

# Factly Weekly

**Compilation**

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**For UPSC CSE Prelims  
Exam**

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## UPSC Syllabus: Science and technology

### NASA's PREFIRE Polar Mission

#### Why in News?

NASA will soon launch 2 satellites under PREFIRE polar mission. PREFIRE stands for Polar Radiant Energy in the Far-InfraRed Experiment.

#### Objectives of the PREFIRE Polar Mission:

- 1) The mission will be aimed at filling the knowledge gap about two of the most remote regions on Earth — the Arctic and Antarctic.
- 2) It will measure the **amount of far-infrared radiation(heat) emitted** from two of the coldest, most remote regions on the planet, into space.
- 3) It will find out how **atmospheric water vapor and clouds** influence the amount that escapes to space.

#### About the Mission

PREFIRE is composed of **two small CubeSats** outfitted with specialized miniature heat sensors.

They will be launched with the **help of Electron launch vehicle**, which is equipped with the technology proven on Mars.

#### Significance of the PREFIRE Polar Mission

At the tropics, Earth absorbs a lot of energy from the Sun. This **energy is travelled to polar regions** with the help of wind movement and water currents. Then this heat is transferred to into the space.

About **60 percent of the heat energy, going outwards** into space from earth in the form of far-infrared wavelengths, **has never been measured**.

The knowledge from the **mission will improve computer models** that are used **to predict** how Earth's ice, seas, and weather will change in a warming world.

## First High Energy Photon Source (HEPS) Synchrotron Radiation facility in China

### Why in News?



China is about to complete its High Energy Photon Source (HEPS) facility in Huairou Science City in Beijing. After completion, it will be the brightest Synchrotron Radiation (SR) source and first fourth-generation synchrotron facilities in the world. **High Energy Photon Synchrotron Radiation**

### About High Energy Photon Source (HEPS)

The HEPS is a next-generation synchrotron that generates a specific type of synchrotron light source.

HEPS operates by **accelerating electrons to nearly the speed of light and making them travel in a circular path**. As these high-speed electrons change direction under the influence of magnetic fields, they emit Synchrotron Radiation, which includes X-rays. These X-rays are then harnessed for various scientific applications.

### Salient Features of HEPS

- 1) It can accelerate electrons up to energies of 6 gigaelectron volts, within its storage ring, with 1.36 Km of circumference.
- 2) HEPS generates X-rays that are ten times brighter than those produced by existing synchrotron facilities, allowing for unprecedented clarity in imaging and analysis.
- 3) It offers extremely precise imaging capabilities, enabling scientists to observe and manipulate materials at the atomic and molecular levels.
- 4) It will reduce the time taken by experiments, from milliseconds to hundreds of nanoseconds.

### Applications of HEPS

- **Material Science:** HEPS enables the detailed study of materials' structure and properties, which is crucial for developing new materials with enhanced performance.
- **Biology:** The facility allows for the examination of biological molecules and complex protein structures, aiding in understanding diseases and developing new treatments.
- **Nanotechnology:** HEPS will support the development of nanotechnology by providing insights into the behavior of nanomaterials and their applications.

### What is a Synchrotron?



A synchrotron is a large circular machine, the size of a football field. It is a type of particle accelerator that produces high-energy X-rays and other forms of electromagnetic radiation. It accelerates electrons to near-light speeds and guide them in a circular path, causing them to emit synchrotron radiation.

Prominent synchrotron facilities include the European Synchrotron Radiation Facility (ESRF) and the Advanced Photon Source (APS) in the USA.

### Critical Priority Pathogens

#### Why in the news?

The latest Bacterial Pathogens Priority List (BPPL) updated by the World Health Organization (WHO) notes that critical priority **pathogens pose major global threats because of their high burden** and their ability to resist treatment and spread resistance to other bacteria.

#### About Critical Priority Pathogens

**1. About Critical Priority Pathogens:** They are **bacteria that pose significant global health threats** because they can resist current treatments and spread their resistance to other bacteria.

**2. World Health Organization's Updated List:** The WHO has updated its Bacterial Pathogens Priority List (BPPL). It includes **15 families of antibiotic-resistant bacteria**.

These are categorized into **critical, high, and medium priority groups** to help prioritize responses.

**3. High Burden in Specific Regions:** The list highlights that certain high-priority pathogens like **Salmonella and Shigella** carry a particularly **high burden in low- and middle-income countries**. These pathogens pose major challenges in healthcare settings.

**4. Resistance to Antibiotics:** These pathogens include **gram-negative bacteria** that are resistant to last-resort antibiotics and Mycobacterium tuberculosis that is resistant to Rifampicin which is a key antibiotic.

**5. Antimicrobial Resistance (AMR):** AMR occurs **when bacteria, viruses, fungi, and parasites no longer respond to medicines**. This makes infections harder to treat and increasing the risk of disease spread, severe illness, and death. The **misuse and overuse of antimicrobials** are significant drivers of AMR.

**6. Challenges associated with Critical Priority Pathogens:** Pathogens like antibiotic-resistant Neisseria gonorrhoeae and Enterococcus faecium are known for **causing persistent infections and showing resistance to multiple antibiotics**. This necessitates targeted research and public health interventions.

#### About WHO Bacterial Priority Pathogens List

1. The 2024 WHO Bacterial Priority Pathogens List (WHO BPPL) serves as an essential resource in the worldwide battle against antimicrobial resistance.

2. This version updates the 2017 edition and enhances the ranking of antibiotic-resistant bacterial pathogens to meet the changing threats posed by antibiotic resistance.

## UPSC Syllabus: Science and technology (Health)

### AK-203 Assault Rifles

#### Why in News?

Recently, the Indian Army received AK-203 assault rifles from Russia.

#### About the AK-203 Assault Rifles



Source: The Hindu

**1. About AK-203 Rifles:** It is an **advanced version of the AK-47 rifle**, designed for improved ergonomics and accuracy. It is developed by the **Russian company Kalashnikov Concern**.

**2. Manufactured by:** The rifles are being **manufactured in India** as part of a joint venture named Indo-Russian Rifles Private Ltd. (IRRPL).

3. As of now, **27,000 AK-203 rifles have been delivered** to the Indian Army. An additional 8,000 rifles are expected to be handed over in the next two weeks.

**5. Indigenisation Efforts:** The **current level of indigenisation** in the production of AK-203 rifles is **approximately 25%**. The **aim** is to increase this to **70% within the next two years**.

#### 6. Strategic Importance:

i) The induction of AK-203 rifles is part of the Indian Army's broader initiative **to modernize its infantry weapons** and replace the older INSAS rifles.

ii) These rifles are considered crucial for **enhancing the combat readiness of the Army**, particularly for troops involved in counter-insurgency operations.

iii) The AK-203 rifles represent a significant upgrade in the Indian Army's arsenal, combining **local manufacturing with critical technology transfer**, thereby boosting both defense capabilities and domestic defense production.

**7. Other Rifle Acquisitions:** Concurrently, the Indian Army has also **inducted 66,400 SIG-716 assault rifles for frontline troops**, highlighting ongoing efforts to bolster its small arms capabilities.

## UPSC Syllabus: Science and technology (Defence)

### Project Astra

Why in News?

Recently, Google showcased an early version of Project Astra at its annual developer conference.

#### About Project Astra



Figure 1. Source: The Indian Express

1. It is Google's initiative to develop AI that understands and responds using text, voice, and visual inputs. It is designed for devices like smartphones and smart glasses.

2. User

**Interaction:** This technology enables users to interact with their environment by capturing information through their device's camera. It is similar to asking a question about something they see or hear.

