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1. China's Open-Weight AI Strategy Challenges U.S. AI Leadership

Prelims:

Science & Technology

Mains:

GS Paper III–Science & Technology

Current relevance:

Chinese AI companies **Moonshot AI and Z.ai** have released advanced **open-weight AI models**, signalling China's growing capability in frontier AI development and challenging the dominance of closed AI models developed by leading U.S. companies.



Highlights:

1. Chinese companies **Moonshot AI and Z.ai** demonstrated their ability to develop **frontier-level AI models**, making advanced AI capabilities available through **open-weight models**.

2. **Moonshot AI** released **Kimi K3**, while **Z.ai** introduced **GLM-5.2**, both emerging as leading open-weight AI models capable of competing with advanced global AI systems.
3. **Open by Design:**
Chinese AI firms allow developers to **download, fine-tune, self-host, and build applications**, encouraging the growth of a wider AI ecosystem.
4. **China's Self-Reliance Strategy:**
China is pursuing greater self-reliance in AI through large-scale investment in **AI data centres**, increased **domestic sourcing**, and the expansion of **indigenous semiconductor manufacturing**.
5. **The AI ecosystem is increasingly evolving into two segments:**
 1. **Open, low-cost models** for routine, high-volume applications.
 2. **Closed, premium models** for advanced reasoning and high-end AI tasks.
6. China's open-weight AI strategy is accelerating the development of an **open AI ecosystem**, strengthening domestic technological capabilities, and reshaping **global competition** between **open and closed AI models**.

Source: THE HINDU - <https://www.pressreader.com/india/the-hindu-international-9bn2/20260802/281968909488343>

2. Retaining Scientific Talent: Strengthening India's Research Ecosystem

Prelims:

Science & Technology

Mains:

Science and Technology

Current relevance:

Recent reports of **nearly 120 scientists resigning from the Indian Space Research Organization (ISRO)** have renewed concerns over the ability of India's public research institutions to retain experienced scientific talent.



Highlights:

1. The reported resignations of nearly **120 ISRO scientists**, along with similar departures from **CSIR laboratories and other government-funded research institutions**, highlight a broader challenge of retaining experienced researchers.
2. **Reasons Behind the Exodus**
 - i. The article suggests that scientists are driven less by higher salaries and more by the need for **professional dignity, intellectual freedom, and the opportunity to pursue research independently**.
 - ii. Many research institutions continue to function under **rigid bureaucratic hierarchies**, where administrative control often takes precedence over **scientific autonomy**, making it difficult for researchers to question established authority.
 - iii. Scientific progress thrives in an environment where **ideas are freely exchanged**, allowing young researchers to question established hypotheses **without fear of professional repercussions**.

- iv. Excessive emphasis on **designation, protocol, and administrative hierarchy** discourages academic interaction and weakens collaborative scientific research.
- v. Scientists often **hesitate to raise concerns regarding workplace culture, harassment, or administrative practices** because of the close-knit nature of the scientific ecosystem and its influence on future career opportunities.

3. Strengthening Scientific Ecosystem

- i. Need for **greater administrative transparency, effective grievance redressal mechanisms, mentoring-based leadership, and reduced bureaucratic control** to create a more supportive research environment.
- ii. Although India continues to produce highly skilled scientists and invest in emerging technologies such as **semiconductors, quantum technologies, artificial intelligence, biotechnology, and space research**, its long-term success will depend on creating research institutions that **enable scientific talent to flourish**.
- iii. India's long-term scientific advancement depends not only on nurturing talented researchers but also on building a research ecosystem founded on **academic freedom, transparency, merit, and scientific autonomy**.

Source: THE HINDU – <https://www.thehindu.com/sci-tech/science/india-produces-smart-scientists-but-is-struggling-to-retain-them/article71297174.ece>

3. Lab-Grown Diamonds

Prelims:

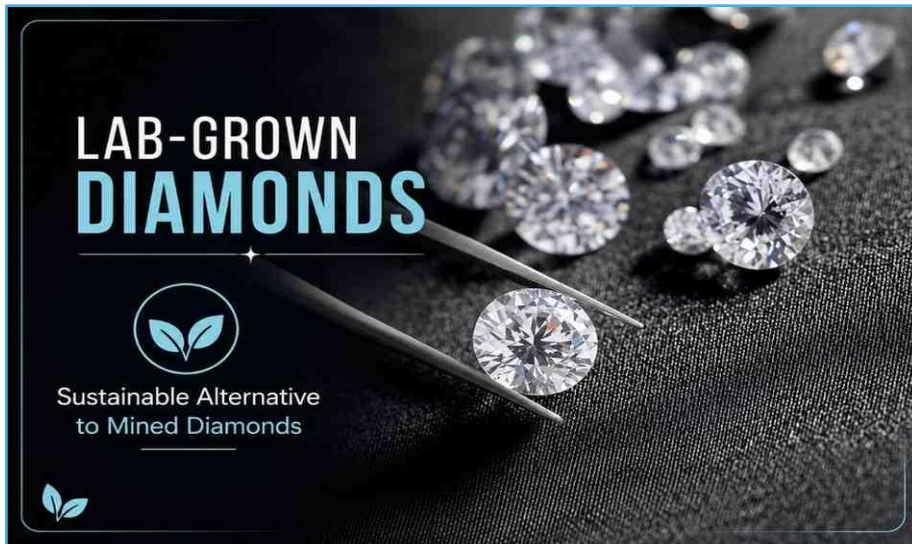
Science & Technology

Mains:

GS paper III-Science & Technology

Current relevance:

Growing concerns over the **environmental, social, and ethical impacts of natural diamond mining** have increased attention on **lab-grown diamonds** as a more sustainable, affordable, and traceable alternative, with India promoting indigenous production and research.



Highlights:

Background:

1. **Natural diamond** production is **declining** as major diamond mines are approaching **exhaustion**, highlighting the finite nature of mined diamond resources.
2. **Challenges of Natural Diamond Mining:**
Diamond mining is associated with **high water and energy consumption, deforestation, ecosystem degradation, soil erosion, water pollution, landslides, labour-related health risks**, and forced displacement.
3. The illicit trade in **blood diamonds** continues to contribute to political conflicts despite mechanisms such as the **Kimberley Process**, owing to regulatory gaps and difficulties in tracing the geographic origin of diamonds.

Lab-Grown Diamonds:

1. They are **chemically, physically, and optically identical** to natural diamonds while offering a **more affordable, traceable, and sustainable alternative** to mined stones.

2. The **High-Pressure High Temperature (HPHT)** process replicates the natural conditions under which diamonds are formed within the Earth's mantle.
3. The **Chemical Vapour Deposition (CVD)** process produces diamonds by depositing carbon onto diamond seeds through chemical reactions involving carbon-rich gases.
4. The **carbon footprint** of lab-grown diamonds depends on the energy source used, with **renewable energy-based production** offering significantly **lower emissions** and supporting sustainable manufacturing.

5. **Applications:**

Diamonds are widely used in **cutting and drilling operations, quantum computing, protective coatings, semiconductor manufacturing**, and other advanced industrial applications.

India's Initiative:

1. The Government of India announced measures in the **Union Budget 2023–24** to encourage indigenous production of lab-grown diamonds and support research in **HPHT** and **CVD** technologies.
2. **IIT Madras** has been supported to establish the **India Centre for Lab-Grown Diamond (In Cent-LGD)** to develop domestic expertise in diamond seeds, machinery, and manufacturing processes.

Source: THE HINDU - <https://www.thehindu.com/sci-tech/science/why-lab-grown-diamonds-are-a-sustainable-alternative-to-mined-stones/article71301201.ece>

4. **Magnetorheological (MR) fluids**

Prelims:

Science & Technology

Mains:

Current relevance:

Scientists from **IIT Patna**, with support from the **Department of Science and Technology (DST)**, have developed an **innovative hybrid magneto-rheometer** to accurately characterise the performance of **magnetorheological (MR) fluids** under real operating conditions.

**Highlights:**

The newly developed **hybrid magneto-rheometer** provides a novel method to characterize the performance of **magnetorheological (MR) fluids** under both magnetic and non-magnetic conditions.

About Magnetorheological (MR) Fluids:

1. MR fluids are **smart materials** that rapidly increase their viscosity when exposed to a **magnetic field**, enabling controlled transmission of force through an electromagnet.
2. Scientists developed **nano iron powder-based MR fluids** and fabricated a hybrid rheometer capable of measuring both **rheological (flow and deformation)** and **tribological (friction and wear)** properties under compression and shear modes.

3. The hybrid rheometer evaluates MR fluid behaviour under **compression plus shear (mixed mode)** in the **presence and absence of a magnetic field**, providing a more comprehensive assessment than conventional methods.

4. Applications:

- MR fluids are suitable for applications in **brakes, clutches, shock absorbers, vibration control systems, dampers, actuators, and medical devices.**
- The technology also supports the study of **viscoelastic materials** used in **polymers, pharmaceuticals, food processing, cosmetics, and petrochemicals.**

5. Significance:

The hybrid magneto-rheometer enhances the understanding of MR fluid behaviour, enabling the development of **high-performance smart materials for medicine, aerospace, defence, automation, and energy-efficient adaptive technologies.**

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2293782®=48&lang=1>

5. African Swine Fever (ASF) Vaccine

Prelims:

Science & Technology, Biotechnology

Mains:

GS Paper III- Science & Technology, Biotechnology

Current relevance:

The **Indian Council of Agricultural Research (ICAR)** has developed India's **first indigenous** MA-104 cell line-based live attenuated vaccine against **African Swine Fever (ASF).**



Highlights:

1. **African Swine Fever (ASF)** is a **trans-boundary viral disease** affecting **domestic and wild pigs**, characterised by **high fever, haemorrhages**, and **mortality rates** that may approach **100%**.

2. **Impact in India:**

Since its detection in India in **2020**, African Swine Fever (ASF) has spread across several States and Union Territories, leading to widespread **pig mortality, disruption of pig production, restrictions on animal movement and trade**, and severe livelihood losses, particularly in the **North-Eastern region**.

3. **About African Swine Fever (ASF) Vaccine:**

- i. Scientists at the **ICAR–National Institute of High Security Animal Diseases (ICAR–NIHSAD)**, Bhopal, have developed India's **first indigenous MA-104 cell line-based live attenuated vaccine** against African Swine Fever (ASF).
- ii. The vaccine has been developed using a **novel attenuated ASFV Genotype II virus** with unique gene deletions.
- iii. The vaccine has successfully undergone **laboratory evaluation** and **field validation**, establishing its **safety and efficacy**.

- iv. It is recommended for **healthy pigs above eight weeks of age** and is administered as a **1 mL intramuscular injection**, followed by a **booster dose after 14 days**.
- v. **Significance:**
- The indigenous vaccine is expected to **reduce pig mortality**, minimise **economic losses**, strengthen **animal health security**, and support the **sustainable growth of India's pig farming sector**.
 - Unlike commercially licensed ASF vaccines available in **Vietnam** that depend on **patented proprietary cell lines**, the indigenous vaccine is developed using the **widely available MA-104 cell line**.
 - This enables **large-scale vaccine production**, lowers manufacturing costs, and reduces dependence on proprietary technologies.
 - Towards **Atmanirbhar Bharat**, the indigenous ASF vaccine marks a major advancement in **veterinary vaccine research** by strengthening disease preparedness, **enhancing food and biosecurity**, and reinforcing India's capability to develop globally competitive animal health technologies.

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2294280®=48&lang=1>

6. Transport, pharma and biotech become India's biggest research investors

Prelims:

Science & Technology

Mains:

GS Paper III–Science and Technology

Current relevance:

The **Department of Science and Technology (DST)**, in its **Research and Development Statistics 2025–26**, reported that **private industry has become the largest contributor to India's R&D expenditure**, with the transportation, pharmaceutical, biotechnology, and IT sectors leading corporate research investments.



Highlights:

1. The **Department of Science and Technology (DST)** has released the **Research and Development Statistics 2025–26** report, highlighting the expanding role of private industry in driving India's research investment and innovation ecosystem.
2. Private industry accounted for **45.5% of national R&D expenditure in 2021–22**, increasing to **51.8% in 2023–24**, marking the first time that businesses contributed more to India's research effort than all levels of government combined.
3. The **transportation industry** became **India's largest corporate R&D investor**, followed by:
 - Pharmaceuticals
 - Biotechnology

- Information Technology (IT)
- Electrical and Electronics

Collectively, these sectors constituted the largest share of private industrial R&D expenditure.

4. India's **R&D expenditure reached 0.83% of GDP in 2021–22**, crossing the 0.8% threshold for the first time since 2009–10.
5. The report **estimates** that R&D expenditure will approach **0.9%** of GDP in **2025–26**.
6. Compared to earlier DST statistics, the **transport sector's R&D investment has nearly tripled**, while **biotechnology** has emerged as one of India's leading research-intensive industries and **IT** has become a major corporate R&D investor.
7. **Private Sector Research Workforce:**
The report estimates that **private industry employed more full-time equivalent (FTE) R&D personnel than government institutions in 2023–24**, indicating a significant shift in India's research workforce.
8. The **growth in private R&D expenditure** was driven primarily by **business enterprises**, with a relatively small number of companies contributing the majority of corporate research investments.

Source: THE HINDU – <https://www.pressreader.com/india/the-hindu-kolkata-9ww9/20260805/281998974265374>

7. Pigeon pea variety

Prelims:

Science & Technology

Mains:

GS Paper III–Science & Technology

Current relevance:

The **Indian Council of Agricultural Research (ICAR)** has developed India's **first fully annotated telomere-to-telomere (T2T) reference genome** of the pigeonpea variety '**Asha**', which has been approved as the **global reference genome** for pigeon pea.



Highlights:

Evolution of Pigeon pea Genomics:

1. In **2011**, ICAR–National Institute for Plant Biotechnology (ICAR–NIPB) published the **world's first draft genome of a pulse crop**, pigeon pea variety '**Asha**', which was also the **first crop genome sequenced entirely in India**.
2. An improved draft genome was released in **2017**, followed by the complete **T2T reference genome**.
3. **Key Features of the T2T Genome:**
 - i. The T2T genome provides a **complete representation of all 11 chromosomes** of pigeon pea.
 - ii. It includes **all centromeres and telomeres**, ensuring chromosome-level completeness.

