever built.
3. Operates at **L2 Lagrange Point** (1.5 million km from Earth).
4. Studies **first light of the universe**, early galaxies, star formation, exoplanets.
5. Uses a **6.5-m gold-coated mirror** for high-sensitivity imaging.
6. Complements Hubble by observing **infrared wavelengths**.
7. Critical for understanding **cosmic evolution and habitable worlds**.

PROTEIN LANGUAGE MODELS (PLMs)

Recent Update: PLMs used to accelerate **new vaccine antigen design** in India's biotech institutes.

About:

1. PLMs adapt **LLM architecture** to study **proteins**, treating amino acids as "tokens".
2. Trained on millions of **protein sequences** to learn folding and structure.
3. Predict **functional properties**, interactions, and mutation effects.
4. Revolutionises **drug discovery** by reducing laboratory time and cost.
5. Allows prediction of **stable structures**, aiding precision medicine.
6. Helps develop **vaccines and therapeutic molecules** faster.
7. Part of the emerging field of **AI-driven biological modelling**.

ACANTHAMOEBA

Recent Update: Medical authorities issued fresh advisories after several **Acanthamoeba-linked eye**

infection cases were reported in contact-lens users.

About:

1. **Acanthamoeba** is a **free-living amoeba** found in **water, soil, dust**, and poorly maintained water systems.
2. Thrives in **swimming pools, hot tubs, drinking water pipelines, humidifiers, and HVAC systems**.
3. Enters the body via **cuts, inhalation**, or through the **eyes** — especially in contact lens users.
4. Causes severe conditions like **Acanthamoeba keratitis (eye)** and **Granulomatous Amoebic Encephalitis (brain)**.
5. Highly resistant to **chlorination** and survives in extreme environmental conditions.
6. Not transmitted person-to-person; exposure occurs from **environmental contamination**.
7. Prevention includes **lens hygiene**, avoiding lenses in water, and disinfecting equipment properly.

CLAMP PROGRAM

Recent Update: CLAMP used in Nagaland fossil-site study indicating **Antarctic influence on monsoon evolution**.

About:

1. **Climate Leaf Analysis Multivariate Program** reconstructs past climate.
2. Uses **fossil leaf morphology** as climate fingerprints.
3. Determines **temperature, rainfall, humidity** of ancient environments.
4. Widely used where **sediment/ice records** are absent.
5. Supports **paleoclimate modelling** and monsoon studies.
6. Helps understand Earth's **geological–climatic transitions**.
7. Valuable tool in **climate change research**.

SPIN90 PROTEIN

Recent Update: Scientists discovered SPIN90's role in **cell shape regulation**.

About:

1. SPIN90 controls formation of **actin meshwork** under cell membrane.
2. Actin rearrangement allows **cell protrusions**.
3. Important for **wound healing**, immune response, cancer metastasis.
4. Regulates direction of **cell movement**.
5. Modulates internal **cytoskeleton architecture**.
6. Essential for cells combating **pathogens**.
7. New therapeutic target for **cancer & inflammatory diseases**.
8. Advances understanding of **cellular biomechanics**.

EXTREME NUCLEAR TRANSIENTS (ENTS)

Recent Update: New ENT detected in a distant galaxy, noted as among the **brightest cosmic explosions**.

About:

1. ENTs occur when massive stars are torn apart by **supermassive black holes**.
2. Tidal forces stretch star into **spaghettified streams**.
3. Releases enormous **electromagnetic energy**.
4. Considered **biggest explosions since Big Bang**.
5. Similar to **Tidal Disruption Events**, but far more energetic.
6. Occur in galaxies with **very massive black holes**.
7. Help understand **black hole accretion & cosmic evolution**.
8. Detected via **high-energy telescopes**.

BIOSIGNATURES ON MARS

Recent Update: NASA's Perseverance rover detected the **strongest potential biosignatures** in Jezero Crater.

About:

1. Biosignatures found in **Cheyava Falls rock** at Sapphire Canyon.
2. Findings include **organic carbon**, **phosphate**, and **electron-transfer minerals**.
3. Rock shows **mottled textures**, black "poppy-seed" inclusions, and **sulphate veins**.
4. Indicates ancient **water–rock interactions** on Mars.
5. Sapphire Canyon was discovered in **2024** in Neretva Vallis near Jezero.
6. Signals possible **microbial-friendly past environments**.
7. Strengthens case for **ancient Martian habitability**.
8. Supports planning for future **Mars Sample Return** missions.

SOURCE: PIB

AQUAMONITRIX

Recent Update: Aquamonitrix introduced as a **portable alternative** to ion chromatography.

About:

1. Designed for **field-based detection** of nitrate and nitrite ions.
2. Replaces bulky laboratory **ion chromatography systems**.
3. Useful for **water-quality monitoring** in polluted environments.
4. Detects harmful **nutrient pollution** in soil and water.
5. Compact, portable, and easy to deploy.
6. Helps monitor **agricultural runoff** and groundwater contamination.
7. Supports **environmental regulation and enforcement**.
8. Relevant for UPSC (2024) context linked to **membrane bioreactors**.

WORLD'S FIRST AI-DESIGNED VIRAL GENOME

Recent Update: Researchers created first **AI-designed bacteriophage genome** using model 'Evo'.

About:

1. Based on **Bacteriophage ΦX174**, which infects *E. coli*.
2. Marks shift from DNA sequencing to **AI-driven DNA design**.
3. Uses **generative genomic model** for virus design.
4. Demonstrates ability to create **synthetic biological systems**.
5. Aims to develop **phage therapies** against antibiotic-resistant bacteria.
6. Builds on earlier breakthroughs like **AlphaFold (2024)**.
7. Strengthens fields of **synthetic biology & genetic engineering**.
8. *E. coli* remains a key **model organism** in biotechnology.

INDIGENOUS 7NM PROCESSOR (IIT MADRAS)

Recent Update: India unveiled its **indigenous 7 nm processor**, developed by IIT Madras under the **SHAKTI initiative**.

About:

1. Represents a major leap in India's **semiconductor design ecosystem**.
2. The 7 nm node offers **higher performance, lower power consumption**, and dense transistor packing.
3. Strengthens national capability in **AI, 5G, IoT, cloud, and defence computing**.
4. Reduces dependence on imported advanced chips.
5. Supports critical sectors like **space, cybersecurity, and strategic communications**.
6. Places India among few nations with **advanced chip-design capability**.
7. Aligned with **India Semiconductor Mission** and digital sovereignty goals.
8. Enhances long-term prospects for domestic **chip fabrication ecosystems**.

DIRECT BROADCAST NETWORK (DBNet)

Recent Update: NCMRWF & NSIL signed MoU to set up **DBNet stations in Delhi & Chennai**.

About:

1. Global system for **real-time LEO satellite data acquisition**.
2. Critical for **Numerical Weather Prediction (NWP)**.
3. Supports cyclone tracking & disaster forecasting.
4. Enhances **climate research & atmospheric modelling**.
5. Integrates multiple **meteorological satellites**.
6. Reduces data latency for **weather alerts**.
7. Improves India's **forecasting accuracy**.
8. Key asset for **early warning systems**.

JAROSITE

Recent Update: Researchers have confirmed **jarosite deposits in Matanomadh (Kutch, Gujarat)** dating back 55 million years.

About:

1. **Jarosite** is a **yellow-brown potassium–iron sulphate mineral** formed in **arid, acidic and saline environments**.
2. It forms when **iron-, sulphur- and potassium-rich rocks react with water**, often linked to **volcanic activity**.
3. First detected on **Mars (2004)** by NASA's **Opportunity Rover**, providing strong evidence of **past water activity**.
4. In India, jarosite is known from **Varkala cliffs (Kerala)** and now **Kutch (Gujarat)**.
5. Globally, it occurs in **Mexico, Canada, Japan, Spain, Utah, and California**.
6. It helps scientists trace **palaeo-environmental conditions** and **planetary evolution**, especially on Mars.
7. Jarosite can **trap organic molecules**, making it important for **astrobiology and future Mars missions**.

TPCR 2025

Recent Update: MoD released the **Technology Perspective & Capability Roadmap 2025**.

About:

1. A **15-year strategic roadmap** to guide defence capability development.
2. Covers requirements for **Army, Navy, Air Force**.
3. Helps industry align R&D with **future battlefield needs**.
4. Focus areas: **AI, drones, cyber warfare, EW systems, advanced materials**.
5. Encourages **indigenisation** under Atmanirbhar Bharat.
6. Improves long-term **procurement planning** and innovation.
7. Strengthens **industry–academia–DRDO** collaboration.

INTERNATIONAL EARTH SCIENCES OLYMPIAD (IESO)

Recent Update: India participated in **IESO 2025** held in **Jining, China**.

About:

1. Established in **2003** by the **International Geoscience Education Organization (IGEO)**.
2. Annual competition for students of **Classes IX–XII**.
3. India has participated since inception and hosted the **2013 edition at Mysore**.
4. Conducted nationally through **INESO** by MoES + Geological Society of India.
5. Supported under **MoES REACHOUT** within the **PRITHVI scheme**.
6. Tests knowledge in **geology, meteorology, oceanography, astronomy**.
7. Promotes scientific temper and international collaboration among students.

GAGANYAAN ANALOG EXPERIMENTS (GYANEX)

Recent Update: ISRO completed **Gyanex-1** with 10-day confinement experiments for astronaut preparation.

About:

1. **Gyanex** = India's *first systematic space-medicine and astronaut-psychology programme*.
2. Conducted jointly by **ISRO, ICMR & Institute of Aerospace Medicine**.
3. Simulates astronaut behaviour for **Gaganyaan Mission 2027**.
4. Gyanex-1: 3 participants including **Group Captain Angad Pratap** completed 11 experiments.
5. Experiments covered **psychology, biomedicine, communication** & behavioural adaptation.
6. Supports future **lunar missions, space stations & interplanetary expeditions**.
7. Related analog missions: **Ladakh Human Analog Mission (2024)** & **HOPE Habitat at Tso Kar (2025)**.
8. Tests survival conditions like **low pressure, UV radiation, saline permafrost**.

MANGANESE

Recent Update: India reaffirmed status as **5th-largest manganese producer** with major deposits in Odisha.

About:

1. **5th most abundant metal** on Earth; occurs as **oxides, carbonates, silicates**.
2. Not found free in nature; often associated with **iron**.

3. Widely used in **steel alloys**, batteries, renewable energy applications.
4. Key minerals: **Pyrolusite (MnO_2)** & **Rhodochrosite ($MnCO_3$)**.
5. Major global producers: **South Africa, Australia, China, Brazil**.
6. India = **5th-largest producer**; major states: **Odisha (44%), Karnataka, Maharashtra, MP, AP**.
7. Essential for **plant nitrate assimilation** & biological enzymes.
8. Used in **Li-ion batteries, solar/wind technologies**.

SMOG

Recent Update: Delhi initiated feasibility studies for **smog-eating TiO_2 coatings**.

About:

1. Smog = **smoke + fog**, caused by **coal burning, vehicles & industries**.
2. Contains pollutants like **SO_2, NO_2, CO, hydrocarbons, ozone**.
3. Types: **Sulfurous Smog (London Type)** & **Photochemical Smog (Los Angeles Type)**.
4. Aggravated by **inversion layers, low rainfall**, stagnant air.
5. Causes **respiratory distress, eye irritation, visibility loss**.
6. Primary pollutants → directly emitted; Secondary pollutants → formed in atmosphere.
7. **Haze ≠ Smog** (haze = dry particles; smog = pollutants + condensation).
8. Smog-eating coatings use **TiO_2 photocatalysis** to degrade NO_2 & hydrocarbons.

SOURCE: DOWN TO EARTH

SUPERCOMPUTER

Recent Update: AIRAWAT PSAI recognised as **India's largest AI supercomputing system**.

About:

1. Supercomputers perform **exaflop-scale** (10^{18} FLOPS) operations.
2. Used in **weather modelling, nuclear simulations, AI, drug discovery**.

3. India's major systems: **AIRAWAT, PARAM Siddhi, Pratyush, Mihir, Param Shivay**.
4. Measure performance in **FLOPS** (floating-point operations/s).
5. Mission: **National Supercomputing Mission (NSM)** launched 2015.
6. Implemented by **C-DAC & IISc**.
7. **Rudra** = India's first indigenous HPC server.
8. World's fastest: **El Capitan (USA)**; Europe's first exascale: **JUPITER (Germany)**.

GENDERED AND REGIONAL DIMENSIONS OF CANCER IN INDIA

Recent Update: NCRP's 2024–25 analysis highlights widening gender and regional disparities in cancer incidence and mortality.

About:

1. India recorded **1.56 million cases in 2024**, with crude incidence rates slightly higher among women (113.3) than men (107.4).
2. Women face higher risk due to **lifestyle changes, occupational exposure, delayed childbirth**, and hormonal factors linked to pollution.
3. Men show higher mortality due to **late diagnosis**, tobacco use, and rising non-communicable diseases.
4. NCRP identifies the **Northeast** as India's cancer hotspot, with Aizawl and Papumpare recording highest AAIR.
5. Unique regional cancers (oesophageal, stomach, nasopharyngeal) stem from **smoked foods, fermented meats, tobacco liquid (tuibur)** and household smoke.
6. Rural regions are witnessing rising incidence due to increasing consumption of **processed foods** and lack of screening facilities.
7. High mortality persists due to **low awareness, late detection, and uneven oncology capacity** across states.

8. Strategies include targeted screening, risk-factor reduction, early-diagnosis programs, and region-specific interventions.

TRANSMISSION TRAP: CHALLENGES WITH INDIA'S RENEWABLE ENERGY

Recent Update: Solar and wind plants across major states faced curtailments in 2024–25, causing losses exceeding ₹700 crore.

About:

1. Renewable projects in Rajasthan, Gujarat, TN, and Maharashtra were curtailed due to **grid congestion and lack of transmission access**.
2. Delays in building transmission corridors have forced many plants to operate under **Temporary GNA**, offering no compensation for curtailments.
3. Rajasthan alone curtailed nearly **4 GW of capacity**, severely affecting project economics and investor confidence.
4. CEA's inaccurate demand forecasting during unusual monsoon patterns led to **daily 10 GW curtailments** nationwide.
5. Even coal plants ran at **40% load**, highlighting systemic grid imbalance and misalignment of supply-demand systems.
6. TGNA projects face severe financial risks as PPAs do not mandate compensation for forced shutdowns.
7. Sectoral uncertainty threatens India's **500 GW non-fossil fuel** target for 2030.
8. Solutions include rapid transmission expansion, **HVDC lines**, BESS deployment, annual planning cycles, and regulatory clarity.

H3N2 INFLUENZA SURGE IN NCR

Recent Update: NCR reported rising H3N2 influenza cases in early 2025, especially among children and elderly.

About:

1. H3N2 is a subtype of Influenza A known for **severe symptoms and longer recovery** than H1N1.
2. High-risk groups include children <10, adults >60, and people with asthma, diabetes, or cardiac conditions.
3. Hospitals report increased secondary bacterial infections complicating recovery.
4. MoHFW advises mask use, vaccination, and improved surveillance through IDSP.
5. 28 sentinel sites monitor ILI and SARI cases across India.
6. Genome sequencing recommended to detect emerging variants.
7. Early isolation and clinical management are essential to prevent pneumonia.

INDIA'S CARBOHYDRATE-HEAVY DIET & RISING DIABETES

Recent Update: The ICMR–INDIAB study links India's **62% carb-based diet** to rising type-2 diabetes and obesity.

About:

1. Indians derive around **62% of calories** from carbs—mainly **white rice** and **refined grains**.
2. High carb intake raises new diabetes risk by **14%**, per a survey of 1.21 lakh adults.
3. India faces expanding **type-2 diabetes**, driven by insulin resistance and poor dietary diversity.
4. Sedentary lifestyles, processed food consumption, and obesity aggravate metabolic disorders.
5. Rapid urbanisation worsens **nutritional imbalance**.
6. Public-health experts call for **whole grains**, **pulses**, and **protein-rich diets**.
7. Awareness campaigns on **nutrition literacy** remain inadequate.

INDIA ACHIEVES 500 GW ELECTRICITY CAPACITY

Recent Update: India crossed **500 GW installed capacity** (Sept 2025), and on **29 July 2025**, renewables supplied **51.5%** of national power demand.

About:

1. Renewable generation hit a record high: **Solar 44.50 GW**, **Wind 29.89 GW**, **Hydro 30.29 GW**.
2. Non-fossil additions (April–Sept 2025) totalled **28 GW**, exceeding fossil capacity additions.
3. India achieved the **COP26 target** of 50% non-fossil capacity **five years early**.
4. Significantly reduces reliance on coal and enhances **energy security**.
5. Boosts India's global leadership in **clean energy transition**.
6. Creates jobs in solar, wind, storage, and **green hydrogen** sectors.
7. Encourages large-scale domestic and foreign investment in renewable markets.

TOPICS COVERED-

1. **India's Leap in Research and Innovation**
2. **YUVA AI for All**
3. **Cloud Seeding in India**
4. **Data Centres in India**
5. **National Blockchain Framework**
6. **Bharat 6G Mission**
7. **Google's Verifiable Quantum Advantage**
8. **Hepatitis A**
9. **UNESCO's Neurotechnology Ethics Framework**
10. **Solar Storms, Coronal Mass Ejections and Auroras**
11. **National One Health Mission**
12. **Key Pillars of the One Health Mission**
13. **Need for One Health Approach**
14. **National Action Plan on Antimicrobial Resistance (NAP-AMR) 2.0**
15. **Birsa-101 Gene Therapy**
16. **WHO Tuberculosis Report**
17. **GSAT-7R (CMS-03) Satellite**
18. **CAR-T Cell Therapy (NexCAR19)**
19. **Satellite-Based Internet**
20. **Vanadium Redox Flow Battery**
21. **ESCAPADE Mission**
22. **Satellite-Based Internet and Space Security**
23. **Defence Atmanirbharta: Record Production and Exports**
24. **Research, Development and Innovation (RDI) Scheme**
25. **Precision Biotherapeutics**
26. **Auramine O**
27. **Zinc–Ion Batteries**
28. **Ammonium Nitrate**
29. **Altermagnetism**
30. **Odd Radio Circles**
31. **Superbugs**
32. **Birsa-101 Gene Therapy (CRISPR-Based)**
33. **Lab-Grown Milk**
34. **Second Regional Open Digital Health Summit 2025**
35. **National Action Plan on Antimicrobial Resistance (NAP-AMR) 2.0**
36. **African Swine Fever**
37. **Ten Years of AMRIT Pharmacy**
38. **Cohort Connect 2025**
39. **Hepatitis A and Public Health**
40. **Universal Immunisation Programme**

41. **Transplantation of Human Organs and Tissues Rules, 2025**
42. **GNSS Spoofing**
43. **India’s First Indigenous High-Precision Diode Laser**
44. **AI-Based Locking Monitoring System ‘DRISHTI’**
45. **Project Suncatcher**
46. **Maharashtra–Starlink Partnership**
47. **India’s First 500 km Quantum Key Distribution Network**
48. **LVM3-M5 Launch Vehicle**
49. **Interstellar Mapping and Acceleration Probe (IMAP)**
50. **Cassini Spacecraft**
51. **Astra Mark-2 Missile**
52. **Crew Escape System**
53. **Gaia Spacecraft**
54. **Space MAITRI Mission**
55. **NewSpace India Limited**
56. **CMS-03 Satellite (GSAT-7R)**
57. **MuleHunter.AI**
58. **Supercapacitors**

SOURCE: DRISHTI MONTHLY

INDIA'S LEAP IN RESEARCH AND INNOVATION

Recent Update:
India launched the ₹1 lakh crore **Research, Development and Innovation (RDI) Scheme** in November 2025 to strengthen the country's **innovation ecosystem** and accelerate progress towards **Viksit Bharat @2047**.

About:

1. The RDI initiative aims to transform India into a **self-reliant, knowledge-driven economy** by strengthening research capacity across strategic sectors.
2. It represents a shift from **public-funded research** to **public–private innovation partnerships**.
3. Priority areas include **Artificial Intelligence, Quantum Technologies, Semiconductors, Deep Tech, and Biotechnology**.
4. India's **Gross Expenditure on R&D (GERD)** rose from ₹60,196 crore (2010–11) to ₹1.27 lakh crore (2020–21).
5. R&D spending remains around **0.7% of GDP**, lower than the **OECD average of 2–3%**.
6. The **private sector's contribution** to research is increasing steadily.
7. India ranks among the **top three globally in PhD production**, strengthening scientific manpower.

YUVA AI FOR ALL

Recent Update:
The **YUVA AI for All** initiative was launched under the **IndiaAI Mission** to democratise access to artificial intelligence education.

About:

1. It is a **free, self-paced 4.5-hour AI literacy programme** for students, professionals, and citizens.
2. Delivered through **FutureSkills Prime** and **iGOT Karmayogi** platforms.
3. Designed by AI expert **Jaspreet Bindra**.
4. Focuses on **ethical, responsible, and inclusive AI development**.
5. Covers AI fundamentals, real-life applications, and emerging trends.
6. Emphasises **Indian use cases** in governance, healthcare, agriculture, and fintech.
7. Supports the goal of creating a **digitally skilled and AI-ready workforce**.

CLOUD SEEDING IN INDIA

Recent Update:
The Delhi government explored **cloud seeding** with IIT Kanpur to address post-monsoon air pollution.

About:

1. Cloud seeding is a **weather modification technique** used to enhance rainfall.
2. It involves dispersing **silver iodide, potassium iodide, or dry ice** into clouds.
3. These substances act as **condensation or ice nuclei**, aiding precipitation.
4. Cloud seeding works only when **suitable moisture-bearing clouds** are present.
5. It cannot create clouds artificially, only enhance existing ones.
6. The **CAIPEEX programme** under the Ministry of Earth Sciences studies its feasibility.
7. Scientific limitations make its effectiveness **season- and condition-dependent**.

DATA CENTRES IN INDIA

Recent Update:
India's data centre capacity is projected to rise from **1.2 GW (2025)** to **9 GW by 2032**.

About:

1. Data centres house critical **IT infrastructure**, including servers, storage, and networking systems.
2. They are essential for **cloud computing, AI, fintech, and digital governance**.
3. India hosts nearly **150 data centres**, with Mumbai as the primary hub.
4. Rapid growth is driven by **digitalisation, 5G rollout, and AI adoption**.
5. Despite producing **20% of global data**, India holds only **3% of global data capacity**.

6. **Data localisation policies** have accelerated domestic infrastructure investment.
7. The sector is expected to generate **₹50,000 crore** and large-scale employment.

NATIONAL BLOCKCHAIN FRAMEWORK

Recent Update:
India launched the **National Blockchain Framework (NBF)** to strengthen digital governance.

About:

1. NBF provides a **secure, interoperable blockchain architecture** for public services.
2. It enhances **transparency, traceability, and trust** in governance systems.
3. The **Vishvasya Blockchain Stack** forms its technical foundation.
4. Supports land records, judiciary, identity verification, and document management.
5. Integrates with the **Interoperable Criminal Justice System (ICJS)**.
6. Encourages **indigenous blockchain innovation** and digital sovereignty.
7. Strengthens cyber resilience and administrative efficiency.

BHARAT 6G MISSION

Recent Update:
India showcased its leadership vision at the **2nd International Bharat 6G Symposium**.

About:

1. The mission aims to make India a **global co-creator of 6G technologies** by 2030.
2. It supports **affordable, secure, and inclusive digital connectivity**.
3. Promotes indigenous R&D and **intellectual property generation**.
4. Establishes **6G testbeds and advanced telecom labs** nationwide.
5. Encourages collaboration between **government, academia, and industry**.
6. Funded through the **Telecom Technology Development Fund (TTDF)**.
7. Aligns with the vision of **Atmanirbhar Bharat and Viksit Bharat**.

GOOGLE'S VERIFIABLE QUANTUM ADVANTAGE

Recent Update:
Google achieved **verifiable quantum advantage** using its **Willow quantum processor**.

About:

1. Quantum advantage refers to tasks **infeasible for classical supercomputers**.
2. The experiment used the **Quantum Echoes algorithm**.
3. It enabled precise measurement of **quantum entanglement and coherence**.
4. Calculations were completed in hours instead of years.
5. Demonstrates practical potential of **fault-tolerant quantum systems**.
6. Enables progress in **materials science, chemistry, and cryptography**.
7. Marks a significant milestone toward **scalable quantum computing**.

HEPATITIS A

Recent Update:
Experts recommend including **Hepatitis A vaccination** in the Universal Immunisation Programme.

About:

1. Hepatitis A is a **viral liver disease** transmitted through contaminated food and water.
2. Symptoms include **fever, jaundice, nausea, and fatigue**.
3. Improved sanitation has paradoxically increased adult susceptibility.
4. The disease does not cause chronic infection but can be severe.
5. Vaccination provides **long-term immunity** and outbreak prevention.
6. Indigenous vaccines like **Biovac-A** are widely used in India.
7. Inclusion in UIP would reduce disease burden and healthcare costs.

UNESCO'S NEUROTECHNOLOGY ETHICS FRAMEWORK

Recent Update:
UNESCO released the first global framework on the **ethical governance of neurotechnology**.