**3. Goals:** The main aim is to facilitate real-time information exchange and interaction through wearable technology.

#### 4. Functionality:

**i) Accessing Information:** The Google AI Assistant within Project Astra can retrieve and provide information from both the internet and real-world scenes captured by the device's camera.

**ii) Learning and Adaptation:** The AI is designed to learn from interactions and the user's environment, enhancing its effectiveness as a personal assistant.

#### 5. Comparison with OpenAI's GPT-4o

**1. Modalities and Platforms:** Project Astra employs a multimodal approach (text, voice, and visuals) and is versatile across various platforms, including smart glasses. In contrast, GPT-4o primarily focuses on voice interactions and is mainly used on smartphones.

**2. Impact and Advancement:** Project Astra is considered a significant step forward, potentially changing how users interact with AI across multiple devices. Meanwhile, GPT-4o marks progress in voice and text-based AI capabilities, but it primarily enhances smartphone applications.



## UPSC Syllabus: Science and technology

### Pig Butchering Scam

#### Why in the News?

Pig Butchering Scams are on the rise globally including in India. It is a type of online financial fraud.

#### About Pig Butchering Scam



Figure 2. Source: dotsecurity.com

**1. About Pig Butchering Scam:** It is also known as a “sha zhu pan” scam. It is a type of online investment fraud.

The term “pig butchering” comes from the scammers’ practice of “fattening up” their victims by building trust over time before “slaughtering” them and stealing their money.

#### 2. Execution Method:

a) Scammers, or “hosts,” initiate contact through social media, dating apps, or misleading messages. The host establishes a fake relationship or friendship with the target, referred to as the “pig.”

b) The scammer introduces the concept of cryptocurrency trading to pique interest. Victims are directed to a fraudulent trading app, where they are misled to believe they are making profitable trades.

c) As trust builds, the scammer persuades the victim to increase their investment, effectively “fattening” them for the scam. When victims attempt to withdraw funds, they face excuses or high fees from the fake platform, revealing the scam’s true nature.

**3. Challenges in Fund Recovery:** Due to the irreversible nature of blockchain transactions, recovering lost funds is often extremely challenging.

## UPSC Syllabus: Science and technology

### Psychedelics

#### Why in the News?

Researchers are advocating for domestic clinical trials of psychedelic drugs, motivated by the increase in global trials and the low effectiveness of existing medications in treating mental health issues.

#### About Psychedelics

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**1. About Psychedelics:** Psychedelics are drugs that **alter perception, behavior, consciousness, and thought**, often intensifying sensory awareness.

2. This category of drugs is a **subset of psychotropic substances** known for their ability to drastically change an individual's thoughts, perceptions, and can cause vivid hallucinations.

### 3. Categories of Psychedelics:

**a) Classical Psychedelics:** These compounds primarily cause **hallucinations** by activating the serotonin 5-HT receptor, which is prevalent throughout the human body, including in the gastrointestinal tract, platelets, and the nervous system.

Examples include LSD (lysergic acid diethylamide), psilocybin, and DMT (N, N-Dimethyltryptamine).

**b) Non-Classical Psychedelics:** These substances interact with a variety of receptors. Notable examples are ketamine and MDMA (3,4-methylenedioxy-N-methamphetamine).

### 4. How it works:

Most psychedelics **enhance the presence of serotonin**, a hormone that stabilizes mood, by binding to serotonin receptors. These receptors are molecules located on cell surfaces that trigger specific biochemical reactions when they bind with certain chemicals.

**5. Research and Clinical Use:** Currently, five psychedelics are being extensively studied in clinical research focused on treating mental health issues: **psilocybin, LSD, MDMA, ketamine, and DMT**.

**6. Regulation:** The **1971 United Nations' Convention on Psychotropic Substances** regulates approximately 200 **psychotropic substances divided into four schedules**, with Schedule I listing those with the highest potential for abuse. The convention does not specify the count, or the types of substances classified as psychedelics.

## UPSC Syllabus: Science and technology

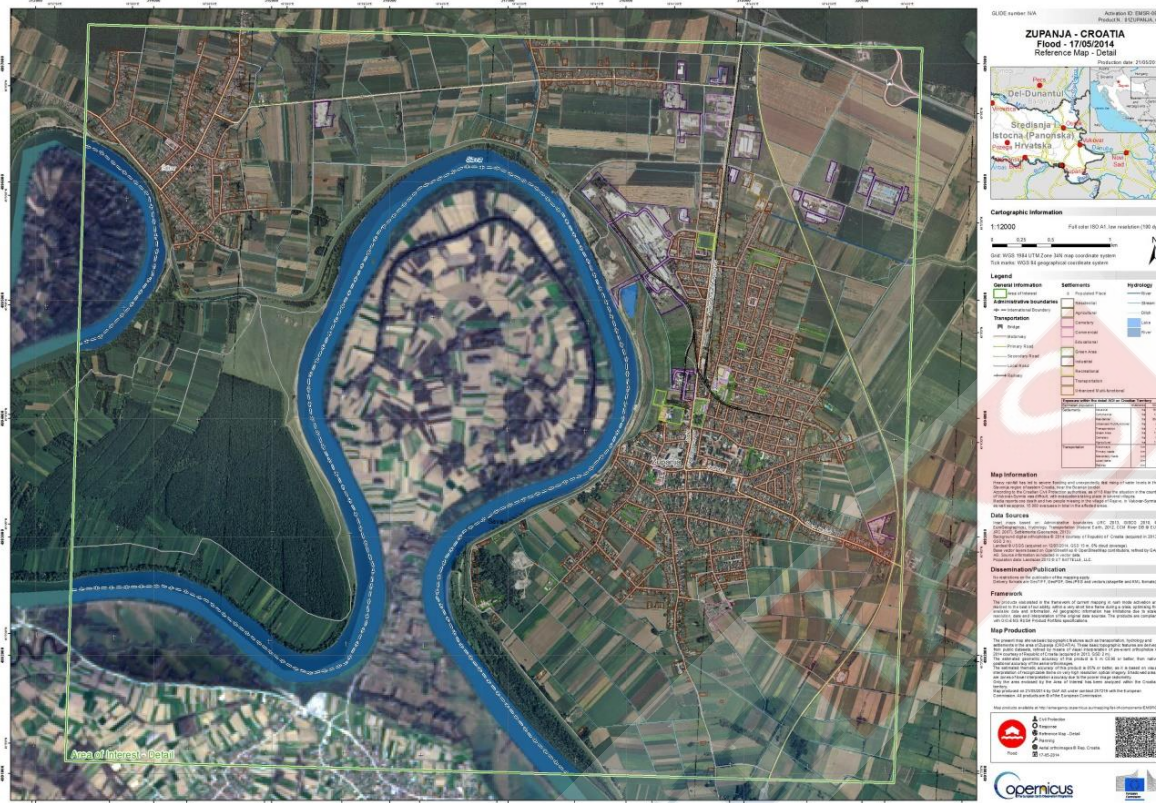
### Copernicus Emergency Management Service (EMS) Programme

#### Why in News?

Following a helicopter crash in East Azerbaijan province carrying Iranian President Ebrahim Raisi, the European Union **activated its Copernicus EMS rapid response mapping service** in response to a request from Iran, as part of a collaborative effort.

#### About Copernicus Emergency Management Service (EMS) Programme

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Source: [emergency.copernicus.eu](https://emergency.copernicus.eu)

**1. About Copernicus Emergency Management Service (EMS) Programme:** It was originally launched as the Global Monitoring for Environment and Security Programme (GMES) in **1998**.

2. The program employs a **comprehensive suite of data sources**, including satellites, and terrestrial, airborne, and maritime measurement systems, to offer environmental information useful to researchers, policymakers, public authorities, international organizations, and both commercial and private users.