- iii. Comprehensive genome annotation identified genes and coding sequences, while transcriptome mapping confirmed the genome's high accuracy and completeness.

Objective:

- i. To accelerate the development of **climate-resilient varieties, high-yielding varieties, nutritionally enriched pigeon pea varieties**.
- ii. It will strengthen India's pulse improvement programme and support enhanced productivity, improved farmer livelihoods, and food and nutritional security.

About Pigeon pea:

- i. It popularly known as **Arhar or Tur**, pigeon pea is one of India's most important pulse crops and a **major source of dietary protein**.
- ii. It plays a vital role in ensuring the country's **food and nutritional security**.
- iii. It is cultivated extensively across the **tropics and subtropics** and is **predominantly grown under rainfed conditions**, making it an important crop for **dryland farmers**.
- iv. **India** is the **world's largest producer, consumer, and importer of pigeon pea**, accounting for a major share of global production.

Role of ICAR:

- i. ICAR promotes pulse improvement by developing **high-yielding, pest-resistant, and climate-resilient varieties**, while supervising breeder seed production and conducting multi-location trials.
- ii. It demonstrates improved production technologies through its research institutes and **Krishi Vigyan Kendras (KVKs)**.
- iii. ICAR also provides **scientific support for capacity building** and technology dissemination to strengthen pulse cultivation across the country.

Mission for Aatmanirbharta in Pulses:

- i. The Government of India has launched the **Mission for Aatmanirbharta in Pulses (2025–26 to 2030–31)** to achieve self-sufficiency in pulse production, reduce import dependence, and enhance farmers' income through improved seeds, technology

adoption, area expansion, assured procurement, strengthened post-harvest infrastructure, and research-led interventions.

- ii. The mission aims to increase India's pulse production to about **35 million tonnes by 2030–31**.

Source: PIB –

[https://www.pib.gov.in/PressReleasePage.aspx?PRID=2294441®=48&lang=2#:~:tex
t](https://www.pib.gov.in/PressReleasePage.aspx?PRID=2294441®=48&lang=2#:~:text=)

8. Odisha's Integrated Science & Technology Roadmap

Prelims:

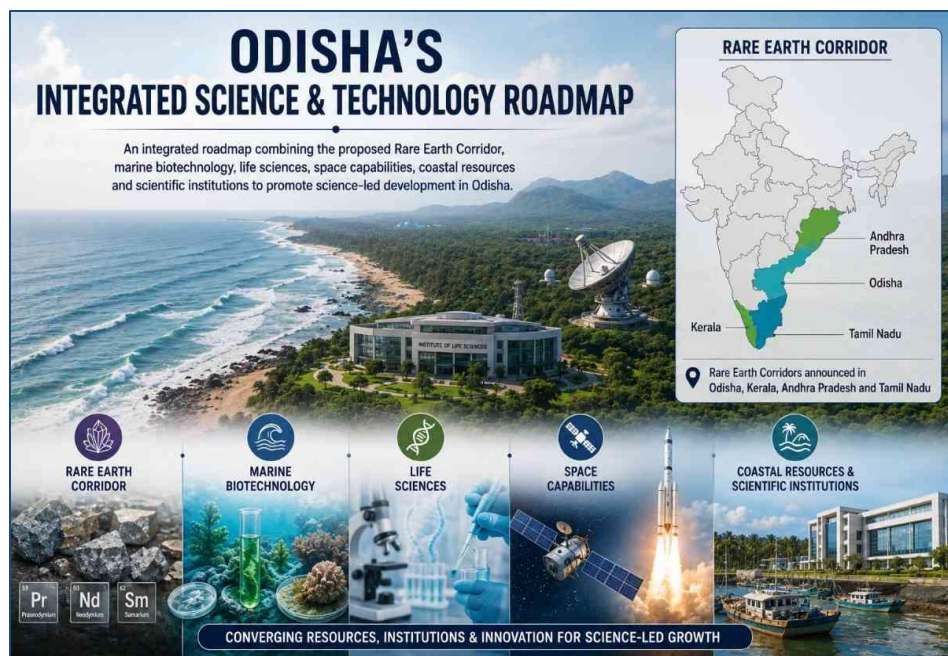
Science & Technology, Geography

Mains:

GS Paper III – Science & Technology

Current relevance:

The Central Government and Odisha Government discussed an **integrated science and technology roadmap** combining the proposed **Rare Earth Corridor, marine biotechnology, life sciences, space capabilities, coastal resources** and scientific institutions to promote **science-led development** in Odisha.



Highlights:

1. Rare Earth Corridor:

- i. The **Union Budget 2026–27** announced dedicated **Rare Earth Corridors** in **Odisha, Kerala, Andhra Pradesh and Tamil Nadu**.
- ii. The initiative focuses on **mining, processing, research and manufacturing** to develop an integrated domestic rare-earth value chain.
- iii. **Odisha's coastal mineral resources** and existing scientific capabilities provide scope for further **rare-earth exploration and technology development**.
- iv. The initiative is linked with national priorities in **atomic minerals, advanced materials and strategic technologies**.

2. Marine Biotechnology & Life Sciences:

- i. The Odisha Marine Biotechnology Research & Innovation Corridor (OMBRIC) is being developed as a collaborative research platform.
- ii. It has partnerships with IIT Bhubaneswar, Berhampur University, Fakir Mohan University, NIT Rourkela, IISER Berhampur and Institute of Life Sciences (ILS), Bhubaneswar.

- iii. OMBRIC is proposed to be aligned more closely with Earth Sciences, CSIR and the Department of Biotechnology.
- iv. The expansion of Institute of Life Sciences, Bhubaneswar, under the Department of Biotechnology, was finalised with provision for an additional 50 acres of land from the Odisha Government.
- v. The expanded capacity could support the Bio-E3 framework – Biotechnology for Economy, Environment and Employment.
- vi. Odisha's marine resources offer biotechnology opportunities in bio-resources, health, food, materials and environmental solutions.

3. Space & Scientific Capabilities:

- i. Discussions explored closer alignment of Odisha's **Space Applications Centre with ISRO**.
- ii. The possibility of establishing a **Space Research and Manufacturing Centre in PPP mode** was discussed.
- iii. The proposed ecosystem seeks to connect **government institutions, national space agencies, research organisations and industry** for space applications, research, technology development and manufacturing.
- iv. A proposed **Science City** is envisaged to promote scientific awareness, innovation, experiential learning and youth engagement.

4. Ocean Resources & Blue Economy:

- i. Odisha's **long coastline and marine resource base** provide opportunities to integrate **ocean science, fisheries, marine technology and coastal economic activities**.
- ii. The **Deep Ocean Mission** and opportunities in **deep-sea fisheries** formed part of the broader coastal development agenda.
- iii. The **Odisha Deep Sea Fishing Mission (2026–2036)** aims to unlock offshore and deep-sea fisheries potential and strengthen marine value chains.

- iv. Odisha will also participate in the **‘Swachh Sagar, Surakshit Sagar’** campaign, involving coastal districts in coastal cleanliness and marine-environment awareness.

Source: PIB-

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2297681®=48&lang=1>

9. Indian Sanchar Mitras

Prelims:

Science & Technology

Mains:

GS Paper II – International Institutions, GS Paper III – Science & Technology,

Current relevance:

The **Department of Telecommunications (DoT)** has facilitated the selection of **three Sanchar Mitras from India** as **International Telecommunication Union (ITU) Generation Connect Youth Envoys (GCYE) for 2026–2030**, recognising the growing participation of Indian youth in shaping the global digital future.

DEPARTMENT OF TELECOMMUNICATIONS
Government of India

Three Sanchar Mitras Selected as ITU Generation Connect Youth Envoys for the period 2026–2030

The Department of Telecommunications (DoT) has facilitated the selection of **three Sanchar Mitras from India** as International Telecommunication Union (ITU) Generation Connect Youth Envoys (GCYE) for **2026–2030**, recognising the growing participation of Indian youth in shaping the global digital future.

संचार मित्र SANCHAR MITRA

They were recognised for their contribution under the **Sanchar Mitra Scheme** of the Department of Telecommunications.

OUR YOUTH. OUR FUTURE. OUR DIGITAL WORLD.

Ankit Kumar Pal 📍 Delhi	Manish Kumar Mandal 📍 Bengaluru	Susmita Sain 📍 Guwahati
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Empowering young changemakers.
Building a connected and inclusive digital future.

www.dot.gov.in

Highlights:

Generation Connect Youth Envoys Programme:

- i. The three selected Sanchar Mitras form part of the **third cohort of ITU Generation Connect Youth Envoys** for **2026–2030**.
- ii. The programme enables young people to contribute to **national, regional and global discussions** and initiatives.
- iii. Its focus areas include **Information and Communication Technologies (ICTs), digital transformation and inclusive digital development**.
- iv. The programme provides a platform for greater **youth participation** in **global conversations on technology and connectivity**.

Selected Youth Envoys from India:

The three Sanchar Mitras selected are:

1. Ankit Kumar Pal – Delhi
2. Manish Kumar Mandal – Bengaluru
3. Susmita Sain – Guwahati

They were recognised for their contribution under the **Sanchar Mitra Scheme of the Department of Telecommunications**.

About Sanchar Mitra Scheme:

- i. Implemented by the **Department of Telecommunications (DoT)**.
- ii. Envisions engaging **Yuva Shakti** as catalysts for **digital empowerment and societal outreach**.
- iii. Sanchar Mitras conduct awareness programmes in **communities, educational institutions and public spaces**.
- iv. Major areas include **citizen-centric telecom services, prevention of telecom fraud, mobile security, digital safety and responsible telecom usage**.
- v. It is open to students from participating technical institutions with programmes in **telecom, electronics, computers, cybersecurity or related fields**.

Implementation & Global Exposure:

- i. The scheme has been implemented across **all States and Union Territories** through the **LSA field offices of DoT**.
- ii. It provides selected Sanchar Mitras exposure to **national and international telecom platforms, including the ITU**.
- iii. Candidates for the GCYE programme were identified based on engagement in areas such as **digital inclusion, ICT education and skills, research, innovation, entrepreneurship and community-level ICT initiatives**.

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2298552®=48&lang=2>

10. GARUD High-Resolution Binoculars

Prelims:

Science & Technology, Defence

Mains:

GS Paper III: Science & Technology, Internal Security

Current relevance:

India Optel Limited (IOL), a **Mini Ratna**

Category-I Defence Public Sector

Undertaking under the **Department of Defence Production**, launched the indigenous **‘GARUD’ High Resolution Binoculars** for the civilian market on 13 August 2026 in New Delhi.



Highlights:

About GARUD:

1. GARUD is an **indigenously designed** and manufactured **high-resolution binocular** developed for the civil market.
2. It is developed and manufactured by **Ordinance Factory, Dehradun**, a unit of India Optel Limited.
3. It draws upon a binocular platform that has been used by the **Defence Forces and Central Armed Police Forces** under demanding operational conditions.
4. Its launch marks **IOL's entry into the civilian optics market.**

Key features:

1. It offers **8× magnification**, enabling users to view distant objects with greater clarity and detail for **effective long-range observation.**
2. It comes with a **±5 diopter adjustment**, allowing users to fine-tune the focus according to individual eyesight requirements for clearer and more comfortable viewing.
3. The binoculars feature **soft-touch eyecups** and an **ergonomic grip** for comfortable handling, while their **weather-resistant construction** supports reliable outdoor use under varied conditions.
4. Weighing approximately **610 grams**, GARUD has a **compact and portable design** that makes it easy to carry while maintaining **dependable optical performance.**

Purpose and application:

GARUD is designed to make **defence-grade optical capabilities available to civilian users** and can be used for:

1. Birdwatching and wildlife observation
2. Nature exploration and travel
3. Sports and forestry
4. Marine activities

5. Security-related applications

Significance:

1. **Aatmanirbhar Bharat:** Reflects indigenous design and manufacturing capabilities in precision optics.
2. **Defence-to-Civil Technology:** Extends optical expertise developed for defence and security forces to civilian users.
3. **Indigenous Manufacturing:** Builds upon India's long-standing precision optical manufacturing expertise dating back to **1943**.
4. **Civilian Market Expansion:** Marks IOL's diversification into **the civilian optics market**, widening public access to domestically manufactured high-quality optical products.

Source: PIB-

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2298964®=48&lang=1>

11. RSVC-AMRIT Platform

Prelims:

Science & Technology

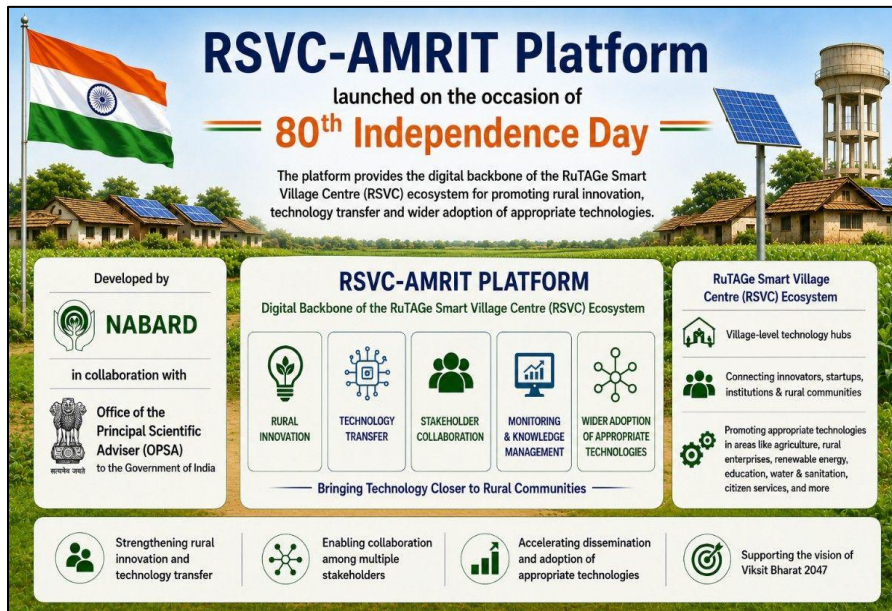
Mains:

GS Paper II: Government policies and interventions for development, GS Paper III: Science & Technology

Current relevance:

The Principal Scientific Adviser to the Government of India, launched the **RSVC-AMRIT platform** on the occasion of the 80th Independence Day. Developed by NABARD in collaboration with the Office of the Principal Scientific Adviser (OPSA), the platform provides the digital backbone of the RuTAGE Smart Village Centre (RSVC) ecosystem for

promoting rural innovation, technology transfer and wider adoption of appropriate technologies.



