

Prelims Exam Topics

HAYABUSA2 EXPLORER

Context:

Japan's **Japan Aerospace Exploration Agency (JAXA)** successfully conducted a close flyby of **Asteroid Torifune** as part of the extended mission of the **Hayabusa2** spacecraft.

About Hayabusa2 Explorer

- **Hayabusa2** is an asteroid sample-return mission developed by the **Japan Aerospace Exploration Agency (JAXA)**.
- To demonstrate and advance **deep-space exploration technologies**, including precision landing, sample collection, and return missions.
- It explored the near-Earth asteroid **Ryugu**, collected surface and subsurface samples, and successfully returned them to Earth for scientific analysis.

HIMALAYAN PANGOLIN

Context:

Researchers have confirmed that the **Himalayan pangolin (*Manis aurita*)** is a **distinct living species**, separate from the **Chinese Pangolin**.

About Himalayan Pangolin

- It is a **species of Asian pangolin** found in the Himalayan region.
- **Threats**
 - **Illegal wildlife trade** for its scales and body parts.
 - Pangolin-derived products continue to enter **regulated traditional medicine markets**.
 - Faces **genetic risks due to inbreeding**, as its populations are small and isolated.

	Himalayan Pangolin (<i>Manis aurita</i>)	Chinese Pangolin (<i>Manis pentadactyla</i>)
Distribution	Southern Himalayan foothills: Nepal, South Tibet, Northeast India (Assam)	East and Southeast Asia
Size	Larger (≈ 95 cm)	Smaller (≈ 71 cm)
Features	Larger skull, longer tail, smaller ears	Smaller skull, shorter tail, larger ears

CHANGPA TRIBE

Context:

The Ladakh administration has launched initiatives to strengthen the **Pashmina value chain** and improve the livelihoods of the **Changpa pastoral community**.

About the Changpa Tribe

- The **Changpas** are a **semi-nomadic pastoral community** inhabiting the **Changthang** region of the **Trans-Himalayas** in India.
- They are renowned for rearing **high-quality Pashmina (Cashmere) goats**, whose fine wool is used to produce world-famous **Pashmina**.
- The Changpas primarily follow **Buddhism**.
- They are recognized as a **Scheduled Tribe (ST)** in India.
- The nomadic Changpas live in distinctive **conical yak-skin tents**, known as **Reboo**.
 - Every **Reboo** houses the family's deity along with an image of their spiritual leader, usually **Dalai Lama**.
- Based on their lifestyle:
 - **Phalpa** – Nomadic Changpas who migrate seasonally with their livestock.
 - **Fangpa** – Changpas who have adopted a settled way of life.
- **Festivals**
 - **Jyabten** – A major purification ritual in which offerings of various food items are made to **Padmasambhava**.
 - **Tangpe Chona** – Celebrated on the **15th day of the first month of the lunar calendar**, the ceremony typically marks the celebration of good over evil and involves devotees performing traditional rituals.

GLOBAL PASSPORT INDEX

Context:

India's position in the **Global Passport Index (GPI) 2026** has declined by one place, ranking **125th** globally.

About the Global Passport Index (GPI)

- **GPI** assesses passports based on **international mobility** as well as the opportunities they provide for **living, working, and investing abroad**.

- **Published by:** Global Citizen Solutions.
- The index assigns scores under three broad pillars: **Enhanced Mobility – 50%, Investment Opportunities – 25% and Quality of Living – 25%**
- **Top-ranked Passports:** Sweden, Switzerland, Finland, Germany, Denmark, and Netherlands (joint leaders).

	2021	2025	2026
India's Rank	127	124	125

VEPDEGESTRANT

Context:

The **U.S. Food and Drug Administration** has approved **Vepdegestrant**, the world's first approved medicine based on **PROTAC (Proteolysis-Targeting Chimera)** technology.