3. This information **supports a range of applications**, such as climate change response, disaster management, and agriculture.

4. The space component of the program comprises a constellation of satellites known as **the Sentinels and the Contributing Missions**.

This is supplemented by a **ground component**, which consists of in-situ sensors that facilitate access to data from the Sentinels and Contributing Missions.

**2. Components of the Service:** It has two component that are **mapping component and Early Warning Component**:

**i. Mapping component** provides **maps and analysis based on satellite imagery**.

**a) Rapid Mapping (RM):** It **offers timely maps and analyses** within hours or days for immediate response needs.

**b) Risk and Recovery Mapping (RRM):** It **produces detailed maps for long-term disaster management**, focusing on prevention, preparedness, disaster risk reduction, and recovery, usually within weeks or months.

**ii. Early Warning Component:** It **issues alerts and provides near-real-time assessments of environmental threats** such as floods, droughts, and forest fires.



### 3. How does rapid mapping work?

i) This service involves the **acquisition, processing, and analysis of satellite imagery, geospatial data**, and pertinent social media content in a rapid manner.

ii) It offers **four types of “products”**: one pre-event reference and three post-event products (first estimate, delineation, and grading). It includes:

**a) Reference Product** which gives **quick information on the area of interest** and assets before the emergency/disaster takes place.

**b) First Estimate Product** provides a **quick assessment of the most affected locations** after the disaster has taken place.

**c) Delineation Product** **supplies information on the impact, extent, and update on the situation** after the disaster has taken place.

**d) Grading Product** which **provides damage assessment, spatial distribution**, and extent after the disaster has taken place.

iii) Each product **includes a set of deliverables consisting of maps** and a vector package of spatial data.

## UPSC Syllabus: Science and technology

### Space tourism

#### Why in News?

India-born aviator and commercial pilot Gopi Thotakura became the first space tourist from India. He is flying on the Blue Origin NS-25 mission.

#### About Space tourism



Source: Indian Express

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1. Space tourism is **human space travel for recreational or leisure purposes**. It is divided into different types which includes **orbital, suborbital, and lunar space tourism**.
2. Space tourism is also as a **commercial activity** related to space. It includes going to space as a tourist, watching a rocket launch, going stargazing, or travelling to a space-focused destination.

### About Sub-Orbital Trips

1. Sub-Orbital Trips involves flights that **cross the Karman line (about 100 km above Earth)**, the boundary between Earth's atmosphere and outer space, without entering orbit around Earth. **Most space tourism flights are sub-orbital trips**.
2. The spacecraft crosses the Karman line stays briefly in space, and then descends back to Earth.

**Note:** Anything flying below the **Karman line** is classified as an **aircraft** and above it is a **spacecraft**.

### Scope of longer Space Journeys

1. **Orbit and ISS Stays:** Space tourists can orbit Earth and spend days on the International Space Station (ISS) at an **altitude of about 400 km**. Dennis Tito, in 2001, spent over seven days on the ISS.
2. **Future Prospects:** Space tourism can be extended to deeper space trips to the Moon, other planets, or asteroids.

## UPSC Syllabus: Science and technology

### AI Agents

#### Why in News?

GPT-4o and Project Astra are also termed as 'AI agents'. These surpass traditional voice assistants like Alexa and Siri. This signals a shift from simple chatbots to advanced, multimodal AI agents.

#### About AI Agents



Source: Indian express



## Factly Compilation May (Third Week) 2024

**1. Definition:** AI agents are **advanced AI systems** that interact in real-time with humans using multiple modes of communication such as text, voice, and images.

Unlike traditional language models that operate solely on text, **AI agents can also process voice and visual inputs.**

**2. Functionality:** They perceive their environment via **sensors**, **process this information with AI algorithms**, and take actions based on this data. This allows them to adapt to new situations and handle a variety of scenarios.

### Differences from Large Language Models (LLMs)

**1. Enhanced Interaction:** They provide **more natural and immersive interactions** by integrating voice, vision, and environmental sensing, unlike LLMs which are restricted to generating text.

**2. Contextual Awareness:** They **understand and respond based on the context of interactions**, which makes them capable of offering personalized and relevant responses. They have autonomy to perform complex tasks such as coding and data analysis.

### Potential Uses of AI Agents

**1. Versatile Assistants:** They **can manage tasks ranging from giving personalized recommendations** to scheduling appointments, ideally suited for customer service.

**2. Educational Tools:** They can **act as personal tutors**, adapting to different learning styles and offering customized instructions.

**3. Healthcare Support:** They **can assist medical professionals** by providing diagnostic support and real-time patient monitoring.

### Risks and Challenges

**1. Privacy and Security:** As they can access and use a lot of personal and environmental data, there is a significant concern about **how this information is protected and used.**

**2. Bias:** They might also **replicate biases present in the data** or algorithms they were trained on. This **can result in unfair or harmful decisions.**

**3. Regulation Needs:** As AI agents become more widespread, there **needs to be strong rules and guidelines** to ensure they are used responsibly and safely.

## UPSC Syllabus: Polity and nation

### Foreigners Tribunals (FTs)

#### Why in News?

The Supreme Court recently stopped the deportation of a woman who had been declared a foreigner by a Foreigners' Tribunal in Assam.

#### About Foreigners Tribunals (FTs)

1. Foreigners Tribunals were established **under the Foreigners (Tribunals) Order, 1964**, which was enacted by the Central government utilizing powers from Section 3 of the Foreigners Act, 1946.

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**2. Geographical Application:** While **applicable across India**, FTs are currently **operational only in Assam**. In other states, suspected illegal immigrants are presented before local courts under the Foreigners Act, 1946.

**3. Recent amendment:** Initially, only the Central government could establish FTs. The **2019 amendment** to the Foreigners (Tribunals) Order granted this power to state governments as well.

### 4. Role and Functions of FTs

**a) Detection of Suspected Foreigners:** The superintendents of police (SPs) and district commissioners identify suspected foreigners. The Election Commission of India can also refer cases of 'Doubtful' voters to the local SP, who then refers them to the FTs.

**b) National Register of Citizens (NRC):** Individuals excluded from the final draft of the NRC released in August 2019, can appeal to the FTs to establish their citizenship.

### 5. Procedures Followed by FTs

**a) Issuance of Notices:** Upon receiving a referral, the tribunal serves the suspected individual with a copy of the grounds of suspicion and a show-cause notice within 10 days, indicating the burden of proof lies with the individual to demonstrate they are not a foreigner.

**b) Opportunity for Defense:** The FT provides the individual a fair chance to make a representation in person or via a lawyer and to present evidence supporting their claim of citizenship.

**c) Consequences of Non-Compliance:** If the individual fails to prove their citizenship and cannot secure bail, the FT orders their detention and transfer to a detention center.

**6. Legal Authority and Precedence:** SC held that the decisions of the FTs on a person's nationality are binding and hold more weight than those of the Government, NRC verification authority, or other credentials.

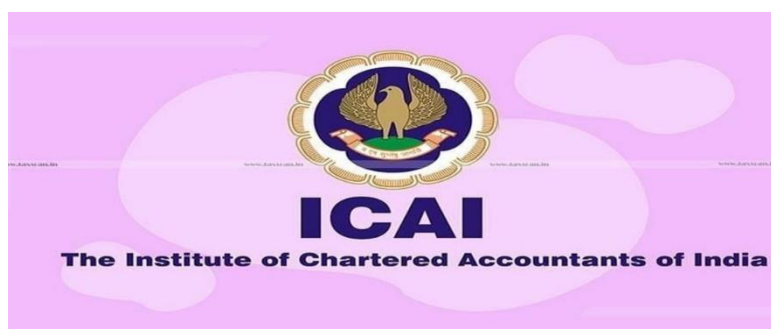
## UPSC Syllabus: Polity and nation

### Institute of Chartered Accountants of India (ICAI)

#### Why in News?

The Supreme Court recently **confirmed a regulation from the Institute of Chartered Accountants of India (ICAI) that limits chartered accountants to accepting no more than the** "specified number of tax audit assignments" in a financial year.