Highlights:

Objectives of RSVC-AMRIT:

1. **Bridge Rural Technology Gaps:** Connect rural needs with appropriate innovations, institutions and implementation mechanisms.
2. **Technology Dissemination:** Facilitate wider adoption of suitable technologies and take **innovation closer to the last mile**.
3. **Digital Integration:** Create a comprehensive digital ecosystem supporting the complete lifecycle of RSVC activities.
4. **Stakeholder Collaboration:** Bring innovators, startups, technology providers, academic institutions, funding agencies, implementation partners and rural communities onto a shared platform.
5. **Knowledge Management:** Facilitate systematic management and sharing of information relating to rural innovations and technologies.

Key Features of AMRIT:

1. It acts as the **digital backbone of the RSVC ecosystem**.

2. Supports the complete technology lifecycle from **technology discovery and validation to deployment tracking.**
3. Facilitates **collaboration, monitoring and knowledge management.**
4. Adds a **digital layer** to the physical village-level outreach of RSVCs.
5. Expected to evolve into a **national repository of rural innovations**, technologies, best practices and collaboration opportunities.

RuTAGE Smart Village Centre (RSVC) Ecosystem:

1. RSVCs function as **village-level technology hubs** for transferring appropriate and affordable technologies to rural communities.
2. Technologies are sourced from **research institutions, innovators and startups.**
3. RSVCs cover areas such as **agriculture, rural enterprises, renewable energy, education, assistive technologies, water and sanitation, and citizen services.**
4. **Eight RSVCs** are currently being supported by NABARD.
5. New RSVCs will be supported by **NABARD** and established in collaboration with corporates through **CSR initiatives**, with **NABFOUNDATION** serving as the implementation partner.

Significance:

1. **Last-Mile Innovation:** Helps take scientific and technological solutions closer to rural communities.
2. **Rural Technology Adoption:** Addresses the challenge of connecting India's innovation ecosystem with **actual rural requirements.**
3. **Institutional Convergence:** Creates linkages among innovators, research institutions, startups, funding agencies, implementation partners and communities.
4. **Scalable Rural Development:** Combines **physical RSVC hubs with AMRIT's digital infrastructure**, potentially enabling wider dissemination of technologies.

5. **Viksit Bharat 2047:** Wider adoption of appropriate technologies and rural innovations supports the broader vision of **technology-led rural development** and Viksit Bharat 2047.

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2299885®=48&lang=2>

12. VIHAAN Chip

Prelims:

Science & Technology

Mains:

GS Paper III: Science & Technology

Current relevance:

Aheesa Digital Innovations, a Chennai-based fabless semiconductor startup supported under the **Design Linked Incentive (DLI) Scheme**, has achieved **first-pass silicon success** with '**VIHAAN**', a networking System-on-Chip (SoC) designed for fibre broadband using the **indigenous VEGA microprocessor**. The chip is expected to proceed towards **production tape-out targeted for 2027**.

Aheesa Digital Innovations
Chennai-based fabless semiconductor startup
Supported under the **Design Linked Incentive (DLI) Scheme**

Achieved
FIRST-PASS SILICON SUCCESS ✓

'VIHAAN'
A Networking System-on-Chip (SoC) designed for Fibre Broadband

- Built using the indigenous **VEGA Microprocessor**
- Purpose-built for **Fibre Broadband**
- Proceeding towards production tape-out **Targeted for 2027**

Indigenous Innovation | Strengthening Digital Infrastructure | Atmanirbhar Bharat | Building India's Semiconductor Ecosystem

Highlights:

About VIHAAN:

1. **Indigenous Broadband Chip:** VIHAAN is a **networking System-on-Chip (SoC)** purpose-built for **fibre broadband**.
2. **Indigenous Technology:** It has been built using the **indigenous VEGA microprocessor**.
3. **Developer:** Designed by **Aheesa Digital Innovations**, a Chennai-headquartered Indian fabless semiconductor startup specialising in chips for **broadband networking and security**.
4. **Development Milestone:** The chip was **taped out on Republic Day** and achieved **first-pass silicon success on Independence Day**.
5. **Next Stage:** It will proceed towards **production tape-out**, targeted for 2027.

Design Linked Incentive (DLI) Scheme – Role:

1. The **DLI Scheme** supports Indian startups in designing semiconductor chips for **strategic and commercial applications**.
2. Supported applications include **satellite communications, drones, surveillance cameras**, defence and aerospace systems, automotive, IoT devices, LED drivers, **AI systems, telecom equipment and smart meters**.
3. DLI-supported companies have collectively achieved over **30 chip-design tape-outs** across various foundries.
4. These companies have raised **more than US\$100 million in venture capital funding**, indicating growing investor confidence in India's semiconductor design capabilities.
5. Aheesa raised around **₹40 crore** from **TNIFMC through the Tamil Nadu Emerging Sector Seed Fund (TNESSF)** and other private investors.

Strengthening India's Chip-Design Ecosystem:

1. **High Value Addition:** Semiconductor chip design contributes up to **50% of overall value addition** across the semiconductor value chain.

2. **Electronic Products:** Semiconductor design accounts for approximately **15–35% of the Bill of Materials (BOM)** cost of electronic products.
3. **Design Infrastructure:** State-of-the-art chip-design tools have been provided to **455 organisations**, comprising **350 academic institutions and 105 startups**.
4. **Academic Ecosystem:** Under **the Chips to Startup (C2S) Programme**, **245 chip designs** have been taped out by **71 academic institutions** to support future workforce requirements.
5. **Commercialisation:** Indian-designed chips are increasingly progressing from laboratories to **fabrication, testing, validation and customer trials**.

Other Recent DLI-Supported Successes:

1. **Vervesemi Microelectronics:** Achieved first-pass silicon success for its **BLDC Motor Controller chip** using an indigenous microprocessor by Incore Semiconductor, along with its Motor Driver chip.
2. **Netrasemi:** Successfully tested a **12nm Vision SoC** with integrated video analytics acceleration.
3. **OptoML:** Received its **12nm compute-in-memory SoC**, designed for faster and more power-efficient AI processing.
4. **Mindgrove Technologies:** Partnered with PRAMA India to explore the use of its **Vision SoC in CCTV surveillance cameras**.
5. **IndieSemiC:** Secured global certification for its **Bluetooth (BLE 6) chip module**.

Significance for India:

1. **Digital Infrastructure:** Indigenous broadband chips can support India's expanding **optical fibre, 5G and broadband-led services**.
2. **Technological Self-Reliance:** Domestic semiconductor design strengthens **self-reliance and domestic supply chains** in a strategically important technology.
3. **Deep-Tech Investment:** Growing venture-capital funding demonstrates increasing investor confidence in **Indian semiconductor startups**.

4. **Complete Semiconductor Ecosystem:** Government initiatives seek to build capabilities across **chip design, manufacturing, advanced packaging, equipment, materials, R&D and skilled manpower.**
5. **Semicon 2.0:** Approved in **July 2026** with an outlay of **₹1,27,500 crore**, it seeks to take India's efforts towards building a **globally competitive semiconductor ecosystem** to the next level.

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2299883®=48&lang=2>

13. India's Lunar Future

Prelims:

Science & Technology – Space technology

Mains:

GS Paper II: bilateral relations, GS Paper III: Awareness in the fields of Space and achievements in Science & Technology, Indigenisation and development of new technologies

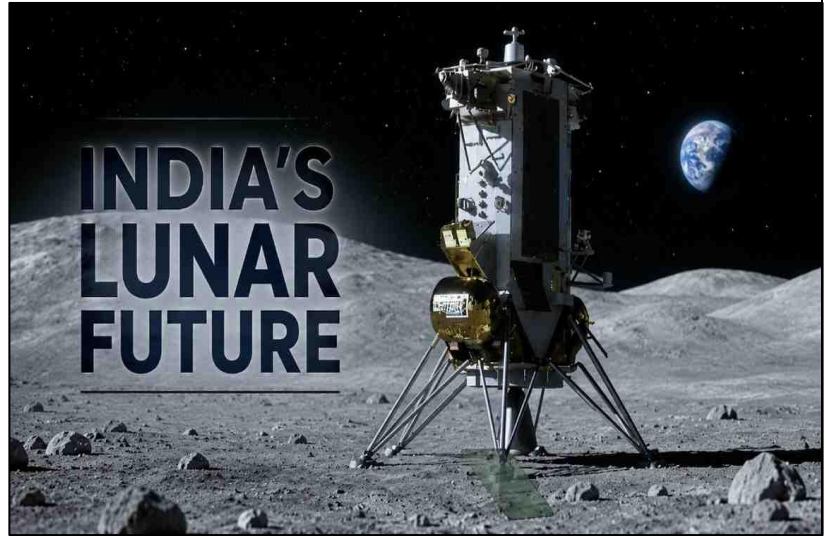
Current relevance:

At the **9th India–U.S. Civil Space Joint Working Group meeting** held at ISRO headquarters, **NASA invited ISRO to participate in its 'Moon Base' programme.** The proposed human outpost is planned near the Moon's south pole, with development targeted around 2030, further deepening India–U.S. cooperation under the **Artemis Accords.**

Highlights:

1. **NASA'S 'MOON BASE' PROGRAMME:**

- i. NASA plans to establish a **human outpost near the Moon's south pole**, with construction expected to take shape around **2030**.
- ii. The south polar region is important because **sunlight is available for longer durations**, while permanently shadowed craters contain significant **water-ice deposits**.
- iii. The base is envisioned as **humanity's first outpost on another celestial body**.
- iv. It is expected to initially support **intermittent astronaut presence**, eventually moving towards a continuous **human presence on the Moon**.

2. **INDIA-U.S. space cooperation:**

- i. India became a signatory to the **Artemis Accords in 2023**, strengthening its space partnership with the U.S.
- ii. NASA has trained Indian astronaut candidates for India's **Gaganyaan human spaceflight mission**.
- iii. ISRO launched the **NASA-ISRO Synthetic Aperture Radar (NISAR)**, representing a major scientific collaboration developed over nearly a decade.
- iv. NASA instruments are also expected aboard **forthcoming Chandrayaan missions**, continuing scientific cooperation between the two agencies.

3. **Growing Geopolitical Competition on the Moon:**

Lunar exploration is increasingly becoming an extension of **U.S.-China strategic competition on Earth**.

- i. The U.S.-led **Artemis programme** is increasingly focused on developing long-term lunar infrastructure.

- ii. In contrast, **China and Russia** announced the **International Lunar Research Station (ILRS) in 2021**, targeting a long-term lunar science and technology facility near the **Moon's south pole by 2035**.
- iii. The ILRS is also an international initiative, involving **17 countries and organisations and more than 50 research institutions**, according to the given information.

4. **Challenge to india's strategic autonomy:**

- i. Greater integration with the **U.S.-led lunar technological ecosystem** could make future cooperation with competing systems more difficult and expensive.
- ii. Differences in **communication protocols, data formats, equipment and operational procedures** could create technological incompatibilities between rival lunar ecosystems.
- iii. India could therefore face difficult choices if it seeks cooperation with both the **Artemis programme and China-led ILRS** in the future.
- iv. However, the **Artemis Accords do not prohibit signatories** from cooperating with non-signatory countries, leaving India some diplomatic flexibility.

5. **Opportunities for india:**

- i. Participation in the Moon Base programme could deepen India's access to a **large and technologically diverse U.S.-led space ecosystem**.
- ii. Cooperation can strengthen Indian capabilities in **human spaceflight, lunar exploration, scientific missions and space infrastructure**.
- iii. India's engagement with both Western partners and forums such as **BRICS space cooperation** provides scope for maintaining multiple channels of engagement.
- iv. The Moon could potentially emerge as a domain where **India and China find practical opportunities** for cooperation despite terrestrial competition.

6. **Way forward – open standards & interoperability:**

- i. India should deepen cooperation with NASA while avoiding **technological dependencies that could restrict its independent space programme.**
- ii. It can promote **open international standards** for lunar communication, data, hardware and operational systems.
- iii. Such standards could enable **interoperability between competing lunar ecosystems** while allowing countries to retain sovereign control over their technologies.
- iv. By promoting interoperable systems and avoiding exclusive technological dependence, India can combine **international space cooperation with strategic autonomy.**
- v. This could also provide India an opportunity to exercise **diplomatic and technological leadership in shaping future lunar governance.**

Source: THE HINDU - <https://www.thehindu.com/sci-tech/science/moon-base-indias->

14. CYBER KUSHTI 2026

Prelims:

Science & Technology

Mains:

GS Paper III- Science & Technology, Awareness in the fields of IT, Challenges to internal security through communication networks.

Current relevance:

The **National Institute of Electronics and Information Technology (NIELIT)** launched **CYBER KUSHTI 2026**, a national **Cybersecurity and Artificial Intelligence hackathon**, on **15 August 2026**.

Highlights:

1. **About CYBER KUSHTI 2026:**

- i. **CYBER KUSHTI 2026** is a national-level **Cybersecurity and AI hackathon** launched by **NIELIT**, under the Ministry of Electronics and Information Technology (MeitY).



- ii. It is the official parallel technical track of the **3rd National Conference on Cyber Security, Digital Forensics and Intelligence (NCCDFI 2026)**.
- iii. It is being conducted in collaboration with the **Information Sharing and Analysis Center (ISAC Foundation)** under the **National Security Database (NSD)**.
- iv. CERT-In is also India's **national nodal agency for responding to cybersecurity incidents** under **the Information Technology Act, 2000**. It serves as the **Knowledge Partner for CYBER KUSHTI 2026**.
- v. Participation is **free and open to students** and independent researchers in teams of three.