About:

1. The framework safeguards **mental privacy and cognitive liberty**.
2. Regulates technologies that record or influence brain activity.
3. Mandates **informed consent and transparency** in neuro-data use.
4. Prohibits manipulation of thoughts or behavioural control.
5. Protects **vulnerable populations**, including children.
6. Promotes **accountability, fairness, and inclusivity**.
7. Establishes global norms for responsible neurotechnology development.

SOLAR STORMS, CMES AND AURORAS

Recent Update:
Intense solar activity during the current solar cycle has caused widespread auroral displays.

About:

1. The **solar cycle** is an approximately 11-year variation in solar activity.
2. **Solar flares** release bursts of electromagnetic radiation.
3. **Coronal Mass Ejections (CMEs)** eject charged plasma into space.
4. Interaction with Earth's **magnetosphere** causes geomagnetic storms.
5. These storms generate auroras near polar regions.
6. Severe storms can disrupt **satellites, power grids, and navigation systems**.
7. Continuous monitoring is vital for space weather preparedness.

SOURCE: VISION MONTHLY

NATIONAL ONE HEALTH MISSION

Recent Update:
The Government of India is set to launch the **National One Health Mission (NOHM)** to strengthen India's integrated response to health threats arising from humans, animals, and the environment.

About:

1. The National One Health Mission is a **multi-sectoral and transdisciplinary initiative** aimed at integrating **human, animal, wildlife, and environmental health systems** under a unified framework.
2. It seeks to establish an **early warning and coordinated disease surveillance system** to prevent, detect, and respond to zoonotic and emerging infectious diseases.
3. The mission is anchored in the vision of creating a **resilient, predictive, and preventive public health architecture** rather than a reactive one.
4. It was approved by the **Prime Minister's Science, Technology and Innovation Advisory Council (PM-STIAC)** in 2022.
5. The **Indian Council of Medical Research (ICMR)** serves as the nodal implementing agency under the **Office of the Principal Scientific Adviser (PSA)**.
6. The **National Institute of One Health, Nagpur**, functions as the institutional hub for research, surveillance, and capacity building.
7. The mission promotes collaboration among public health, veterinary science, wildlife, environmental agencies, and academia.

KEY PILLARS OF THE ONE HEALTH MISSION

About:

1. **Research and Development:** Focuses on developing vaccines, diagnostics, and therapeutics for zoonotic and emerging diseases.
2. **Clinical Preparedness:** Strengthens healthcare infrastructure and workforce readiness for outbreak management.

3. **Integrated Data Systems:** Enables real-time data sharing across human, animal, and environmental health domains.
4. **Community Engagement:** Encourages public participation to maintain disease surveillance at the grassroots level.
5. **Policy Coordination:** Aligns ministries and departments to enable unified decision-making.
6. **Global Collaboration:** Aligns with international health security frameworks and best practices.

NEED FOR ONE HEALTH APPROACH

About:

1. Nearly **60% of emerging infectious diseases are zoonotic**, highlighting the interconnectedness of human and animal health.
2. Increasing **human–animal interface**, deforestation, and urbanisation elevate spillover risks.
3. Climate change is expanding the geographical spread of **vectors such as mosquitoes**, increasing disease burden.
4. The approach strengthens **pandemic preparedness** by shifting from reactive to anticipatory governance.
5. It addresses **antimicrobial resistance (AMR)** arising from misuse of antibiotics in humans, animals, and agriculture.
6. Enhances livestock productivity, rural livelihoods, and food security.
7. Aligns India with global frameworks led by **WHO, FAO, WOAH, and UNEP**.

NATIONAL ACTION PLAN ON ANTIMICROBIAL RESISTANCE (NAP-AMR) 2.0

Recent Update:
The Government launched **NAP-AMR 2.0 (2025–2029)** to strengthen India's response to antimicrobial resistance through a unified One Health framework.

About:

1. The plan adopts a **Whole-of-Government and Whole-of-Society approach** to combat AMR.
2. It integrates human health, animal health, agriculture, and environmental sectors.
3. Introduces **enforceable accountability mechanisms** across ministries and states.
4. Mandates **surveillance of antibiotic residues** in humans, animals, and the environment.
5. Strengthens **genomic surveillance** and laboratory networks for early detection.
6. Promotes **antimicrobial stewardship programmes (AMSPs)** in hospitals.
7. Supports data sharing, research, and innovation to curb resistance trends.

BIRSA-101 GENE THERAPY

Recent Update:
India launched **BIRSA-101**, its first indigenous **CRISPR-based gene therapy** for sickle cell disease.

About:

1. Developed by **CSIR–Institute of Genomics and Integrative Biology (IGIB)**.
2. Named in honour of **Birsa Munda**, symbolising indigenous resilience.
3. Utilises **CRISPR–Cas9 gene-editing technology** to correct defective genes.
4. Targets **sickle cell disease**, a major genetic disorder in tribal populations.
5. Enables permanent correction of defective haemoglobin genes.
6. Technology transfer has been enabled through **Serum Institute of India** for scalability.
7. Represents a major leap in **affordable, indigenous gene therapy innovation**.

WORLD HEALTH ORGANIZATION – TUBERCULOSIS REPORT

Recent Update:
WHO reported a **21% reduction in India's TB incidence**, marking significant progress.

About:

1. Tuberculosis remains among the **top infectious killers globally**.
2. India contributes around **25% of the global TB burden**.

3. TB incidence in India declined from 28 to 21 per lakh population.
4. Drug-resistant TB remains a major concern, including **MDR-TB and XDR-TB**.
5. The disease spreads through airborne droplets, primarily affecting lungs.
6. Early diagnosis and treatment are key to eliminating TB.
7. India's National TB Elimination Programme aims to eliminate TB by **2025**.

GSAT-7R (CMS-03) SATELLITE

Recent Update:
India successfully launched **GSAT-7R**, enhancing secure naval communication capabilities.

About:

1. GSAT-7R is a **dedicated military communication satellite** for the Indian Navy.
2. It strengthens maritime surveillance and network-centric warfare capabilities.
3. Operates in **UHF, S, C, and Ku bands** for multi-channel communication.
4. Placed in **geostationary orbit** at around 36,000 km above Earth.
5. Supports real-time data, voice, and video transmission.
6. Enhances India's maritime domain awareness and national security.
7. Replaces and upgrades the earlier GSAT-7 (Rukmini) satellite.

CAR-T CELL THERAPY (NEXCAR19)

Recent Update:
India developed its first indigenous CAR-T cell therapy, **NexCAR19**, for blood cancers.

About:

1. CAR-T therapy modifies a patient's own T-cells to attack cancer cells.
2. NexCAR19 targets B-cell malignancies such as leukemia and lymphoma.
3. Developed by **ImmunoACT**, supported by IIT Bombay and Tata Memorial Hospital.
4. Significantly reduces treatment cost compared to imported therapies.
5. Provides long-term immunity by persisting in the patient's body.
6. Represents a breakthrough in **precision oncology**.
7. Strengthens India's position in advanced biopharmaceutical innovation.

SATELLITE-BASED INTERNET

Recent Update:
India signed agreements to expand **satellite-based internet services** for remote connectivity.

About:

1. Satellite internet delivers broadband using orbiting satellites instead of cables.
2. Low Earth Orbit (LEO) satellites offer low latency and high-speed connectivity.
3. Enables internet access in remote, mountainous, and disaster-prone regions.
4. Supports digital inclusion, education, and emergency communication.
5. Enhances strategic communication and disaster resilience.
6. Complements terrestrial fibre networks.
7. Strengthens India's digital public infrastructure.

SOURCE:INSIGHTS MONTHLY

VANADIUM REDOX FLOW BATTERY (VRFB)

Recent Update:
India inaugurated its first megawatt-scale **Vanadium Redox Flow Battery** project.

About:

1. VRFBs store energy using liquid electrolytes containing vanadium ions.
2. They are ideal for **large-scale renewable energy storage**.
3. Offer longer life cycles and higher safety than lithium-ion batteries.
4. Suitable for grid balancing and renewable energy integration.

5. Operate with minimal degradation over decades.
6. Reduce fire and explosion risks.
7. Support India's clean energy transition goals.

ESCAPADE MISSION

Recent Update:
NASA launched the **ESCAPADE mission** to study Mars' atmospheric loss.

About:

1. The mission studies interaction between solar wind and Mars' magnetosphere.
2. Uses two spacecraft orbiting Mars in tandem.
3. Aims to understand how Mars lost its atmosphere over time.
4. Enhances knowledge of planetary evolution.
5. Operates from a Lagrange point for fuel efficiency.
6. Contributes to future Mars exploration strategies.
7. Advances planetary science and space weather research.

SATELLITE-BASED INTERNET & SPACE SECURITY

Recent Update:
India is expanding satellite-based communication networks to strengthen digital and strategic autonomy.

About:

1. Satellite internet enables connectivity in remote and border regions.
2. It supports defence communication, disaster response, and governance.
3. Enhances redundancy in national communication infrastructure.
4. Enables faster disaster response and surveillance.
5. Strengthens India's position in the global space economy.
6. Complements terrestrial telecom infrastructure.
7. Supports Digital India and strategic autonomy goals.

DEFENCE ATMANIRBHARTA: RECORD PRODUCTION AND EXPORTS

Recent Update:
India achieved its **highest-ever defence production and exports** in FY 2024–25, reinforcing its transition from a major arms importer to an emerging global defence manufacturer under the **Atmanirbhar Bharat** initiative.

About:

1. India's **indigenous defence production** reached **₹1.27 lakh crore** in FY 2023–24, registering a sharp rise from ₹46,429 crore in 2014–15, reflecting sustained policy reforms and domestic capacity building.
2. Total defence production crossed **₹1.54 lakh crore** in FY 2024–25, indicating strong contributions from Defence Public Sector Undertakings (DPSUs), private industry, and MSMEs.
3. Defence exports rose to **₹23,622 crore**, up from less than ₹1,000 crore a decade ago, showcasing growing global confidence in Indian platforms and systems.
4. The **private sector's share increased to 23%**, with over **16,000 MSMEs** integrated into defence supply chains.
5. The Ministry of Defence signed **193 capital procurement contracts** worth ₹2.09 lakh crore in FY 2024–25, with 90% reserved for domestic industry.
6. Reforms such as **Positive Indigenisation Lists**, defence corridors, and simplified procurement have driven self-reliance.
7. The initiative strengthens India's strategic autonomy while positioning it as a **net security provider** in the Indo-Pacific.

RESEARCH, DEVELOPMENT AND INNOVATION (RDI) SCHEME

Recent Update:
The Prime Minister launched the **₹1 lakh crore Research, Development and Innovation (RDI) Scheme** at the Emerging Science & Technology Innovation Conclave (ESTIC) 2025.

About:

1. The RDI Scheme aims to transform India into a **high-technology, innovation-driven economy**.
2. It promotes **high-risk, high-impact research** that typically lacks early-stage private funding.
3. India's **Gross Expenditure on R&D (GERD)** rose to ₹1.27 lakh crore in 2020–21, though it remains below 0.7% of GDP.
4. Government contributes nearly **44% of total R&D funding**, while private participation remains comparatively low.
5. The scheme supports **deep-tech sectors** such as AI, quantum computing, semiconductors, and biotechnology.
6. It encourages **industry–academia collaboration** to accelerate translation of research into market-ready technologies.
7. The initiative strengthens India's innovation ecosystem and reduces dependence on imported critical technologies.

PRECISION BIOTHERAPEUTICS

Recent Update:
Advances in genomics and biotechnology are enabling India to emerge as a hub for **precision biotherapeutics**, transforming disease treatment models.

About:

1. Precision biotherapeutics focus on **personalised medical treatment** based on an individual's genetic, molecular, and cellular profile.
2. These therapies move away from "one-size-fits-all" medicine toward **targeted, patient-specific interventions**.
3. Technologies involved include **CRISPR gene editing, mRNA platforms, monoclonal antibodies, and cell-based therapies**.
4. Genomic profiling helps identify disease-causing mutations, enabling precise therapeutic targeting.
5. AI and bioinformatics assist in drug design, dosage optimisation, and treatment response prediction.
6. Such therapies are particularly effective for **genetic disorders, cancers, and rare diseases**.
7. India's growing biotech ecosystem and manufacturing capacity position it as a future global hub for precision medicine.

SOURCE: INDIAN EXPRESS

AURAMINE O

Recent Update: Auramine O, a **banned industrial yellow dye**, has again been **detected in food products** during **State food safety inspections**, raising **serious public health and regulatory concerns**.
About:

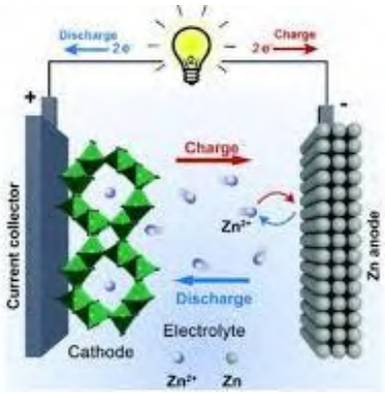
1. **Auramine O** is a **synthetic diarylmethane-based dye** mainly used for **industrial purposes** such as **textile colouring**, **leather processing**, and **laboratory staining**, and is not intended for human consumption.
2. **Chemically**, it appears as a **bright yellow crystalline compound** that is **insoluble in water** but **highly soluble in organic solvents** like **ethanol** and **DMSO**.
3. It is **strictly prohibited for food use**, yet is **illegally added** to food items to enhance **visual appeal** due to its **low cost**, **easy availability**, and **strong pigmentation**.
4. In laboratories, it is used in **microbiological staining**, particularly the **Auramine–Rhodamine technique**, to detect **acid-fast bacteria** such as **Mycobacterium tuberculosis**.
5. **Unregulated chemical markets** and **weak enforcement mechanisms** enable its **misuse by small and informal food manufacturers**.
6. **Chronic exposure** can cause **liver toxicity**, **kidney damage**, **endocrine disruption**, and **mutagenic effects**, posing **severe long-term health risks**.
7. **Auramine O** is classified as a **Group 2B possible carcinogen** by the **International Agency for Research on Cancer (IARC)**.
8. **Food adulteration** using **industrial dyes** is a punishable offence under the **Food Safety and Standards Act, 2006**, attracting **criminal and monetary penalties**.

ZINC–ION BATTERIES (ZIBs)

Recent Update: A **Bengaluru-based DST institute** developed an **advanced zinc-ion battery** using an **improved cathode architecture**.

About:

1. **Zinc-ion batteries** use **zinc metal as the anode**, offering a **safer**, **non-flammable**, and **more abundant alternative** to **lithium-based batteries**.
2. **Researchers modified vanadium oxide (V_2O_5)** using a **thermo-electrochemical process** to improve **zinc-ion mobility and reversibility**.
3. The **modified Zn–V_2O_5 structure** enables **faster ion transport**, **higher energy storage**, and



improved battery efficiency.
4. These batteries use **aqueous electrolytes**, significantly reducing the risk of **fire, explosion, and thermal runaway**.
5. **Long cycle life**, **high stability**, and **lower manufacturing costs** make them suitable for **large-scale stationary energy storage**.
6. The technology supports **grid storage**, **renewable energy integration**, and **reduced dependence on lithium imports**.
7. **Zinc's high volumetric capacity** enhances **energy density**, especially for **grid-level applications**.
8. **ZIBs** mitigate **geopolitical and supply-chain risks** linked to **critical minerals** such as **lithium and cobalt**.

AMMONIUM NITRATE

Recent Update: A **deadly blast involving ammonium nitrate** renewed concerns regarding **storage safety**, **regulatory oversight**, and **enforcement failures**.

About:

1. **Ammonium nitrate** is a **highly oxidising chemical compound** widely used in **fertilisers** and **industrial explosives**.
2. **Chemically represented as NH_4NO_3**, it is a **white crystalline solid** that readily **absorbs moisture** from the atmosphere.
3. When subjected to **high temperatures**, **confinement**, or **contamination with fuel or organic material**, it becomes **highly explosive**.
4. In India, it is regulated under the **Explosives Act, 1884**, and governed by the **Ammonium Nitrate Rules, 2012**.
5. It is extensively used in **mining and quarrying operations** in the form of **ANFO (ammonium nitrate–fuel oil)**.
6. **Improper storage, weak monitoring, and unsafe handling practices** have caused **major industrial disasters globally**.
7. **Safe storage protocols** require **ventilation**, **temperature control**, and **strict separation from combustible substances**.
8. **Global incidents**, including the **Beirut explosion (2020)**, highlight its **catastrophic destructive potential**.

ALTERMAGNETISM

Recent Update: Scientists have experimentally confirmed altermagnetism as a **new and distinct magnetic state**.

About:

1. **Altermagnetism** is characterised by **alternating atomic spin orientations** governed by **crystal symmetry** rather than random alignment.
2. Despite having **ordered spin structures**, it shows **zero net magnetisation**, unlike **ferromagnetic materials**.
3. It exhibits **spin-split electronic bands**, allowing **high-speed and low-loss spin transport**.
4. This phenomenon has been observed in materials such as **manganese telluride** and **ruthenium dioxide**.
5. **Ultra-fast switching** at **terahertz frequencies** becomes possible due to its unique magnetic properties.

6. It holds strong promise for **spintronics**, **quantum computing**, and **next-generation memory devices**.
7. Altermagnetism combines advantages of **ferromagnets** and **antiferromagnets** while avoiding their limitations.
8. It supports development of **energy-efficient, high-speed electronic technologies**.

ODD RADIO CIRCLES (ORCs)

Recent Update: Indian scientists identified a **rare twin Odd Radio Circle** using **LOFAR telescope data**.

About:

1. **Odd Radio Circles (ORCs)** are **large, circular astronomical structures** that emit only **radio-frequency radiation**.
2. They are invisible in **optical**, **infrared**, and **X-ray wavelengths**, making them difficult to detect.
3. ORCs are believed to originate from **powerful cosmic events** such as **black hole activity** or **galactic shockwaves**.
4. These structures can span **millions of light-years**, making them **among the largest known cosmic objects**.
5. Their study helps scientists understand **galaxy evolution** and **energy transfer in intergalactic space**.
6. ORCs are **extremely rare**, with only a **small number detected globally**.
7. Their detection relies on **low-frequency radio astronomy** and **advanced computational analysis**.

SUPERBUGS

Recent Update: Rising antimicrobial resistance in **India** has increased **treatment failures** and **healthcare burden**.

About:

1. **Superbugs** are **bacteria that have developed resistance** to **multiple classes of antibiotics**.
2. Common examples include **E. coli**, **Klebsiella pneumoniae**, **Acinetobacter baumannii**, and **MRSA**.
3. Resistance emerges due to **antibiotic misuse**, **over-prescription**, and **poor infection control practices**.
4. Superbugs cause **prolonged illness**, **higher mortality**, and **longer hospital stays**.
5. They significantly increase **healthcare costs** and **economic burden**.
6. Superbugs threaten the safety of **surgeries, chemotherapy, and organ transplants**.
7. **Antimicrobial resistance** is recognised as a **global public health emergency**.

BIRSA 101 GENE THERAPY

Recent Update: India launched its **first indigenous CRISPR-based gene therapy** for **sickle cell disease**.

About:

1. **BIRSA 101** is a **gene-editing therapy** designed to treat **sickle cell disease**.
2. It corrects **defective haemoglobin genes** responsible for abnormal red blood cells.
3. The therapy was developed by **CSIR–IGIB** in collaboration with the **Serum Institute of India**.
4. It uses **CRISPR-Cas9 technology** for **precise genetic correction**.
5. It offers a **potential one-time curative treatment**, unlike lifelong symptomatic management.

6. The therapy can significantly reduce **pain crises**, **blood transfusions**, and **mortality**.
7. It represents a major advance in **India's precision medicine and biotechnology ecosystem**.

LAB-GROWN MILK

Recent Update: Remilk announced the **commercial launch of lab-grown milk** from **January 2026**.

About:

1. **Lab-grown milk** is produced using **precision fermentation**, where **genetically engineered microbes** produce milk proteins.
2. These proteins are combined with **plant-based fats, sugars, and minerals** to replicate conventional milk.
3. The final product is **lactose-free**, **cholesterol-free**, and **hormone-free** while retaining nutrition.
4. It significantly reduces **greenhouse gas emissions**, **land use**, and **water consumption**.
5. It provides an **ethical, animal-free dairy alternative**.
6. It is suitable for **lactose-intolerant individuals** and environmentally conscious consumers.
7. **Regulatory approval and consumer acceptance** remain key challenges, especially in **India**.

SECOND REGIONAL OPEN DIGITAL HEALTH SUMMIT 2025

Recent Update: India hosted the **Second Regional Open Digital Health Summit 2025** for **WHO-SEARO nations**.
About:

1. The summit promotes **interoperable, people-centric digital health systems**.
2. It focuses on harmonising **FHIR standards**, **open APIs**, and **digital public infrastructure**.
3. It supports integration of **fragmented health data systems** across countries.
4. India showcased **ABDM**, **CoWIN**, and **UPI** as **global digital public goods**.
5. It encourages adoption of **AI-driven diagnostics** and **digital health analytics**.
6. The summit strengthens **regional pandemic preparedness**.
7. It enhances **cross-border health cooperation**.

NAP-AMR 2.0

Recent Update: India launched the **National Action Plan on AMR (2025–29)**.

About:

1. **NAP-AMR 2.0** adopts a **One Health approach**.
2. It integrates **human, animal, and environmental health sectors**.
3. It focuses on **surveillance**, **rational antibiotic use**, and **infection prevention**.
4. It strengthens **laboratory networks** and **monitoring mechanisms**.
5. It addresses **implementation gaps** in the earlier plan.
6. It promotes **public awareness and capacity building**.
7. It aligns with the **WHO Global Action Plan on AMR**.

AFRICAN SWINE FEVER (ASF)

Recent Update: Assam imposed movement restrictions after a surge in **ASF cases**.

About:

1. **African Swine Fever** is a **highly contagious viral disease** affecting **domestic and wild pigs**.
2. It is caused by a **DNA virus** of the **Asfarviridae family**.
3. Mortality rates can reach **nearly 100%**.
4. Transmission occurs through **infected animals**, **contaminated feed**, and **ticks**.
5. The virus can survive for long periods in **meat products**.
6. There is **no vaccine or treatment** available.
7. The disease causes **severe economic losses** to pig farmers.

10 YEARS OF AMRIT PHARMACY

Recent Update: AMRIT Pharmacy completed **ten years of operation**.
About:

1. **AMRIT** was launched in **2015** under the **Ministry of Health and Family Welfare**.
2. It provides **quality medicines, implants, and consumables** at **subsidised prices**.
3. It is operated by **HLL Lifecare Limited**, a public sector enterprise.
4. Over **250 outlets** function across **government hospitals**.
5. It reduces **out-of-pocket expenditure** for patients.
6. It supports **universal health coverage**.
7. It improves **equitable access to healthcare**.

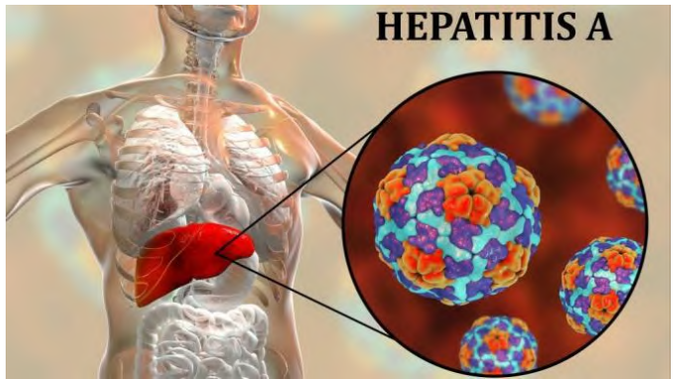
COHORT CONNECT 2025

Recent Update: India launched the **Phenome India Cohort Connect initiative**.
About:

1. It integrates **long-term population cohort studies** under a national framework.
2. It examines interactions between **genetics**, **lifestyle**, and **environment**.
3. It focuses on **non-communicable diseases**.
4. It uses **genomics**, **biomarkers**, and **digital health tools**.
5. It enables **predictive and preventive healthcare**.
6. It supports **evidence-based policymaking**.
7. It advances **personalised medicine in India**.

HEPATITIS A

Recent Update: Rising outbreaks renewed calls to include the **Hepatitis A vaccine** under **UIP**.



About:

1. **Hepatitis A** is an **acute viral liver infection**.
2. It spreads through the **faeco-oral route**.
3. It is associated with **poor sanitation and unsafe water**.
4. Symptoms include **fever, nausea, jaundice, and abdominal pain**.
5. There is **no specific antiviral treatment**.
6. Recovery provides **lifelong immunity**.
7. Prevention depends on **sanitation, hygiene, and vaccination**.

UNIVERSAL IMMUNISATION PROGRAMME (UIP)

Recent Update: Experts recommended **Hepatitis A inclusion** under **UIP**.
About:

1. **UIP** is India's **flagship immunisation programme**.
2. It was launched in **1978** and expanded nationwide.
3. It targets **infants, children, and pregnant women**.
4. It prevents **major vaccine-preventable diseases**.
5. It is among the **largest immunisation programmes globally**.
6. It reduces **morbidity and mortality**.
7. It forms the backbone of **preventive public health**.