#### About Institute of Chartered Accountants of India (ICAI)



Source: taxscan.in

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Aspects	Description
About	ICAI is a <b>statutory body</b> created by the Chartered Accountants Act of 1949, tasked with regulating the <b>Chartered Accountancy profession in India</b> .
Operated under	It operates under the administrative control of the <b>Ministry of Corporate Affairs, Government of India</b> .
<b>Location</b>	The headquarters are located in <b>New Delhi</b> .
<b>Global Standing</b>	It ranks as the <b>second-largest professional body of chartered accountants</b> globally.
Governance	<b>1. Council Structure:</b> The affairs of the ICAI are overseen by a Council according to the <b>Chartered Accountants Act, 1949</b> , and the <b>Chartered Accountants Regulations, 1988</b> . <b>2. Council Composition:</b> The Council <b>comprises 40 members, with 32 elected by Chartered Accountants and 8 nominated by the Central Government</b> . <b>3.</b> The nominees typically represent entities like the Comptroller and Auditor General of India, the Securities and Exchange Board of India, and the Ministries of Corporate Affairs and Finance, among other stakeholders.
Functions	<b>Regulation:</b> It oversees the Chartered Accountancy profession. <b>Education and Examination:</b> Manages the education and examination of the Chartered Accountancy course. <b>Professional Development:</b> It facilitates continuing professional education and conducts post-qualification courses. <b>Standard Setting:</b> It formulates accounting standards and prescribes standard auditing procedures. <b>Ethical Standards:</b> It establishes ethical standards for the profession. <b>Quality Assurance:</b> It monitors quality through peer reviews and ensures the performance standards of its members. <b>Disciplinary Actions:</b> It exercises disciplinary jurisdiction over members. <b>Financial Reporting Review:</b> It conducts reviews of financial reporting. <b>Policy Advisory:</b> It provides input on policy matters to the government.

## UPSC Syllabus: Polity & Governance

### Election Commission Stance on Voter Turnout Disclosure

#### Why in News?

The Election Commission (EC) stated to the Supreme Court that there was **no "legal mandate"** to provide the voter turnout data to any person other than electoral candidates or their agents. The NGO on electoral

reforms ADR, claimed **delays and discrepancies in voter turnout data**, suggesting these issues could demotivate voters and raise doubts about the electoral process.

### Election Commission's Stance on Voter Turnout Disclosure

1. ECI stated there is **no legal mandate to share Form 17C data** (account of votes recorded) with anyone other than candidates or their agents, as **per the Conduct of Election Rules, 1961**.

2. **Rules 49S and 56C of the Conduct of Election Rules, 1961**: Under these rules, the presiding officer prepares an account of votes recorded in Part-I of Form 17C and makes it available to every polling agent present at the close of the poll. ECI emphasized that this framework has **"held the field for the last 60 years,"** and any changes would require amendments to the existing rules.

3. ECI opposed ADR's plea on two grounds:

a) **EC's concerns about Form 17C data**- Indiscriminate disclosure of Form 17C could lead to **image morphing and public mistrust**. Lack of scanners and internet facilities at polling stations complicates uploading Form 17C.

b) **Impracticality**- EC held that releasing authenticated voter turnout data within 48 hours is impractical due to the **detailed verification process required**.

4. **Legal Context and Previous Judgments**: Supreme Court has previously upheld the Form 17C procedure. Judiciary interference in the electoral process is barred **under Article 329(b)** from notification issuance to result declaration.

## UPSC Syllabus: Polity and nation

### eVTOL Aircraft

#### Why in News?

The **ePlane Company, incubated by the Indian Institute of Technology, Madras**, plans to launch its e-flying taxis in Bengaluru this year. However, the Indian government has not yet finalized policies for eVTOL flying taxis.

#### About eVTOL Aircraft

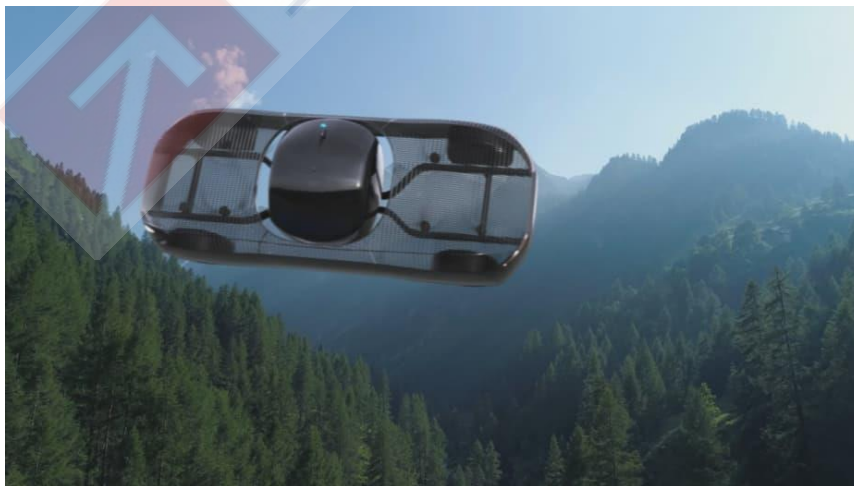


Figure 3. Source: Alef Aeronautics

1. An eVTOL (electric vertical take-off and landing) aircraft is a **type of VTOL (vertical take-off and landing)** aircraft that **utilizes electric power for hovering, takeoff, and vertical landing**. These aircraft represent a significant **advancement in aerospace technology**.

2. It is designed **primarily for low-altitude urban air**

**mobility.** It typically accommodates a small number of passengers, with models ranging from six to eight seats.

### 3. Technology Behind eVTOLs:

i) **Distributed Electric Propulsion:** eVTOLs incorporate **distributed electric propulsion technology**, which involves integrating a sophisticated propulsion system directly with the airframe.

ii) This system **includes multiple motors** that serve various functions, enhancing the aircraft's efficiency and safety.

iii) The development of eVTOL technology has been driven by **advancements in electric propulsion**, which in turn have been supported by progress in motor, battery, fuel cell, and electronic controller technologies.

iv) This growth is also spurred by the demand for innovative vehicle technologies that **facilitate urban air mobility (UAM)**.

**4. Applications of eVTOL Aircraft:** eVTOL aircraft are used in a variety of applications including:

- a) Air taxis for quick urban transportation.
- b) Delivery services for goods and packages.
- c) Emergency Medical Services (EMS) for rapid medical assistance.
- d) Cargo transport in urban and suburban areas.
- e) Recreational purposes for leisure and sightseeing.

### Advantages of eVTOL Aircraft

1. **Cost-Effectiveness:** eVTOLs are cheaper to operate and maintain compared to helicopters, potentially lowering user costs.
2. **Urban Accessibility:** Their ability to take off and land vertically enables them to operate in tight urban spaces without needing runways.
3. **Time Efficiency:** Capable of speeds up to 200 km/h, eVTOLs can significantly reduce travel times, especially in congested areas. Their speed and maneuverability make them ideal for urgent medical and other emergency services.
4. **Environmental Benefits:** As electric vehicles, eVTOLs generate no emissions, supporting cleaner urban environments. Some models are designed for quieter operations, making them suitable for noise-sensitive urban areas.