2. **Institutional & Safety Framework:**

- i. **NIELIT** is an **Autonomous Scientific Society under MeitY** engaged in skill development and digital empowerment in the Electronics and ICT domain.
- ii. **ISAC Foundation** is a registered **not-for-profit cybersecurity organisation** focusing on cybersecurity, AI and professional ethics.
- iii. The **National Security Database (NSD)** is a professional recognition and certification project for information-security practitioners.

- iv. All hackathon activities will occur within **controlled environments provided by the organisers.**
- v. Participants are **not permitted to interact with live systems, third-party systems or public infrastructure,** ensuring that the competition remains controlled and safe.

3. Purpose – human judgment over detection speed:

- i. Unlike conventional cybersecurity contests centred on **vulnerability discovery or Capture the Flag (CTF) challenges,** CYBER KUSHTI evaluates participants' ability to **assess, prioritise and defend security decisions.**
- ii. It recognises that AI and automated tools can rapidly generate security findings, but **human judgment remains important** in determining which findings are **genuine, significant and require priority action.**
- iii. Participants are rewarded not only for detecting genuine vulnerabilities but also for **correctly rejecting false findings.**
- iv. Thus, the competition emphasises **critical reasoning and decision-making alongside technical cybersecurity skills.**

4. Unique Competition Model:

- i. Every team receives an identical, deliberately imperfect **Security Assessment Package.**
- ii. It contains **AI-generated findings, static analysis outputs, dependency and secrets scans, architecture documentation,** source code and application logs.
- iii. The package deliberately includes **false, duplicated and genuine findings,** while some real vulnerabilities are intentionally omitted.
- iv. Teams must prepare a **corrected and prioritised security assessment** and subsequently defend the reasoning behind their decisions.
- v. Since every team receives the same tool-generated material, the format seeks to **reduce the advantage associated with access to expensive security tools.**

5. Three-Stage Competition:

- i. **The Akhada** – Round 1 for 50 teams will advance.
- ii. **The Dangal** – Round 2 from which 10 finalist teams will be selected.
- iii. **The Kesari** – Final: In-person round at the **Dr. Ambedkar International Centre, New Delhi.**
- iv. During the final round, an **automated analysis of the same assessment material** will be displayed alongside the teams' assessments, enabling comparison between **machine-generated analysis and expert human judgment.**

6. Significance:

- i. **Human-AI Collaboration:** Demonstrates areas where automated cybersecurity analysis and human expertise **converge or differ.**
- ii. **Cybersecurity Skill Development:** Promotes skills in validation, prioritisation, **reasoning and security decision-making** rather than detection alone.
- iii. **Equal Opportunity:** Identical assessment material helps participants compete on more equal terms regardless of access to costly security tools.
- iv. **Responsible AI Use:** Encourages participants to **critically examine AI-generated findings** instead of accepting automated outputs unquestioningly.
- v. **Cyber Capacity Building:** Connects students and independent researchers with experts from **government, industry and academia.**

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2300120®=3&lang=1>

15. SraVaani

Prelims:

Science & Technology

Mains:

GS Paper II: Issues relating to development and inclusion, GS Paper III: Developments and applications of Science & Technology

Current relevance:

Researchers at the **SPIRE Lab of the Indian Institute of Science (IISc), Bengaluru**, in collaboration with **ARTPARK and Google**, have released **SraVaani**.

Highlights:

1. About SraVaani:

- i. SraVaani is a **multilingual Indian speech-recognition model** trained on **65 Indian languages and dialects**.

- ii. It has been developed by researchers at **IISc's SPIRE Lab**, in collaboration with **ARTPARK and Google**.

- iii. It extends **Automatic Speech Recognition (ASR)** beyond widely supported languages to include several **regional and non-scheduled Indian languages**.
- iv. The model is **freely and publicly available** on Hugging Face under an **MIT licence**.

2. Purpose & Key Advantage:

- i. SraVaani seeks to address the **underrepresentation of regional and non-scheduled Indian languages** in existing speech technologies.



- ii. More than **40 of the languages covered by the model** are not officially supported by existing speech-recognition systems.
- iii. Its multilingual approach can help extend **speech-based AI technologies to a wider range of India's linguistic communities.**

3. Significance:

- i. **Linguistic Inclusion:** Expands speech-recognition capabilities beyond scheduled and widely supported Indian languages.
- ii. **Inclusive AI:** Helps bring speech-based artificial intelligence to languages and dialects that remain **underserved by existing technologies.**
- iii. **Open Accessibility:** Its availability under an **MIT licence** enables free public access to the model.
- iv. **Indian-language AI:** Demonstrates efforts to develop AI systems capable of handling India's **extensive linguistic diversity.**

Source: THE HINDU – <https://www.thehindu.com/news/national/karnataka/first-multilingual-indian-speech-recognition-model-trained-on-65-languages-and-dialects-released/article71341129.ece> [lunar-future/article71350559.ece](https://www.thehindu.com/news/national/karnataka/first-multilingual-indian-speech-recognition-model-trained-on-65-languages-and-dialects-released/article71350559.ece)

16. Friedreich's Ataxia (FRDA)

Prelims:

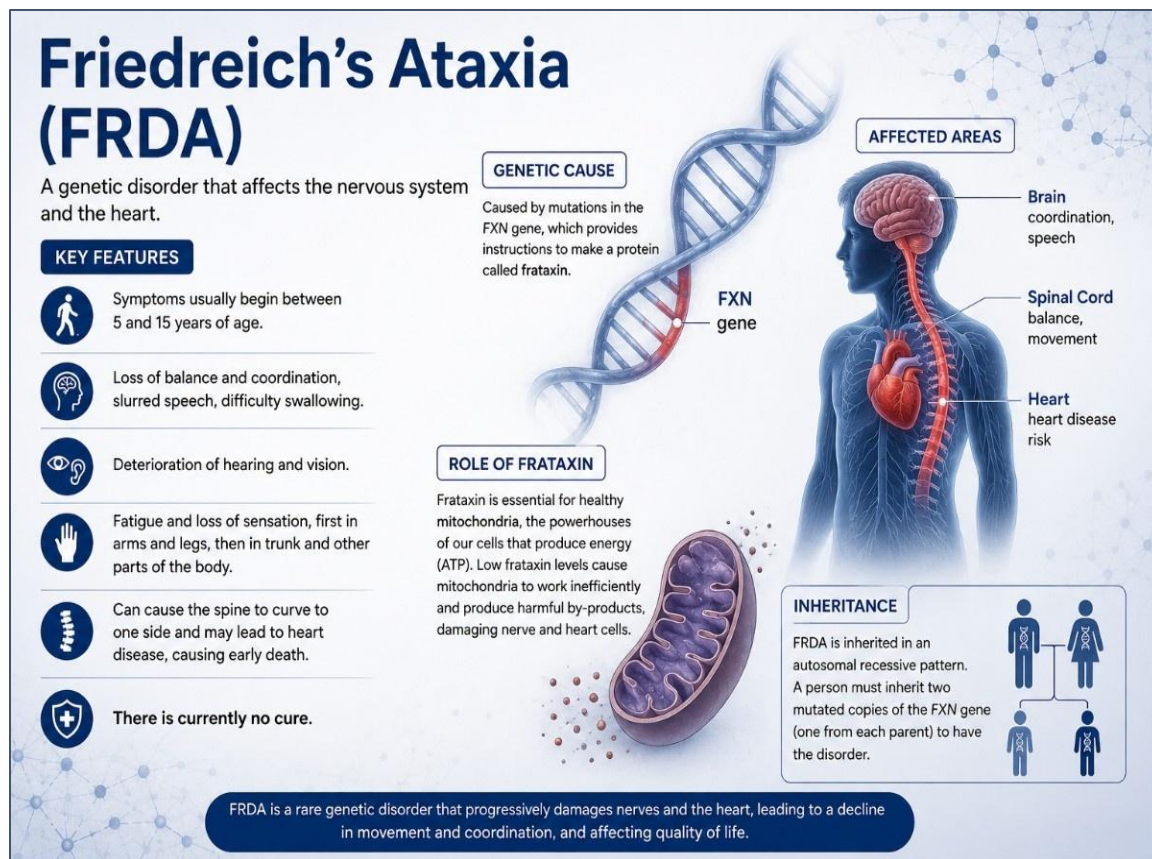
Science & Technology, Biotechnology

Mains:

GS Paper II: Issues relating to health and healthcare, GS Paper III: Science & Technology, Biotechnology

Current relevance:

A new study by researchers at the **University of Oklahoma Health Sciences Center**, published in **Human Molecular Genetics**, has provided an explanation for the unusual geographical distribution of **Friedreich's ataxia (FRDA)**.



Highlights:

About Friedreich's Ataxia:

1. Friedreich's ataxia (FRDA) is a **genetic disorder** that progressively damages the **nervous system and heart**.
2. Symptoms generally begin between **5 and 15 years of age**.
3. It can cause **loss of balance and coordination**, slowed or slurred speech, difficulty swallowing, **deterioration of hearing and vision**, **fatigue and loss of sensation**.
4. It can cause **abnormal curvature of the spine** and potentially **fatal heart disease** at a **young age**, and there is currently **no cure for the disorder**.

Genetic Basis – Fxn Gene & Frataxin:

1. FRDA occurs when the **FXN gene** becomes mutated.

2. The FXN gene codes for a protein called **frataxin**, which is essential for the functioning of **mitochondria**.
3. Mitochondria produce most of the cell's **ATP**, which acts as its energy currency.
4. Abnormally low frataxin levels make mitochondrial ATP production **less efficient** and cause the accumulation of **toxic by-products**.
5. High-energy-demand cells, particularly those of the **nerves, spinal cord, brain and heart muscles**, are consequently affected.

Role of Repeat Expansion:

1. The most common disease-causing mutations occur within an **intron of the FXN gene**, involving changes in the number of repeated DNA sequences.
2. Normal FXN variants contain approximately **5–11 repeats (short-normal) or 12–33 repeats (long-normal)**.
3. In individuals with FRDA, the expanded variants were found to contain around **100–1,500 repeats**.
4. These expanded variants force the chromosome into a more **closed structure**, reducing the expression of frataxin.
5. An individual develops FRDA when they inherit **two expanded copies**, one from each parent; those with only one copy are carriers.

Reason for FRDA concentrated in certain populations:

1. The study found that around **95% of expanded variants** originated from just **two long-normal variants**.
2. These underwent ancestral mutations, termed “**protomutations**,” on **two occasions in Eurasia**.
3. Long-normal variants are **absent in East Asian populations**, which may explain why the problematic mutations did not originate there.
4. The uneven geographical distribution of these ancestral protomutations therefore provides an explanation for why FRDA occurs predominantly in **certain populations**.

5. Ancient DNA analysis found that both protomutations were present in **Europe and Western Asia at least 9,000 years ago**, but were not detected in **Neanderthals and Denisovans**.

Significance:

1. The findings connect the present-day distribution of FRDA with **ancient human genetic variation and population history**.
2. The genetic changes may progress gradually from **long-normal variants to protomutations, then to pre-mutations, and finally to expanded disease-causing variants**.
3. Protomutations and pre-mutations can remain in populations as genetic **“reservoirs”**, capable of producing expanded variants over generations.
4. Understanding how the **two protomutations differ from other long-normal variants** could help researchers identify ways to **prevent or slow the genetic changes that lead to FRDA**.

**Source: THE HINDU - [https://www.thehindu.com/sci-tech/science/friedreich-ataxia-scientists-find-why-a-cruel-genetic-disorder-affects-only-
eurasians/article71352059.ece](https://www.thehindu.com/sci-tech/science/friedreich-ataxia-scientists-find-why-a-cruel-genetic-disorder-affects-only-eurasians/article71352059.ece)**

17. Helicase: the DNA separator

Prelims:

Science & Technology

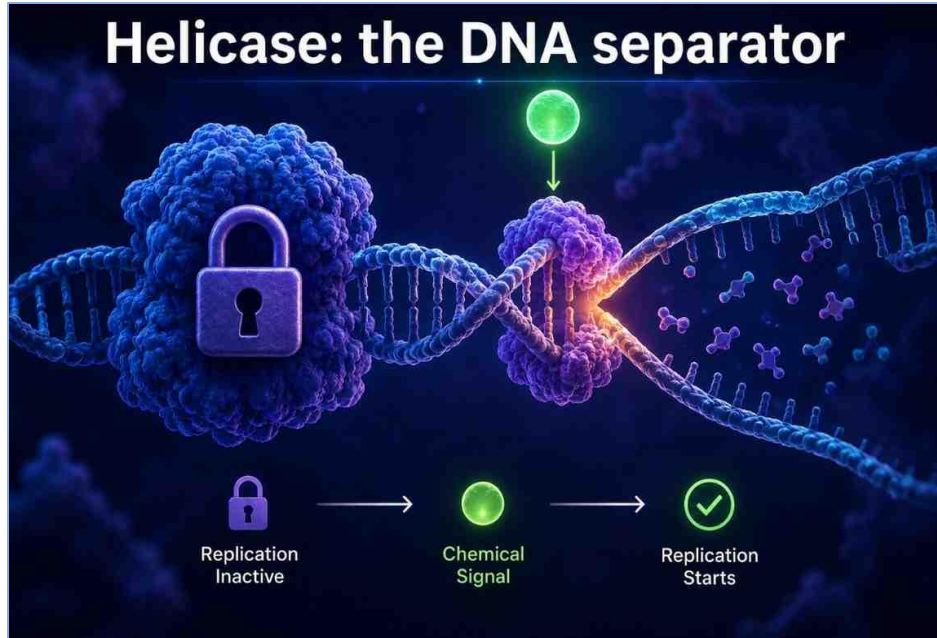
Mains:

GS Paper III: Science & Technology – developments and their applications, GS Paper III:

Biotechnology and developments in genetics

Current relevance:

A recent study published in **Nature Communications** has examined how cells ensure that **DNA replication begins only at the appropriate time**, finding that a **molecular safety mechanism** keeps the DNA-copying machinery inactive until a chemical signal releases it.