TRANSPLANTATION OF HUMAN ORGANS AND TISSUES RULES, 2025

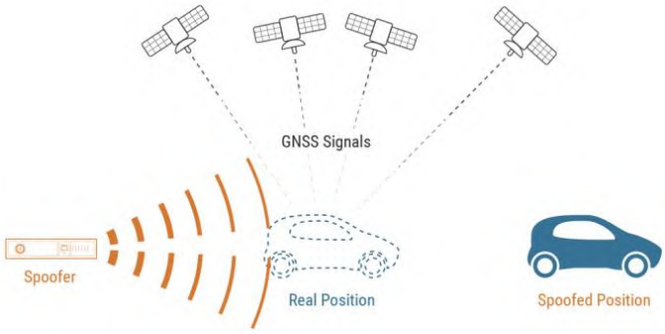
Recent Update: The government simplified **corneal transplantation rules**.
About:

1. Amendments were made under **THOTA, 1994**.
2. The removal of **mandatory specular microscopy** lowers entry barriers.
3. It improves **access in rural and semi-urban areas**.
4. It strengthens **National Organ Transplant Programme coordination**.
5. It enhances **equity and transparency**.
6. It reduces **procedural delays**.
7. It boosts **organ donation utilisation**.

GNSS SPOOFING

Recent Update: Aircraft near **Delhi** reported **navigation anomalies**.
About:

1. **GNSS spoofing** involves transmitting **fake satellite signals**.
2. It misleads **navigation and positioning systems**.
3. Types include **spoofing**, **jamming**, and **meaconing**.

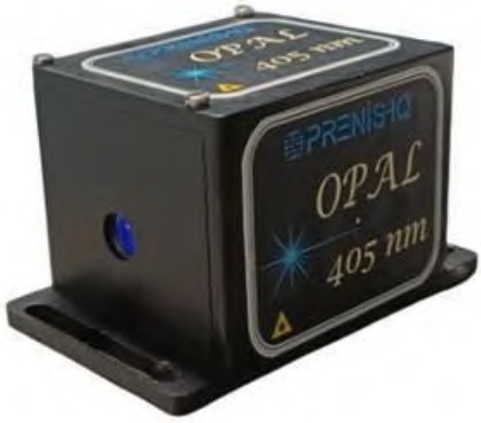


4. It is difficult to detect due to **signal similarity**.
5. It poses serious **aviation safety risks**.
6. It can cause **navigation deviation and false alerts**.
7. It threatens **national security**.

SOURCE: DOWN TO EARTH

INDIA'S FIRST INDIGENOUS HIGH-PRECISION DIODE LASER

Recent Update: India launched its **first indigenous high-precision diode laser**.



About:

1. It is designed for **quantum communication and sensing**.
2. It features **ultra-narrow linewidth**.
3. It has **high thermal stability**.
4. It produces **low noise output**.
5. It supports **advanced scientific research**.
6. It reduces **import dependence**.
7. It strengthens the **quantum ecosystem**.

AI-BASED LOCKING MONITORING SYSTEM 'DRISHTI'

Recent Update: Indian Railways introduced **DRISHTI** for freight monitoring.

About:

1. **DRISHTI** uses **AI, cameras, and sensors**.
2. It monitors **freight wagon locking systems**.
3. It detects **tampering and abnormal movement**.
4. It improves **cargo safety**.
5. It reduces **manual inspection errors**.
6. It enhances **operational efficiency**.
7. It prevents **theft and accidents**.

PROJECT SUNCATCHER

Recent Update: Google announced Project Suncatcher.

About:

1. It uses **space-based solar panels**.
2. It powers **AI data centres**.
3. It provides **continuous clean energy**.
4. It reduces **carbon footprint**.
5. It uses **optical communication links**.
6. It supports **sustainable digital infrastructure**.
7. It represents **space-energy innovation**.

MAHARASHTRA–STARLINK PARTNERSHIP

Recent Update: Maharashtra partnered with **Starlink**.

About:

1. It enables **high-speed satellite internet**.
2. It uses **low-Earth orbit satellites**.
3. It offers **low-latency connectivity**.
4. It supports **telemedicine and digital education**.
5. It improves **disaster response capabilities**.
6. It enhances **digital inclusion**.
7. It strengthens **rural connectivity**.

INDIA'S FIRST 500 KM QKD NETWORK

Recent Update: India demonstrated a **500 km quantum key distribution network**.

About:

1. It enables **ultra-secure communication**.
2. It is based on **quantum mechanical principles**.
3. It detects **eavesdropping instantly**.
4. It uses **optical fibre infrastructure**.
5. It strengthens **cyber and defence security**.
6. It supports **strategic communications**.
7. It is part of the **National Quantum Mission**.

LVM3-M5 LAUNCH VEHICLE

Recent Update: ISRO successfully launched CMS-03 using **LVM3-M5**.

About:

1. **LVM3-M5** is India's **heaviest launch vehicle**.
2. It can carry **8,000 kg payload to LEO**.
3. It uses an **indigenous cryogenic engine**.
4. It supports **strategic and defence missions**.
5. It enables **commercial satellite launches**.
6. It ensures **autonomous access to space**.
7. It strengthens **India's heavy-lift capability**.

SOURCE: THE HINDU

INTERSTELLAR MAPPING AND ACCELERATION PROBE (IMAP)

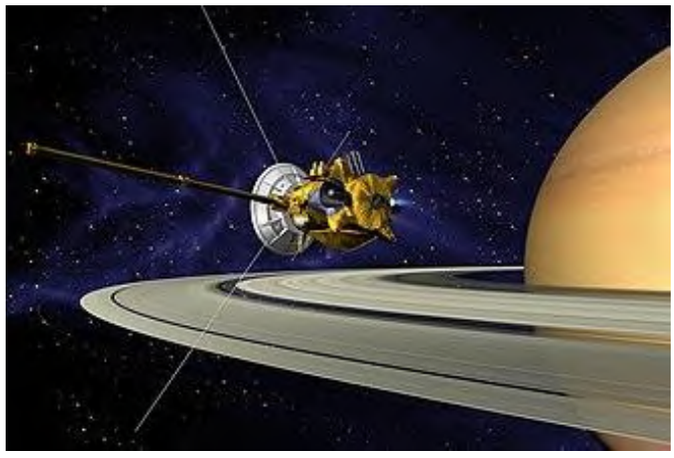
Recent Update: NASA's IMAP mission will provide unprecedented insights into the **heliosphere** and **space-weather dynamics**.

About:

1. The **Interstellar Mapping and Acceleration Probe (IMAP)** is a **NASA mission** positioned at the **Earth–Sun L1 point**, nearly **one million miles from Earth**.
2. It is designed to map the **heliosphere**, the **solar-wind–driven bubble** surrounding the entire **solar system**.
3. IMAP studies interactions between **solar wind particles** and **interstellar matter** at the heliosphere's boundary.
4. The mission provides **near real-time data** on **solar wind** and **energetic particles**.
5. This data strengthens **space-weather forecasting** and prediction of **radiation hazards**.
6. IMAP investigates **particle acceleration processes** at **micro and cosmic scales**.
7. It identifies **cosmic material** entering the heliosphere from **interstellar space**.
8. The mission improves understanding of how the heliosphere **shields Earth from high-energy galactic cosmic rays**, protecting **life on Earth**.

CASSINI SPACECRAFT

Recent Update: Reanalysis of **Cassini mission data** has strengthened evidence that **Enceladus** may support **life**.



About:

1. **Cassini** was a joint **NASA–ESA–ASI** mission launched on **15 October 1997**.
2. It comprised the **Cassini orbiter** (first to orbit **Saturn**) and the **Huygens probe**.
3. **Huygens** successfully landed on **Titan**, Saturn's largest moon.
4. Cassini studied **Saturn's atmosphere**, **winds**, **temperatures**, **internal structure**, and **rings**.
5. It analysed **Titan's atmospheric composition**, **aerosols**, and **surface features**.
6. The mission examined **Saturn's magnetosphere** and its interaction with **solar wind** and **satellites**.
7. **Enceladus**, about **504 km in diameter**, was found to host a **subsurface ocean** beneath a **20–30 km ice crust**.
8. Evidence of **hydrothermal vents** releasing **mineral-rich water** suggests environments similar to **early Earth**.

ASTRA MARK 2 MISSILE

Recent Update: Astra Mark 2 is advancing as India's **next-generation BVR air-to-air missile**.

About:

1. **Astra Mark 2** is a **Beyond Visual Range (BVR)** missile developed by **Defence Research and Development Organisation**.
2. It is designed with a **strike range exceeding 200 km**.
3. It is an upgraded version of **Astra Mark-1**, which has a **90–100 km range**.
4. **Astra Mark-1** is already **inducted into the Indian Air Force**.
5. The missile is integrated with **LCA Tejas** and **Su-30 MKI** aircraft.
6. Development involves multiple **DRDO laboratories** and **50+ public and private industries**.
7. It enhances **India's air-combat superiority**.
8. Astra Mark 2 is planned as an **export-grade missile** for **friendly nations**.

CREW ESCAPE SYSTEM (CES)

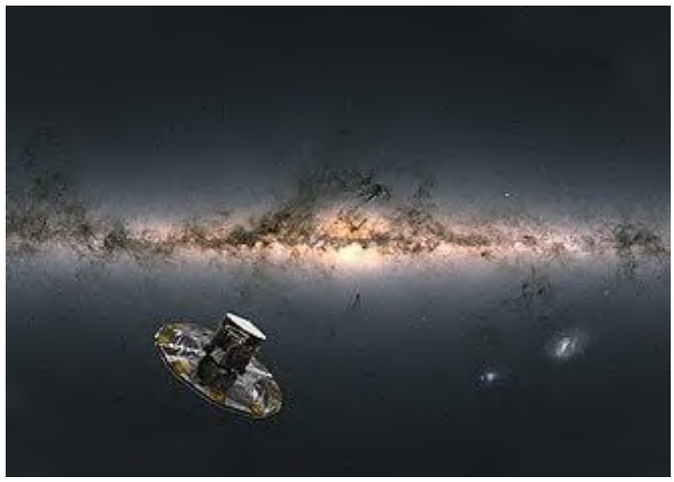
Recent Update: ISRO continues validating the **Crew Escape System** for the **Gaganyaan mission**.

About:

1. The **Crew Escape System (CES)** is a critical **emergency safety mechanism**.
2. It rapidly **pulls the crew module away** from a failing **launch vehicle**.
3. ISRO uses a **puller-type CES**, unlike the **pusher-type** used by SpaceX.
4. **High-thrust rockets** mounted on an **escape tower** extract the crew capsule.
5. A **multi-stage parachute system** ensures **controlled descent**.
6. The crew module lands safely within **physiological tolerance limits**.
7. The system is supported by **Integrated Vehicle Health Management (IVHM)**.
8. Similar **puller-type systems** are used by **Saturn V**, **Soyuz**, and **Long March** rockets.

GAIA SPACECRAFT

Recent Update: Gaia continues revolutionising astronomy with **ultra-precise stellar mapping**.



About:

1. **Gaia** is a space observatory launched by the **European Space Agency** in **December 2013**.
2. It operates from the **Sun–Earth L2 point**, about **1.5 million km from Earth**.
3. Gaia observes target stars **around 14 times per year**.
4. It measures **stellar positions, distances, motions, and brightness** with extreme precision.
5. Gaia is mapping nearly **two billion celestial objects**.
6. It is discovering **exoplanets**, **brown dwarfs**, and **asteroids**.
7. Observations of **distant quasars** enable tests of **Einstein's General Relativity**.
8. The mission provides a **3D map of the Milky Way**, crucial for understanding **galactic evolution**.

SPACE MAITRI MISSION

Recent Update: Space MAITRI has strengthened **India–Australia space cooperation**.

About:

1. **Space MAITRI** stands for **Mission for Australia–India's Technology, Research and Innovation**.
2. It deepens **strategic partnership** between **India and Australia** in space.
3. The mission links **commercial, institutional and governmental space organisations**.
4. A key focus is **space-debris management** and **orbital sustainability**.
5. Under this mission, **NewSpace India Limited** will launch **Australia's Optimus spacecraft**.
6. **Optimus** weighs about **450 kg**, making it Australia's largest domestically built satellite.
7. It will be launched in **2026** using **ISRO's Small Satellite Launch Vehicle (SSLV)**.
8. The mission enhances **India's role as a commercial launch partner**.

NEWSPACE INDIA LIMITED (NSIL)

Recent Update: NSIL is expanding **commercial satellite and launch services** after space-sector reforms.

About:

1. **NSIL** is the **commercial arm of the Department of Space**.
2. It was incorporated in **March 2019**.
3. NSIL handles **high-technology, demand-driven space activities**.
4. After **2020 space reforms**, it undertakes **operational satellite missions** commercially.
5. It is responsible for **building, launching, owning and operating satellites**.
6. NSIL provides **satellite-based services** to domestic and global customers.
7. It follows a **customer-oriented commercial model**.
8. Its headquarters is in **Bengaluru**.

CMS-03 SATELLITE (GSAT-7R)

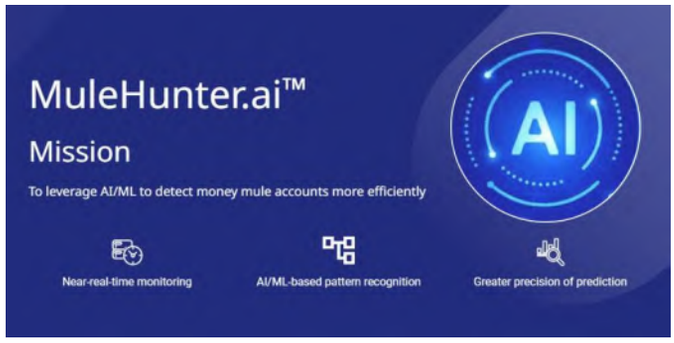
Recent Update: CMS-03 will significantly enhance **India's secure communication capability**.

About:

1. **CMS-03 (GSAT-7R)** is an upcoming **military communication satellite** of **ISRO**.
2. It will be launched using **LVM3** from **Sriharikota**.
3. The satellite carries a **multi-band communication payload**.
4. It covers a wide **oceanic region** and the **Indian landmass**.
5. With a mass of **~4,400 kg**, it is India's **heaviest communication satellite**.
6. It enhances **bandwidth and connectivity** for **civil, strategic and maritime users**.
7. It will first be placed in **Geosynchronous Transfer Orbit (GTO)**.
8. It will finally occupy a **geosynchronous (Clarke) orbit**, remaining fixed over a longitude.

MULEHUNTER.AI

Recent Update: MuleHunter.AI is strengthening detection of **mule bank accounts** in India.



About:

1. **MuleHunter.AI** is an **AI/ML-based model** developed by the **Reserve Bank Innovation Hub (RBIH)**.
2. It detects **mule accounts** used for **money laundering and digital fraud**.
3. The system analyses **large-scale transaction patterns**.
4. It enables **near real-time monitoring** of suspicious activities.

5. Banks can **flag, freeze and act** on mule accounts quickly.
6. It supports **AML and CFT compliance**.
7. The model promotes **inter-bank and law-enforcement collaboration**.
8. It improves **financial-system integrity** and fraud prevention.

SUPERCAPACITORS

Recent Update: Coconut-husk-based supercapacitors have shown **four-fold efficiency improvement**.

About:

1. **Supercapacitors** are **next-generation energy-storage devices**.
2. They offer **very high power density** and **ultra-fast charging**.
3. They have **longer life cycles** than **lithium-ion batteries**.
4. Key components include **electrodes**, **electrolyte**, **separator**, and **current collector**.
5. **Activated carbon from coconut husk** provides **high surface area (~1200 m^2/g)**.
6. **Microwave-assisted pyrolysis** enables **low-cost, zero-waste production**.
7. High power output can run **LEDs for extended durations**.
8. Supercapacitors are promising for **sustainable energy and high-power applications**.

TOPICS COVERED

1. **Quantum-Powered Economy Roadmap**
2. **India's Research Deficit**
3. **Department of Biotechnology Achievements**
4. **Nuclear Power in Space**
5. **National Supercomputing Mission (NSM)**
6. **Department of Atomic Energy Year-End Review**
7. **Google Project Suncatcher (Space Data Centres)**
8. **Indigenous TnpB-Based Gene Editing Technology**
9. **BIRSA 101 Indigenous CRISPR Gene Therapy**
10. **India Advances Quantum Technology (Cryogenics Infrastructure)**
11. **Private Sector Participation in Nuclear Energy**
12. **India Adds New Names to Martian Map**
13. **Genome-Edited Crops Policy Shift**
14. **World AIDS Day & National AIDS Control Programme**
15. **Alaknanda Galaxy**
16. **Bioremediation in India**
17. **ANEEL Thorium Fuel**
18. **Thalassemia Burden in India**
19. **Google Quantum Echoes Experiment**
20. **Raccoon Roundworm (Baylisascaris procyonis)**
21. **Plasser's Quick Relaying System (PQRS)**
22. **Nuclear Energy Mission (SMRs)**
23. **Solar Flares**
24. **Indian Pharmacopoeia Commission (IPC)**
25. **Candida auris**
26. **Anopheles stephensi**
27. **AI-Driven Diabetic Retinopathy Screening (AFMS)**
28. **FSSAI Egg Safety Drive – Nitrofurans**
29. **PathGennie Drug Discovery Software**
30. **Rare-Earth Elements (REEs)**
31. **AILA – Artificially Intelligent Lab Assistant**
32. **Agentic AI**
33. **Dhruv64 Indigenous Microprocessor**
34. **Q-Day (Post-Quantum Cryptography Threat)**
35. **Brain–Computer Interface (BCI)**
36. **Tensor Processing Unit (TPU)**
37. **SIM Binding**
38. **Micrometeoroids and Orbital Debris (MMOD)**
39. **MAVEN Spacecraft**
40. **RESPOND Basket (ISRO Academia Programme)**
41. **Geminid Meteor Shower**

42. **BlueBird-6 & LVM3 Launch**
43. **Planetary-Defence Exercise on 3I/ATLAS**
44. **AstroSat**
45. **Ultra-Violet Imaging Telescope (UVIT)**
46. **National Blood Transfusion Bill**
47. **Second WHO Global Summit on Traditional Medicine**
48. **Quantum Economy**
49. **LVM3-M6 Mission**
50. **Rare Earth Permanent Magnets (REPM) Scheme**
51. **United Nations General Assembly Declaration on NCDs & Mental Health**
52. **Young Stellar Objects (YSOs)**
53. **Dorjilung Hydroelectric Power Project**
54. **Kodaikanal Solar Observatory**
55. **LOFAR Radio Telescope**
56. **Liquefied Petroleum Gas (LPG)**
57. **Hepatitis A**
58. **Omen Hybrid-Electric Drone**
59. **DNA Double Helix Model**
60. **Tuberculosis (TB)**
61. **Rheumatoid Arthritis**
62. **Visible Emission Line Coronagraph (VELC)**
63. **Indian Institute of Astrophysics (IIA)**
64. **Soil Organic Carbon (SOC)**
65. **Ricin**
66. **Christmas Island**
67. **Scrub Typhus**
68. **GSAT-7R (CMS-03) Satellite**
69. **LVM3-M5 Launch Vehicle**
70. **Alfvén Waves**
71. **Leprosy (Hansen's Disease)**
72. **Notifiable Disease Concept**
73. **Gamma-Ray Bursts (GRBs)**

SOURCE: INSIGHTS MONTHLY

TRANSFORMING INDIA INTO A LEADING QUANTUM-POWERED ECONOMY

Recent Update: NITI Aayog's **Frontier Tech Hub** released a national roadmap targeting **global quantum leadership by 2035**

About

1. The roadmap is a **national strategic blueprint** prepared by **NITI Aayog with IBM as knowledge partner**, outlining India's long-term vision for quantum computing, communication, sensing and advanced materials.
2. It seeks to build a **globally competitive quantum ecosystem**, integrating research, startups, manufacturing and secure digital infrastructure.
3. The **2035 vision** aims to position India among the **top three quantum economies**, with 10+ startups crossing **USD 100 million revenues**.
4. Plans large-scale **deployment in strategic sectors** such as defence, healthcare, finance, mining, energy and critical infrastructure.
5. Emphasises **"Quantum Atmanirbharta"**, ensuring participation across hardware, processors, cryogenics, materials and software stacks.
6. Introduces a **two-phase milestone plan (2025–30 and 2030–35)** including testbeds, pilots, PQC rollout and export corridors.
7. Calls for a **10× expansion of quantum-skilled workforce**, making India a top destination for deep-tech talent.
8. Aims to convert quantum technology into a **strategic and economic multiplier**, strengthening cybersecurity, supply chains and technological sovereignty.

INDIA'S RESEARCH DEFICIT

Recent Update: Debate renewed as India spends only **~0.7% of GDP on R&D**, far below global innovation leaders

About

1. India's **research deficit** refers to chronic underinvestment and weak academia–industry linkages, resulting in **low innovation output despite a large talent base**.
2. R&D spending remains **0.6–0.7% of GDP**, compared to China (~2.4%), USA (~3.5%) and Israel (~5.4%), limiting high-end technology development.
3. Researcher density is only **255 per million**, far below global averages, constraining knowledge creation capacity.
4. Government contributes **~63% of R&D funding**, while private sector participation remains limited, unlike innovation-driven economies.
5. Weak domestic R&D keeps India **import-dependent in strategic technologies**, such as sub-28 nm chips and aero-engines.
6. Leads to **brain drain**, with lakhs of students pursuing advanced STEM research abroad due to inadequate lab infrastructure.
7. Low research output (only ~3% global share) undermines **economic competitiveness and value-chain upgradation**.
8. Strengthening R&D is vital for **strategic autonomy, demographic dividend utilisation and India-specific solutions** in climate, health and defence sectors.

ACHIEVEMENTS OF THE DEPARTMENT OF BIOTECHNOLOGY (DBT) IN 2025

Recent Update: India's **bio-economy crossed $165.7 billion**, marking biotechnology as a key growth pillar

About

1. The **Department of Biotechnology (DBT)** is the nodal body under the Ministry of Science & Technology for **policy, funding and ecosystem development** in biotech.
2. India's **bio-economy expanded 16-fold** in a decade, positioning the country among the **top global biotech hubs**.
3. Launched the **National Biofoundry Network** under the BioE3 Policy to accelerate biomanufacturing of APIs, smart proteins and climate-resilient crops.
4. The **GenomeIndia Project** released 10,000 whole-genome sequences, strengthening

precision medicine and indigenous genomic research.

5. Strengthened **biomedical research talent** through BRCP Phase-III with ₹1,500 crore support for fellowships and grants.
6. Achieved breakthroughs in **space biotechnology**, including India's first human muscle stem-cell experiment on the ISS.
7. Advanced **agri-biotech innovations**, including gene-edited high-yield rice and drought-resistant varieties to enhance food security.
8. Expanded startup ecosystem via **BioNEST and E-YUVA centres**, supporting 3,000+ startups and promoting IP-led innovation nationwide.

NUCLEAR POWER IN SPACE

Recent Update: U.S. plans to deploy a **small nuclear reactor on the Moon** in the early 2030s for sustained operations

About

1. **Nuclear power in space** involves using compact reactors to generate **reliable, high-density energy** for long-duration missions beyond Earth.
2. Solar energy is unreliable on the Moon and Mars due to **long nights, dust storms and weak sunlight**, limiting continuous operations.
3. Nuclear reactors provide **stable, weather-independent power**, essential for habitats, life-support systems and research facilities.
4. Enables **In-Situ Resource Utilisation (ISRU)**, such as extracting water, oxygen and fuel from lunar or Martian resources.
5. Supports **surface mobility**, powering rovers, drilling units and autonomous exploration systems.
6. Facilitates **deep-space propulsion**, including Nuclear Thermal Propulsion (NTP) for faster travel and reduced radiation exposure.
7. Nuclear Electric Propulsion (NEP) offers **efficient long-duration thrust** for cargo and deep-space probes.
8. Represents a critical technology for **permanent human presence and sustainable space exploration**, reducing dependence on Earth-based logistics.

NATIONAL SUPERCOMPUTING MISSION (NSM)

Recent Update: Indigenous content in India's HPC systems crossed **50%**, targeting full indigenisation by 2030

About

1. NSM aims to build **self-reliant high-performance computing (HPC)** through indigenous design, development and manufacturing.
2. Promotes **research accessibility**, providing supercomputing facilities to academic, scientific and government institutions.
3. **Phase I** established basic infrastructure with domestically assembled supercomputers across institutions.
4. **Phase II** focused on indigenous manufacturing and software stacks, achieving **40% value addition**.
5. **Phase III** targets complete indigenisation of processors, networks and system design.
6. **Trinetra network**, developed by C-DAC, enables high-speed inter-node communication for efficient data transfer.
7. PARAM Rudra systems operate at **petaflop-scale speeds**, enabling advanced simulations and AI research.
8. Strengthens India's **digital sovereignty, weather modelling, defence simulations and scientific computing capacity**.

YEAR-END REVIEW 2025 – DEPARTMENT OF ATOMIC ENERGY (DAE)

Recent Update: DAE achieved record **nuclear generation and healthcare expansion** while boosting strategic technologies

About

1. DAE expanded nuclear capacity with **Mahi Banswara NPP** and approval for **10 new 700 MWe PHWR units**.
2. NPCIL generated **56,681 million units of electricity**, avoiding ~49 million tonnes of CO_2 emissions.
3. Strengthened **cancer care infrastructure**, including Homi Bhabha Cancer Hospital and Tata Memorial's global recognition.
4. Developed **Certified Reference Material for Rare Earth Elements**, supporting defence and electronics industries.
5. Commissioned **Boron-11 enrichment facility**, vital for semiconductors and high-tech manufacturing.
6. Contributed to **national security systems**, including missile control and relay units.
7. Released **radiation-induced mutant crop varieties**, enhancing agricultural productivity and resilience.
8. Demonstrates DAE's role beyond energy, spanning **healthcare, research, defence and societal applications**.