### Disadvantages of eVTOL Aircraft

1. **Regulatory Challenges:** Lack of existing regulations could delay integration and operational approval for urban use.
2. **Safety Concerns:** Ensuring the safety of eVTOL operations in crowded cities is crucial for their acceptance.
3. **Infrastructure Needs:** Requires investment in specific infrastructure like landing zones and charging stations.
4. **Air Traffic Control:** Integration into current air traffic systems is necessary to avoid collisions and manage flight paths.
5. **Limited Range and Capacity:** Most eVTOLs are suitable only for short trips and small groups, limiting their broader application.



**6. Public Acceptance:** Overcoming public skepticism regarding safety, privacy, and aesthetic impacts is essential for widespread adoption.

## UPSC Syllabus: Science and technology

### Travel & Tourism Development Index 2024

#### Why in News?

India has raised its ranking in the newly released Travel & Tourism Development Index compared to the previous report.

#### About Travel & Tourism Development Index 2024

1. This index is second edition and it has evolved from a flagship series produced by the **World Economic Forum since 2007**.
2. It is developed in partnership with the University of Surrey and incorporating insights from top Travel & Tourism (T&T) stakeholders, thought leaders, and data partners.
3. It evaluates the factors and policies that facilitate sustainable and resilient T&T development.
4. India holds the 39th position, making it the highest-ranked nation in South Asia and among other lower-middle-income economies. **This is a notable rise from the 54th position in 2021.**

#### 2. Factors Influencing India's Improved Ranking:

**a) Cultural and Natural Attractions:** India's rich cultural heritage and diverse landscapes contribute significantly to its appeal as a travel destination.

**b) Investments in Tourism:** Increased investments in tourism infrastructure, along with efforts to enhance sustainability and safety in travel and tourism, have positively impacted India's ranking.

**c) Competitive Advantages:** India is highly ranked for its price competitiveness (18th), air transport (26th), and ground and port infrastructure (25th).

It stands out as one of only three countries ranked in the top 10 across all resource pillars, with Natural Resources at 6th and Cultural and Non-Leisure Resources at 9th.

#### Challenges and Current Performance

**a) Performance Decline Since 2019:** Despite the overall improvement, India's TTDI score in 2024 is 2.1% lower than in 2019, influenced by global inflation and supply issues.

**b) Recovery from Pandemic:** While there has been a decline in price competition, and air transport and tourist services have not fully rebounded to 2019 levels, there is optimism as the sector begins to recover post-pandemic.

#### Global Tourism Trends and Outlook

The lifting of COVID-19 travel restrictions and increased travel demand are expected to drive a significant resurgence in international tourist arrivals.

The travel and tourism sector's contribution to global GDP is anticipated to return to pre-pandemic levels this year, boosting the global industry.

## UPSC Syllabus: Schemes and programme

### National Savings Certificate (NSC)

#### Why in News?

Prime Minister Narendra Modi disclosed his investments in the National Savings Certificate (NSC) scheme.

#### About National Savings Certificate (NSC)



1. **About:** The NSC is a **fixed-income investment**

Figure 4. Source: Sarkariyojna.com

scheme introduced by the Government of India. It is designed to **encourage investment and tax savings**, especially for low- to mid-income investors.

**2. Investment Process:** NSCs can be **purchased at any post office**. They can be bought in an individual's name, for a minor, or jointly with another adult.

**3. Eligibility Criteria:** Only individual Indian citizens who are residents of India. There is no age restriction for purchasing NSC. Hindu Undivided Families (HUFs), trusts, and private and public limited companies cannot invest.

#### 4. Features of NSC

i) NSC is a **secure, government-backed investment**. It offers fixed returns and significant tax benefits, making it a popular choice among conservative investors who prefer low-risk investment options.

ii) **Interest Rates:** The certificates **earn a fixed annual interest**, revised quarterly by the government.

iii) **Maturity Period:** The investment matures after **five years**.

iv) **Investment Limit:** There is **no maximum limit** on the amount that can be invested.

v) **Tax Benefits:** Investments **qualify for tax savings** under Section 80C of the Income Tax Act, up to ₹1.5 lakhs annually.

vi) **Accessibility:** NSCs are **easily transferable between post offices and individuals** without affecting the interest or maturity.

**vii) Collateral:** They can be **used as collateral for loans in banks and non-banking financial companies (NBFCs)**. Investors can nominate a family member (including minors) to inherit the certificate in case of their demise.

**viii) Premature withdrawal:** It is **not allowed except under specific conditions** such as the death of the investor, court orders, or forfeiture by a pledgee who is a Gazetted Government Officer.

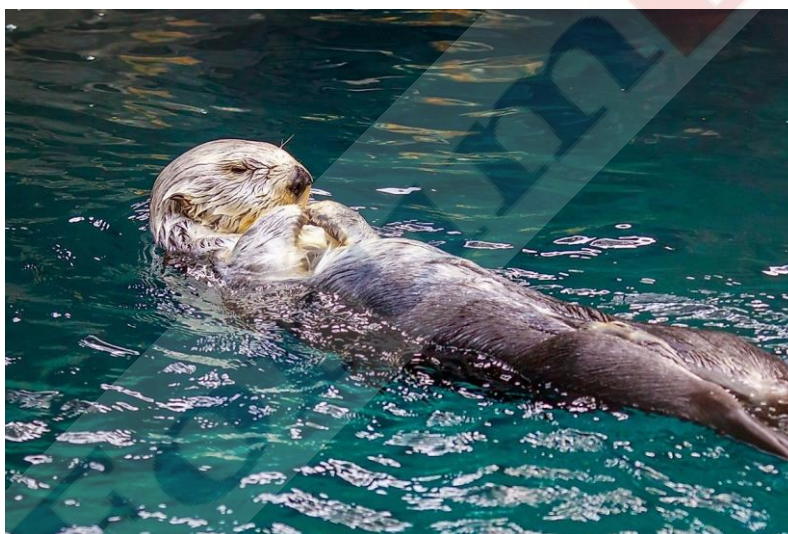
## UPSC Syllabus: Environment

### Sea otters.

#### Why in News?

A new study reveals that sea otters use tools like rocks to break open hard-shelled prey, which allows them to consume larger food items and minimizes tooth damage. The research also found that female otters use tools more frequently than males.

#### About sea otters



Aspects	Description
About	Sea otters belong to the <b>weasel family</b> and are <b>aquatic animals</b> . They are found along the <b>coasts of the Pacific Ocean</b> in North America and Asia.
Habitat	Sea otters <b>spend most of their time in the water</b> but occasionally come ashore to sleep or rest.
Physical Characteristics	They have <b>webbed feet</b> and <b>water-repellent fur</b> to stay dry and warm, with nostrils and ears that close in the water.
Diet	Sea otters typically consume about a quarter of their body weight daily, mainly foraging in <b>kelp forests and seagrass beds</b> .



Ecological Role	<p><b>1, Keystone Species:</b> The <b>health of sea otters is indicative</b> of the overall health of nearby ecosystems and other marine species.</p> <p><b>2. Ecosystem Impact:</b> They prey on sea urchins and with this sea otters <b>maintain the population balance of these creatures</b>. This prevents the overpopulation that can destroy kelp forests.</p> <p><b>3. Kelp Forests:</b> They play a crucial role in <b>preserving kelp forests</b>, which are essential for the survival of various marine species by providing shelter and food.</p> <p><b>4. Biodiversity:</b> Their presence <b>helps sustain the biodiversity</b> and <b>overall health of marine ecosystems</b>.</p>
Conservation Status	<b>IUCN Red List:</b> Sea otters are classified as <b>Endangered</b> .