Highlights:

About Helicase:

1. Helicase is an **enzyme that unwinds and separates the two strands of DNA**, allowing the genetic information stored in them to be copied.
2. DNA normally exists as a **double helix**, consisting of two long strands held together by bonds between bases.
3. During cell division, these strands must be separated so that the cell can **produce a copy of its DNA**.
4. Helicase therefore plays a crucial role in initiating and facilitating **DNA replication**.

How Does Helicase Work:

1. Helicase first **attaches to a particular region of DNA** and then moves along the DNA molecule.

2. It uses energy derived from **ATP**, the cell's main chemical energy source, to change its shape and **force the two DNA strands apart**.
3. As helicase moves, the **bonds between the bases of the two strands are broken**, exposing the individual DNA strands.
4. This produces a **Y-shaped region called the replication fork**, similar to the opening created when a zipper separates.
5. Each exposed strand can subsequently act as a **template for the formation of a new complementary DNA strand**.

Role of Topoisomerases & Regulation:

1. As helicase moves along DNA, the molecule tends to become **increasingly twisted ahead of the replication fork**.
2. Enzymes called **topoisomerases relieve this twisting**, preventing DNA from becoming tangled or breaking.
3. Once the strands are separated, other components of the **DNA replication machinery** use them as templates to produce complementary strands.
4. The recent study found that cells also possess a **molecular safety mechanism** that keeps the DNA-copying machinery inactive until an appropriate **chemical signal** allows replication to begin.

Source: THE HINDU - https://www.pressreader.com/india/the-hindu-chennai-9ww3/20260819/282394111285714?srsIid=AfmBOooVN66fHLuX3vE81AD5D3PXM-Ww_o4ApTGftd6jh52HSqKCokAO

18. Gaganyaan's Thermal Protection System

Prelims:

Science & Technology

Mains:

GS Paper III: Science & Technology, Indigenisation of technology and development of new technology

Current relevance:

The **Gaganyaan crew module** will face **extreme heat during atmospheric re-entry**. To protect the spacecraft and its crew, it will use an **ablative Thermal Protection System (TPS)** that absorbs and dissipates heat while maintaining the module's **structural integrity and safe internal conditions**.

**Highlights:****Atmospheric Re-entry Challenges:**

1. The Gaganyaan crew module will enter Earth's atmosphere at an extremely high velocity of about **7,500–8,000 m/s**.
2. More than **99% of its kinetic energy will be dissipated into the atmosphere as heat**, but even the small portion directed back towards the module could melt it without adequate protection.

3. Some exterior regions of the crew module may experience temperatures as high as **1,800°C**.
4. Once atmospheric descent begins, there is **no provision to abort the mission**, while the rapid descent and continuously changing deceleration forces provide little scope for manual crew intervention.
5. Therefore, the spacecraft's systems must be sufficiently **robust and reliable to withstand extreme re-entry conditions**.

Ablative Heat Shield Working mechanism:

1. Gaganyaan uses an **ablative Thermal Protection System**, which protects the spacecraft by **sacrificing its outer layers** through physical and chemical processes.
2. The TPS absorbs intense thermal energy and chemically decomposes to form **solid char and outgassing vapours**, carrying heat away as the material burns off.
3. The escaping gases also create a **cooler boundary layer**, reducing the transfer of intense heat into the crew module.
4. Despite being only around **30–35 mm thick**, the TPS is designed to maintain structural integrity by keeping the module's temperature **safely below 150°C**.
5. **Carbon phenolic and silica phenolic** are examples of ablative thermal-protection materials.

Types of Thermal Protection Systems:

A TPS is predominantly classified into **three types** depending on how it removes heat:

1. **Ablative TPS:** Removes heat by allowing protective material to **decompose and shed its outer layers**. It is primarily a single-use system.
2. **Radiative TPS:** Absorbs re-entry heat and releases it back as **electromagnetic radiation**, mainly infrared. Since it remains intact, it is suitable for **reusable re-entry vehicles**.

3. **Heat Sink TPS:** Protects the spacecraft by **absorbing thermal energy and increasing its own temperature without melting or undergoing a phase change**; copper and aluminium are examples.

Reasons for the Selection of Ablative TPS for Gaganyaan:

1. An ablative TPS is a **proven and highly robust solution** suited to Gaganyaan's **single-use crew module design**.
2. It can withstand **extreme and fluctuating thermal loads** without requiring complex or delicate surface maintenance.
3. Compared with reusable radiative systems, it avoids **expensive manufacturing, specialised inspection and complex installation processes**, making it a safer and more cost-effective option.
4. ISRO has prior experience with ablative technology: the **Space Capsule Recovery Experiment (SRE)** used carbon phenolic material, while the **LVM-3/CARE mission in 2014** successfully demonstrated crew-module re-entry using an ablative TPS.
5. These experiences provide the **technological foundation for the thermal protection system being used in Gaganyaan**.

Source: THE HINDU - <https://www.thehindu.com/sci-tech/science/how-gaganyaans-thermal-protection-system-will-survive-re-entry-explained/article71369185.ece>

19. AIKosh

Prelims:

Science & Technology

Mains:

GS Paper II: Governance, GS Paper III: Science & Technology

Current relevance:

The **IndiaAI Mission** organised a workshop on **AIKosh**, the national platform for **datasets, AI models and related resources**, in New Delhi.



Highlights:

About AIKosh:

1. **National AI Platform:** AIKosh is a national platform for **datasets, AI models and related resources** under the **IndiaAI Mission**.
2. **Purpose:** It enables greater **discoverability, access and responsible use of AI-ready resources** for India's AI ecosystem.
3. **Current Resources:** The platform hosts over **15,000 datasets, 300 AI models and 30 toolkits**.
4. **Beneficiaries:** It enables **researchers, startups, developers and students** to develop AI solutions using trusted national resources.
5. **Sovereign AI:** Unlocking the value of India's data assets is considered important for strengthening India's **sovereign AI capabilities, innovation and national development**.

Key Focus Areas:

1. **Data Governance:** Develop mechanisms for **lawful and responsible** sharing of data.

2. **Data Harmonisation:** Make data more discoverable, understandable, **interoperable and securely** accessible.
3. **Privacy Protection:** Strengthen **privacy-preserving mechanisms** for accessing and exchanging AI-ready data.
4. **Developer Ecosystem:** Identify the **datasets, platforms and data architecture** required for AI applications and foundational models suited to India's context.
5. **Sectoral Applications:** Priority use cases and datasets were explored in **Health & Lifesciences, Agriculture & Livelihoods, and Education, Science & Technology.**

Institutional Collaboration:

1. **IndiaAI–NeGD–CDPI/IIIT–B MoU:** Cooperation will strengthen India's **AI and Digital Public Infrastructure ecosystem.**
2. The partnership will provide **technical, architectural, policy and knowledge** support to India AI and NeGD.
3. It will support population-scale **AI-enabled governance solutions** and seamless, secure exchange of AI-ready datasets, models and resources through AIKosh.
4. **IndiaAI–EkStep Foundation MoU:** Seeks to promote collective intelligence, scalable and cost-efficient AI operating systems, open-gate models, platforms and solutions.
5. These partnerships aim to enable **accessible and impactful AI innovation at scale.**

Significance:

1. **AI-Ready Data Ecosystem:** Provides a common national platform connecting data resources with India's AI ecosystem.
2. **Responsible AI:** Privacy-preserving data exchange and responsible access can support the development of **safe and trusted AI applications.**
3. **Innovation at Scale:** Access to datasets, models and toolkits can support **startups, researchers, students and developers.**
4. **AI-enabled Governance:** Integration with Digital Public Infrastructure can facilitate the development of **population-scale AI solutions for governance.**

5. **Viksit Bharat 2047:** Responsible utilisation of AI as a **horizontal and cross-cutting technology** can support improvements in quality of life and India's broader development ambitions.

Source: PIB –

<https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2301666®=48&lang=1>

20. Narwhal Tusk

Prelims:

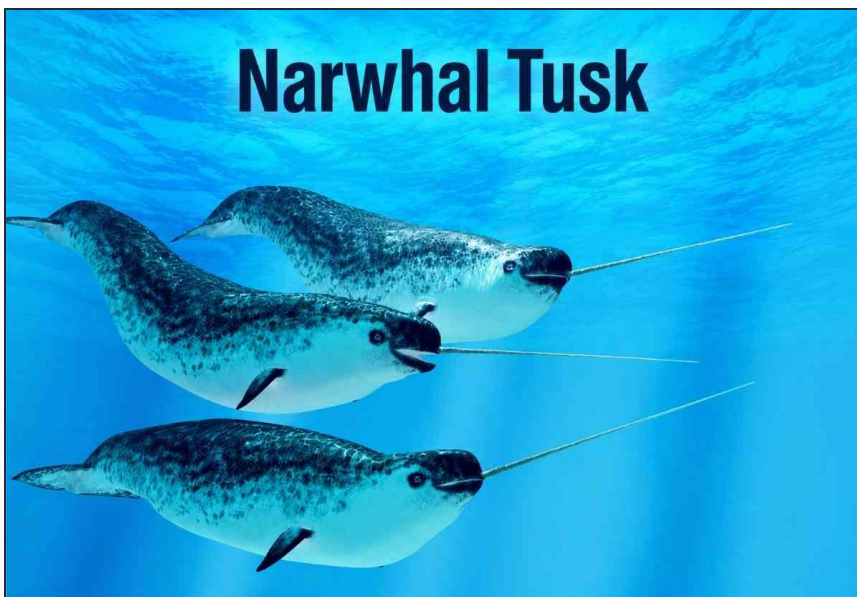
Science & Technology

Mains:

GS Paper III: Science & Technology

Current relevance:

Scientists have identified how the **narwhal tusk**, described as nature's **only straight tusk**, develops its distinctive structure.



Key Points:

Native Range & Distribution:

1. It is an **Arctic marine mammal**, naturally occurring in the **Arctic Ocean**.

2. Important areas include **Baffin Bay, Davis Strait, Northern Hudson Bay, the Canadian Arctic Archipelago, Greenland** and the **Greenland Sea**.
3. Narwhals undertake **seasonal migrations**, moving between winter pack ice and coastal/inshore waters during warmer months.

Important Characteristics:

1. It is a **medium-sized toothed whale** and the only species of its genus.
2. It has a **robust body, small bulbous head, short blunt flippers**.
3. Narwhals are **deep divers** and feed mainly on **Arctic fish, squid and shrimp**.
4. **Unique Narwhal Tusk:**
 - The narwhal tusk is described as **nature's sole straight tusk**.
 - It possesses a characteristic **left-handed twist**.
5. **Microscopic Structure:**
 - X-ray images revealed that the tusk is built from **microscopic collagen fibrils**.
 - These fibrils are organised into **two distinct layers**.
6. **Double-Twist Arrangement**
 - The tusk has a **double-twist structure**, with the **outer layer twisting to the left** and the **inner layer twisting to the right** in opposite directions.
7. **Mechanism Behind its Strength:**
 - The opposing twists generate **internal tension** within the tusk.
 - This internal tension enables the tusk to grow **straight and strong**.
8. **Conservation Status:**
 - **CITES: Appendix II.**
 - **United States:** Protected throughout its range under the **Marine Mammal Protection Act (MMPA)**.

Source: THE HINDU - <https://www.thehindu.com/sci-tech/science/science-snapshots-august-23-2026/article71380714.ece>

21. Nationwide Cloud & AI Skilling Initiative for Tier-2 and Tier-3 Youth:

Prelims:

Government initiatives, Science & Technology

Mains:

GS Paper II: Government policies and interventions for development, GS Paper III: Science & Technology

Current relevance:

The **National Skill Development Corporation (NSDC)** and **Cultus Education**, in collaboration with **Amazon Web Services (AWS)**, have launched a nationwide Cloud and Artificial Intelligence skilling initiative.



Highlights:

About the Initiative:

1. The initiative has been launched by **NSDC**, under the guidance of the **Ministry of Skill Development & Entrepreneurship (MSDE)**, and Cultus Education, in collaboration with AWS.
2. It seeks to equip **1.5 lakh learners with foundational AI and cloud literacy** through AWS digital training content.

3. Another **10,000 participants** will receive intensive, job-ready training through **AWS re/Start**.
4. The programme will cover **all States and Territories**, while prioritising youth from **Tier-2 and Tier-3 cities and underserved communities**.
5. Training will be delivered **100% online through Cultus Education**, the delivery partner selected by NSDC.

Training & Skill Development:

1. Learners begin with **AWS digital training content**, enabling them to acquire foundational **AI and cloud skills at their own pace**.
2. Participants demonstrating readiness can progress to **AWS re/Start**, a free, cohort-based workforce development programme.
3. It provides structured training in **cloud infrastructure, security, networking and AI fundamentals**.
4. Participants also develop skills in **programming, relational databases, networking and security** through coursework, hands-on labs and real-world scenario-based learning.
5. Graduates earn an **AWS Certification**, an industry-recognised credential validating cloud-computing skill.

Employment & Inclusion Focus:

1. The initiative addresses challenges faced by youth outside major metropolitan centres, including **limited access to globally recognised technical training, technology employers and relevant credentials**.
2. Its online model enables learners from Tier-2 and Tier-3 cities to access technology training **without relocating to metropolitan centres**.
3. AWS re/Start connects participants with **employment opportunities at local employers**, while graduates gain access to **qualified interview opportunities**.