GOOGLE'S PROJECT SUNCATCHER – DATA CENTRES IN SPACE

Recent Update: Google announced **solar-powered space data centres**, with prototype launches planned for 2027

About

1. **Project Suncatcher** aims to deploy **solar-powered computing racks on satellites**, creating orbital data centres.
2. Utilises **continuous solar radiation in space**, eliminating energy intermittency faced on Earth.
3. Equipped with **Tensor Processing Units (TPUs)** for AI-intensive workloads and high-efficiency computation.
4. Satellites form **constellations**, functioning collectively as distributed data centres.
5. **Laser-based optical links** enable high-speed, low-latency inter-satellite communication.
6. Supports **edge processing**, analysing Earth observation or AI data directly in orbit.
7. Requires **radiation-hardened hardware** to withstand vacuum, radiation and extreme temperatures.
8. Could reduce **energy costs, latency and terrestrial carbon footprint**, redefining future cloud infrastructure.

SOURCE: DRISHTI MONTHLY

INDIGENOUS TNPB-BASED GENE EDITING TECHNOLOGY

Recent Update: ICAR–CRRI developed an **IP-free indigenous TnpB genome editing tool**, transferred to Serum Institute for scale-up

About

1. The technology uses **TnpB (transposon-associated protein)** as a compact genome editor, offering a **low-cost alternative to patented CRISPR-Cas systems**.
2. TnpB functions as a **miniature molecular scissor**, enabling precise **DNA cuts and targeted gene modifications** in crops.
3. Its **small size (~408 amino acids)** allows easier delivery into plant cells, reducing dependence on complex tissue-culture steps.
4. Eliminates reliance on **foreign CRISPR patents** held by institutions like Broad Institute and Corteva, lowering licensing costs.
5. Enables development of **affordable genome-edited crops**, improving yield, resilience and nutritional traits.
6. Supports **Atmanirbhar Bharat in agri-biotechnology**, strengthening domestic research and commercialisation.

7. Facilitates faster breeding cycles compared to conventional GM approaches.
8. Enhances **technological sovereignty**, ensuring India controls next-generation crop innovation without multinational dependency.

BIRSA 101 – INDIA'S INDIGENOUS CRISPR GENE THERAPY

Recent Update: CSIR–IGIB developed **India's first indigenous CRISPR therapy** for Sickle Cell Disease

About

1. **BIRSA 101** is a precise **gene-editing therapy** designed to directly correct the mutation causing **Sickle Cell Disease (SCD)**.
2. Uses **engineered enFnCas9 CRISPR platform**, enabling highly accurate DNA correction with minimal off-target effects.
3. Named after **Bhagwan Birsa Munda**, recognising the heavy disease burden among tribal communities.
4. Targets the **root genetic defect**, offering potential long-term cure rather than symptomatic treatment.
5. Designed as a **low-cost alternative** to expensive global therapies like Casgevy (~USD 2.2 million).
6. Developed fully through **indigenous research**, reducing dependence on foreign biotech monopolies.
7. Strengthens India's capacity in **precision medicine and gene therapeutics**.
8. Marks a major step toward **equitable healthcare access for rare genetic diseases**.

INDIA ADVANCES QUANTUM TECHNOLOGY

Recent Update: IIT Bombay inaugurated **Liquid Helium Facility** to support ultra-low temperature quantum research

About

1. The facility enables production of **liquid helium**, critical for achieving **cryogenic temperatures below –272°C** required for quantum computing.
2. Supports **dilution refrigerators**, essential for stabilising qubits and superconducting systems.
3. Strengthens indigenous capability in **cryogenics, superconductivity, sensing and photonics**.
4. **QMagPI magnetometer** measures ultra-low nanotesla magnetic fields for defence and mineral exploration.
5. **Quantum Diamond Microscope (QDM)** enables nanoscale magnetic imaging, aiding neuroscience and chip testing.
6. **Q-Confocal System** improves cellular imaging, supporting early cancer diagnostics.
7. Reduces import dependence for **advanced scientific instrumentation**, boosting self-reliance.
8. Positions India among **select nations with full-stack quantum research infrastructure**.

PRIVATE SECTOR PARTICIPATION IN NUCLEAR ENERGY

Recent Update: Government plans **Atomic Energy Bill 2025** to allow private investment in civil nuclear sector

About

1. India plans to scale nuclear capacity from **8.8 GW to 100 GW by 2047**, requiring massive capital and manpower.
2. Public sector (NPCIL) alone lacks **financial and construction capacity** to meet expansion targets.
3. Private participation can mobilise **long-term funding**, bridging the ₹15 lakh crore investment gap.
4. Improves **project execution speed**, reducing chronic delays in reactor construction.
5. Encourages adoption of **advanced reactors and Small Modular Reactors (SMRs)**.
6. Strengthens **domestic supply chains** in engineering, procurement and EPC services.
7. Enhances **uranium mining and fuel processing capacity**, improving energy security.

8. Supports **clean, reliable baseload power**, aiding decarbonisation and Net Zero goals.

INDIA ADDS 7 NEW NAMES TO THE MARTIAN MAP

Recent Update: IAU approved **seven Indian names** for Martian geological features

About

1. The **International Astronomical Union (IAU)** assigns official names to planetary features for global scientific reference.
2. New names include **Periyar Vallis, Varkala Crater, Bekal Crater, Thumba Crater and Valiamala Crater**.
3. **Krishnan Crater and Krishnan Planus** honour geologist M. S. Krishnan.
4. Strengthens **India's symbolic presence in planetary science and space exploration history**.
5. Reflects contributions of Indian locations linked to **geology and space research**.
6. Promotes **public engagement and scientific pride** in astronomy.
7. Demonstrates India's growing participation in **global planetary mapping missions**.
8. Reinforces integration of **Indian heritage with international scientific nomenclature**.

INDIA'S POLICY SHIFT TOWARD GENOME-EDITED CROPS

Recent Update: Two GE rice varieties cleared; GE mustard under advanced trials

About

1. **Genome editing (GE)** enables precise modification of existing genes without introducing foreign DNA.
2. GE crops are exempt from **strict GM biosafety rules**, simplifying regulatory approvals.
3. Only **Institutional Biosafety Committee clearance** is required, accelerating field deployment.
4. Government increased **funding support (~₹500 crore)** for GE research and breeding.
5. GE improves **elite local varieties** without altering culinary or regional traits.
6. Faces **higher public acceptance** compared to controversial transgenic GM crops.
7. Allows **faster trait development**, such as drought tolerance and higher yields.
8. Strengthens **food security and climate resilience** through indigenous biotechnology.

WORLD AIDS DAY 2025 & NATIONAL AIDS CONTROL PROGRAMME (NACP)

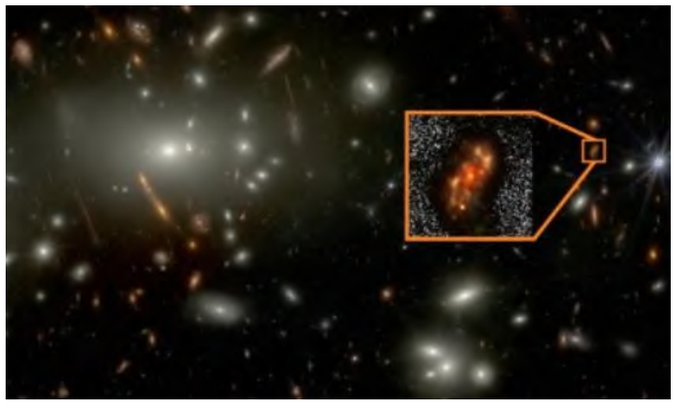
Recent Update: India's HIV prevalence fell to **0.20%**, among lowest globally

About

1. **NACP**, implemented by **NACO**, is India's flagship programme for HIV prevention, treatment and care since 1992.
2. Expanded through multiple phases focusing on **prevention, treatment, stigma reduction and integration**.
3. Introduced **'Test and Treat' policy**, ensuring immediate ART for all diagnosed individuals.
4. HIV prevalence declined significantly from **0.33% (2010) to 0.20% (2024)**.
5. New infections reduced by **49%**, outperforming global averages.
6. ART coverage expanded, with **millions receiving lifelong therapy**.
7. Supported by **legal safeguards (HIV/AIDS Act 2017)** prohibiting discrimination.
8. Aligns with **SDG 3.3 goal** of ending AIDS as a public health threat by 2030.

ALAKNANDA GALAXY

Recent Update: JWST discovered **well-structured spiral galaxy** only 1.5 billion years after Big Bang



About

1. **Alaknanda Galaxy** lies about **12 billion light-years away**, dating to the early universe.
2. Exhibits a clear **textbook spiral structure**, challenging theories that such galaxies form later.
3. Suggests **rapid early galaxy evolution**, revising cosmological models.
4. Detected using **James Webb Space Telescope's deep infrared imaging**.
5. Highlights processes like **star formation, mergers and gravitational shaping**.
6. Provides clues about **dark matter and cosmic web structure**.
7. Strengthens India's presence in **global astrophysics research**.
8. Expands understanding of **galaxy formation timelines** in early universe history.

BIOREMEDIATION IN INDIA

Recent Update: India expanding **microbial and biotech-based pollution clean-up projects**

About

1. **Bioremediation** uses bacteria, fungi, algae or plants to **degrade toxic pollutants into harmless products**.
2. It is **eco-friendly and cost-effective**, compared to chemical or mechanical clean-up methods.
3. Applied in **oil spills, sewage treatment, heavy metal removal and pesticide degradation**.
4. Includes **in-situ and ex-situ approaches** depending on contamination type.
5. Advances involve **genetically engineered microbes** and synthetic biology for stubborn pollutants.
6. "Biosensor organisms" provide **early toxin detection** through colour change.
7. Supported by **DBT programmes, IIT research and biotech startups**.
8. Offers sustainable solutions for **India's rising soil, water and waste pollution crisis**.

ANEEL FUEL FOR THORIUM-BASED REACTORS

Recent Update: Clean Core Thorium Energy proposes **ANEEL fuel for India's PHWR fleet**

About

1. **ANEEL (Advanced Nuclear Energy for Enriched Life)** is a thorium-uranium blended fuel designed for **Pressurised Heavy Water Reactors**.
2. Combines **thorium with HALEU**, improving efficiency and safety.
3. Enables **drop-in use in existing reactors**, requiring minimal modifications.
4. Could reduce **Levelised Cost of Electricity by 20–30%**, enhancing competitiveness.
5. Produces **85% less nuclear waste**, lowering long-term storage burden.
6. Thorium is **3–4 times more abundant than uranium**, ensuring resource security.
7. Supports India's **three-stage nuclear programme** leveraging thorium reserves.
8. Promotes **clean, safe and proliferation-resistant nuclear energy** for sustainable growth.

THALASSEMIA BURDEN IN INDIA

Recent Update: Five thalassemia children in Jharkhand contracted **HIV through contaminated transfusions**, raising blood safety concerns

About

1. **Thalassemia** is an **inherited hemoglobin disorder** where the body produces insufficient or defective hemoglobin, leading to chronic anemia and weak red blood cells.
2. It results from **genetic mutations affecting globin chains**, reducing oxygen-carrying capacity and causing fatigue, organ damage and growth delays.
3. **Alpha Thalassemia** occurs due to reduced or absent alpha-globin chain production, while beta variants affect beta chains.
4. Severe patients require **lifelong periodic blood transfusions**, increasing risks of iron overload and transfusion-transmitted infections.
5. The **Comprehensive Guidelines on Hemoglobinopathies (2016)** provide protocols for diagnosis, treatment, monitoring and psychosocial support.

6. **National Health Mission (NHM)** strengthens blood banks, labs, day-care centres and trained manpower.
7. **Thalassemia Bal Sewa Yojana (TBSY)** offers up to ₹10 lakh assistance for **Bone Marrow Transplant**, the only curative option.
8. **e-RaktKosh digital platform** improves blood availability tracking, ensuring safe and timely transfusions for dependent patients.

GOOGLE'S QUANTUM ECHOES EXPERIMENT

Recent Update: Google demonstrated **Quantum Echoes on its 65-qubit Willow processor**, intensifying debate on encryption security and Q-Day

About

1. The experiment studied how **quantum information scrambles and refocuses** inside highly entangled systems, producing a measurable "echo."
2. Conducted on Google's **65-qubit Willow processor**, advancing understanding of quantum chaos and coherence.
3. Scientists used **Out-of-Time-Order Correlator (OTOC)** techniques to perturb the system and observe signal recovery.
4. Demonstrates improved control over **entanglement and error dynamics**, critical for scalable quantum computing.
5. Revives the **Q-Day concept**, when quantum machines could break current public-key encryption standards.
6. **RSA-2048 encryption**, used globally, may be vulnerable to **Shor's algorithm**, which factors primes exponentially faster.
7. Raises "**harvest now, decrypt later**" risks where stored encrypted data may be cracked in the future.
8. However, present hardware remains limited, needing **millions of stable qubits**, far beyond current noisy processors.

SOURCE: INDIAN EXPRESS

RACCOON ROUNDWORM (BAYLISASCARIS PROCYONIS)

Recent Update: European study reports **widespread infection in raccoons across nine countries**, raising zoonotic health risks

About

1. **Raccoon roundworm** is a **zoonotic parasitic disease** caused by the nematode **Baylisascaris procyonis**, primarily infecting raccoons but accidentally infecting humans.
2. Humans become infected by **ingesting eggs from contaminated soil or surfaces**, after which larvae migrate through organs.
3. The parasite is **native to North America**, where raccoons act as natural reservoir hosts.
4. It spread to **Europe via pet trade and fur farms**, with escaped raccoons establishing wild populations.
5. Found mainly in **raccoons (primary host)**, but dogs, birds, rodents and small mammals act as accidental hosts.
6. Human infection causes **visceral, ocular and neural larva migrans**, damaging liver, eyes and brain tissues.
7. Severe complications include **blindness, neurological impairment, coma and death**, especially in children.
8. Prevention depends on **wildlife control, hygiene awareness and soil contamination management**, since treatment success is limited.

PLASSER'S QUICK RELAYING SYSTEM (PQRS)

Recent Update: Northeast Frontier Railway achieved **1,033 m single-day track renewal** using PQRS technology

About

1. **PQRS** is a **semi-mechanised track renewal system** used by Indian Railways to quickly replace old rail tracks with prefabricated panels.
2. Developed by **Plasser & Theurer (Austria)**, a global leader in railway maintenance machinery.
3. Designed to **speed up renewal within short traffic blocks**, reducing disruption to train operations.
4. Uses **self-propelled portal cranes** moving on auxiliary tracks to lift and shift panels safely.
5. **Old rails and sleepers are removed**, while new prefabricated panels are placed simultaneously using Track Laying Equipment.
6. Removed panels are directly loaded onto **Bogie Flat Wagons (BFRs)**, reducing extra handling.
7. Minimises **manual labour, safety risks and lifecycle maintenance costs** compared to traditional methods.
8. Enhances **track reliability, passenger safety and operational efficiency** for high-density rail corridors.

NUCLEAR ENERGY MISSION

Recent Update: India plans **5 indigenous Small Modular Reactors (SMRs) by 2033** with ₹20,000 crore R&D support

About

1. **Nuclear Energy Mission** is a national framework to expand nuclear capacity using **indigenous and advanced technologies**.
2. Targets **100 GW nuclear power by 2047**, supporting long-term clean energy transition.
3. Focuses on **Small Modular Reactors (SMRs)** that are compact, factory-built and suitable for decentralised generation.
4. ₹20,000 crore allocated for **design, research and deployment** of next-generation reactors.
5. BARC is developing **BSMR-200, SMR-55 and high-temperature reactors** for hydrogen production.
6. SMRs support **industrial decarbonisation, captive power and remote/off-grid areas**.
7. Provides **24×7 baseload electricity**, stabilising grids alongside renewables like solar and wind.
8. Strengthens **energy security, low-carbon growth and Net Zero 2070 commitments**.

SOLAR FLARES

Recent Update: NASA detected **X1.9-class flare causing radio blackout over Australia**, linked to giant sunspot AR 4294–96

About

1. **Solar flares** are sudden, intense bursts of **electromagnetic radiation** caused by rapid magnetic energy release near sunspots.
2. Form when **twisted magnetic fields accumulate stress**, storing huge energy in solar plasma.
3. **Magnetic reconnection** suddenly releases this energy, heating plasma to millions of degrees.
4. Emit radiation across **radio, X-ray and gamma wavelengths**, reaching Earth within minutes.
5. Often accompanied by **Coronal Mass Ejections (CMEs)** that eject plasma clouds into space.
6. Classified by intensity as **A, B, C, M, X classes**, with X being most powerful.

7. Disrupt **satellite communications, GPS, aviation radio and power grids**.
8. Highlight growing need for **space-weather monitoring and resilient infrastructure**.

INDIAN PHARMACOPOEIA COMMISSION (IPC)

Recent Update: Indian Pharmacopoeia 2026 (10th Edition) to be launched strengthening drug quality standards

About

1. **IPC** is the national authority responsible for publishing **Indian Pharmacopoeia**, the official drug standards book.
2. Ensures **identity, purity, strength, quality and safety** of medicines under the Drugs and Cosmetics Act.
3. Established in **2009** as an autonomous body under **MoHFW**.
4. Publishes and updates **monographs for APIs, excipients, formulations and herbal drugs**.
5. Issues **National Formulary of India (NFI)** to guide rational prescribing.
6. Acts as **National Coordination Centre for Pharmacovigilance Programme of India (PvPI)**.
7. Provides **IP Reference Substances** for standardised drug testing.
8. Supports **Atmanirbhar Bharat in pharmaceuticals** and global regulatory harmonisation.

CANDIDA AURIS

Recent Update: Indian-led study warns of **rising virulence and global spread of multidrug-resistant Candida auris**

About

1. **Candida auris** is a **multidrug-resistant fungal pathogen** causing severe invasive hospital infections.
2. First identified in **2009**, now considered a **global health threat** due to treatment failure.
3. Spreads easily in **ICUs and long-term care facilities**, surviving on surfaces and medical devices.
4. Causes **bloodstream infections (candidemia)** with symptoms resembling bacterial sepsis.
5. Shows **resistance to multiple antifungal classes**, limiting therapeutic options.
6. Mortality rates often exceed **50% even with treatment**.
7. Requires **strict infection control, isolation and surveillance** in hospitals.
8. Highlights urgent need for **new antifungal drugs and antimicrobial stewardship**.

ANOPHELES STEPHENSI

Recent Update: Rapid urban spread threatens **India's malaria elimination target 2030**

About

1. **Anopheles stephensi** is an **urban malaria vector**, transmitting **Plasmodium falciparum and vivax**.
2. Native to South Asia but now spreading globally as an **invasive mosquito species**.
3. Breeds in **man-made containers**, similar to dengue mosquitoes, increasing urban survival.
4. Thrives in **water tanks, construction sites and household storage**, complicating control.
5. Efficiently spreads malaria in **cities rather than rural zones**, shifting disease geography.
6. Challenges traditional **rural-focused malaria strategies**.
7. Requires **urban surveillance, source reduction and integrated vector management**.
8. Poses major risk to **India's zero indigenous case targets**.

AI-DRIVEN DIABETIC RETINOPATHY SCREENING – AFMS

Recent Update: AFMS launched **MadhuNetrAI-based community screening** for early diabetic eye disease detection

About

1. First **AI-enabled national community screening programme** for Diabetic Retinopathy (DR).

2. Uses **handheld fundus cameras and AI image analysis** for rapid retinal grading.
3. Enables **early detection and timely referral**, preventing avoidable blindness.
4. Conducted by **trained medical officers and paramedics** at community level.
5. Provides **automated triaging and specialist referrals**.
6. Generates **real-time dashboards** for disease mapping and policy planning.
7. Integrated with **National NCD programmes** for continuity of care.
8. Demonstrates scalable use of **AI for public health equity and accessibility**.

FSSAI EGG SAFETY DRIVE – NITROFURANS

Recent Update: Nationwide surveillance launched after reports of **banned antibiotic residues in eggs**

About

1. **Nitrofurans** are synthetic **broad-spectrum antimicrobial agents** historically used in veterinary medicine.
2. Compounds include **nitrofurantoin, furazolidone and nitrofurazone**.
3. Banned in food animals due to **carcinogenic and toxic effects**.
4. Residues in eggs violate **food safety standards and export norms**.
5. Exposure linked to **cancer risk, neurological toxicity and hypersensitivity reactions**.
6. FSSAI initiated **testing and surveillance across poultry supply chains**.
7. Ensures **consumer trust and regulatory compliance**.
8. Strengthens **One Health approach linking animal husbandry and food safety**.

PATHGENNIE SOFTWARE

Recent Update: Indigenous **open-source tool accelerates drug discovery simulations**

About

1. **PathGennie** is a computational platform simulating **drug–protein unbinding pathways** accurately.
2. Developed by **S. N. Bose National Centre, Kolkata**.
3. Predicts **drug residence time**, a key factor for efficacy and safety.
4. Runs **multiple short simulations**, selecting only promising trajectories.
5. Avoids **artificial distortions or forced dynamics**, preserving physical realism.
6. Reduces **computational time and costs** compared to traditional methods.
7. Applicable to **drug design, catalysis, phase transitions and molecular kinetics**.
8. Supports **faster, affordable and indigenous pharmaceutical innovation**.

RARE-EARTH ELEMENTS (REES)

Recent Update: Supply-chain vulnerabilities highlight **strategic importance of REEs for green and defence tech**

About

1. REEs include **17 elements (15 lanthanides + scandium + yttrium)** with unique magnetic and electronic properties.
2. Critical for **EVs, wind turbines, semiconductors, defence systems and electronics**.
3. Physically **soft, dense and highly reactive**, often used as oxides.
4. Chemically difficult to **extract and refine**, increasing processing costs.
5. China controls **90%+ of global refining and magnet production**, creating dependence risks.

6. India holds **~6.9 million tonnes reserves**, offering strategic opportunity.
7. Essential for **clean energy transition and advanced manufacturing**.
8. Requires **diversified supply chains and domestic processing capacity**.

AILA – ARTIFICIALLY INTELLIGENT LAB ASSISTANT

Recent Update: IIT Delhi developed **AI system autonomously conducting experiments**

About

1. **AILA** is an AI-driven lab assistant capable of **designing and executing scientific experiments independently**.
2. Automates **instrument control, data collection and analysis** end-to-end.
3. Makes **real-time decisions**, adjusting parameters dynamically.
4. Reduces tasks from **hours to minutes**, boosting research productivity.
5. Learns from outcomes, improving **adaptive intelligence** over time.
6. Enables wider access to **advanced research infrastructure**.
7. Bridges gap between **AI reasoning and practical experimentation**.
8. Supports India's **AI-for-Science and deep-tech innovation ecosystem**.

AGENTIC AI

Recent Update: Businesses increasingly adopting **autonomous goal-driven AI agents** for workflow automation

About

1. **Agentic AI** refers to **autonomous, goal-oriented AI systems** capable of independent decision-making.
2. Built on **LLMs and reasoning engines** that plan, act and learn continuously.
3. Perceives environment via **data streams, sensors and APIs**.
4. Sets goals, plans steps and **executes actions using external tools**.
5. Coordinates multiple **specialised agents** in complex workflows.
6. Learns from feedback, improving **adaptability and efficiency**.
7. Reduces **human supervision and operational costs**.
8. Represents shift from **AI as assistant to AI as active digital workforce**.

DHRUV64 MICROPROCESSOR

Recent Update: India launched **DHRUV64**, its first indigenously designed **1.0 GHz, 64-bit dual-core processor** under the Digital India RISC-V programme

About

1. **DHRUV64** is India's first **fully indigenous 64-bit dual-core microprocessor** based on the **open-source RISC-V architecture**.
2. Designed by **C-DAC** under MeitY's **Microprocessor Development Programme (MDP)** to reduce reliance on imported chips.
3. Operates at **1.0 GHz**, suitable for embedded systems, IoT, industrial electronics, and secure strategic platforms.
4. Fabricated as the **third chip under DIR-V**, following **THEJAS32 and THEJAS64** processors.
5. Supports both **commercial applications (consumer electronics, automation)** and **strategic uses (defence, secure computing)**.
6. Promotes a **domestic semiconductor ecosystem**, enabling startups, academia and MSMEs to design indigenous products.
7. Strengthens **national security and supply-chain resilience**, reducing exposure to foreign chip restrictions.
8. Forms the base for future advanced SoCs like **DHANUSH64 and DHANUSH64+**, accelerating India's chip self-reliance journey.