### Venezuela first country to loose all its glaciers

#### Why in News?

Venezuela has **become the first country in modern history to loose all its glaciers**. Scientists have reclassified the **Humboldt glacier**, which was Venezuela’s last remaining glacier, as an ice field rather than a glacier.

#### About Glacier



Figure 5. Source: Indian Express

1) Glaciers are **large, thick masses of ice** formed from accumulated snow over centuries. They are typically found in areas where **mean annual temperatures are near freezing**.

2) They develop from significant snow accumulations that do not fully melt. They flow slowly like rivers due to gravity.

3) According to the

United States Geological Survey (USGS), the common size threshold to be classified as a glacier is about **10 hectares**

#### Reason behind disappearance of Glacier

**1) Global Warming:** The primary cause of glacier melt is global warming. It increases temperatures and leads to ice melting.

**2) Human Impact:** Since the Industrial Revolution, **human activities**, especially the burning of fossil fuels, **have increased greenhouse gas emissions**. These gases trap heat in the atmosphere, contributing to global temperature rises.

**3) Recent Trends:** Notable temperature increases in regions like the Andes have been documented, with rates up to 0.10 degrees Celsius per decade over the last seventy years. Events like **El Niño also exacerbate warming**, leading to more rapid glacier melting.

### Impacts of Glacier Loss

**1) Water Resources:** Glaciers are vital sources of freshwater, especially during dry periods. Their loss means increased dependence on unpredictable rainfall for water.

**2) Ecological Impact:** Melting glaciers affect downstream water temperatures, which is crucial for aquatic species that require colder water to survive.

**3) Sea Level Rise:** Melting of glaciers contribute substantially to global sea level rise.

**4) Cultural and Economic Effects:** In places like Venezuela, glaciers form part of the cultural identity and are important for tourism and mountaineering. Losing them can have significant cultural and economic impacts.

## UPSC Syllabus: Environment

### Critical Tiger Habitat (CTH)

#### Why in the News?

Recently, the Supreme Court directed the Rajasthan government to close 68 mines that are operating within a 1-kilometer radius of the critical tiger habitat (CTH) of the Sariska reserve.

#### About Critical Tiger Habitat (CTH)



Figure 6. Source: Times of India

**1. About Critical Tiger Habitat (CTH):** CWLHs are **designated areas within National Parks and**

**Sanctuaries** deemed necessary to remain 'inviolable' for wildlife conservation.



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They are also known as the **core areas of tiger reserves**. They are designated under the **Wild Life Protection Act (WLPA) of 1972**.

2. These areas are scientifically **identified to be maintained as inviolate zones for tiger conservation**, ensuring that the rights of the Scheduled Tribes and other forest dwellers are not affected.

3. It includes two main components within a tiger reserve:

**i) Core or Critical Tiger Habitat:** This area has **National Park or Sanctuary** status and is essential for the survival of tigers.

**ii) Buffer or Peripheral Area:** Surrounds the core habitat and provides additional support for tiger conservation.

4. The core habitat is specifically designated to ensure the long-term viability of tiger populations without compromising the rights of Scheduled Tribes or other forest dwellers.

5. Tigers are territorial animals, so their core habitat is distinct from the broader “critical wildlife habitat” applicable to other wild species.

### 6. Purpose and Criteria for CWLHs:

a) Identification of CWLHs is a **scientific process conducted on a case-by-case basis**, involving Forest Departments and scientific institutions.

b) Declaration of CWLHs involves **settling the rights of tribals and other traditional forest dwellers first**.

**7. Consultation and Consent Process:** The notification of CTH is done by the state government in consultation with the expert committee constituted for the purpose.

### About Sariska Tiger Reserve

Specifications	Details
<b>Location</b>	1. It is situated in the Alwar district of Rajasthan, within the Aravali Hills. 2. It is renowned for being the first reserve globally to have successfully relocated tigers.
<b>History</b>	It was originally a royal hunting preserve for the Maharaja of Alwar. It was designated a wildlife sanctuary in 1955 and upgraded to a national park in 1979.
<b>River</b>	The Ruparel River flows through the Sariska Tiger Reserve in Rajasthan, India.
<b>Terrain</b>	It is characterized by rocky landscapes, arid scrub thorn forests, grasslands, cliffs, and semi-deciduous forests.
<b>Flora</b>	It is dominated by dhok trees, covering 90% of the area. Other species present include salar, kadaya, gol, ber, banyan, gugal, bamboo, kair, adusta, etc.
<b>Fauna</b>	It supports a diverse array of animals such as tigers, leopards, sambhar, chital, nilgai, four-horned antelope, wild boar, rhesus macaque, langur, hyena, and jungle cats.

## UPSC Syllabus: Environment

### Bharals (Blue sheep) and Himalayan ibex Census

#### Why in News?

Wildlife authorities in Himachal Pradesh's high-altitude, cold desert district of Lahaul & Spiti have **initiated surveys to estimate the populations** of blue sheep (bharal) and Himalayan ibex. These are the primary prey for the iconic snow leopard.

#### About Bharals (Blue Sheep)



Source: Down to earth

Aspects	Description
About	<ol style="list-style-type: none"><li>1. The Blue Sheep, also known as <b>Bharal</b>, is a species of caprid (goat-antelope) <b>native to the high Himalayas</b>.</li><li>2. The term "blue" refers to the <b>bluish sheen on its coat</b>, which can appear under certain lighting conditions.</li></ol>
Habitat	<ol style="list-style-type: none"><li>1. Blue Sheep inhabit the <b>mountainous regions of the Himalayas</b>.</li><li>2. They <b>prefer steep, rugged terrains</b> where they can easily navigate and escape predators.</li><li>3. These areas often have <b>sparse vegetation and rocky outcrops</b>, providing them with ample hiding spots.</li></ol>
Physical Characteristics	<ol style="list-style-type: none"><li>1. Blue Sheep have a robust build, with a body length of about 115 to 165 cm (45 to 65 inches).</li><li>2. <b>Males are generally larger than females</b> and possess distinctive backward-curving horns that can grow up to 80 cm (31 inches) in length.</li><li>3. Their coat is <b>dense and woolly</b>, providing insulation against the cold, with a bluish-gray colour that blends well with their rocky surroundings.</li></ol>

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Diet	<ol style="list-style-type: none"> <li>Blue Sheep are <b>herbivores</b>, primarily grazing on <b>grasses, herbs, and shrubs</b>.</li> <li>In the harsh, high-altitude environment, they adapt their diet to the <b>seasonal availability of vegetation</b>.</li> <li>During the summer, they feed on fresh, green grasses. In winter, they survive on dry grasses and lichens.</li> </ol>
Distribution	<ol style="list-style-type: none"> <li>Blue Sheep are distributed across the mountainous regions of <b>Central and South Asia</b>, including parts of <b>China, India, Nepal, Bhutan, and Pakistan</b>.</li> <li>They are particularly abundant in the <b>Tibetan Plateau and the Himalayas</b>.</li> </ol>
Conservation Status	<ol style="list-style-type: none"> <li>The International Union for Conservation of Nature (IUCN) lists the <b>Blue Sheep as "Least Concern"</b> due to their wide distribution and relatively stable population.</li> <li>They do face <b>threats from habitat loss, poaching, and competition with livestock</b> for grazing areas.</li> <li>Conservation efforts focus on <b>habitat protection and reducing human-wildlife conflict</b> to ensure their populations remain stable.</li> </ol>