4. The initiative creates a structured pathway that enables learners to progress from **foundational digital literacy to advanced training, industry-recognised certification and employment opportunities.**

Significance:

1. **Future-ready Workforce:** Develops skills required for emerging **cloud and AI-based employment opportunities.**
2. **Bridging Geographic Gaps:** Extends technology skilling beyond major metropolitan centres to **underserved and emerging talent hubs.**
3. **Viksit Bharat 2047:** Supports the goal of building an **inclusive, skilled and technology-ready workforce** irrespective of geography or background.
4. **Industry-linked Skilling:** Combines technical training with **industry-recognised certification and employment connections.**
5. **National Hackathon:** The learning journey culminates in a **National Hackathon**, where participants can showcase cloud and AI solutions before **hiring managers, industry leaders and other stakeholders.**

Source: PIB –

<https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2302495®=1&lang=1>

22. Popcorn Maize Hybrid Seed

Prelims:

Agriculture, Science & Technology

Mains:

GS Paper III – Agriculture, Science & Technology

Current relevance:

The Vice-President of India, launched **India's first non-GMO, high-expansion popcorn maize hybrid seed** at Musunuru in Eluru district, Andhra Pradesh.



Highlights:

Key Features of the New Hybrid:

1. It is described as **India's first non-GMO**, high-expansion popcorn maize hybrid seed.
2. It is an **indigenously developed hybrid**, representing domestic innovation in seed technology.
3. India had previously depended on **imported hybrid technology for high-quality popcorn maize**. The indigenous hybrid is expected to help **reduce import dependence and conserve foreign exchange**.
4. It has the potential to produce popcorn maize capable of **competing in global markets**.

Farmer-Enterprise Partnership:

1. **Gourmet Popcornica**, an Andhra Pradesh-based enterprise, works with over **17,500 farmers across eight States**, cultivating nearly **40,000 acres** of popcorn maize.
2. The model links farmers with **processing and market access**, potentially strengthening income opportunities for farming families.

3. The enterprise also operates facilities covering **maize processing, quality control, packaging, cold storage and storage.**

Initiatives:

The programme also referred to farmer-centric initiatives such as **PM-KISAN, PM Fasal Bima Yojana, National Food Security and Nutrition Mission and Nammo Drone Didi**, alongside Andhra Pradesh initiatives including **Rythu Bazaars, horticulture promotion and natural farming.**

Significance for Indian Agriculture:

1. **Technological self-reliance:** Domestic hybrid development can reduce dependence on imported agricultural technology.
2. **Import substitution:** Indigenous technology can contribute to **foreign-exchange conservation.**
3. **Value addition:** Processing, quality control, packaging and storage enable agriculture to move beyond primary production.
4. **Farmer-market integration:** Enterprise partnerships can strengthen **market access and income opportunities** for farmers.
5. **Global competitiveness:** Indigenous agricultural products with suitable quality can compete in international markets.
6. **Aatmanirbhar Bharat:** The initiative demonstrates how locally developed agricultural technology can strengthen a **self-reliant agricultural sector.**

Source: PIB-

<https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2302659®=48&lang=1>

23. India's Planned Space Re-entry Guidelines: From Global Norms to Domestic Regulation

Prelims:

Science & Technology

Mains:

GS Paper II: Important international institutions, GS Paper III: Awareness in the field of Space, Science & Technology – developments and their applications

Current relevance:

The **Indian National Space Promotion and Authorisation Centre (IN-SPACe)** has released **India's first guidelines on planned re-entry of space objects**, as the country's orbital activities and private-sector participation expand.



Highlights:

Planned Re-entry & Need for Regulation:

1. **Planned re-entry** covers space objects designed to survive atmospheric re-entry or those intentionally controlled towards a specified **landing or impact area**.
2. Objects expected to **burn up, melt or sufficiently fragment through natural orbital decay** are not considered planned re-entries.

3. Re-entering spacecraft can **deviate from their planned trajectory, fragment into smaller pieces, affect airspace and maritime zones**, or potentially land within another country's jurisdiction.
4. The rapid increase in satellites in **Low-Earth Orbit (LEO)** and deliberate post-mission disposal of satellites have increased the importance of safe re-entry.

Authorisation & Accountability:

1. Any **Indian entity** conducting a planned re-entry, whether within or outside Indian territory, requires **IN-SPACE authorisation**.
2. A **non-Indian entity** planning re-entry over Indian territory must undertake it through an **Indian-incorporated entity**, such as a subsidiary, joint venture or partnership.
3. Such an Indian entity becomes responsible for compliance with **Indian laws, regulations and national-security requirements**.
4. Objects deliberately designed to survive re-entry or reach a predetermined landing or impact zone require **separate authorisation**.

Risk Assessment & Operational Safeguards:

1. The expected **casualty risk must remain below 1 in 10,000**, supported by survivability and ground-casualty assessments.
2. Operators must assess **failure scenarios, fragmentation patterns, ballistic coefficients, de-orbit plans, flight-path angles and danger zones**.
3. They must identify components likely to survive re-entry as well as hazardous systems such as **batteries and pressure vessels**.
4. IN-SPACE will re-verify re-entry parameters approximately **three months before** the proposed operation.
5. If planned re-entry is decided after launch, an application must be made at least **six months in advance**.
6. An **IN-SPACE advisory note** for warnings to airborne and marine vessels must be obtained at least **45 days before re-entry**.

- Where the re-entry site falls under another country's territorial control, including its **Exclusive Economic Zone (EEZ)**, relevant clearance from that State must be submitted.

Global Space Norms:

- The IN-SPACE guidelines draw upon international space-sustainability principles, particularly the **Inter-Agency Space Debris Coordination Committee's Space Debris Mitigation Guidelines** and the **UN Committee on the Peaceful Uses of Outer Space Guidelines for the Long-term Sustainability** of Outer Space Activities.
- Article IX of the Outer Space Treaty, 1967** provides an important foundation for environmental responsibility in outer space activities.
- Under the **Space Liability Convention, 1972**, a launching State bears **absolute liability for damage caused by its space object** on the Earth's surface or to aircraft in flight.

Significance of the Guidelines:

- The guidelines translate international **"soft law" principles into domestic regulatory obligations** for space operators in India.
- They strengthen **accountability** by linking re-entry authorisation with risk assessment, fragmentation analysis, liability and insurance requirements.
- Operators undertaking planned re-entry remain responsible for **third-party damage and claims** and must meet applicable **third-party insurance requirements**.
- The framework promotes **responsible private-sector participation, public safety and long-term sustainability** as India's space activities expand.

Source: THE HINDU - <https://www.thehindu.com/sci-tech/science/global-space-norms-find-a-firm-footing-in-india-new-re-entry-rules/article71380693.ece>

24. Smartphone-Based Alzheimer's Diagnostic Platform

Prelims:

Science & Technology

Mains:

GS Paper II: Issues relating to development and management of health, GS Paper III:

Science & Technology

Current affairs:

Scientists at the **Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)**, an autonomous institute of the **Department of Science and Technology (DST)**, have developed **TZ-48**, a fluorescence-responsive molecular probe, along with **ADxFluor**, a smartphone-integrated platform.

The infographic features the logos of JNCASR and the Department of Science and Technology, Government of India. It highlights the development of two key components: **TZ-48**, a fluorescence-responsive molecular probe, and **ADxFluor**, a smartphone-integrated platform. These are combined for the detection of Alzheimer's disease biomarker amyloid- β ($A\beta$). A diagram of a human brain shows the location of amyloid- β plaques. The bottom section lists four goals: Innovative Science, Smart Technology, Towards Early Detection, and More Accessible Diagnosis, with the tagline 'Science for a Healthier Tomorrow'.

Highlights:

Alzheimer's Disease & Role of Amyloid- β :

1. Alzheimer's disease (AD) is a progressive **neurodegenerative disorder** characterised by **memory loss, cognitive decline and behavioural impairment**.
2. A major feature of AD is the **misfolding and aggregation of amyloid- β ($A\beta$)** into fibrils and extracellular plaques.

3. These plaques trigger **neurotoxic processes**, resulting in synaptic dysfunction and neurodegeneration.
4. The **NIA-AA framework** identifies **amyloid- β , tau and neurodegeneration** as core biomarkers for definitive AD diagnosis across the **brain, cerebrospinal fluid (CSF) and blood**.
5. **A β pathology** appears early and is AD-specific, making it a reliable diagnostic indicator.

TZ-48 Fluorescence Probe:

1. **TZ-48** is a tiny molecule that acts as a **fluorescence-responsive probe for amyloid- β** .
2. When it interacts with A β , its **fluorescence intensity changes**, enabling detection and measurement.
3. It provides **highly selective, sensitive and differential detection of A β fibrils** through turn-on fluorescence and distinct lifetime signatures.
4. TZ-48 exhibits **Blood-Brain Barrier (BBB) permeability** and can label **A β plaques in transgenic Alzheimer's disease mouse brains**.
5. It is compatible with **Confocal Laser Scanning Microscopy (CLSM)** and **Fluorescence Lifetime Imaging Microscopy (FLIM)**.
6. It can also detect A β in **CSF and blood serum**.

ADxFluor: Smartphone-Integrated Detection:

1. **ADxFluor** is a smartphone-integrated platform developed to use the fluorescence response of **TZ-48**.
2. Changes in fluorescence are **captured and quantified through a dedicated smartphone application**.
3. It enables **rapid and unbiased quantification of serum A β load**.
4. The platform has potential applications in the **screening and staging of Alzheimer's disease**.

5. The system integrates **dual-mode brain imaging, biofluid detection and** smartphone-based A β quantification.

Significance:

1. **Accessible Diagnosis:** Provides a simpler alternative to diagnostic methods requiring expensive and specialised infrastructure.
2. **Early Detection:** Targets **A β pathology**, an early and AD-specific biomarker.
3. **Point-of-Care Potential:** Smartphone integration improves the **portability and accessibility** of diagnostic testing.
4. **Cost-effectiveness:** Offers the potential for a **low-cost and scalable diagnostic platform**.
5. **Wider Application:** The TZ-48-ADxFluor system could provide a foundation for **next-generation smart diagnostics** for Alzheimer's disease and other neurodegenerative diseases.

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2303169®=48&lang=2>

25. Gnani Artha

Prelims:

E-Governance, Science & Technology

Mains:

GS Paper II: E-Governance and Parliament, GS Paper III: Science & Technology

Current relevance:

Vice President C. P. Radhakrishnan launched '**Gnani Artha**', a sovereign AI stack developed by GNANI AI, at Uprashtrapati Bhavan, New Delhi, on 28 August 2026.



Highlights:

About Gnani Artha:

1. **Sovereign AI Stack:** Gnani Artha is described as a **sovereign AI stack** developed by GNANI AI.
2. **Two Components:** It comprises **Evon 3.3 and Plexus**.
3. **Evon 3.3:** A **Large Language Model (LLM)** forming the intelligence component of the stack.
4. **Plexus:** A platform designed to connect **AI intelligence with real-world work and institutions**.
5. **Indigenous Capability:** The initiative demonstrates the ability of **Indian engineers to build frontier technologies**, rather than merely use them.

Sovereign AI & Technological Self-Reliance:

1. **Sovereign Capability:** The launch highlights the importance of developing sovereign AI capabilities to strengthen India's technological and strategic autonomy.
2. **Creator Economy:** India should move beyond being merely a **consumer of technology** towards becoming **a creator of technology**.

3. **Domestic Capability:** Indigenous technological development can reduce dependence on external technological ecosystems.
4. **Strategic Autonomy:** Building domestic capabilities in frontier technologies strengthens India's capacity to pursue its technological priorities independently.
5. The initiative forms part of the broader national journey towards **technological self-reliance, innovation and global leadership**.

India's Emerging AI Ecosystem:

1. The launch reflects the **growing strength** of India's technology ecosystem.
2. The **IndiaAI Mission** and **Centres of Excellence for AI** are highlighted as important initiatives driving India's AI transformation.
3. India's approach seeks to strengthen its capabilities across **emerging technologies**.

AI in Governance – Digital Sansad:

1. **Digital Sansad** enables parliamentary debates and papers to be accessed in **multiple Indian languages**.
2. **AI-based simultaneous interpretation** was introduced in **eight languages** during the recently concluded Session of Parliament.
3. The facility is expected to be expanded to **all Scheduled Languages**.
4. This demonstrates the potential of AI to improve **linguistic accessibility of parliamentary information and proceedings**.

AI, Employment & Economic Growth:

1. The emergence of **Artificial Intelligence (AI)** was compared with the earlier **growth and widespread adoption of computers and information technology**.
2. Initial concerns that computers would replace employment were followed by the IT sector creating **numerous employment opportunities in India and abroad**.
3. Similarly, AI is expected to create **new avenues of employment and growth**.
4. AI therefore has the potential to contribute to taking **India's economic progress to the next stage**.

Source: PIB –

<https://chatgpt.com/g/g-p-6a6569ac61088191b0fbbdd5a83e1f87-jp/c/6a812467-c6a0-83ee-a1dc-8a5e60219a57>

26. Aditya-L1 Detects Early Warning Signs of Solar Flares

Prelims:

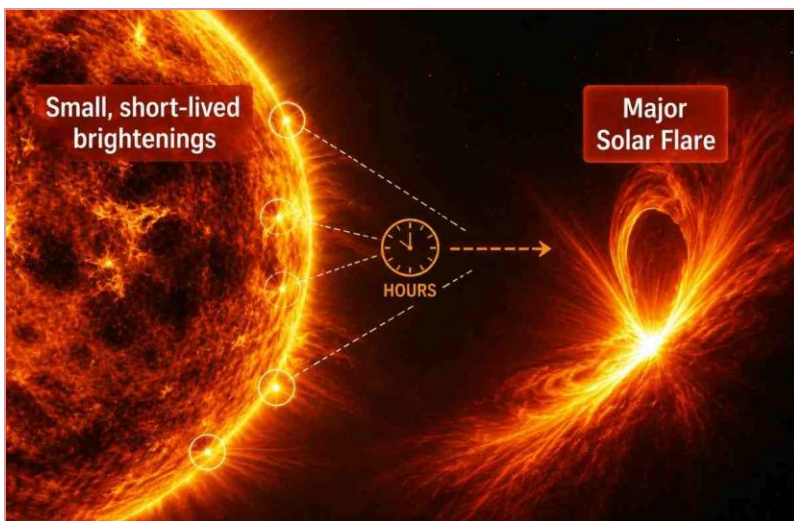
Science & Technology

Mains:

GS Paper III – Science & Technology

Current relevance:

A new study using **simultaneous ultraviolet (UV) and X-ray observations** from three payloads aboard **Aditya-L1** has detected **small, short-lived brightenings in the Sun's atmosphere hours before major solar flares**, providing potential clues for improving **solar-flare forecasting and space-weather prediction**.