Q-DAY

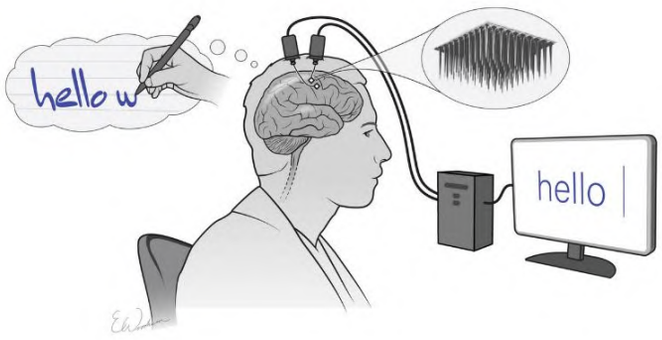
Recent Update: Google's **Quantum Echoes experiment** has revived debate on the possible arrival of **Q-day**, when quantum computers could break encryption

About

1. **Q-day** refers to the future moment when **quantum computers become powerful enough to break current public-key cryptography**.
2. The concern arises from **Shor's Algorithm (1994)**, which can factor large numbers exponentially faster than classical methods.
3. Could break **RSA and ECC encryption**, threatening banking, military, cloud and internet communications.
4. Enables the **"Harvest Now, Decrypt Later"** strategy, where encrypted data is stored today and cracked later.
5. Requires **millions of logical qubits**, whereas present machines have only a few hundred noisy qubits.
6. Has triggered development of **Post-Quantum Cryptography (PQC)** like **CRYSTALS-Kyber and Dilithium**, standardised by NIST.
7. Forces governments and enterprises into a **global cybersecurity transition** before quantum maturity.
8. Seen as a **strategic digital arms race**, shaping geopolitical power in the next computing era.

BRAIN–COMPUTER INTERFACE (BCI)

Recent Update: India exploring **BCIs for healthcare and defence**, joining global neurotechnology race



About

1. A **Brain–Computer Interface (BCI)** directly connects **brain signals to external devices**, enabling thought-based control.
2. Captures neural activity using **invasive implants or non-invasive EEG electrodes**.
3. Uses **AI/ML decoding algorithms** to translate signals into commands like movement or typing.
4. Controls devices such as **robotic limbs, wheelchairs, prosthetics, or communication tools**.
5. Offers **real-time interaction**, bypassing damaged nerves or muscles in paralysed patients.
6. Emerging **bidirectional BCIs** can also stimulate the brain to restore lost functions.
7. Applications include **stroke recovery, Parkinson's therapy, assistive tech, and mental communication systems**.
8. Raises **ethical, privacy and security concerns**, especially in defence and surveillance contexts.

TENSOR PROCESSING UNIT (TPU)

Recent Update: Google unveiled **Ironwood TPU**, enhancing AI-specialised computing

About

1. **TPU** is a **custom ASIC chip** built specifically to accelerate **machine learning and deep neural networks**.
2. Developed by **Google in 2015**, later deployed via **Google Cloud** for global AI workloads.
3. Uses **Matrix Multiply Units (MXUs)** that perform massive parallel calculations efficiently.
4. Optimised for **tensor operations**, which dominate modern AI tasks like LLMs and computer vision.
5. Consumes **less power per computation** compared to GPUs and CPUs.
6. Outperforms **CPUs**, which lack parallelism for heavy ML math.
7. More efficient than **GPUs**, which still carry general-purpose overheads.
8. Critical for scaling **AI training, inference and large language model deployment**.

SIM BINDING

Recent Update: Government mandates **SIM-based identity linking for messaging apps** under Telecom Cybersecurity Rules 2025

About

1. **SIM Binding** permanently links a **digital service or messaging account to a physical SIM card**.
2. The app works only when the **original SIM is present**, acting as a hardware authentication token.
3. Enforced by **Department of Telecommunications (DoT)** under amended cybersecurity rules.
4. Uses SIM identifiers like **IMSI, ICCID and Ki** for continuous verification.
5. Blocks access if SIM mismatch occurs, preventing **identity spoofing or account takeover**.
6. Web sessions must **auto-logout periodically**, strengthening remote security.
7. Targets **OTP bypass frauds, impersonation scams and cross-border cybercrime**.
8. Enhances **digital identity integrity and telecom ecosystem security**.

MICROMETEOROIDS AND ORBITAL DEBRIS (MMOD)

Recent Update: Spacecraft damage incident renews focus on **MMOD risks to astronauts and satellites**

About

1. **MMOD** combines threats from **natural micrometeoroids and human-made orbital debris**.
2. Debris concentrated in **Low Earth Orbit (200–2000 km)** where most satellites operate.
3. Micrometeoroids originate from **asteroid collisions and comet fragments**.
4. Human debris arises from **defunct satellites, explosions, collisions and ASAT tests**.
5. Travel at **10–72 km/s**, meaning even tiny fragments can cause catastrophic damage.
6. Over **34,000 large objects tracked**, but millions of smaller fragments remain untraceable.
7. Can trigger **Kessler Syndrome**, a chain reaction of collisions.
8. Requires **shielding, avoidance manoeuvres and international debris governance**.

MAVEN SPACECRAFT

Recent Update: NASA temporarily lost contact with **Mars Atmosphere and Volatile Evolution (MAVEN)** orbiter

About

1. **MAVEN** is a NASA orbiter studying **Mars' upper atmosphere and atmospheric escape processes**.
2. Launched in **2013** to understand why Mars transformed from **warm–wet to cold–dry**.
3. Follows an **elliptical orbit**, sampling multiple atmospheric layers.
4. Carries **eight instruments** including mass spectrometers and plasma sensors.
5. Studies **solar wind interactions and ion loss mechanisms**.
6. Confirmed **hydrogen escape**, explaining Mars' historic water loss.
7. Observed **solar storms sharply increasing atmospheric erosion**.
8. Supports **data relay for surface missions**, aiding rover operations.

RESPOND BASKET 2025

Recent Update: ISRO invites academia through **mission-aligned research problems**

About

1. **RESPOND Basket** lists **curated research challenges** directly tied to ISRO's future missions.
2. Published by **ISRO under Department of Space**.
3. Bridges **academia–space programme collaboration**.
4. Encourages **problem-driven innovation** rather than theoretical research.
5. Open to **universities and recognised R&D institutions**.
6. Includes **technical briefings and mentorship from ISRO scientists**.
7. Uses **I-GRASP digital portal** for submissions.
8. Builds a **future-ready talent pipeline and indigenous space capability**.

SOURCE: PIB

GEMINID METEOR SHOWER

Recent Update: Geminids peak over India with **100–120 meteors/hour**

About

1. **Geminids** are an annual **December meteor shower**, among the brightest visible events.
2. Originate from **asteroid 3200 Phaethon**, unlike comet-based showers.
3. Caused by **solar heating shedding debris**, which Earth crosses yearly.
4. Radiates from **constellation Gemini**, best seen post-midnight.
5. Produces **bright yellow-white fireballs**.
6. Travel at **~35 km/s**, slower but highly visible.
7. Peak activity during **mid-December under dark skies**.
8. Valuable for **public astronomy awareness and scientific observation**.

BLUEBIRD-6 & LVM3 LAUNCH

Recent Update: ISRO launching **6.5-tonne BlueBird-6**, heaviest US commercial satellite on **LVM3**

About

1. **BlueBird-6** is a **LEO communication satellite** under AST SpaceMobile's direct-to-device broadband constellation.
2. Features **largest phased-array antenna (~2,400 sq ft)** for high-capacity connectivity.
3. Offers **10,000 MHz bandwidth**, enabling mobile coverage without ground towers.
4. Launched aboard **LVM3**, India's heaviest-lift rocket.
5. LVM3 can carry **8 tonnes to LEO and 4 tonnes to GTO**.
6. Three-stage system with **solid boosters, liquid core and cryogenic upper stage**.
7. Human-rated variant will support **Gaganyaan missions**.
8. Strengthens India's **commercial launch market credibility and space diplomacy**.

PLANETARY-DEFENSE EXERCISE ON 3I/ATLAS

Recent Update: ESA and NASA launched the **world's largest planetary-defence drill** centred on tracking the fast-moving object **3I/ATLAS**

About

1. The **3I/ATLAS exercise** is a large-scale **global simulation** designed to test how countries **detect, track and respond to near-Earth space threats** such as asteroids and comets.
2. Led jointly by **ESA, NASA and the UN-backed International Asteroid Warning Network (IAWN)** with participation from agencies like **ISRO, JAXA and CNSA**.
3. The **aim** is to evaluate **early-warning systems, telescope networks, emergency planning and citizen communication mechanisms** under realistic conditions.
4. Agencies continuously **track 3I/ATLAS using ground telescopes and space-based sensors**, refining its **position, speed and orbital path in real time**.
5. Scientists analyse **trajectory deviations** caused by **gravity, solar radiation pressure or outgassing**, updating models to detect possible Earth-approach risks.
6. Thousands of **impact probability simulations** are conducted to estimate whether the object

might intersect **Earth's orbit or remain safely distant**.

7. Teams simulate **deflection missions, civil-defence mobilisation, evacuation strategies and disaster-response protocols**, testing operational readiness.

8. The exercise strengthens **international coordination, data-sharing, misinformation control and psychological preparedness**, improving global planetary security governance.

ASTROSAT

Recent Update: Indian Institute of Astrophysics marked **10 years of UVIT operations**, celebrating a decade of discoveries from **AstroSat**

About

1. **AstroSat** is India's **first dedicated multi-wavelength space observatory**, enabling simultaneous studies in **ultraviolet, optical, soft X-ray and hard X-ray bands**.

2. Launched in **2015 by PSLV-C30 into a 650 km orbit**, marking India's entry into advanced space astronomy missions.

3. The **aim** is to study **high-energy cosmic processes**, compact objects, star formation, galaxies and black holes through coordinated observations.

4. Carries **five scientific payloads** covering energies from **UV to 100 keV X-rays**, providing broad spectral coverage in a single platform.

5. Enables **simultaneous multi-wavelength imaging**, allowing scientists to correlate emissions across bands for better astrophysical insights.

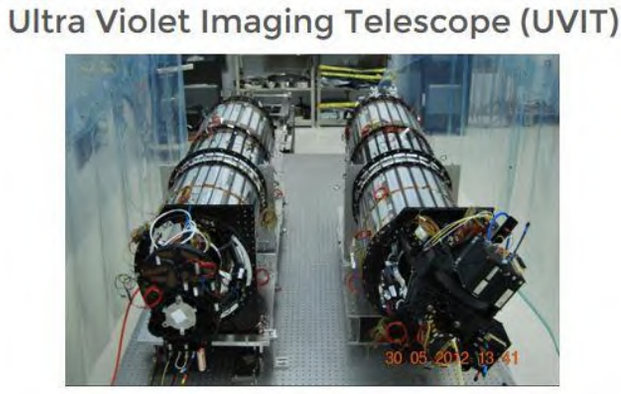
6. Data is **processed and archived by ISSDC (Bylalu)** and mission operations handled by **ISTRAC (Bengaluru)** for global scientific access.

7. Designed for **5 years but operating far beyond**, reflecting high reliability and mission success.

8. Has positioned India as a **serious contributor to global space astronomy**, supporting both domestic and international research collaborations.

ULTRA-VIOLET IMAGING TELESCOPE (UVIT)

Recent Update: UVIT completes **a decade of high-resolution ultraviolet observations**, among the world's best UV imagers



About

1. **UVIT** is a **twin-telescope ultraviolet imager** mounted on AstroSat, capable of observing in **near-UV, far-UV and visible bands** simultaneously.

2. Provides **spatial resolution better than 1.5 arcseconds**, making it one of the **highest-resolution UV telescopes globally**.

3. Contains **two co-aligned telescopes**, one for **NUV+Visible** and another for **FUV observations**, enhancing spectral versatility.

4. Developed by a **national consortium led by IIA**, with technical support from multiple **ISRO centres**, reflecting indigenous capability.

5. Enables detailed studies of **hot stars, star clusters, dwarf galaxies and active galactic nuclei**, which emit strongly in ultraviolet.

6. Key discoveries include **hot companions of Be stars, blue stragglers, UV disks in dwarf galaxies, novae in Andromeda, and AGN UV–X-ray correlations**.

7. Serves as **India's first UV space telescope** and only the **second globally after Hubble** with strong far-UV capability.

8. Significantly enhances **India's astrophysics research ecosystem**, training scientists and enabling frontier space-based astronomy.

SOURCE: VISION MONTHLY

NATIONAL BLOOD TRANSFUSION BILL, 2025

Recent Update: Bill introduced to create **uniform national framework for regulation of blood banks and transfusion services**

About

1. Seeks to establish **standardised licensing, testing, storage and transfusion protocols** across all States.
2. Addresses **patient safety risks**, highlighted by incidents like **HIV transmission to thalassaemic children**.
3. Replaces fragmented governance under **Drugs and Cosmetics Act, 1940**, which caused regulatory loopholes.
4. Mandates **uniform screening for TTIs (HIV, Hepatitis, Syphilis etc.)**, ensuring safer transfusions.
5. Promotes **component separation, leukoreduction and advanced compatibility testing** for better outcomes.
6. Tackles **seasonal shortages and poor inventory management** through centralised monitoring systems.
7. Reduces **urban–rural disparities** by strengthening peripheral blood centres and storage units.
8. Aims to ensure **equitable, safe and reliable blood access**, strengthening India's public health infrastructure.

SECOND WHO GLOBAL SUMMIT ON TRADITIONAL MEDICINE

Recent Update: India and WHO adopted **Delhi Declaration on integrating Traditional Medicine into primary healthcare**

About

1. Jointly organised by **WHO and Ministry of AYUSH**, promoting global collaboration in traditional healing systems.
2. Declaration stresses **integration of traditional medicine into primary healthcare delivery**.
3. Calls for **stronger regulation, safety standards and scientific validation** of practices.
4. Launch of **Traditional Medicine Global Library** to ensure equitable access to validated knowledge.
5. Recognises TM's role in **One Health approach**, linking human, animal and environmental well-being.
6. Up to **80% of global population relies on TM** for basic healthcare needs.
7. India's **AYUSH sector valued at $43+ billion**, reflecting economic potential.
8. Enhances India's **soft power diplomacy through Ayurveda, Yoga and holistic wellness systems**.

ISRO'S LVM3-M6 MISSION

Recent Update: LVM3-M6 successfully launched **BlueBird Block-2 satellite into Low Earth Orbit**

About

1. Sixth operational flight of **LVM3 heavy-lift launch vehicle** and third dedicated commercial mission.
2. Conducted under agreement between **NSIL (ISRO's commercial arm) and AST SpaceMobile (USA)**.
3. Launched from **Satish Dhawan Space Centre, Sriharikota**.
4. BlueBird Block-2 part of **global LEO constellation enabling direct-to-mobile connectivity**.
5. Supports **4G/5G voice, video, text and data services via satellite**, bridging digital divide.
6. Payload features **223 m^2 phased array**, largest commercial communications satellite in LEO.
7. Heaviest payload by LVM3 at **6,100 kg**, showcasing enhanced launch capacity.
8. Strengthens India's **commercial space launch market and private-sector participation**.

SCHEME TO MANUFACTURE RARE EARTH PERMANENT MAGNETS (REPMs)

Recent Update: Cabinet approved **₹7,280 crore scheme to promote domestic REPM manufacturing**

About

1. Aims to reduce **import dependence on critical rare earth magnets**, vital for EVs, wind turbines and defence.

2. Targets **6,000 MTPA integrated manufacturing capacity** within India.
3. Provides **₹6,450 crore sales-linked incentives** and **₹750 crore capital subsidy**.
4. Covers **end-to-end value chain: oxides → metals → alloys → finished magnets**.
5. Allocates capacity among **five beneficiaries via competitive bidding**.
6. Encourages **advanced sintering technology** for stronger, corrosion-resistant magnets.
7. Enhances **strategic autonomy in critical mineral supply chains**.
8. Supports **Make in India, green energy and high-tech manufacturing ecosystem**.

UNGA DECLARATION ON NON-COMMUNICABLE DISEASES AND MENTAL HEALTH

Recent Update: UNGA adopted **first joint political declaration addressing NCDs and mental health together**

About

1. Expands NCD focus to **oral health, lung diseases and childhood cancers**.
2. Recognises **environmental determinants** like air pollution, clean cooking and toxic exposures.
3. Addresses **digital health risks**, including excessive screen time and misinformation impacts.
4. Calls for **stronger regulation of tobacco, trans fats, unhealthy foods and e-cigarettes**.
5. Promotes **whole-of-government and whole-of-society approach**, involving civil society and private sector.
6. Sets **clear accountability with UN Secretary-General reporting on targets**.
7. NCDs cause **~18 million premature deaths annually**, major global health burden.
8. Integrates mental health, recognising **1+ billion people affected worldwide**, strengthening SDG 3 commitments.

SOURCE: THE HINDU

YOUNG STELLAR OBJECTS (YSOs)

Recent Update: Scientists decoded the early evolutionary stages of **Young Stellar Objects** using a decade of data from **NASA's WISE and NEOWISE missions**.

About

1. Young Stellar Objects are **stars in the earliest stages of their life cycle**, before they fully enter the main sequence phase.
2. They represent a phase where **hydrogen fusion begins gradually in the stellar core**, marking the birth of a star.
3. YSOs form through the **gravitational collapse of dense molecular clouds rich in gas and dust**.
4. This collapse is often triggered by **nearby supernova explosions, intense stellar radiation, or interstellar turbulence**.
5. YSOs exist mainly as **protostars or pre-main sequence stars**, embedded within thick clouds of gas.
6. They are found in **dense, cold, gas-rich molecular clouds**, often invisible in optical wavelengths.
7. Studying YSOs helps scientists understand **star formation, planetary system development, and early cosmic evolution**.

DORJILUNG HYDROELECTRIC POWER PROJECT

Recent Update: Bhutan's **Dorjilung Hydroelectric Power Project** continues to progress as a major cross-border renewable energy initiative.

About

1. Dorjilung is a **1,125 MW run-of-river hydropower project**, designed to generate electricity without creating a large reservoir.
2. The project is located across the **Lhuentse and Mongar districts of eastern Bhutan**, enhancing regional energy infrastructure.
3. It is being constructed on the **Kurichhu River**, which is a tributary of the **Drangmechhu river system**.
4. The river ultimately flows into **India**, strengthening India–Bhutan hydropower interdependence.
5. The project is **financed by the World Bank**, reflecting strong multilateral support.
6. It is jointly developed by **Druk Green Power Corporation (DGPC)** and **Tata Power Company Limited**.
7. Dorjilung will contribute significantly to **clean energy generation and Bhutan's export-oriented hydropower economy**.

KODAIKANAL SOLAR OBSERVATORY (KoSO)

Recent Update: The **Kodaikanal Solar Observatory** continues to be globally recognised for its long-term solar data archives.

About

1. KoSO was established in **1899** at **Kodaikanal, Tamil Nadu**, making it one of the world's oldest solar observatories.
2. It is operated by the **Indian Institute of Astrophysics (IIA)** under the Department of Science and Technology.
3. The observatory is renowned for the discovery of the **Evershed Effect in 1909**, explaining gas flows in sunspots.
4. The **Kodaikanal Tower Tunnel Telescope** enables high-resolution solar observations.
5. KoSO has contributed significantly to understanding **sunspots, solar flares, and solar magnetic fields**.
6. It maintains one of the **longest continuous solar observation datasets in the world**.
7. The observatory plays a critical role in **space weather research and solar cycle analysis**.

LOFAR (LOW-FREQUENCY ARRAY)

Recent Update: LOFAR continues to produce **cutting-edge observations** on the **early universe and solar activity**.

About

1. **LOFAR** is a **pan-European distributed radio interferometer** developed by **ASTRON (Netherlands)**.
2. It operates at **low radio frequencies (90–200 MHz)**, which are inaccessible to most traditional telescopes.
3. LOFAR has the ability to **observe the entire sky simultaneously** without physical movement.
4. It uses **digital beam-forming technology** instead of mechanical steering.
5. The telescope studies the **early universe**, **cosmic magnetism**, and **solar storms**.
6. Its **core array is located in the Netherlands**, with stations across **Germany, France, and the UK**.
7. LOFAR supports **multi-user and rapid repointing operations**.

LIQUEFIED PETROLEUM GAS (LPG)

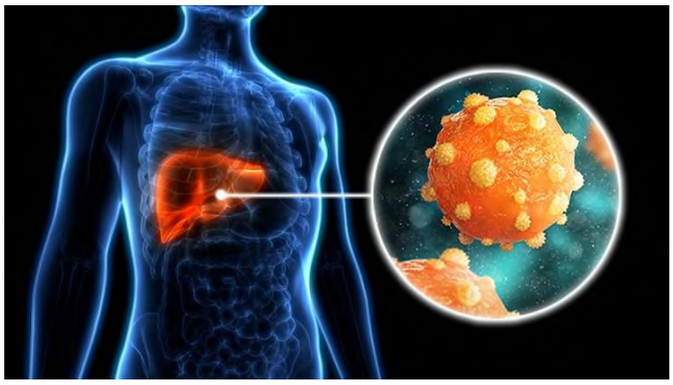
Recent Update: India finalised its **first structured LPG import deal with the United States for 2026**.

About

1. **LPG** is a **flammable fuel gas** consisting mainly of **propane and butane**.
2. It is produced during **crude oil refining** and **natural gas processing**.
3. LPG is stored as a **liquid under pressure** and vaporises on release.
4. India imports **over 65% of its LPG demand**, with domestic production around **35%**.
5. **Qatar** is India's **largest LPG supplier**, followed by **UAE and Saudi Arabia**.
6. **Ethyl mercaptan** is added to LPG for **leak detection**.
7. LPG is widely used for **domestic cooking**, **industrial heating**, and **automotive fuel**.

HEPATITIS A

Recent Update: Hepatitis A continues to be reported from regions with **poor sanitation**, highlighting the need for **vaccination and safe drinking water**.



About

1. **Hepatitis A** is an **acute viral infection of the liver** caused by the **Hepatitis A Virus (HAV)** and leads to **temporary liver inflammation**.
2. It spreads mainly through the **faeco-oral route**, particularly by **consuming contaminated food or water** or through **close contact with infected persons**.
3. Unlike **Hepatitis B and Hepatitis C**, it **does not cause chronic liver disease**, though **severe acute hepatitis** may occur rarely.
4. There is **no specific antiviral treatment**, and the **body clears the virus naturally**, usually within **six months**.
5. **Vaccines are available for Hepatitis A and B**, while **no vaccine exists for Hepatitis C**.
6. Most infected individuals **recover completely** and develop **lifelong immunity**.
7. The disease is most common in **low- and middle-income countries** with **poor sanitation infrastructure**, where infection occurs early in life.

OMEN DRONE

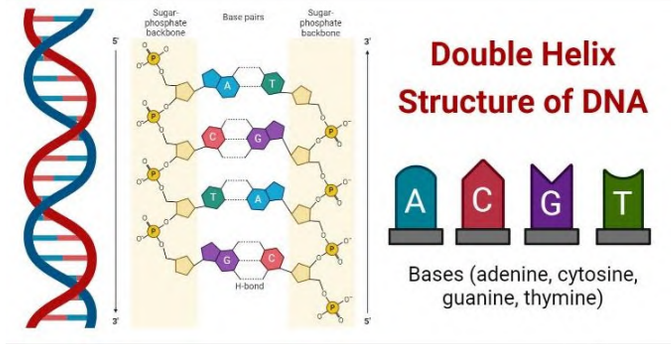
Recent Update: The **Omen drone** has gained attention for its **hybrid-electric VTOL design** suitable for advanced defence operations.

About

1. **Omen** is a **next-generation tail-sitting vertical take-off and landing (VTOL) drone**.
2. It uses a **hybrid-electric propulsion system**, combining **efficiency with extended endurance**.
3. The drone is **jointly developed** by **Anduril (United States)** and **EDGE Group (UAE)**.
4. It features a **twin-rotor configuration** designed for **rapid deployment**.
5. The aircraft **takes off and lands vertically** while resting in an **upright tail-sitting position**.
6. When deployed, the system stands approximately **10 feet tall**.
7. It is designed for **surveillance, reconnaissance, and defence missions**.

DNA DOUBLE HELIX MODEL

Recent Update: James Watson, one of the co-discoverers of the **DNA double helix**, **passed away recently**.



About

1. The **DNA double helix structure** was discovered in **1953** by **James Watson and Francis Crick**.
2. **Watson, Crick, and Maurice Wilkins** received the **1962 Nobel Prize in Physiology or Medicine**.

3. DNA consists of **two long strands twisted around each other** forming a **helical structure**.
4. Each strand has a **sugar-phosphate backbone** that provides **structural stability**.
5. **Nitrogenous bases pair specifically**, with **Adenine–Thymine** and **Cytosine–Guanine**.
6. The two strands run in **opposite directions**, known as **antiparallel orientation**.
7. This structure enables **accurate replication and transmission of genetic information**.

TUBERCULOSIS

Recent Update: As per the **Global TB Report 2025**, **India's TB incidence declined by 21% between 2015 and 2024**.

About

1. **Tuberculosis (TB)** is a **bacterial infectious disease** caused by **Mycobacterium tuberculosis**.
2. It spreads through the **air**, when infected persons **cough, sneeze, or spit**.
3. TB exists in two forms: **Latent TB infection** and **Active TB disease**.
4. Common symptoms include **persistent cough, fever, weight loss, chest pain, and night sweats**.
5. Although lungs are most affected, TB can also involve the **brain, kidneys, spine, and skin**.
6. The **BCG vaccine** provides **moderate protection against severe childhood TB**, such as TB meningitis.
7. India has introduced **BPaLM regimen**, **AI-based Deep CXR**, and **rt-LAMP diagnostics** under **NTEP**.

RHEUMATOID ARTHRITIS

Recent Update: Rheumatoid Arthritis continues to be managed mainly through **anti-inflammatory and disease-modifying therapies** to reduce disability.