### About Himalayan ibex

Aspects	Description
About	<ol style="list-style-type: none"> <li>The Himalayan Ibex is a subspecies of the <b>Siberian Ibex</b> which is a type of wild goat found in the <b>mountainous regions of Central Asia</b>.</li> <li>It is known for its <b>impressive, curved horns and agility on steep terrains</b>.</li> </ol>
Habitat	<ol style="list-style-type: none"> <li>Himalayan Ibex <b>inhabit high-altitude regions</b>, typically between 3,200 to 5,000 meters (10,500 to 16,400 feet) above sea level.</li> <li>They are found in <b>rocky, precipitous areas</b> where they can evade predators.</li> <li>Their habitat includes <b>alpine meadows, scree slopes, and cliffs, often in regions with sparse vegetation</b>.</li> </ol>
Physical Characteristics	<ol style="list-style-type: none"> <li>They are <b>social animals and live in small groups, called herds</b>. During the breeding season, males compete for the attention of females and establish a hierarchy within the herd.</li> <li><b>Males are larger than females</b> and <b>possess long, curved horns</b> that can reach up to 130 cm (51 inches) in length.</li> <li>Their coat is <b>thick and coarse</b>, providing insulation against the cold.</li> <li>The <b>coloration varies seasonally</b>, from brown in summer to a darker, more insulated coat in winter.</li> </ol>
Diet	<ol style="list-style-type: none"> <li>They are <b>herbivores</b> and primarily graze on <b>grasses, herbs, and shrubs</b>.</li> <li>They are <b>well-adapted to the limited food resources</b> of their high-altitude habitats, often feeding on whatever vegetation is available.</li> </ol>
Distribution	<ol style="list-style-type: none"> <li>They are predominantly found in several regions of India, particularly in the states of <b>Jammu and Kashmir, Himachal Pradesh, and Uttarakhand</b>.</li> <li>They inhabit <b>high-altitude areas of the Himalayas</b>, including the Trans-Himalayan region, typically at elevations ranging from 3,000 to 5,800 meters.</li> </ol>
Conservation Status	It is currently classified as a <b>"Near Threatened"</b> species on the IUCN Red List of Threatened Species.

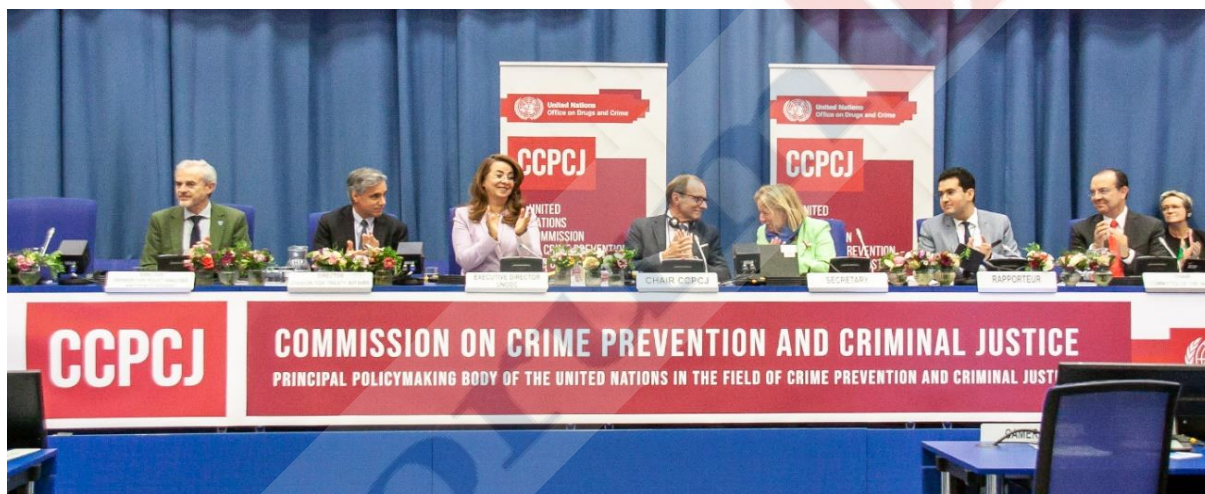
## UPSC Syllabus: International organisation

### Commission on Crime Prevention and Criminal Justice (CCPCJ)

#### Why in News?

The 33rd session of the Commission on Crime Prevention and Criminal Justice (CCPCJ) was concluded after five days of discussions. It aimed at enhancing crime prevention, criminal justice responses, and cooperation.

#### About Commission on Crime Prevention and Criminal Justice (CCPCJ)



Source:unodc.org

Aspects	Description
<b>About</b>	1) The Commission on Crime Prevention and Criminal Justice (CCPCJ) is a <b>functional commission</b> of the United Nations Economic and Social Council (ECOSOC). 2) It <b>serves as the primary organ</b> guiding the UN's activities in the fields of crime prevention and criminal justice
<b>Purpose</b>	CCPCJ provides a platform for Member States <b>to share expertise, experiences, and information.</b>
<b>Objective</b>	The aim is <b>to develop both national and international strategies</b> and to identify priorities for crime prevention.
<b>Membership</b>	<b>40 member states</b> , elected by ECOSOC, led by a Bureau



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<b>Mandates</b>	ECOSOC established the mandates and priorities for the CCPCJ in Resolution 1992/22, which encompass the following areas: i) International efforts to <b>address national and transnational crimes</b> , including organized crime, economic crime, and money laundering. ii) Advocating for the <b>role of criminal law in environmental protection</b> . iii) Focusing on <b>crime prevention in urban settings</b> , particularly juvenile crime and violence. iv) Enhancing the <b>efficiency and fairness of criminal justice systems</b> .
<b>Function</b>	i) The CCPCJ <b>acts as the preparatory and implementing body</b> for the quinquennial United Nations Congress on Crime Prevention and Criminal Justice. ii) Following the adoption of General Assembly Resolution 61/252, the <b>CCPCJ now serves as the governing body of the UN Office on Drugs and Crime (UNODC)</b> . iii) It also <b>oversees the budget for the United Nations Crime Prevention and Criminal Justice Fund</b> , which funds global technical assistance in crime prevention and criminal justice. iv) The Commission has <b>strong connections with research institutes</b> within the UN Crime Prevention and Criminal Justice Programme Network (PNI).

## UPSC Syllabus: International organization

### Antarctic Treaty Consultative Meeting (ATCM 46)

#### Why in News?

India is hosting the **46th session of the Antarctic Treaty Consultative Meeting (ATCM 46)**, also referred to as the Antarctic Parliament, from May 20-30 in Kochi.

#### About 46th Antarctic Treaty Consultative Meeting (ATCM 46)



Figure 7. Source: The Indian Express

1. About: **46th Antarctic Treaty Consultative Meeting (ATCM 46)** is also referred to as the Antarctic Parliament. It is to be **hosted from May 20-30 at Kochi, India**.

2. Organizer: **The National Centre for Polar and Ocean Research, Goa** has organised the meeting under the auspices of the Ministry of Earth Sciences (MoES). India last hosted the ATCM in New Delhi in

2007.

3. Participation: Representatives from **all 56 member countries** of the Antarctic Treaty.

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## About Antarctic Treaty

**1. About Antarctic Treaty:** It is an international agreement that governs activities in Antarctica. It was signed on December 1, 1959, and entered into force on June 23, 1961.

**2. Purpose:** The treaty designates **Antarctica as a scientific preserve** and ensures that it remains exclusively for peaceful purposes.

**3. Principles:** The Antarctic Treaty designates Antarctica as a neutral, demilitarized zone to be used solely for peaceful purposes.

**4. Signatories:** It was initially signed by 12 countries. It now includes **56 countries, with India joining in 1983.**

### 5. Key Provisions:

i) Antarctica is strictly for peaceful activities; military activities, including fortification and weapon testing, are prohibited.

ii) All activities, especially scientific research, are to be conducted freely with cooperation and data sharing among signatory nations.

iii) Nuclear explosions and the disposal of radioactive waste are forbidden.