About Vepdegestrant

- **Vepdegestrant** is the **first approved PROTAC-based oral therapy** that destroys disease-causing proteins instead of merely blocking their activity.
- **Developed by:** Arvinas, Inc. in collaboration with Pfizer.
- It specifically targets **mutated estrogen receptors**, which often become resistant to conventional hormone therapies.

How PROTAC Technology Works?

- A **PROTAC** (*a molecule that brings a harmful protein and the cell's disposal machinery together*) attaches to the **disease-causing protein** and an **E3 ligase** (*a cellular protein that marks unwanted proteins for disposal*).
- The **E3 ligase** attaches **ubiquitin** (*a small protein tag that signals a protein should be destroyed*) to the harmful protein.
- The **proteasome** (*the cell's protein recycling and disposal system*) breaks down the tagged protein, while the **PROTAC** molecule is released and reused to destroy more disease-causing proteins.

BATTERY MANAGEMENT SYSTEM (BMS)

Context:

The **Ministry of Electronics and Information Technology** directed **Apple** and **Google** to remove battery management apps such as **BAT-BMS**, **Lossigy**, and **Epoch Li-ion** after reports of their misuse to remotely disable e-rickshaw batteries.

About Battery Management System (BMS)

- A **Battery Management System (BMS)** is an **Electronic Control Unit (ECU)** that monitors and manages the performance of **lithium-ion battery packs**.
- It tracks **Voltage, Current, Temperature, Charging and discharging**
- It ensures **safe operation, longer battery life, and balanced performance of battery cells**.

About BAT-BMS App

- **BAT-BMS** is a **battery monitoring and management application** that connects to **Bluetooth-enabled Battery Management Systems (BMS)** in lithium-ion batteries.
- It was developed for **battery diagnostics, maintenance, and performance monitoring**, not for hacking.

TEESTA RIVER

Context:

During an official visit to **China**, Bangladesh PM signed a strategic agreement with Beijing to expedite the feasibility study for the **Teesta River Comprehensive Management and Restoration Project**.

About the Teesta River

- The **Teesta River** (tributary of the **Brahmaputra River**) is a **glacier-fed transboundary river** flowing through **India (Sikkim and West Bengal)** and **Bangladesh**.
- **Origin:** **Tso Lhamo Lake** in **Sikkim**.
- The river flows southward through a **deep gorge in the Siwalik Hills**, east of **Darjeeling**.
- It then turns southeast, enters the **plains of West Bengal** through the **Sivok Khola Pass**, and flows into **Bangladesh**.
- In Bangladesh, it joins the **Jamuna River**, the main distributary of the **Brahmaputra River**.
- **Major Tributaries**
 - **Right-bank:** **Dik Chhu, Kanaka Chhu, Rangyong Chhu, Rangeet River**.
 - **Left-bank:** **Lachung Chhu, Lachen Chhu, Chakung Chhu, and Rani Khola**.

Mains Exam Topics

ARTIFICIAL INTELLIGENCE IN MODERN WARFARE

Context:

The strategic-military landscape is undergoing a transformative shift, with **Artificial Intelligence (AI)**, **military autonomy** and **algorithmic warfare** redefining the nature of modern warfare.

How is AI Reshaping Modern Warfare?