About

1. **Rheumatoid Arthritis (RA)** is a **chronic autoimmune inflammatory disorder** primarily affecting the **joints**.
2. In RA, the **immune system mistakenly attacks healthy joint tissues**, causing **painful swelling and stiffness**.
3. The disease can affect **people of all ages and genders**, though it is more common among **middle-aged women**.
4. RA differs from **osteoarthritis**, which is caused by **wear and tear of cartilage** rather than immune dysfunction.
5. Persistent inflammation can lead to **joint deformity, reduced mobility, and functional disability**.
6. The **prevalence of arthritis increases with age**, although RA may begin much earlier in life.
7. **NSAIDs such as Nimesulide** are widely used to **relieve pain and inflammation**, along with DMARDs for long-term control.

VISIBLE EMISSION LINE CORONAGRAPH (VELC)

Recent Update: VELC, the **primary payload of Aditya-L1**, is delivering **unprecedented close-range observations of the solar corona**.

About

1. **VELC** is the **main scientific instrument** onboard **Aditya-L1**, India's **first dedicated solar mission** positioned at the **L1 Lagrange point**, about **1.5 million kilometres from Earth**.
2. It has been **designed and built by the Indian Institute of Astrophysics (IIA)** at its **CREST campus in Hosakote, Karnataka**.
3. VELC is an **internally occulted solar coronagraph**, meaning it **blocks the bright solar disc internally** to study the faint corona.
4. It enables **simultaneous imaging, spectroscopy, and spectro-polarimetry**, allowing **multi-dimensional solar diagnostics**.
5. The payload studies the **solar corona**, the **outermost and extremely tenuous layer** of the Sun's atmosphere.
6. VELC can image the corona down to **1.05 times the solar radius**, the **closest ever achieved** by any coronagraph.

7. It plays a critical role in studying **Coronal Mass Ejections (CMEs)** and **solar wind**, essential for **space-weather forecasting**.

INDIAN INSTITUTE OF ASTROPHYSICS (IIA)

Recent Update: IIA continues to lead **India's solar and astrophysical instrumentation efforts**, including **VELC for Aditya-L1**.

About

1. **IIA** was founded in **1971** as a **premier national institute** for **astronomy and astrophysics research**.
2. It functions as an **autonomous institution fully funded by the Department of Science and Technology (DST)**.
3. The institute operates the **Vainu Bappu Observatory** at **Kavalur, Tamil Nadu**, a historic optical facility.
4. It manages the **Gauribidanur Radio Observatory** in **Karnataka**, supporting low-frequency radio astronomy.
5. **Hanle Observatory** in **Ladakh** is another major facility, ideal for **high-altitude astronomical observations**.
6. IIA is actively involved in **solar physics, instrumentation, space science, and theoretical astrophysics**.
7. The **headquarters is located in Bengaluru, Karnataka**, serving as a national research hub.

SOIL ORGANIC CARBON (SOC)

Recent Update: Global studies highlight **SOC as a key tool for climate mitigation and soil health improvement**.

About

1. **Soil Organic Carbon (SOC)** is the **carbon component of soil organic matter**, accounting for roughly **60% of it**.
2. It includes **living organisms, decomposed plant residues, and animal materials** within the soil.
3. SOC **excludes fresh undecomposed plant litter** lying on the soil surface.
4. Higher SOC improves **nutrient cycling, moisture retention, soil structure, and microbial activity**.
5. Soil organic matter constitutes only **2–10% of soil mass**, yet strongly influences **agricultural productivity**.
6. The **Russian Federation region holds over 50% of global SOC stocks**, making it climatically significant.
7. Laboratories measure **SOC instead of SOM** because **SOC can be quantified more reliably**.

RICIN

Recent Update: Ricin continues to be classified as a **high-risk chemical toxin under international conventions**.

About

1. **Ricin** is a **highly toxic naturally occurring substance** extracted from **castor beans**.
2. It may appear as a **powder, mist, or pellet**, and can dissolve in **water or weak acids**.
3. Ricin remains **chemically stable under normal conditions**, but **loses toxicity above 80°C**.
4. Exposure through **inhalation, ingestion, or injection** can be **fatal even in small doses**.
5. It acts by **blocking protein synthesis inside cells**, causing **organ failure and death**.
6. There is **no known antidote** or specific treatment for ricin poisoning.
7. Ricin is controlled as a **Schedule-I toxin under the Chemical Weapons Convention**, to which **India is a party**.

CHRISTMAS ISLAND

Recent Update: Google announced plans to establish a **large AI data centre** on **Christmas Island**.

About

1. **Christmas Island** lies in the **Indian Ocean**, about **360 km south of Java**.
2. It is administered as an **external territory of Australia**.
3. **Flying Fish Cove** is the **main port and settlement** of the island.
4. The island's economy historically depended on **phosphate mining**.
5. It is largely covered by **dense tropical rainforest**, rich in endemic biodiversity.

6. **Murray Hill** is the **highest point** on the island.
7. Its remote location makes it attractive for **strategic digital infrastructure projects**.

SCRUB TYPHUS

Recent Update: Scrub typhus has re-emerged as a **public health concern** in several Indian states during monsoon seasons.

About

1. **Scrub typhus** is a **life-threatening bacterial infection** caused by **Orientia tsutsugamushi**.
2. It spreads through the bite of **infected chiggers**, which are larval forms of mites.
3. The disease is endemic to **South and Southeast Asia**, forming part of the so-called **"tsutsugamushi triangle"**.
4. Typhus diseases are classified into **epidemic typhus, scrub typhus, and murine typhus**, each with different vectors.
5. Scrub typhus commonly causes **fever, headache, myalgia, eschar, and organ failure** if untreated.
6. There is **no vaccine available**, but the disease responds effectively to **doxycycline antibiotic therapy**.

GSAT-7R (CMS-03) SATELLITE

Recent Update: GSAT-7R (CMS-03) was launched to significantly enhance **secure maritime and strategic communications** for India.

About

1. **GSAT-7R (CMS-03)** is an **advanced communication satellite** developed for the **Indian Navy** to strengthen network-centric warfare.
2. It was launched by **ISRO using the LVM3 heavy-lift launch vehicle**, highlighting India's autonomous space capability.
3. With a mass of about **4,400 kg**, it is **ISRO's heaviest communication satellite** to date.
4. The satellite is designed to deliver **higher bandwidth, sharper connectivity, and encrypted communication links**.
5. It has been placed in a **Geosynchronous Transfer Orbit (GTO)** for wide and continuous coverage.
6. GSAT-7R ensures **robust telecommunication coverage across the Indian Ocean Region (IOR)**.
7. The satellite supports **civil, strategic, naval, and maritime domain awareness operations** simultaneously.

SOURCE: DOWN TO EARTH

LVM3-M5 LAUNCH VEHICLE

Recent Update: The **LVM3-M5 mission** successfully placed CMS-03 into orbit, reinforcing confidence in India's heavy-lift rocket.

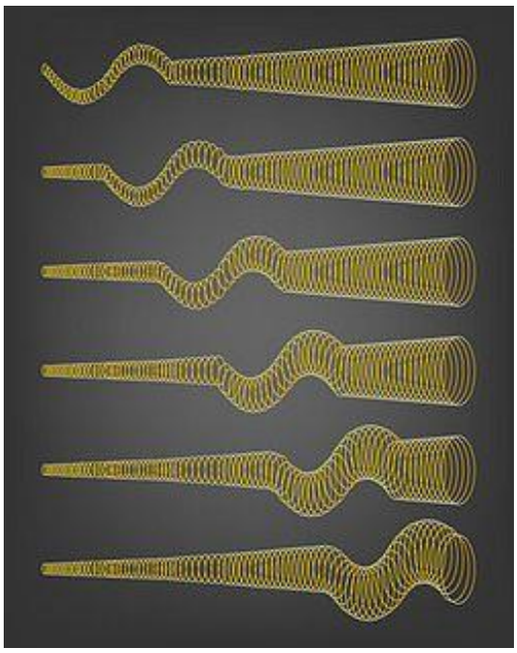
About

1. **Launch Vehicle Mark-III (LVM3)**, also known as **"Baahubali"**, is India's most powerful operational rocket.
2. It is capable of launching **4-tonne class satellites into GTO** and **8-tonne payloads into Low Earth Orbit (LEO)**.
3. The vehicle uses an **indigenous cryogenic engine (C25)** developed by **Vikram Sarabhai Space Centre (VSSC)**.
4. LVM3 follows a **three-stage configuration**, combining solid, liquid, and cryogenic propulsion.
5. The **LVM3-M5 mission** marked another success after **Chandrayaan-3 (2023)** and other flawless launches.
6. The launcher has achieved **eight consecutive successful missions**, demonstrating high reliability.

7. **LVM3 is the designated launch vehicle for India's human spaceflight programme Gaganyaan**.

ALFVÉN WAVES

Recent Update: Scientists recently observed **small twisting (torsional) Alfvén waves** directly in the **solar corona** for the first time.



About

1. **Alfvén waves** are **low-frequency plasma waves** that propagate along **magnetic field lines**.
2. They were first proposed in **1942 by Hannes Alfvén**, who later received the **Nobel Prize**.
3. These waves are generated by interactions between **magnetic fields and electric currents** in plasma.
4. Earlier observations detected only **large, irregular Alfvén waves associated with solar flares**.
5. The recent discovery confirmed the presence of **fine torsional Alfvén waves** in the Sun's outer atmosphere.
6. These waves help explain why the **solar corona is far hotter than the Sun's surface**.
7. The breakthrough was achieved using the **Cryogenic Near Infrared Spectropolarimeter (Cryo-NIRSP)** at the **Daniel K. Inouye Solar Telescope**.

LEPROSY (HANSEN'S DISEASE)

Recent Update: The **Maharashtra government declared leprosy a notifiable disease**, strengthening disease surveillance.

About

1. **Leprosy** is a **chronic infectious disease** caused by **Mycobacterium leprae** bacteria.
2. It primarily affects the **skin, peripheral nerves, eyes, and upper respiratory tract**.
3. Transmission occurs through **prolonged close contact** via **droplets from the nose and mouth**.
4. The disease is **completely curable** using **Multi-Drug Therapy (MDT)**.
5. MDT includes **dapsone, rifampicin, and clofazimine**, provided free under public health programmes.
6. India introduced a **three-drug regimen for Pauci-Bacillary cases**, replacing the earlier two-drug protocol.
7. Leprosy is classified as a **Neglected Tropical Disease (NTD)** alongside dengue, rabies, and snakebite envenoming.

NOTIFIABLE DISEASE

Recent Update: In **November 2025**, **leprosy was added** to the list of notifiable diseases in several states.

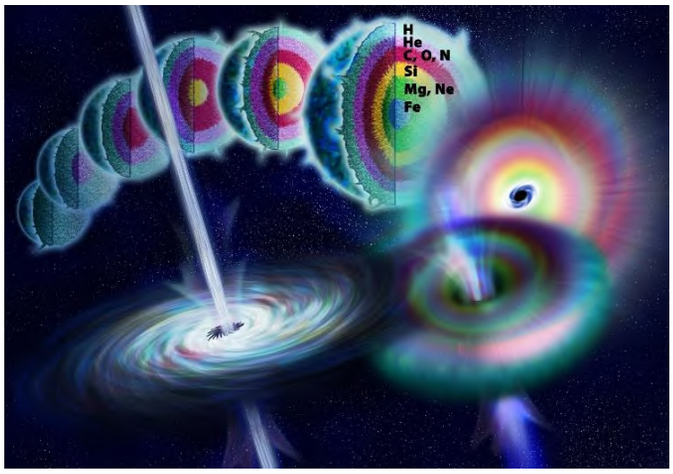
About

1. A **notifiable disease** is one that must be **legally reported** to government health authorities.
2. Failure to report cases becomes a **punishable offence** for medical practitioners or institutions.
3. Since **Health is a State subject**, only **State Governments** can declare diseases as notifiable.
4. The **Central Government** also maintains a national list of notified diseases.
5. Examples include **TB, cholera, dengue, measles, rabies, polio, malaria, and hepatitis-B**.
6. **Cancer is not a notifiable disease**, despite expert committee recommendations.

7. **WHO International Health Regulations** mandate disease reporting for global health security.

GAMMA-RAY BURSTS (GRBs)

Recent Update: A distant **supernova-triggered GRB** was found to have **disturbed Earth's ionosphere**.



About

1. **Gamma-Ray Bursts** are **extremely energetic cosmic explosions**.
2. They were first detected in the **late 1960s by Vela satellites**.
3. GRBs can last from **milliseconds to several hours**.
4. They are the **brightest electromagnetic events** in the universe.
5. A single GRB can emit energy equal to the **Sun's lifetime output**.
6. They originate from **supernovae or neutron-star/black-hole mergers**.
7. GRBs help scientists study **stellar evolution and cosmic distances**.

TOPICS COVERED –

1. **Reusable Rockets and the Future of Spaceflight**
2. **OrbitAid's AyulSAT**
3. **Greenwald Limit**
4. **White Dwarf System (EX Hydrae)**
5. **Earth Observation Satellite EOS-N1 (Anvesha)**
6. **Dust Experiment (DEX)**
7. **Artemis II Mission**
8. **BSNL Voice over WiFi (VoWiFi)**
9. **Humanoid Robot 'ASC Arjun'**
10. **Vehicle-to-Vehicle (V2V) Communication Technology**
11. **Battery Pack Aadhaar Number (BPAN)**
12. **Spina Bifida**
13. **Bio-Bitumen**
14. **Nimesulide**
15. **Traditional Indelible Ink**
16. **Project Suncatcher**
17. **Biomaterials India**
18. **Nipah Virus**
19. **Coconut Root Wilt Disease**
20. **Mpemba Effect**
21. **PSLV Failures and Implications**
22. **Marine and Space Biotechnology**
23. **Remote Sensing and IRS Programme**
24. **IndiaAI Mission**
25. **Nanorobots in Healthcare**
26. **LVM3 and BlueBird Block-2**
27. **Superkilonova**
28. **Cosmic Filament**
29. **Paraná Valles (Mars)**
30. **Geminid Meteor Shower**
31. **Butterfly Nebula (NGC 6302)**
32. **Alaknanda Galaxy**
33. **Solar Flare**
34. **Solar Storm**
35. **WIMPs (Weakly Interacting Massive Particles)**
36. **Kessler Syndrome**
37. **Laws Governing Nuclear Power in Space**
38. **3I/ATLAS Planetary Defence Drill**
39. **Ultraviolet Imaging Telescope (UVIT)**
40. **Baikonur Cosmodrome**
41. **GhostPairing**
42. **Dhruv64 Microprocessor**
43. **Satellite Communication (Satcom)**
44. **Scramjet Engine**
45. **Hypersonic Weapons**
46. **Fourth Industrial Revolution (Industry 4.0)**

SOURCE: INSIGHTS MONTHLY

REUSABLE ROCKETS AND THE FUTURE OF SPACEFLIGHT

Recent Update: SpaceX's **Starship** and ISRO's **Orbital Return Flight Experiment** aim to mainstream rocket reusability.

About

1. A **reusable rocket** is designed to return intact, enabling refurbishment and repeated launches.
2. Reusability can reduce launch costs by **up to 80%**, transforming space economics.
3. It shifts spaceflight from a **disposable launch model to an aviation-style transportation model**.
4. India faces challenges in developing **Thermal Protection Systems resisting ~2000°C re-entry heat**.
5. Achieving **precision autonomous landing from orbital velocity** remains technologically complex.
6. Development of **LOX–Methane restartable engines** is critical for Indian reusability goals.
7. Economic viability depends on **refurbishment costs being lower than fresh manufacturing**.
8. Infrastructure gaps include **recovery systems, telemetry networks, and dedicated landing runways**.

ORBITAID'S AYULSAT

Recent Update: OrbitAid's **AyulSAT** launched onboard PSLV-C62 to demonstrate in-orbit refuelling.

About

1. **AyulSAT** is a 25-kg tanker satellite designed for in-orbit fuel transfer experiments.
2. Developed by **OrbitAid Aerospace**, a Chennai-based space startup.
3. Demonstrates **fuel, power, and data transfer in microgravity conditions**.

4. Uses the proprietary **Standard Interface for Docking and Refuelling Port (SIDRP)**.
5. Enables satellite life-extension and **reduction of space debris accumulation**.
6. Will support **future spacecraft-to-spacecraft docking operations by 2026**.
7. Represents India's first **commercial docking and refuelling interface in orbit**.
8. Lays foundation for a sustainable **on-orbit space servicing economy**.

GREENWALD LIMIT

Recent Update: China's EAST reactor exceeded the **Greenwald density limit by 65%**.

About

1. The **Greenwald limit** defines maximum plasma density in a tokamak reactor.
2. Exceeding this threshold typically causes **plasma instability and collapse**.
3. Fusion requires high **density, temperature, and confinement time simultaneously**.
4. Higher density increases **atomic collisions and energy output rates**.
5. It links density to **plasma current and reactor size parameters**.
6. For decades, it constrained **fuel packing capacity in fusion designs**.
7. Breaking this barrier may accelerate progress toward **self-sustaining fusion ignition**.
8. It holds major implications for future **clean and limitless energy production**.

WHITE DWARF SYSTEM (EX HYDRAE)

Recent Update: NASA's **IXPE mission** probed the white dwarf system EX Hydrae using X-ray polarization.

About

1. A **white dwarf** is a dense Earth-sized remnant of a Sun-like star.
2. Supported by **electron degeneracy pressure under Pauli Exclusion Principle**.
3. In binary systems, it accretes gas from a **companion star's outer layers**.
4. EX Hydrae is an **intermediate polar with moderate magnetic field strength**.
5. Infalling matter emits intense **high-energy X-rays at millions of degrees**.
6. White dwarfs obey the **Chandrasekhar limit (~1.4 solar masses)**.
7. IXPE studied polarization to reveal **internal gas flow and magnetic structures**.
8. Insights enhance understanding of **stellar evolution and compact object physics**.

EARTH OBSERVATION SATELLITE EOS-N1 (ANVESHA)

Recent Update: ISRO to launch **EOS-N1 (Anvesha)** aboard PSLV-C62 in January 2026.

About

1. EOS-N1 is a **hyperspectral Earth observation satellite**.
2. Captures data across **hundreds of spectral bands for material identification**.
3. Enhances **border surveillance and national security monitoring**.
4. Supports agriculture through **crop health and soil moisture assessment**.
5. Enables precise **urban land-use and infrastructure mapping**.
6. Monitors **ecosystem changes and pollution trends**.
7. Strengthens India's **strategic reconnaissance capabilities**.
8. Integrates civilian and defense applications in **remote sensing systems**.

DUST EXPERIMENT (DEX)

Recent Update: ISRO confirmed IDP entry every **16 minutes** using DEX onboard POEM.

About

1. DEX is India's first **indigenous cosmic dust detector**.
2. Developed by **ISRO and Physical Research Laboratory (PRL)**.
3. Detects hypervelocity particles traveling above **4 km/s speeds**.
4. Operated in **Low Earth Orbit at ~350 km altitude**.
5. Recorded dust flux of **6.5×10^{-3} particles per m^2 per second**.
6. Helps assess risks to **satellite and crewed spacecraft safety**.
7. Supports understanding of **space environment and orbital debris dynamics**.
8. Provides insights into **early solar system evolution processes**.

ARTEMIS II MISSION

Recent Update: NASA scheduled **Artemis II launch for February 6**, first crewed lunar mission in 50 years.

About

1. Artemis II is NASA's first **crewed mission under Artemis programme**.
2. Four astronauts will conduct a **lunar flyby without landing**.
3. Uses a **free-return trajectory leveraging Earth–Moon gravity**.
4. Tests life support, navigation, and **deep-space communication systems**.
5. Astronauts will travel over **230,000 miles from Earth**.
6. Mission duration is approximately **10 days with ocean splashdown**.
7. Prepares groundwork for **Artemis III lunar landing mission**.

8. Marks revival of sustained **human deep-space exploration beyond Apollo era**.

BSNL VOICE OVER WIFI (VOWIFI)

Recent Update: BSNL launched **VoWiFi services nationwide** across telecom circles.

About

1. VoWiFi enables calls using **Wi-Fi networks instead of mobile towers**.
2. Operates via **IP Multimedia Subsystem (IMS) architecture**.
3. Authentication occurs through **SIM-based secure verification**.
4. Allows seamless switching between **Wi-Fi and VoLTE networks**.
5. Requires no additional apps, using **default mobile dialer interface**.
6. Improves connectivity in **indoor and low-signal environments**.
7. Offloads traffic, reducing **mobile network congestion levels**.
8. Provides better call clarity with **no extra subscriber charges**.

SOURCE: INDIAN EXPRESS

HUMANOID ROBOT 'ASC ARJUN'

Recent Update: Indian Railways deployed AI-powered humanoid robot **ASC ARJUN** at Visakhapatnam station.

About

1. **ASC ARJUN** assists the Railway Protection Force in surveillance and crowd management.
2. Developed indigenously by an **Indian Railways technical team in Visakhapatnam**.
3. Uses **Face Recognition System (FRS)** for intrusion detection and monitoring.
4. Sends **real-time alerts to RPF control rooms** during suspicious activities.
5. Equipped with **fire and smoke detection systems** for emergency response.
6. Makes automated announcements in **English, Hindi, and Telugu languages**.
7. Performs semi-autonomous patrolling with **obstacle avoidance navigation capability**.
8. Enhances passenger safety while optimizing **manpower deployment efficiency**.

VEHICLE-TO-VEHICLE (V2V) COMMUNICATION TECHNOLOGY

Recent Update: Government announced nationwide rollout of **V2V technology by 2026** to reduce road crashes.

About

1. **V2V communication** enables vehicles to exchange safety data wirelessly in real time.
2. Operates on dedicated **5.875–5.905 GHz radio frequency band**.
3. Shares location, speed, braking, and direction data continuously.
4. Provides **360-degree alerts beyond driver's line of sight**.
5. Works independently of mobile internet using **short-range direct signals**.
6. Integrates with **Advanced Driver Assistance Systems (ADAS)** for smart braking.
7. Helps prevent pile-ups during **fog, dust storms, and low-visibility conditions**.
8. Effectiveness depends on **large-scale vehicle adoption nationwide**.

BATTERY PACK AADHAAR NUMBER (BPAN)

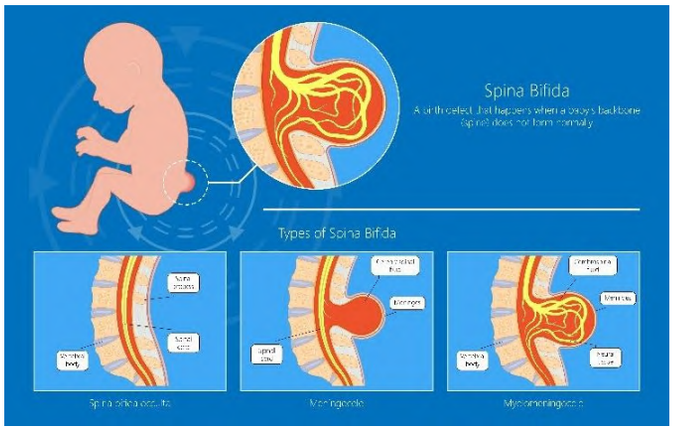
Recent Update: MoRTH proposed **BPAN** for lifecycle traceability of EV batteries.

About

1. **BPAN** is a 21-character unique identification number for battery packs.
2. Proposed under draft guidelines by **Ministry of Road Transport and Highways**.
3. Ensures end-to-end **lifecycle traceability from production to recycling**.
4. Mandates data upload on an official **digital BPAN portal**.
5. Requires visible and durable marking on **battery pack surfaces**.
6. Promotes efficient recycling and **second-life battery utilization**.
7. Targets EV batteries, which account for **80–90% of India's Li-ion demand**.
8. Strengthens transparency and environmental compliance in **India's EV ecosystem**.

SPINA BIFIDA

Recent Update: India reports high burden of **Spina Bifida**, preventable with folic acid.



About

1. **Spina Bifida** is a congenital neural tube defect affecting spinal development.
2. Occurs within first **28 days of pregnancy** due to neural tube closure failure.
3. Strongly linked to **maternal folic acid deficiency**.
4. Causes paralysis, hydrocephalus, and **lifelong neurological disabilities**.
5. Often presents as visible **sac-like swelling on the back at birth**.
6. Management includes **early surgical repair and VP shunt placement**.
7. Long-term care requires **physiotherapy and orthopaedic interventions**.
8. Pre-conception folic acid can prevent over **70% of cases**.

BIO-BITUMEN

Recent Update: India became first country to commercially produce **bio-bitumen for roads**.

About

1. **Bio-bitumen** is a bio-based alternative to petroleum-derived road binder.
2. Produced from **rice straw and agricultural residues via pyrolysis**.
3. Can replace **20–30% of conventional bitumen safely**.
4. Reduces emissions from **crop residue burning practices**.
5. Successfully tested for rutting, cracking, and **durability performance standards**.
6. A trial stretch was laid on **Jorabat–Shillong Expressway (NH-40)**.
7. Lowers lifecycle carbon footprint and **construction costs**.
8. Developed by **CSIR-CRRI and CSIR-IIP collaboration**.

NIMESULIDE

Recent Update: Government banned oral **Nimesulide formulations above 100 mg**.