Highlights:

Key Findings of the Study:

1. Scientists observed numerous **small, short-lived brightenings or “transient events”** in active regions of the Sun **before major solar flares**.

2. These transient events were concentrated around the **location where the major flare subsequently occurred**.
3. Some transient brightenings also exhibited **X-ray signatures**, indicating the **release of magnetic energy**.
4. The observations suggest that repeated **small-scale energy releases** may progressively destabilise the magnetic field in an active region, eventually resulting in a **major solar flare**.

Aditya-L1 Payload:

The study combined observations from **three Aditya-L1 payloads**:

1. Solar Ultraviolet Imaging Telescope (SUIT):

- i. Observes the Sun through **11 near-ultraviolet (NUV) filters**.
- ii. These observations reveal different atmospheric layers extending from the **upper photosphere to the chromosphere**.
- iii. NUV observations are particularly important from space because **Earth's atmosphere absorbs most ultraviolet radiation**, making these wavelengths largely inaccessible from the ground.

2. Solar Low Energy X-ray Spectrometer (SoLEXS):

- i. Measures **X-ray emissions** associated with energetic processes in the **solar corona**.

3. High Energy L1 Orbiting X-ray Spectrometer (HELIOS):

- i. Also measures X-ray emission associated with **energetic processes in the solar corona**.

Space-Based Infrastructure:

- i. Improved understanding and forecasting of solar flares can help protect:
 - **Satellites**
 - **Astronauts**
 - **Communication systems**
 - Other **critical technologies**

- ii. Thus, the findings demonstrate how **multi-wavelength observations from Aditya-L1** can improve understanding of solar activity and contribute to better space-weather preparedness.

Significance for Solar-Flare Forecasting:

1. **Early-warning potential:** Transient brightenings occurring hours before major flares could potentially serve as **precursor signatures**.
2. **Understanding flare mechanisms:** The findings provide insights into the physical processes responsible for **triggering solar flares**.
3. **Magnetic-energy dynamics:** They indicate that a major flare may emerge through the cumulative effect of **repeated small-scale magnetic-energy releases**.
4. **Improved forecasting:** Identifying reliable precursor signals could move scientists closer to **reliable solar-flare forecasting**.
5. **Space-weather prediction:** Better flare forecasting can improve the prediction of potentially disruptive **space-weather events**.

Source: THE HINDU - <https://www.thehindu.com/sci-tech/science/new-study-captures-suns-early-warning-signs-before-solar-flares/article71407804.ece>

27. National Commission for Indian System of Medicine (NCISM)

Prelims:

Health

Mains:

GS Paper II-Health

Current relevance:

The **National Commission for Indian System of Medicine (NCISM)** issued a circular on 29 July 2026 clarifying that qualified and registered practitioners of recognised Indian

Systems of Medicine (ISM) **cannot legally be described as "quacks" or "bogus doctors"** merely because they practise traditional medicine.



Highlights:

About National Commission for Indian System of Medicine (NCISM):

1. It is a **statutory regulator** established under the **National Commission for Indian System of Medicine Act, 2020** and it functions under the **Ministry of Ayush**, Government of India.
2. NCISM regulates the following recognised Indian Systems of Medicine **Ayurveda, Unani, Siddha, Sowa-Rigpa**.
3. Aims to ensure **quality medical education**, transparent regulation of institutions and practitioners, and the availability of **qualified professionals** in the Indian Systems of Medicine.
4. It also maintains **uniform standards of medical education, professional ethics**, and regulatory oversight across recognised traditional systems of medicine.

Objective of the Circular:

1. NCISM clarified that **qualified and registered practitioners** holding recognised ISM degrees and registered under the **NCISM Act** are **legally recognised medical practitioners** and cannot be labelled as **"quacks" or "bogus doctors."**

2. The clarification was issued following reports that registered ISM practitioners were being labelled as fake doctors, criticised in the media, targeted through public notices, and subjected to harassment, with the **aim of protecting their professional standing and preventing misinformation.**
3. The circular recognises ISM practitioners as **legally recognised medical practitioners within their own systems of medicine**, but **does not equate them with MBBS doctors** or automatically authorise them to practise modern (allopathic) medicine.

4. Judicial Position:

The Supreme Court has held that practitioners **cannot practise a system of medicine for which they are not qualified**, and cross-practice is permissible **only where specifically authorised under law.**

5. About Quack:

It generally refers to a person who **falsely claims medical qualifications** or practises medicine **without the required qualifications or legal registration.**

Source: THE HINDU – <https://www.thehindu.com/sci-tech/health/what-does-nscims-latest-order-say-about-ayush-doctors-explained/article71289017.ece>

28. Hexavalent Vaccine

Prelims:

Health

Mains:

GS Paper II-Issues Relating to Health

Current relevance:

A study conducted by the **Union Health Ministry** along with partner organisations has found that introducing the **hexavalent (six-in-one) vaccine** under India's **Universal Immunisation Programme (UIP).**



Highlights:

1. The study suggests that introducing the **hexavalent vaccine** under the **Universal Immunisation Programme (UIP)** could significantly improve the efficiency of India's childhood immunisation programme.
2. **About Hexavalent Vaccine:**
 - i. The hexavalent vaccine is a combination vaccine that protects infants against **diphtheria, tetanus, pertussis (Whooping Cough), Hepatitis B, Haemophilus influenzae type b (Hib), Polio.**
 - ii. It provides protection against **all six diseases** through a **single injection.**
 - iii. **Advantages:**
 - The hexavalent vaccine **reduces the number of injections** required during infancy.
 - It **simplifies the childhood immunisation schedule** by combining protection against six diseases into a single vaccine.
 - The vaccine has the potential to **improve vaccination coverage** and enhance the overall efficiency of immunisation programmes.
 - It reduces the workload of frontline healthcare workers while **saving time for caregivers.**

- The vaccine streamlines **immunisation logistics** by replacing the separate pentavalent vaccine and **inactivated polio vaccine (IPV) doses**.

Source: PIB – [https://www.thehindu.com/sci-tech/health/hexavalent-vaccine-could-improve-indias-immunisation-programme-study/article71304936.ece#:~:text=Introducing%20the%20hexavalent%20\(six%2Din,Health%20India%2C%20the%20Gates%20Foundation%2C](https://www.thehindu.com/sci-tech/health/hexavalent-vaccine-could-improve-indias-immunisation-programme-study/article71304936.ece#:~:text=Introducing%20the%20hexavalent%20(six%2Din,Health%20India%2C%20the%20Gates%20Foundation%2C)

29. National Leprosy Eradication Programme

Prelims:

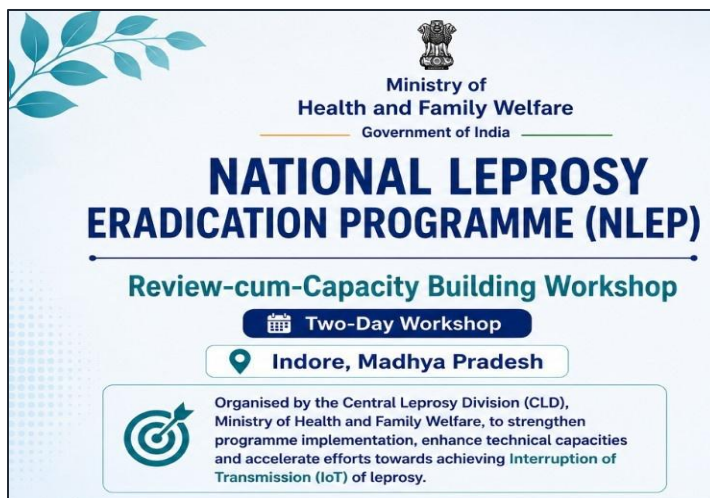
Public Health

Mains:

GS Paper II: Issues relating to health and human resources

Current relevance:

The **Central Leprosy Division (CLD)**, Ministry of Health and Family Welfare, organised a two-day National Leprosy Eradication Programme (NLEP) Review-cum-Capacity Building Workshop in **Indore, Madhya Pradesh**.



Highlights:

Objectives of the Workshop:

1. **Strengthen NLEP Implementation:** Identify programme gaps and improve implementation at the state and district levels.
2. **Capacity Building:** Enhance the **technical capacities of health officials and programme personnel** involved in leprosy control.
3. **Interruption of Transmission:** Accelerate focused interventions towards the national goal of **Interruption of Leprosy Transmission**.
4. **Evidence-Based Intervention:** Use programme data to identify **priority districts and areas requiring intensified surveillance and targeted action**.
5. **Peer Learning:** Promote sharing of **field experiences, best practices and replicable approaches** among district teams.

Key Strategies under NLEP:

1. **Early Case Detection:** Strengthen identification of leprosy cases at an early stage.
2. **Contact Tracing:** Improve **retrospective and reverse contact tracing** to identify potentially missed or undiagnosed cases and understand transmission dynamics.
3. **Timely Treatment:** Ensure the **timely initiation and completion of treatment**.
4. **Disability Prevention:** Strengthen measures for preventing disabilities associated with leprosy.
5. **Intensified Surveillance:** Focus surveillance and targeted interventions on priority areas as part of the **last-mile strategy** for interrupting transmission.
6. **Prevalence Reduction:** Implement focused strategies to bring the **prevalence rate below 1 per 10,000 population**.

Significance:

1. **Last-Mile Disease Control:** Focused surveillance and contact tracing can help detect cases that may otherwise remain unidentified.
2. **Data-Driven Approach:** Programme data enables identification of **high-priority districts** requiring targeted interventions.

3. **Strengthened District Capacity:** Capacity building improves the ability of local health systems to implement NLEP effectively.
4. **Transmission Reduction:** Combining **early detection, contact tracing, treatment completion, disability prevention and surveillance** strengthens efforts towards the national goal of Interruption of Leprosy Transmission.

About Leprosy:

1. Leprosy, also known as **Hansen disease**, is a **chronic infectious disease** and is classified by WHO as a **Neglected Tropical Disease (NTD)**.
2. It is caused mainly by the bacterium ***Mycobacterium leprae***.
3. The disease predominantly affects the **skin and peripheral nerves** and can also affect the **mucosa of the upper respiratory tract and eyes**.
4. **Transmission:** Spread through **droplets from the nose and mouth of an untreated person**, particularly following prolonged and close contact.
5. **Symptoms:**
 - **Skin Patches:** Pale or reddish patches may develop on the skin, often accompanied by **reduced or complete loss of sensation**.
 - **Peripheral Nerve Damage:** Affected peripheral nerves may become **thickened or enlarged**, leading to sensory impairment.
 - **Muscle Weakness:** Damage to peripheral nerves can result in **weakness of the muscles** supplied by those nerves.
 - **Skin Lesions:** Lesions may appear **flat, raised or nodular** and may occur either singly or in multiple areas.
 - **Permanent Disability:** Without timely treatment, progressive nerve damage may cause **long-term or permanent physical disability**

Source: PIB –

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2301249®=48&lang=2>

30. Chlorpheniramine Maleate and Phenylephrine Hydrochloride

Prelims:

Public health

Mains:

GS Paper II- Public health

Current affairs:

The Government has restricted the manufacture, sale and distribution of all **Fixed Dose Combinations (FDCs)** containing **Chlorpheniramine Maleate and Phenylephrine Hydrochloride**, requiring them to carry a clear warning that they shall not be used in **children below four years of age**.



Highlights:

1. The Government has now mandated that **all FDC formulations** containing these **two ingredients must carry a warning that they shall not be used in children below four years of age**, citing potential risks and the availability of safer alternatives.
2. The warning must be displayed on the:
 - i. **Label**
 - ii. **Package insert**

iii. **Promotional literature**

3. The notification has been issued under **Section 26A of the Drugs and Cosmetics Act, 1940.**

4. **Significance:**

- i. The measure seeks to strengthen the **health and safety of young children.**
- ii. Extending the restriction to **all formulations containing the two ingredients** creates broader and more consistent coverage.
- iii. Mandatory warnings help communicate **age-specific safety restrictions** to users.
- iv. The measure demonstrates the role of **expert assessment and regulatory intervention** in ensuring the safe use of medicines.

5. **About Chlorpheniramine Maleate and Phenylephrine Hydrochloride:**

The Chlorpheniramine Maleate + Phenylephrine Hydrochloride combination brings together an **antihistamine and a decongestant** and is used for **symptomatic relief of upper-respiratory symptoms such as runny nose and nasal congestion.** The Indian Pharmacopoeia specifically contains standards for Phenylephrine Hydrochloride and Chlorpheniramine Maleate **Drops and Syrup.**

Source: PIB-

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2302237®=48&lang=2>

31. Ribociclib

Prelims:

Polity & Health

Mains:

GS Paper II: issues relating to healthcare access and affordability

Current relevance:

The **Kerala High Court** has allowed a breast cancer patient from **Malappuram** to be impleaded in a case concerning the allegedly **exorbitant price of the life-saving breast cancer medicine Ribociclib**.



Highlights:

About Ribociclib:

1. Ribociclib is an **antineoplastic (anti-cancer) medicine** belonging to the class of **protein kinase inhibitors**.
2. **Major Use:** It is used in **hormone receptor-positive (HR-positive)**, HER2-negative breast cancer, including certain **early breast cancers at high risk of recurrence** and locally advanced or metastatic breast cancer.
3. **Combination Therapy:** Ribociclib is generally used with **endocrine (hormonal) therapy**—such as an **aromatase inhibitor or fulvestrant**, depending on the clinical setting.
4. It is an **oral prescription medicine**. EMA describes a treatment schedule of once-daily tablets for **21 days followed by a 7-day break**, forming a 28-day cycle; treatment and dosing require specialist medical supervision.