- **AI-Enabled Battlefield Awareness:** AI integrates data from satellites, drones, sensors and intelligence networks to generate a common operational picture, enabling commanders to assess threats and coordinate operations in real time.
 - **E.g.** The U.S. **Project Maven** employs AI to process drone imagery for intelligence and target identification.
- **Machine-Speed Targeting:** AI-powered **kill webs** connect sensors, command centres and weapon systems, reducing the time between target detection and engagement.
 - **E.g.** The U.S. **Joint All-Domain Command and Control (JADC2)** initiative links assets across land, sea, air, space and cyber for rapid targeting.
- **Drone-Centric Warfare:** Unmanned systems have become indispensable for intelligence, surveillance, reconnaissance (ISR), precision strikes, logistics support and damage assessment, lowering operational risks to troops.
 - **E.g.** The **Russia–Ukraine War** has demonstrated the large-scale use of FPV drones for reconnaissance and precision attacks.
- **Autonomous Warfare:** AI-enabled autonomous platforms can independently navigate, detect and engage targets with minimal human intervention, expanding the role of machines in combat operations.
 - **E.g.** Israel's **Harpy** loitering munition autonomously detects and destroys enemy radar installations.
- **Startup-Driven Defence Innovation:** Defence innovation is increasingly being led by agile technology startups developing AI, autonomous systems and advanced military software in partnership with conventional defence industries.
 - **E.g.** **Anduril Industries** has developed the AI-enabled **Lattice** platform for autonomous surveillance and battlefield command and control.

What are the Key Challenges for India in Modern AI Warfare?

- **Lack of an Integrated AI Battlefield Network:** India lacks a unified AI-enabled command-and-control architecture capable of integrating data from land, air, sea, space and cyber domains into a single operational picture.
 - **E.g.** Projects such as **Project Sanjay** and the **Combat Information Decision Support System (CIDSS)** are under development, but India still lacks an integrated multi-domain battlefield network comparable to advanced militaries.
- **Limited AI Integration in Military Operations:** AI-driven decision support, predictive analytics, autonomous systems and human-machine teaming remain at an early stage of operational deployment.
 - **E.g.** The **Army AI Incubation Centre** is fostering AI innovation, but large-scale integration across the Army, Navy and Air Force remains limited.
- **Limited Persistent Space-Based ISR Capabilities:** India lacks sufficient Low Earth Orbit (LEO) satellite coverage for continuous intelligence, surveillance and reconnaissance (ISR), constraining real-time situational awareness.
- **Interoperability and Software Integration Constraints:** AI integration is hindered by the diverse mix of foreign and indigenous military platforms operating on incompatible software architectures.
 - **E.g.** Integrating **Russian, French, American and indigenous** platforms into a unified AI-enabled command network remains difficult due to proprietary and closed software systems.
- **Slow Defence Procurement and Institutional Reforms:** Defence acquisition and organisational processes have struggled to keep pace with the rapid advancement of AI, software and autonomous technologies.
 - **E.g.** Despite reforms under the **Defence Acquisition Procedure (DAP)** and **iDEX**, procurement and induction cycles remain significantly slower than commercial technology innovation.

Way Forward

- **Develop an Indigenous AI Battlefield Network:** Build an integrated AI-enabled command-and-control platform that fuses real-time data from land, air, sea, space and cyber domains for faster decision-making.
 - **E.g.** Develop an indigenous battlefield management system on the lines of **Ukraine's Delta**, adapted to India's multi-front operational environment.

- **Advance Autonomous Drone Warfare:** Develop indigenous AI software for autonomous drone swarms capable of collaborative navigation, target recognition and mission execution with human oversight.
 - **E.g.** Scale up swarm technologies under **iDEX** and **Army Design Bureau** initiatives.
- **Scale Indigenous Drone Production:** Create a robust domestic drone manufacturing ecosystem to ensure affordable, mass deployment during high-intensity conflicts.
 - **E.g.** Expand production through the **Production Linked Incentive (PLI)** scheme and private defence startups.
- **Expand Space-Based ISR:** Increase the number of Low Earth Orbit (LEO) satellites to enable persistent intelligence, surveillance and reconnaissance across multiple theatres.
 - **E.g.** Fast-track the **Space-Based Surveillance (SBS-III)** programme with greater participation from private space companies.
- **Prioritise Software-Centric Defence Modernisation:** Shift defence investment from hardware-centric procurement towards AI, software, cloud computing, cybersecurity and advanced data analytics.
 - **E.g.** Allocate a dedicated share of the defence modernisation budget for AI and digital warfare technologies.