About

1. **Nimesulide** is a non-steroidal anti-inflammatory drug (NSAID).
2. Works by inhibiting **prostaglandin synthesis mediating inflammation**.
3. Used for short-term management of **pain and fever**.
4. Higher doses linked to **hepatotoxicity and liver damage risks**.
5. Common side effects include nausea and **elevated liver enzymes**.
6. Ban imposed under **Section 26A of Drugs and Cosmetics Act, 1940**.
7. Safer alternative analgesics are available in **Indian pharmaceutical market**.
8. Decision prioritizes public health over **risk-prone drug formulations**.

TRADITIONAL INDELIBLE INK

Recent Update: Maharashtra reverted to **traditional indelible ink** for local elections.

About

1. **Indelible ink** marks voters' fingers to prevent repeat voting.
2. First used in India during **1962 General Elections**.
3. Manufactured exclusively by **Mysore Paints and Varnish Limited**.
4. Based on **silver nitrate reacting with keratin** in skin.
5. Leaves long-lasting stain visible for **days on skin and weeks on nails**.
6. Applied on **left index finger across nail and cuticle**.

7. Difficult to remove using soap or common chemicals.
8. Ensures integrity and credibility of **large-scale democratic elections**.

PROJECT SUNCATCHER

Recent Update: Google unveiled **Project Suncatcher** for solar-powered AI data centres in orbit.

About

1. Project Suncatcher proposes **AI datacentres in Low-Earth Orbit (LEO)**.
2. Operates using uninterrupted **solar power in sun-synchronous orbits**.
3. Reduces dependence on terrestrial grids and **water-intensive cooling systems**.
4. Uses radiation-tolerant **Tensor Processing Units (TPUs)**.
5. Employs petabit-scale **inter-satellite networking for distributed AI tasks**.
6. Minimizes Earth bandwidth by limiting **downlink to inputs and outputs**.
7. Aims to cut AI's growing **energy and carbon footprint**.
8. Represents futuristic model of **space-based sustainable computing infrastructure**.

BIOMATERIALS INDIA

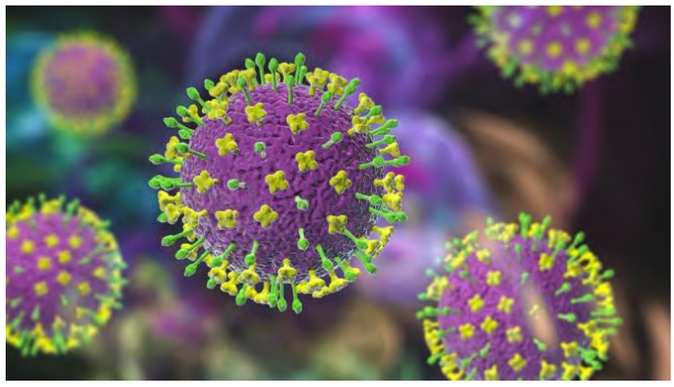
Recent Update: India operationalised large-scale **PLA bio-manufacturing facilities in 2026**.

About

1. **Biomaterials** are derived from biological sources or fermentation processes.
2. Produced from renewable feedstocks like **sugarcane, maize, and residues**.
3. Include **drop-in, drop-out, and novel bio-based materials**.
4. Offer biodegradability, reducing long-term **microplastic persistence**.
5. Used in packaging, textiles, healthcare, and **sustainable agriculture**.
6. PLA is synthesized from **lactic acid via microbial fermentation**.
7. Supports circular economy through **renewable carbon cycles**.
8. Advances India's push toward **green manufacturing transformation**.

NIPAH VIRUS

Recent Update: Continued vigilance against **Nipah Virus outbreaks** in India.



About

1. **Nipah virus (NiV)** is a zoonotic pathogen causing encephalitis.
2. Primary reservoir is **fruit bats (Pteropus species)**.
3. Transmission occurs via contaminated food or **respiratory droplets**.
4. Incubation period ranges from **4 to 14 days**.
5. Case fatality rate varies between **40% and 75%**.
6. Causes acute respiratory distress and **brain inflammation**.
7. No specific antiviral drug or vaccine currently available.
8. Control relies on early isolation, **contact tracing, and infection management**.

COCONUT ROOT WILT DISEASE

Recent Update: Rapid spread of **Coconut Root Wilt Disease** affects southern India.

About

1. Caused by a **phytoplasma pathogen** affecting coconut palms.
2. First reported over **150 years ago in Kerala**.
3. Spread through sap-sucking vectors like **Stephanitis typica**.
4. Symptoms include drooping leaves and **yellowing from leaf tips**.
5. Leads to poor flowering and **sharp decline in nut yield**.
6. Infected palms act as long-term **disease inoculum sources**.
7. Management includes selecting **tolerant high-yielding palms**.
8. Strengthening soil health improves **palm resilience against infection**.

MPEMBA EFFECT

Recent Update: Indian scientists simulated **Mpemba Effect** using supercomputer modelling.

About

1. The **Mpemba Effect** describes hot water freezing faster than cold water.
2. Named after Tanzanian student **Erasto Mpemba (1969)**.
3. Influenced by evaporation reducing **mass of hot water**.
4. Heating removes dissolved gases affecting **freezing behaviour**.
5. Convection currents enhance **internal heat loss dynamics**.
6. Supercooling differences allow earlier **solidification onset**.
7. Important for understanding **non-equilibrium thermodynamics**.
8. Relevant to climate modelling and **industrial freezing technologies**.

SOURCE: DRISHTI MONTHLY

PSLV FAILURES AND IMPLICATIONS

Recent Update: Back-to-back **PSLV-C61 (May 2025)** and **PSLV-C62 (Jan 2026)** failures due to third-stage anomalies have raised concerns over ISRO's quality control and global launch credibility.

About

1. **PSLV** is ISRO's third-generation launch vehicle, first successfully launched in October 1994.
2. Known as ISRO's **"workhorse"**, it pioneered liquid propulsion stages in Indian rockets.
3. Suited primarily for **Low Earth Orbit (LEO)** and **Sun-Synchronous Polar Orbit (SSPO)** missions.
4. Four-stage configuration combines **solid and liquid propulsion systems** for reliability.
5. Payload capacity is about **1,750 kg to 600 km SSPO** and 1,425 kg to Sub-GTO.
6. Key missions include **Chandrayaan-1** and **Mars Orbiter Mission**, enhancing global prestige.
7. Widely used for launching **foreign small satellites through commercial contracts**.
8. Recent third-stage anomalies highlight vulnerabilities in **propellant integrity and manufacturing processes**.

MARINE AND SPACE BIOTECHNOLOGY

Recent Update: India expanded focus on marine and space biotechnology under **Blue Economy, Deep Ocean Mission and BioE3 initiative** to reduce import dependence and strengthen biomanufacturing leadership.

About

1. Utilises marine microbes, algae, and sea organisms for **bioactives, enzymes, and biomaterials**.
2. India cultivates nearly **70,000 tonnes of seaweed annually** for industrial applications.
3. Imports agar, carrageenan, and alginates used in **food, pharma, and cosmetics sectors**.

4. Supported under Blue Economy and **Deep Ocean Mission frameworks**.
5. Key institutions include **CMFRI and innovative private startups**.
6. India's 11,000+ km coastline and vast EEZ offer **rich marine biodiversity potential**.
7. Promotes sustainable production reducing **land, water, and fossil resource pressure**.
8. Enhances climate-resilient and circular **bio-manufacturing ecosystems**.

REMOTE SENSING AND IRS PROGRAMME

Recent Update: India continues expanding its **Indian Remote Sensing (IRS) constellation** to support governance, agriculture, and disaster management.

About

1. IRS Programme began with **IRS-1A in 1988**, operated by ISRO.
2. Among the world's largest constellations providing **multi-resolution satellite data**.
3. Supports agriculture, forestry, urban planning, and **environmental monitoring sectors**.
4. Includes missions like **Cartosat, Resourcesat, Oceansat, and RISAT series**.
5. Enables geo-tagging of over **6.24 crore MGNREGA assets for transparency**.
6. Supports PMKSY watershed projects using **Cartosat-2S and Cartosat-3 imagery**.
7. Strengthens disaster monitoring under **Disaster Management Support Programme (DMSP)**.
8. Faces challenges of data cost, cloud cover, skill gaps, and fragmentation.

INDIAAI MISSION

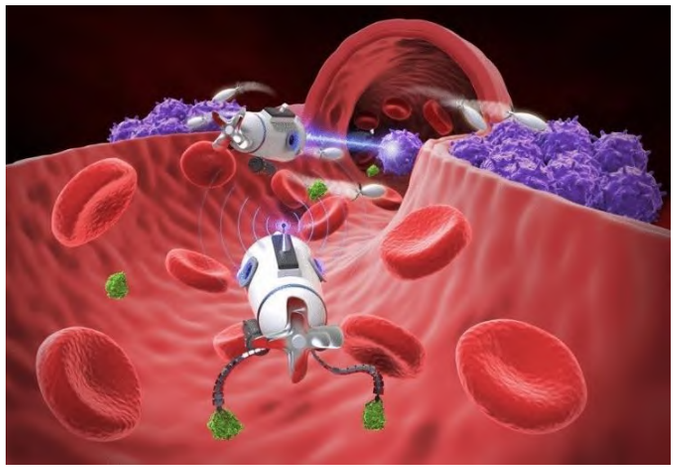
Recent Update: Government deployed **38,000 GPUs** under ₹10,300 crore IndiaAI Mission to build sovereign AI capacity.

About

1. IndiaAI Mission aims at **"Making AI in India and for India"** vision.
2. Implemented by IndiaAI division under **Ministry of Electronics and IT (MeitY)**.
3. Builds sovereign AI compute infrastructure with **high-end GPU clusters**.
4. Includes BharatGen AI for multilingual foundation models.
5. AIKosh provides curated **national AI datasets platform**.
6. Supports startups through structured **AI financing and incubation pillars**.
7. Focuses on safe and trusted **ethical AI governance frameworks**.
8. Strengthens India's ecosystem of **1,800+ Global Capability Centres**.

NANOROBOTS IN HEALTHCARE

Recent Update: IISc researcher won international awards for developing **magnetic nanorobots for targeted cancer therapy**.



About

1. Magnetic nanorobots are microscopic machines guided by **external magnetic fields**.
2. Made of biocompatible materials like **silica and iron oxide composites**.
3. Deliver drugs directly to tumours, reducing systemic **side effects significantly**.
4. Mimic corkscrew bacterial motion for **precise vascular navigation**.
5. Useful in diagnostics, imaging, and **biofilm removal applications**.
6. Enhance regenerative medicine through **targeted gene and stem-cell delivery**.

7. Face challenges of nanotoxicity, regulatory gaps, and **ethical governance concerns**.
8. Require translational funding to bridge the **lab-to-market innovation gap**.

LVM3 AND BLUEBIRD BLOCK-2

Recent Update: ISRO launched **BlueBird Block-2 (6,100 kg)**, its heaviest commercial payload, using LVM3.

About

1. **LVM3** is ISRO's most powerful heavy-lift launch vehicle.
2. Can carry up to **8,000 kg to LEO** and 4,000 kg to GTO.
3. Uses S200 solid boosters, liquid core stage, and **C25 cryogenic upper stage**.
4. BlueBird Block-2 placed into **520 km Low Earth Orbit**.
5. Supports direct-to-mobile **4G/5G connectivity services globally**.
6. Demonstrates cost-effective alternative to global heavy launch providers.
7. Will support **Gaganyaan and Bharatiya Antariksh Station missions**.
8. Enhances India's commercial credibility in heavy-lift launch market.

SOURCE: THE HINDU

SUPERKILONOVA

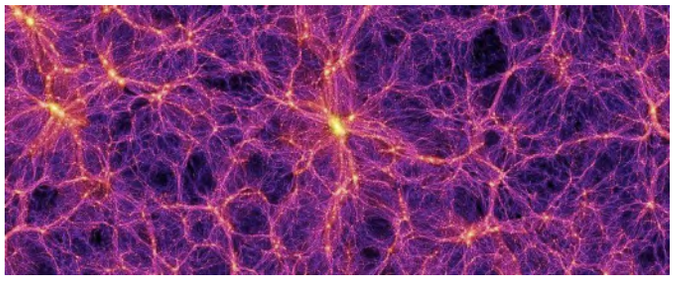
Recent Update: Scientists observed a possible **superkilonova event nearly 1.3 billion light-years away**, indicating an unusually energetic neutron star merger.

About

1. A **superkilonova** is an exceptionally powerful version of a neutron star merger explosion.
2. It originates when **two neutron stars collide after spiralling inward** due to gravitational waves.
3. Neutron stars themselves form after **massive stars explode as supernovae**.
4. The merger produces heavy elements like **gold and platinum through rapid neutron capture**.
5. It emits intense radiation across optical, infrared, and sometimes gamma-ray wavelengths.
6. Considered brighter and more energetic than a **standard kilonova event**.
7. Helps scientists understand **r-process nucleosynthesis in the universe**.
8. Provides insights into gravitational waves and extreme **relativistic astrophysical processes**.

COSMIC FILAMENT

Recent Update: Oxford researchers traced a **50-million-lightyear cosmic filament connecting at least 14 galaxies**.



About

1. Cosmic filaments are the largest thread-like structures in the **universe's cosmic web**.
2. Composed of galaxies, dark matter, and **intergalactic gas arranged in strands**.
3. Can stretch hundreds of millions of **light-years across space**.
4. Form where gravity pulls matter at intersections of **cosmic sheets**.
5. Surround vast empty regions known as **cosmic voids**.
6. Act as highways guiding gas and galaxies toward **massive clusters**.
7. Supply pristine gas that fuels **star formation and galaxy growth**.
8. Influence long-term structure and evolution of the **large-scale universe**.

PARANÁ VALLES (MARS)

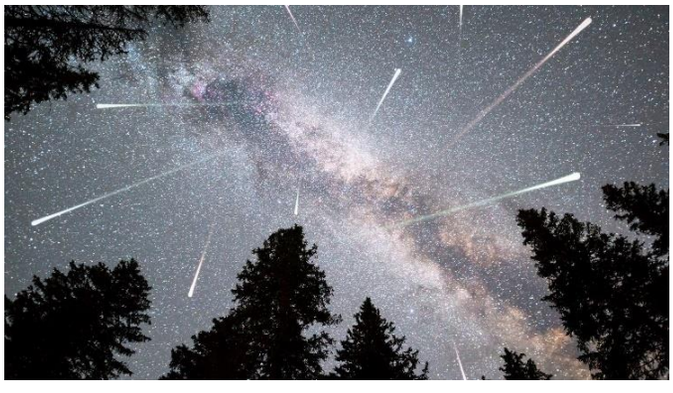
Recent Update: Scientists mapped **16 major ancient river basins on Mars**, including Paraná Valles.

About

1. Paraná Valles is an ancient **fluvial drainage system on Mars**.
2. Located in the southern hemisphere within **Margaritifer Terra region**.
3. Shows strong geological evidence of **past rainfall and surface runoff**.
4. Indicates sustained liquid water flow in **early Martian history**.
5. Consists of valley networks carved by **erosional processes**.
6. Suggests Mars once had a **warmer and wetter climate**.
7. Strengthens hypothesis of potential **habitability in ancient Mars**.
8. Helps refine models of Martian **hydrological evolution**.

GEMINID METEOR SHOWER

Recent Update: Annual **Geminid meteor shower** is set to peak in mid-December.



About

1. The Geminids are one of the most spectacular **annual meteor showers**.
2. Named after the constellation **Gemini**, their apparent radiant point.
3. Unlike most showers, they originate from **asteroid 3200 Phaethon**.
4. Meteors appear bright and often leave **persistent glowing trails**.
5. Caused by Earth passing through debris left by **3200 Phaethon**.
6. Peak activity typically occurs in **mid-December each year**.
7. Visible in both hemispheres under **clear, dark sky conditions**.
8. Provide insights into asteroid-comet transitional **celestial bodies**.

BUTTERFLY NEBULA (NGC 6302)

Recent Update: Recently imaged in detail by **Gemini South Telescope in Chile**.

About

1. The Butterfly Nebula (NGC 6302) lies about **2,500–3,800 light-years away**.
2. Formed from gas expelled by a **dying white dwarf star**.
3. Classified as a bipolar **planetary nebula with wing-like lobes**.
4. Contains extremely hot central star with **surface temperature above 200,000°C**.
5. Glows due to ionised gas illuminated by **intense ultraviolet radiation**.
6. Rich in complex dust grains and **heavy elements**.
7. Represents late evolutionary stage of **Sun-like stars**.
8. Helps astronomers study stellar death and **chemical enrichment processes**.

ALAKNANDA GALAXY

Recent Update: Researchers from NCRA–TIFR discovered a well-structured spiral galaxy named Alaknanda.

About

1. Alaknanda is a massive **spiral galaxy located 12 billion light-years away**.
2. Discovered using the **James Webb Space Telescope**.
3. Named after the Himalayan river **Alaknanda**.
4. Exhibits two well-defined **spiral arms and central bulge**.
5. Challenges early-universe models predicting **chaotic and clumpy galaxies**.
6. Suggests organised galactic structures formed **earlier than expected**.
7. Considered a "sister" to **Milky Way-type spiral galaxies**.
8. Provides insights into early cosmic **structure formation theories**.

SOLAR FLARE

Recent Update: Increased solar activity has raised concerns over **X-class solar flare impacts**.

About

1. A solar flare is an intense burst of **radiation from sunspots**.
2. Caused by release of tangled **magnetic field energy**.
3. Emits energy across radio, X-ray, and **gamma-ray spectrum**.
4. Energy output can exceed a million times a **volcanic eruption**.
5. Classified as A, B, C, M, and **X-class flares**.
6. Often accompanied by **coronal mass ejections (CMEs)**.
7. Can disrupt satellite communication and **radio signals on Earth**.
8. May trigger geomagnetic storms causing **auroras at lower latitudes**.

SOLAR STORM

Recent Update: India's Aditya-L1 joined global satellites to study **unusual 2024 solar storm behaviour**.

About

1. A solar storm is a massive outburst of **particles and magnetic energy**.
2. Begins with magnetic reconnection on the **Sun's surface**.
3. Can include solar flares and **coronal mass ejections**.
4. Disturbs Earth's magnetosphere causing **geomagnetic storms**.
5. Classified on G-scale from **G1 (minor) to G5 (extreme)**.
6. May disrupt navigation, satellites, and **power grids**.
7. Protected by Earth's atmosphere and **magnetic field shielding**.
8. Important for understanding space weather and **spacecraft safety**.

WIMPS (WEAKLY INTERACTING MASSIVE PARTICLES)

Recent Update: New research explores WIMPs as potential explanation for **dark matter mystery**.

About

1. WIMPs are hypothetical particles proposed to explain **dark matter composition**.
2. Do not emit or absorb light, making them **invisible to telescopes**.
3. Interact weakly with ordinary matter and **gravitational forces**.
4. May annihilate upon collision producing **detectable gamma rays**.
5. Central to many cosmological and **particle physics models**.
6. Extensively searched in underground detectors and **collider experiments**.
7. Remain undetected despite improved **laboratory sensitivity**.
8. Crucial for understanding universe's mass-energy **distribution structure**.

KESSLER SYNDROME

Recent Update: The CRASH (Collision Realization and Significant Harm) Clock warns that Earth's satellite fleet faces rising risks of collision cascades in Low Earth Orbit.

About

1. **Kessler Syndrome** refers to a theoretical cascade of collisions creating uncontrollable and self-sustaining space debris.
2. Proposed by **NASA scientist Donald Kessler in 1978**, highlighting long-term orbital congestion risks.
3. Occurs mainly in **Low Earth Orbit (LEO)** where satellite traffic density is highest.
4. Each collision produces fragments that trigger **further chain-reaction impacts over time**.
5. Excess debris can render near-Earth space **unusable for decades or even centuries**.
6. Threatens operational satellites, crewed missions, and **future commercial space activities**.
7. Intensified by mega-constellations and **anti-satellite weapon testing activities**.
8. Requires active debris removal and strict **global space traffic management frameworks**.

LAWS GOVERNING NUCLEAR POWER IN SPACE

Recent Update: The United States announced plans to deploy a **small nuclear reactor on the Moon** in the early 2030s.

About

1. The **Outer Space Treaty (1967)** bans nuclear weapons in orbit but allows peaceful nuclear reactors.
2. The **Liability Convention (1972)** provides compensation rules for damage caused by space objects.
3. The **Nuclear Non-Proliferation Treaty (NPT)** regulates weapons material but leaves gaps for space propulsion uses.
4. The **UN Principles on Nuclear Power Sources (1992)** mandate reactor safety and pre-launch risk assessments.
5. Existing frameworks mainly focus on **power-generation reactors, not advanced nuclear propulsion systems**.
6. Legal ambiguity exists regarding accidents involving reactors on the **Moon or deep space missions**.
7. Enforcement mechanisms remain weak in ensuring **accountability beyond Earth's orbit**.
8. Growing lunar and Mars missions demand updated **international nuclear governance frameworks**.

3I/ATLAS PLANETARY DEFENCE DRILL

Recent Update: ESA, NASA and the UN-IAWN network conducted the largest planetary defence simulation for the fast-moving object 3I/ATLAS.

About

1. 3I/ATLAS drill simulates tracking of a **rapid hyperbolic near-Earth object** approaching Earth.
2. The object travels at nearly **57–68 km per second**, making detection challenging.

3. Jointly led by **European Space Agency**, NASA and UN-IAWN network.
4. Tests global early detection, **orbit modelling and impact probability systems**.
5. Evaluates emergency response coordination among **space agencies and governments**.
6. Assesses public communication and crisis **decision-making protocols during alerts**.
7. Strengthens preparedness against potentially hazardous **asteroid impact threats**.
8. Enhances international collaboration in long-term **planetary defence strategies**.

ULTRAVIOLET IMAGING TELESCOPE (UVIT)

Recent Update: The Indian Institute of Astrophysics marked **10 successful years of UVIT operations** onboard AstroSat.

About

1. UVIT is the primary payload aboard **AstroSat**, launched in 2015.
2. It is India's first dedicated **ultraviolet space observatory mission**.
3. Combines a wide field of view with **high spatial resolution below 1.5 arcseconds**.
4. Observes in far-UV, near-UV, and **visible wavelength bands simultaneously**.
5. Developed by **Indian Institute of Astrophysics (IIA)** with national and international collaboration.
6. Among few global telescopes capable of **high-resolution far-UV observations**.
7. Supports studies on star formation, galaxies, and **stellar evolutionary processes**.
8. India plans next-generation telescope **INSIST** to further expand UV astronomy capabilities.

BAIKONUR COSMODROME

Recent Update: Baikonur continues to serve as Russia's primary site for crewed and strategic space launches.

About

1. Located in **Kazakhstan**, it is leased and operated by Russia.
2. It is the world's largest operational **space launch facility by area**.
3. Launch site of **Sputnik 1**, the first artificial Earth satellite.
4. Hosted historic **Vostok 1 mission carrying Yuri Gagarin**, first human in space.
5. Remains the primary base for Russian **Soyuz crewed missions**.
6. Established in 1955 during the **Soviet space programme era**.
7. Supports interplanetary, commercial, and **International Space Station missions**.
8. Holds immense historical significance in the global **space exploration history**.

GHOSTPAIRING

Recent Update: CERT-In issued an advisory warning users about rising GhostPairing cyber fraud cases.

About

1. GhostPairing is a cyber fraud enabling **unauthorised control of WhatsApp accounts**.
2. Does not require password theft or traditional **SIM swapping attacks**.
3. Exploits WhatsApp's device linking or **QR-based pairing features**.
4. Grants attackers full access to chats, media, and **account monitoring capabilities**.
5. Victims often remain unaware of background **linked-device compromises**.
6. Classified under advanced **social engineering-based cyber threats**.

7. Can lead to financial fraud and **identity misuse incidents**.
8. Prevention requires strong device security and **two-factor authentication activation**.

DHRUV64 MICROPROCESSOR

Recent Update: India introduced DHRUV64 under its indigenous Microprocessor Development Programme to strengthen digital sovereignty.

About

1. DHRUV64 is India's first fully indigenous **1.0 GHz 64-bit dual-core processor**.
2. Developed by the **Centre for Development of Advanced Computing (C-DAC)**.
3. Part of India's broader **Microprocessor Development Programme (MDP)**.
4. Designed to support secure and sovereign **critical computing infrastructure systems**.
5. Complements earlier processors like **SHAKTI, AJIT, and VIKRAM**.
6. Aims to reduce dependence on imported **semiconductor technologies**.
7. Supports strategic sectors including defence and **secure data processing applications**.
8. Next-generation processors such as **Dhanush series** are under development.

SATELLITE COMMUNICATION (SATCOM)

Recent Update: New Satcom Guidelines 2025 mandate local manufacturing, NavIC compliance, and enhanced national security protocols.

About

1. Satellite communication enables wireless transmission via **orbiting communication satellites**.
2. Signals are uplinked from ground, amplified in space, and **downlinked to receivers globally**.

3. Supports broadband internet, television broadcasting, and **remote area connectivity services**.
4. Regulated by the **Department of Telecommunications (DoT)** and TRAI.
5. New guidelines mandate **data localisation and lawful interception mechanisms**.
6. Establishes Special Monitoring Zones near **borders and coastal EEZ regions**.
7. Major players include **SpaceX (Starlink), Eutelsat OneWeb, and Amazon Kuiper**.
8. Strengthens India's digital infrastructure and **strategic communication resilience**.