5. Ribociclib may cause side effects such as **reduced white blood-cell counts, infections, nausea, fatigue and abnormal liver-function tests.**
6. It may also cause a **concentration-dependent increase in the QTc interval**, requiring attention to **cardiac safety monitoring.**

Source: THE HINDU - <https://www.thehindu.com/news/national/kerala/kerala-hc-allows-breast-cancer-patient-to-be-impealed-in-case-on-exorbitant-prices-of-medicines/article71381039.ece>

32. GARBHINI MITRA

Prelims:

Government institutions, Health

Mains:

GS Paper II: Government policies and interventions, Health

Current relevance:

The **All-India Institute of Ayurveda (AIIA), New Delhi**, an autonomous premier institution under the **Ministry of Ayush**, has introduced the GARBHINI MITRA Course for the 2026–27 academic session.

All India Institute of Ayurveda (AIIA), New Delhi
An autonomous premier institution under the Ministry of Ayush

Introduces

GARBHINI MITRA COURSE

For 2026–27 Academic Session

A structured healthcare skill-development programme to train personnel in providing **health education, lifestyle guidance and community-level support** to women during pregnancy and the postnatal period.

Health Education **Lifestyle Guidance** **Community-level Support** **Support during Pregnancy & Postnatal Period**

Empowering Care. Nurturing Mothers. Strengthening Communities.

Highlights:

About GARBHINI MITRA Course:

1. **Institution:** Offered by the **All-India Institute of Ayurveda (AIIA)** at Sarita Vihar, New Delhi.
2. **Duration:** A **six-month offline training programme**.
3. **Capacity:** Each batch admits **20 students**.
4. **Eligibility:** Candidates must have passed **Senior Secondary (10+2)** from a recognised board and be at least **18 years old**; those awaiting Class 12 results can apply provisionally.
5. The programme seeks to develop trained personnel capable of supporting **maternal wellness at the community level**.

Ayurvedic Foundation:

The course is rooted in three traditional Ayurvedic concepts:

1. **Garbhini Paricharya – Antenatal Care:** An Ayurvedic approach to **care during pregnancy**, emphasising suitable **diet, lifestyle practices and mental well-being** to promote the health of both the mother and developing foetus.

2. **Sutika Paricharya – Postnatal Care:** Refers to Ayurvedic **care after childbirth**, aimed at supporting the mother's **recovery and well-being during the postnatal period**.
3. **Garbhadhana Vidhi – Pre-conceptual Care:** Refers to Ayurvedic practices associated with **preparing for conception and pregnancy**, encompassing care and guidance during the **pre-conception stage**.

Training & Key Components:

1. Trimester-specific **dietetics and lifestyle** modifications.
2. Pregnancy-safe **yoga** and maternal wellness practices.
3. Emotional support during labour.
4. Newborn massage and basic life-support protocols.
5. Infection control and sanitisation.
6. Biomedical waste management and workplace safety.
7. Identification of **warning signs** and facilitation of timely referral to qualified doctors and healthcare facilities.

Significance:

1. **Maternal Support:** Creates trained personnel to provide appropriate **health education, lifestyle guidance and community-level assistance** during pregnancy and the postnatal period.
2. **Ayurveda Integration:** Provides structured skill development based on traditional Ayurvedic maternal-care concepts.
3. **Employment Opportunities:** Graduates can work as **Garbhini Mitra Assistants, Prenatal/Postnatal Care Assistants**, Antenatal Wellness Guides and Maternal Health Support Workers.
4. **Wide Application:** Employment opportunities may be available in **Ayush centres, maternity clinics, NGOs, community health projects** and wellness institutions.

5. **Complementary Role:** GARBHINI MITRA does **not replace clinical antenatal care**; routine check-ups, diagnostic tests and monitoring of blood pressure and haemoglobin remain essential.

Source: PIB –

<https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2302658®=48&lang=1>

33. H1N1 Influenza

Prelims:

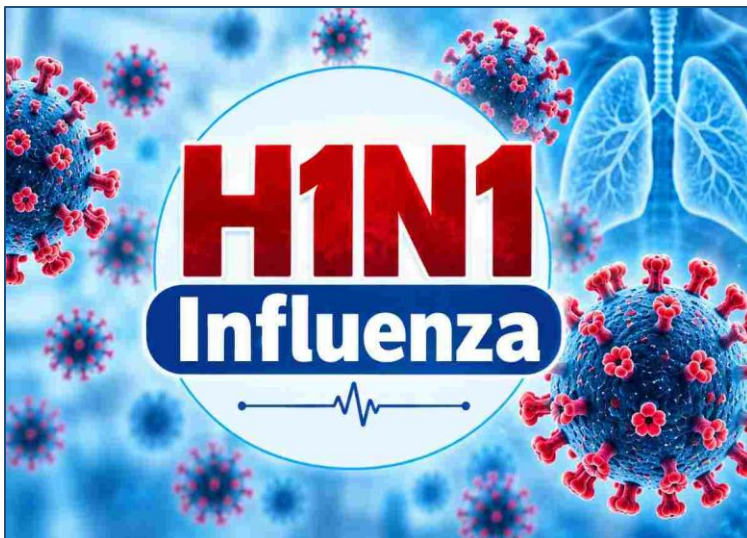
Health & Diseases

Mains:

GS Paper II: Health and human resources

Current relevance:

H1N1 has emerged as the predominant influenza subtype currently circulating in India, accounting for nearly **98% of Influenza A cases**, according to the **ICMR Director-General**.



Highlights:

About H1N1 Influenza:

1. **Type & Causative Agent:**

- i. H1N1 influenza is a **contagious acute respiratory infection** caused by the **Influenza A(H1N1) virus**.
- ii. Influenza virus is an **enveloped RNA virus** belonging to the family **Orthomyxoviridae**.
- iii. The designation **H1N1** refers to two surface antigens — **H (Haemagglutinin)** and **N (Neuraminidase)**.
- iv. The **H1N1 pdm09 virus** emerged during the **2009 influenza pandemic** and subsequently became a seasonal influenza virus.

2. **Mode of Transmission:**

- i. H1N1 spreads mainly **from person to person through respiratory droplets** released when an infected person **coughs or sneezes**.
- ii. Transmission can also occur through **hands or surfaces contaminated with influenza viruses**, followed by touching the **nose, mouth or eyes**.
- iii. Influenza can spread rapidly in **crowded environments**, including schools and other close-contact settings.
- iv. The incubation period for seasonal influenza is generally around **2 days**, usually ranging from **1–4 days**.

3. **Major Symptoms:**

Common symptoms include:

- i. **Sudden onset of fever**
- ii. **Dry cough**
- iii. **Sore throat**
- iv. **Runny or stuffy nose**
- v. **Headache**
- vi. **Muscle and joint pain/body aches**
- vii. **Chills and fatigue**
- viii. **General feeling of illness (malaise)**

ix. Some H1N1 patients may also experience **vomiting and diarrhoea**.

4. High-Risk Groups & Complications:

- i. People at greater risk of severe influenza include **pregnant women, young children, older persons, people with chronic medical conditions and immunocompromised individuals**.
- ii. In severe cases, influenza may lead to serious complications such as **pneumonia and sepsis**, and may require hospitalisation.

5. Prevention:

- i. **Annual seasonal influenza vaccination** is considered the best preventive measure against seasonal influenza.
- ii. Maintain regular **hand hygiene**.
- iii. Cover the **mouth and nose while coughing or sneezing**.
- iv. Reduce close contact with infected individuals and follow appropriate **respiratory hygiene practices**.

Influenza Surveillance in India:

1. India monitors influenza through a network of **73 sentinel hospitals**.
2. The surveillance system tracks both **Influenza A and Influenza B**.
3. It also monitors other respiratory viruses, including:
 - **SARS-CoV-2**
 - **Human metapneumovirus**
 - **Adenovirus**
 - **Parainfluenza viruses**
4. Such surveillance helps track the **circulation and relative prevalence of respiratory viruses**.

Health Preparedness & Preventive Measures:

1. **Dedicated H1N1 wards** have been established at several government hospitals in Delhi.

2. Authorities have been directed to ensure adequate availability of **medicines and testing facilities**.
3. **Surveillance mechanisms** are being intensified to monitor infections.
4. Public **awareness campaigns on preventive measures** are being strengthened.
5. Schools have been asked to adopt a **“Healthy School–Healthy Community”** approach and reinforce **respiratory hygiene and other preventive practices**.
6. Coordinated awareness campaigns involving transport agencies and civic bodies have also been proposed, particularly because **urban density and connectivity can facilitate the spread of respiratory infections**.

Source: THE HINDU – <https://www.thehindu.com/news/national/h1n1-accounts-for-98-of-influenza-a-cases-in-india-icmr-chief/article71388649.ece>

34. Salmonella Infections

Prelims:

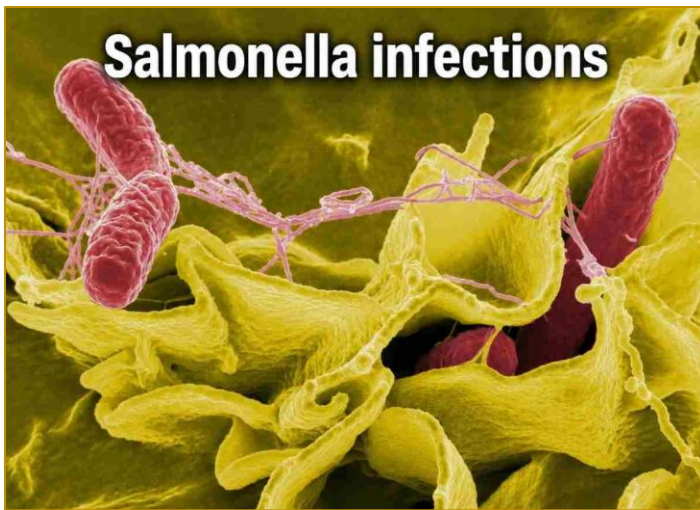
General Science, Health

Mains:

GS Paper II: Issues relating to health and human resources, Government policies and interventions in the health sector, GS Paper III: Science & Technology, public health

Current relevance:

Salmonella infections require greater public-health attention in India because their impact extends beyond **typhoid and mild gastroenteritis** to potentially serious **bloodstream infections**.



Highlights:

Salmonella Infections:

1. **Salmonella** is a group of bacteria that can cause infections ranging from **mild gastrointestinal illness to serious bloodstream infections**.
2. **Typhoid and paratyphoid (enteric fever)** are caused by *Salmonella Typhi* and *Salmonella Paratyphi*, respectively.
3. **Non-typhoidal Salmonella (NTS)** infections are commonly associated with gastroenteritis and food-borne transmission.

Disease Spectrum:

1. NTS commonly causes **diarrhoea, stomach cramps, fever and sometimes vomiting**.
2. Most healthy individuals recover with **supportive care**, but in some cases the infection can become invasive and spread into the **bloodstream**.
3. **Young children, older adults and people with underlying illnesses or weakened immunity** are particularly vulnerable to severe and potentially life-threatening infections.
4. The actual burden of NTS may be underestimated because **many mild infections recover without diagnostic testing**.

Transmission:

1. Both typhoid and non-typhoidal Salmonella infections spread through the **faecal-oral route**, although their sources differ.
2. In **typhoid, humans are the reservoir**, whereas NTS can originate from **animals, food and the environment**.
3. **Poultry, eggs, meat and other animal-derived foods** can serve as important sources of NTS.
4. Contamination may occur at several stages, including **farms, slaughterhouses, food processing, transportation, storage, restaurants and household kitchens**.
5. **Cross-contamination** can also occur when raw meat comes into contact with ready-to-eat food.

One Health Dimension:

1. Salmonella involves interconnected risks across **humans, animals, food and the environment**, making it an important **One Health challenge**.
2. Controlling infection therefore requires interventions throughout the **food-production and consumption chain**, rather than focusing only on infected individuals.
3. Better **food-handler training, sanitation, refrigeration, surveillance, monitoring and enforcement** are important for reducing transmission.
4. Gaps in food-safety measures remain particularly relevant in the **large informal food sector**.

Antimicrobial Resistance:

1. Increasing **antimicrobial resistance (AMR)** is making serious Salmonella infections more difficult to treat.
2. India has experienced a major change in the resistance pattern of **S. Typhi**, particularly involving **fluoroquinolone resistance**.
3. The emergence of **extensively drug-resistant typhoid** demonstrates how resistance across several antibiotic classes can leave clinicians with **limited treatment options**.

4. Addressing the problem requires **appropriate rather than indiscriminate use of antibiotics**.

Diagnostic Challenges:

1. Many mild NTS infections remain **undiagnosed because patients may recover without undergoing testing**, making the true disease burden difficult to estimate.
2. **Blood culture is the main test for suspected typhoid** and should ideally be conducted before starting antibiotics.
3. The **Widal test has limitations and should not be used alone** to diagnose typhoid.
4. Accurate diagnosis is important for determining whether antibiotics are genuinely required and for supporting **antimicrobial stewardship**.

Prevention:

1. **Safe water and sanitation** are essential for reducing faecal-oral transmission.
2. Household precautions include handwashing, using safe water, thoroughly **cooking poultry and eggs, proper refrigeration of perishable foods, and separating raw meat from ready-to-eat food**.
3. Stronger **food-safety surveillance and monitoring** are necessary across the entire food chain.
4. The **WHO recommends typhoid conjugate vaccines for children from six months of age**; however, these are not currently part of India's Universal Immunisation Programme.

Way Forward:

1. Strengthen **food-safety systems, sanitation, refrigeration, monitoring and enforcement**, including within the informal food sector.
2. Improve **diagnostic practices** so that infections requiring treatment are identified accurately.
3. Promote **antimicrobial stewardship** by reserving antibiotics primarily for severe or invasive infections and individuals at greater risk of complications.

4. Adopt a comprehensive **One Health approach** integrating human health, animal sources, food systems and environmental factors.
5. Prevention should combine **vaccination, safer water and sanitation, food safety and responsible antibiotic use** to reduce both infection and antimicrobial resistance.

Source: THE HINDU - <https://www.thehindu.com/sci-tech/health/why-india-needs-to-look-beyond-typhoid-to-address-the-health-burden-of-salmonella-infections/article71387815.ece>