SOURCE: VISION MONTHLY

SCRAMJET ENGINE

Recent Update: The **Defence Research and Development Organisation (DRDO)** successfully conducted a **ground test of a full-scale, actively cooled, long-duration Scramjet engine**, strengthening India's hypersonic missile programme.

About

1. A **Scramjet (Supersonic Combustion Ramjet) engine** is an advanced air-breathing propulsion system designed to operate at **hypersonic speeds above Mach 5**.
2. It is an improvement over the **ramjet engine**, enabling **supersonic combustion of fuel while the airflow remains supersonic inside the engine**.
3. Unlike conventional jet engines, **scramjets have no moving parts such as compressors or turbines**, making them structurally simpler and lighter.
4. The engine uses **hydrogen as fuel and oxygen from atmospheric air as the oxidizer**, eliminating the need to carry oxidizer like rocket engines.

5. Scramjets require **assisted take-off using another propulsion system such as rockets or turbojets**, because they cannot generate thrust at zero airspeed.
6. A **flame stabilisation mechanism** ensures continuous combustion even when airflow speeds exceed **1.5 km per second** inside the engine.
7. Scramjets are considered **more efficient than rocket engines for sustained high-speed atmospheric flight**, as rockets must carry both fuel and oxidizer.
8. India has become the **fourth country after the United States, Russia and China to demonstrate scramjet flight testing capability**.

PSLV-C62 / EOS-N1 MISSION

Recent Update: The **PSLV-C62 / EOS-N1 mission experienced an anomaly during its third stage**, marking the **64th flight of the Polar Satellite Launch Vehicle (PSLV)**.

About

1. The mission aimed to launch **EOS-N1 Earth Observation Satellite along with 15 co-passenger satellites from domestic and international customers**.
2. **EOS-N1 is designed to strengthen India's space-based monitoring and earth observation capabilities**.
3. The mission also carried the **Kestrel Initial Technology Demonstrator (KID)** from a Spanish startup.
4. **KID is a prototype re-entry vehicle** intended to demonstrate atmospheric re-entry technology and splashdown recovery in the South Pacific Ocean.
5. **EOS-N1 and most co-passenger satellites were planned to be placed in a Sun-Synchronous Orbit**, enabling consistent earth imaging.
6. The launch was undertaken by **New Space India Limited (NSIL)**, the commercial arm of ISRO established in **2019**.
7. NSIL is responsible for **commercial satellite launches, technology transfer and promotion of India's space industry**.
8. The mission highlights India's growing role in **commercial space services and satellite launch markets**.

FOURTH INDUSTRIAL REVOLUTION (INDUSTRY 4.0)

Recent Update: The **World Economic Forum announced five new Fourth Industrial Revolution Centres globally**, including a new centre in **Andhra Pradesh, India**.

About

1. The term **Fourth Industrial Revolution (Industry 4.0)** was coined by **Klaus Schwab, founder of the World Economic Forum, in 2016**.
2. It represents a phase where **digital, physical, and biological technologies converge**, transforming economies and societies.
3. Key technologies driving Industry 4.0 include **Artificial Intelligence, robotics, Internet of Things (IoT), biotechnology, blockchain, and quantum computing**.
4. Unlike earlier industrial revolutions, Industry 4.0 **blurs boundaries between human, machine, and biological systems**.
5. It enhances **productivity and economic growth through automation, smart manufacturing, and advanced data analytics**.
6. Developing countries like India can **leapfrog legacy technologies and accelerate digital transformation** through Industry 4.0 adoption.
7. Smart manufacturing facilities known as **"Lighthouse factories" demonstrate improvements in efficiency, reduced emissions, and optimized resource use**.
8. However, the revolution also creates challenges including **technology inequality, workforce disruption due to automation, and rising energy demand from digital infrastructure**.

SOURCE: DRISHTI MONTHLY

ACC-PLI SCHEME (ADVANCED CHEMISTRY CELL)

Recent Update: Report highlights implementation delays and low capacity utilisation

About

1. **ACC-PLI Scheme** launched in **2021** to promote domestic manufacturing of **advanced batteries (Li-ion)**.
2. Aims to **reduce import dependence on China and boost EV ecosystem**.
3. Target: **50 GWh battery capacity by 2026** with ₹18,100 crore outlay.
4. Incentives include **₹2,000 per kWh and value addition targets (25%→60%)**.
5. Current progress: Only **1.4 GWh commissioned; major delays observed**.
6. **No incentives disbursed yet**, reflecting slow implementation.
7. Job creation far below expectations (**1,118 vs 1.03 million target**).
8. Linked with broader **PLI scheme for manufacturing and Atmanirbhar Bharat**.

NEW TELESCOPES IN LADAKH

Recent Update: Budget 2026–27 approves NLST and NLOT in Ladakh

About

1. Two major telescopes: **NLST (solar)** and **NLOT (optical–infrared)** planned.
2. Located in **Ladakh (Hanle Dark Sky Reserve)** with ideal atmospheric conditions.
3. NLST: **2-metre solar telescope** to study solar activity and space weather.
4. NLOT: **13.7-metre segmented telescope**, among world's largest.
5. Supports research on **exoplanets, stellar evolution, and universe origins**.
6. Complements missions like **Aditya-L1 and global astronomy networks**.
7. Enhances **data sovereignty and global scientific collaboration**.
8. Strengthens India's position in **space science and Global South leadership**.

AI IN EDUCATION – THREE A's FRAMEWORK

Recent Update: Experts emphasise integration under NEP 2020

About

1. Framework includes **Adoption, Absorption, and Application of AI**.
2. Adoption: Focus on **AI literacy, digital skills, and tool familiarity**.
3. Absorption: Builds **critical thinking, ethics, and understanding AI limitations**.
4. Application: Enables **innovation, problem-solving, and real-world use**.
5. Aligns with **NEP 2020 vision of tech-driven education system**.
6. Promotes **personalised learning and employability skills**.
7. Challenges include **infrastructure gaps, teacher training issues, and data privacy risks**.
8. Requires reforms like **AI curriculum, evaluation changes, and sovereign AI cloud**.

CAR T-CELL THERAPY BREAKTHROUGH

Recent Update: IIT Bombay develops improved T-cell recovery method

About

1. **CAR T-cell therapy** modifies patient T-cells to target cancer cells.
2. New method uses **Accutase instead of Trypsin for safer cell recovery**.
3. Ensures **higher survival and functionality of T-cells**.
4. Reduces damage to **cell membranes and immune response capacity**.
5. Helps lower treatment costs compared to **₹3–4 crore global therapy cost**.

6. Supports India's **NexCAR19 indigenous therapy initiative**.
7. Marks shift from **generic pharma to advanced biomedical innovation**.
8. Improves accessibility of **cancer immunotherapy in India**.

PATENT LAW IN SPACE

Recent Update: Rising concerns over IP conflicts in outer space

About

1. Current system uses **jurisdiction-by-registration under Outer Space Treaty (1967)**.
2. Conflict between **territorial patent laws and non-sovereignty principle of space**.
3. ISS model assigns **jurisdiction module-wise to participating nations**.
4. Challenges arise in **multinational lunar or Mars missions**.
5. Patent exclusivity may conflict with **"benefit of all mankind" principle**.
6. Legal gaps include **temporary presence doctrine and enforcement issues**.
7. Risk of **"flags of convenience" to bypass regulations**.
8. Calls for **new global IP framework for space technologies**.

TETANUS & DIPHTHERIA (Td) VACCINE

Recent Update: Indigenous Td vaccine launched at CRI Kasauli

About

1. **Td vaccine** provides protection against **tetanus and diphtheria**.
2. Replaces **TT vaccine** with added diphtheria protection.
3. Lower diphtheria dose reduces **side effects while maintaining immunity**.
4. Important as **childhood immunity declines in adulthood**.
5. Included in **Universal Immunization Programme (UIP)**.
6. India eliminated **Maternal & Neonatal Tetanus in 2015**.
7. Addresses risks like **respiratory infections and neurological complications**.
8. Supports **public health strengthening and immunisation coverage**.

SODIUM-ION BATTERIES (SiBs)

Recent Update: Emerging as alternative to lithium-ion for energy security

About

1. **Sodium-ion batteries (SiBs)** use abundant sodium instead of lithium.
2. Offer **lower cost, improved safety, and reduced import dependence**.
3. Suitable for **EVs, grid storage, and renewable energy systems**.
4. Safer due to **lower thermal runaway risks**.
5. Compatible with existing **PLI infrastructure for scaling**.
6. Challenges include **lower energy density and weak supply chains**.
7. Reduces reliance on **critical minerals like lithium, cobalt, nickel**.
8. Strategic for **India's long-term energy security and Atmanirbhar Bharat**.

SOURCE: INSIGHTS MONTHLY

MOLTBOOK PLATFORM

Recent Update: AI-only social platform with autonomous agent interactions gaining attention

About

1. **Moltbook** is an **AI-only social media platform** where only AI agents interact while humans observe.
2. Interactions are based on **probabilistic reasoning and training data, without consciousness**.
3. Allows **only verified AI agents to post, comment, and engage**.
4. Shows **emergent behaviour like religions, politics, and crypto systems**.

5. Achieved **1.5 million agents and large-scale interactions rapidly**.
6. Enables **cross-model interaction across different AI architectures**.
7. Demonstrates **unscripted cultural evolution and digital societies**.
8. Raises questions on **AI ethics, autonomy, and digital ecosystems**.

CARBON CAPTURE AND UTILISATION (CCU)

Recent Update: Increasing focus on CCU for achieving Net Zero targets

About

1. **CCU** captures **CO_2 emissions and converts them into useful products**.
2. Process involves **capture → compression → utilisation stages**.
3. Enables conversion into **fuels, chemicals, construction materials, and biomass**.
4. Types include **direct use, chemical conversion, biological conversion, mineralisation**.
5. Promotes **circular carbon economy by treating CO_2 as a resource**.
6. Can be **retrofitted in existing industries**, extending asset life.
7. Generates **economic value unlike CCS (storage-only approach)**.
8. Supports **climate goals and industrial decarbonisation strategies**.

ASTRAM TRAFFIC MANAGEMENT SYSTEM

Recent Update: Bengaluru's AI-based system draws global interest

About

1. **ASTraM** is an **AI-driven traffic management platform** for urban mobility.
2. Developed by **Bengaluru Traffic Police with Arcadis (Netherlands)**.
3. Integrates data from **CCTV, ANPR systems, and open data sources**.
4. Uses AI to **predict congestion and identify traffic patterns**.
5. Sends **automated alerts to authorities every 15 minutes**.
6. Shifts policing from **reactive to proactive model**.
7. Improves **road safety, congestion management, and incident response**.
8. Represents **smart city governance using big data and AI**.

LARGE LANGUAGE MODELS (LLMs)

Recent Update: Central to AI advancements and governance debates

About

1. **LLMs** are AI systems trained on **massive text data to understand and generate language**.
2. Use **transformer architecture with billions of parameters**.
3. Work by **tokenisation, embeddings, self-attention, and next-token prediction**.
4. Enable **text generation, translation, summarisation, and coding**.
5. Capable of **zero-shot reasoning and in-context learning**.
6. Support **multilingual communication and global accessibility**.
7. Challenges include **bias, hallucinations, and data privacy issues**.
8. Core to **AI ecosystems, governance, and digital transformation**.

BIO-BASED CHEMICALS AND ENZYMES

Recent Update: Growing importance in sustainable industrial production

About

1. Derived from **renewable biomass like sugarcane, corn, and agricultural waste**.
2. Enzymes act as **biological catalysts for industrial processes**.
3. Produced through **fermentation and microbial processes**.
4. Offer **lower carbon footprint compared to petrochemicals**.

5. Enable **energy-efficient production at lower temperatures and pressures**.
6. Widely used in **pharma, food, textiles, and biofuels**.
7. Support **bioeconomy and sustainable industrial transition**.
8. Promote **biodegradable and eco-friendly products**.

SATELLITE PHONE

Recent Update: Increasing relevance in disaster and remote communication

About

1. **Satellite phones** connect directly to **orbiting satellites instead of mobile towers**.
2. Provide **global coverage in remote areas like oceans and mountains**.
3. Operate using **GEO or LEO satellite systems**.
4. Require **clear line-of-sight for communication**.
5. Essential for **emergency, defence, and disaster response**.
6. Offer **basic services like voice calls, SMS, limited data**.
7. Limitations include **high cost, low speed, and signal delay**.
8. Raise **security and regulatory concerns in sensitive regions**.

6TH GENERATION AERO ENGINES

Recent Update: Emerging technology for next-gen stealth fighter aircraft

About

1. Designed for **future fighter jets with adaptive engine capabilities**.
2. Can **change operating modes mid-flight based on mission needs**.
3. Provide **thrust, power, and cooling for advanced systems**.
4. Support **AI systems, radar, and directed-energy weapons**.
5. Enhance **stealth, fuel efficiency, and performance**.
6. Represent **integration of propulsion with digital warfare systems**.
7. Critical for **next-gen military dominance and aerospace innovation**.
8. Reflect shift towards **multi-role, intelligent combat platforms**.

VOICERA PLATFORM (BHASHINI)

Recent Update: Launched at AI Impact Summit 2026 for multilingual AI services

About

1. **VoicERA** is an **open-source voice AI platform under BHASHINI ecosystem**.
2. Enables **multilingual digital governance through speech interfaces**.
3. Developed by **Digital India BHASHINI Division with multiple partners**.
4. Provides **interoperable and scalable AI deployment framework**.
5. Reduces **vendor dependency and duplication of efforts**.
6. Supports **citizen access to services in native languages**.
7. Strengthens **inclusive digital public infrastructure (DPI)**.
8. Key for **AI-enabled governance and language inclusivity in India**.

GRAPHICS PROCESSING UNIT (GPU)

Recent Update: Central to AI computing and data processing expansion

About

1. **GPU** is a processor designed for **parallel processing of large data sets**.
2. Originated with **Nvidia GeForce 256 (1999)**.
3. Performs **thousands of simultaneous calculations efficiently**.
4. Used in **AI, machine learning, gaming, and simulations**.
5. Core to **training large AI models like LLMs**.
6. Works through **rendering pipeline (vertex, rasterisation, shading)**.

7. Enables **high-performance computing and data analytics**.
8. Critical for **digital economy, AI infrastructure, and innovation ecosystems**.

SOURCE: THE HINDU

LAMBDA-CDM MODEL (STANDARD MODEL OF COSMOLOGY)

Recent Update: Continues to guide modern understanding of universe evolution

About

1. The **Lambda-CDM model** is known as the **standard model of cosmology**, explaining the structure and evolution of the universe.
2. It is based on **Einstein's General Theory of Relativity combined with modern astrophysical observations**.
3. The model incorporates key components such as **Big Bang theory, dark matter (CDM), and dark energy (Lambda)**.
4. It explains the **expansion of the universe and large-scale structure formation like galaxies and clusters**.
5. Dark energy (Lambda) accounts for **accelerated expansion of the universe**.
6. Cold Dark Matter (CDM) explains **gravitational effects that cannot be observed directly through light**.
7. Supported by evidence like **cosmic microwave background radiation (CMB)**.
8. Provides a **comprehensive timeline from early universe formation to present structure**.

MICROLENSING

Recent Update: Increasing use in detection of invisible celestial objects

About

1. **Microlensing** is a phenomenon where **gravity of a foreground object bends light from a distant star**, making it appear brighter temporarily.
2. It is a type of **gravitational lensing predicted by Einstein's General Theory of Relativity**.
3. The foreground object acts as a **natural lens even if it emits no light (e.g., black holes)**.
4. Helps scientists **estimate mass, distance, and properties of otherwise invisible objects**.
5. Used to discover **exoplanets, brown dwarfs, neutron stars, and black holes**.
6. Events are **rare, temporary, and difficult to predict accurately**.
7. Duration can range from **hours to months depending on mass and alignment**.
8. Important for **mapping dark matter distribution and galactic structure**.

MOLECULAR CLOUD

Recent Update: L328 cloud study improved understanding of magnetic fields

About

1. A **molecular cloud** is an **interstellar region of gas and dust where molecules like hydrogen (H_2) form**.
2. These clouds have **extremely low temperatures (below 40 Kelvin)** and relatively high density.
3. Size ranges from **few light years to hundreds of light years (giant molecular clouds)**.
4. They are considered the **birthplace of stars and planetary systems**.
5. Star formation occurs through **collapse under gravity, influenced by magnetic fields and turbulence**.
6. They evolve through **processes of contraction, condensation, and accretion**.
7. Their lifespan is **relatively short in cosmic terms compared to stars**.
8. Studying them helps understand **early stages of stellar evolution and galaxy formation**.

LAGRANGIAN POINT (L1)

Recent Update: Used in missions like Aditya-L1 for solar observation

About

1. **Lagrange points** are positions where **gravitational forces of two bodies balance orbital motion**.
2. There are **five such points (L1 to L5)** in a two-body system like Earth–Sun.
3. **L1 lies between Earth and the Sun at about 1.5 million km distance**.
4. It provides a **continuous, unobstructed view of the Sun**.
5. It is ideal for **solar observatories and space weather monitoring missions**.
6. Points L1, L2, L3 are **unstable, requiring station-keeping for spacecraft**.
7. L4 and L5 are **stable points where objects can remain with minimal energy**.
8. Widely used in missions like **SOHO and India's Aditya-L1**.

WHITE DWARF STARS

Recent Update: Observations of shockwave-producing white dwarf

About

1. **White dwarfs** are stellar remnants formed after a star **exhausts its nuclear fuel**.
2. They no longer undergo **nuclear fusion but remain extremely hot and dense**.
3. Composed mainly of **helium, carbon, and oxygen nuclei**.
4. Typically **similar in size to Earth but with mass comparable to the Sun**.
5. Have extremely high density with **gravity about 1,00,000 times Earth's gravity**.
6. If mass exceeds **Chandrasekhar Limit (~1.4 solar masses)**, it leads to supernova explosion.
7. Play key role in **understanding stellar evolution and cosmic distance measurement**.
8. Often observed in **binary systems or as remnants of sun-like stars**.

SOLAR CYCLE

Recent Update: IIT Kanpur developed improved prediction model

About

1. The **solar cycle** is an **approximately 11-year cycle of magnetic activity of the Sun**.
2. It involves **periodic reversal of the Sun's magnetic poles**.
3. Cycle progresses from **solar minimum (low activity) to solar maximum (high activity)**.
4. Sunspots are **key indicators of solar activity intensity**.
5. Solar maximum sees increased **solar flares and coronal mass ejections (CMEs)**.
6. These events release **high-energy particles affecting Earth's magnetosphere**.
7. Impacts include **auroras, satellite disruptions, and power grid failures**.
8. Important for **space weather forecasting and satellite safety**.

STEALTH CORONAL MASS EJECTION (CME)

Recent Update: Highlighted as emerging threat to space infrastructure

About

1. A **stealth CME** is a **solar eruption that occurs without clear warning signs like flares or X-rays**.
2. It appears **weak or nearly invisible in standard solar observations**.
3. Originates from **regions with weak magnetic fields on the Sun**.
4. Caused by **gradual magnetic restructuring rather than sudden explosions**.
5. Despite low visibility, it can **trigger severe geomagnetic storms on Earth**.
6. Can disrupt **satellites, GPS, communication systems, and aviation routes**.
7. Detection is challenging due to **lack of early warning indicators**.
8. Highlights need for **advanced space weather monitoring systems**

FREE SPACE OPTICAL (FSO) COMMUNICATION

Recent Update: Achieved world's first **2 Tbit/s high-speed transmission using optical terminals**

About

1. **FSO communication** is a **wireless data transmission technology that uses laser/light beams instead of optical fibres or cables**.
2. It enables **ultra-high bandwidth and extremely high data transfer rates**, making it suitable for next-generation communication systems.
3. Operates in an **unlicensed optical spectrum, ensuring enhanced security and minimal interference**.
4. Requires a **clear line-of-sight between transmitter and receiver for effective signal transmission**.
5. Performance is affected by **atmospheric conditions such as fog, rain, dust, and turbulence**.
6. Used in **inter-satellite communication, satellite-to-ground links, and High Altitude Platform Stations (HAPS)**.
7. Useful for **disaster and emergency communication where cable infrastructure is unavailable or damaged**.
8. Considered a key technology for **future space-based internet and high-speed global connectivity**.

PARAM SHAKTI SUPERCOMPUTER

Recent Update: Launched at IIT Madras to boost high-performance computing research

About

1. **Param Shakti** is an **indigenous supercomputing system with a capacity of around 3.1 petaflops**.
2. Developed by **C-DAC using RUDRA server architecture and open-source software stack (AlmaLinux)**.
3. Designed to support **complex simulations and data-intensive scientific research**.
4. Applications include **aerospace engineering, materials science, and advanced manufacturing**.
5. Plays a crucial role in **climate modelling, weather forecasting, and disaster prediction**.
6. Supports **drug discovery and biomedical research through high computational capability**.
7. Strengthens India's **self-reliance in supercomputing under National Supercomputing Mission**.
8. Contributes to **AI, data analytics, and digital innovation ecosystem**.

SMALL LANGUAGE MODELS (SLMs)

Recent Update: Dominating global AI usage due to efficiency and low cost

About

1. **SLMs** are compact AI models that **perform natural language tasks similar to LLMs but with fewer parameters**.
2. Typically contain **millions to ~30 billion parameters, compared to hundreds of billions in LLMs**.
3. Require **lower computational power, making them cost-effective and energy-efficient**.
4. Ideal for **on-device AI applications and edge computing environments**.
5. Used in **chatbots, mobile assistants, enterprise tools, and embedded systems**.
6. However, they have **limited accuracy and reduced capability for complex reasoning tasks**.
7. Around **95% of real-world AI workloads are currently handled by SLMs**.
8. Important for **democratising AI access and reducing dependence on large-scale infrastructure**.

EXOMINER++

Recent Update: NASA introduced advanced deep learning system for exoplanet detection

About

1. **ExoMiner++** is a **deep learning software developed by NASA to identify exoplanets from space telescope data**.
2. It is an upgraded version of **ExoMiner used with Kepler mission data**.

3. Analyses data from **Kepler and TESS missions to detect planetary signals**.
4. Works by studying **light curves and detecting periodic dips caused by planetary transits**.
5. Improves accuracy by **distinguishing real exoplanets from false positives**.
6. Enhances speed and efficiency of **astronomical data processing**.
7. Helps expand the catalogue of **habitable and Earth-like planets**.
8. Strengthens use of **AI in space exploration and astrophysics research**.

ASC ARJUN (AI HUMANOID ROBOT)

Recent Update: Deployed at Visakhapatnam Railway Station for surveillance

About

1. **ASC ARJUN** is an **AI-powered humanoid robot developed indigenously by Indian Railways**.
2. Designed to assist **Railway Protection Force (RPF) in surveillance and security operations**.
3. Equipped with **facial recognition, object detection, and real-time monitoring capabilities**.
4. Enhances **crowd management and passenger safety at busy railway stations**.
5. Can provide **information assistance and interact with passengers**.
6. Represents integration of **AI and robotics in public service delivery**.
7. Reduces dependence on **manual surveillance and improves efficiency**.
8. Reflects India's push towards **smart infrastructure and digital governance**.

BIOMATERIALS

Recent Update: Increasing use in healthcare, packaging, and sustainable industries

About

1. **Biomaterials** are materials of **natural, synthetic, or hybrid origin designed to interact safely with biological systems**.
2. Derived from **biological sources or engineered using bio-based processes**.
3. Combine disciplines like **physics, chemistry, biology, medicine, and materials science**.
4. Types include **drop-in (bio-PET), drop-out (PLA), and novel biomaterials (self-healing, bioactive)**.
5. Widely used in **medical implants, tissue engineering, and drug delivery systems**.
6. Also applied in **packaging, textiles, construction, and bioengineering industries**.
7. Promote **sustainability by reducing reliance on fossil-based materials**.
8. Key to development of **circular bioeconomy and eco-friendly technologies**.

BIO-BITUMEN

Recent Update: India becomes first country to commercialise bio-bitumen

About

1. **Bio-bitumen** is a **sustainable alternative to petroleum-based bitumen made from biomass sources**.
2. Produced using **plant oils, agricultural residues, and organic waste materials**.
3. Reduces **carbon emissions and environmental impact of road construction**.
4. Developed using **pyrolysis technology converting biomass into bio-oil**.
5. Can replace **20–30% of conventional bitumen without compromising road quality**.
6. Developed by **CSIR-CRRI and CSIR-IIP as indigenous innovation**.
7. Helps manage **crop residue like rice straw, reducing stubble burning**.
8. Supports **green infrastructure and sustainable construction practices**.

COKING COAL

Recent Update: Notified as critical mineral under MMDR Act

About

1. **Coking coal** is a **high-grade bituminous coal used primarily in steel production**.
2. It is converted into **coke through carbonisation in oxygen-free conditions**.
3. Coke acts as a **reducing agent in blast furnaces to extract iron from ore**.
4. Formed under **higher pressure and heat, resulting in high carbon content**.
5. India is the **second-largest steel producer but lacks high-quality coking coal reserves**.
6. Major reserves located in **Jharkhand (Jharia, Bokaro) and eastern states**.
7. India imports **~95% of its requirement due to poor domestic quality**.
8. Strategic for **industrial growth, infrastructure development, and energy security**.