## India in Antarctica

**1. Consultative Status:** Since 1983, India has been a consultative party to the Antarctic Treaty, participating in decision-making processes about Antarctic governance.

Research Stations:

**Dakshin Gangotri:** India's first research station, **established in 1983** and was operational until 1990.

**Maitri:** It was **established in 1989** in the **Schirmacher Oasis**, is still active, and supports summer and winter crews.

**Bharati:** It was **opened in 2012** and is located on the **Prydz Bay coast**. It focuses on oceanographic and geological studies.

**2. Future Plans:** India intends to establish **Maitri II by 2029** to replace the ageing Maitri station.

**3. Legislative Action:** In **2022**, India enacted the **Antarctic Act** to reaffirm its commitment to the treaty's principles.

## About ATCM (Antarctic Treaty Consultative Meeting)

1. The Antarctic Treaty Consultative Meeting (ATCM) is an annual gathering of the Parties to the 1959 Antarctic Treaty.

2. The ATCM consists of the original twelve signatories of the Antarctic Treaty and other nations that conduct significant research in Antarctica.

## Agenda at ATCM (Antarctic Treaty Consultative Meeting)

**1. Tourism Regulation:** India will introduce a **new working group** aimed at **formulating regulations** to monitor tourism and protect the continent's fragile ecosystem.

**2. Sustainability and Environmental Protection:** The conference will **address sustainable management** of Antarctic resources, biodiversity prospecting, and the impacts of climate change on the continent.

## UPSC syllabus: History

### Stone age and related study

#### Why in News?

New research suggests that the Stone Age, a long prehistoric period known for human and ancestral use of stone tools, could be just as aptly called the 'Wood Age'.

#### About the new research and its findings



Figure 8. Source: Indian Express

**Findings:** The site in Schöningen provided well-preserved wooden tools due to its damp, oxygen-poor soil conditions.

This discovery challenges the notion that early humans primarily used stone, highlighting a potentially greater role for wood.

1. New research from Schöningen, Germany, where wooden tools dated between 300,000 and 400,000 years old were found, suggests **these weren't just simple sticks but complex tools requiring skill and time to create.**

2. The study reveals a **variety of woodworking techniques** such as splitting, scraping, and abrasion, indicating a sophisticated understanding of wood manipulation.

3. **Thomsen's Chronology:** Christian Jürgensen Thomsen, a 19th-century Danish archaeologist, **categorized human prehistory** into the Stone Age, Bronze Age, and Iron Age. This chronology, though refined, largely shapes our understanding of human technological progress.

4. The study also reveals that despite the abundance of wood as a resource, archaeological evidence of its use is scarce compared to stone, bone, and clay due to preservation issues.

#### 5. Importance of Schöningen

### Schöningen's Insights into Early Human Behavior

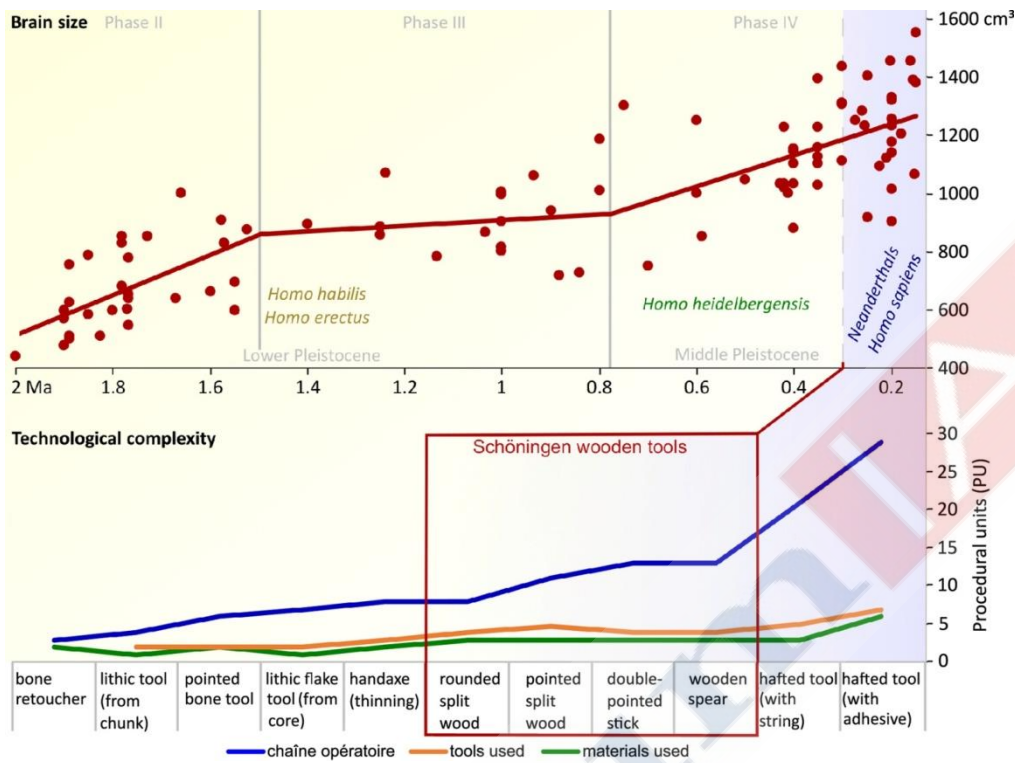


Figure 9 Source: Indian express

**1. Discovery of Spears:** In the mid-1990s, archaeologist Hartmut Thieme discovered wooden spears alongside stone tools and remains of wild horses, suggesting early humans were not mere scavengers but skilled hunters.

**2. Complex Tool Use:** Further analysis of these tools

using advanced technology like 3-D microscopy and micro-CT scanners revealed sophisticated techniques such as wood splitting, previously thought unique to modern humans.

### About stone age

1. The Stone Age is a prehistoric period that spanned from about 3.4 million years ago to 12,000 years ago.
2. This era accounts for 99% of human history and is noted for the initial use of stones for tools, weapons, and fire-making by early humans.
3. This period marks the evolution from nomadic hunter-gatherers to settled agricultural societies, including the domestication of animals and the innovation of tool usage.

### Divisions of the Stone Age

**1. Palaeolithic Period (Old Stone Age):** From the first use of stone tools up to the end of the last Ice Age, approximately 2.5 million to 10,000 years ago.

It is characterized by a nomadic existence with groups living in caves or forests. Technological and Cultural Development Included the creation of simple stone tools and cave paintings.

**2. Mesolithic Period (Middle Stone Age):** This follows the Palaeolithic, lasting from the end of the last Ice Age to the onset of agriculture. A warmer climate which supported early farming developments and the domestication of animals.

This featured more sophisticated stone tools, including the prepared-core technique, allowing the production of similarly shaped tools from the same stone.

**3. Neolithic Period (New Stone Age):** It begins with the start of farming and lasts until the introduction of metal tools, marking the beginning of the Bronze Age. Transition from nomadic to sedentary lifestyles, forming villages and towns has been seen.

This age witnessed animal domestication, the advent of agriculture, and the creation of pottery and textiles.

## UPSC Syllabus: Art and culture

### Recent study on Pyramid Construction Techniques

#### Why in the news?

A recent study on **Pyramid Construction Techniques** provides insights into how ancient Egyptians transported massive stone blocks needed for pyramid construction.

#### Findings of the study

Source: Indian Express

1. The study highlights the critical **role of the River Nile** in facilitating the construction of Egypt's pyramids. Researchers have **identified an extinct branch of the Nile** that ran adjacent to the pyramid sites, which was instrumental in moving heavy materials.
2. **Discovery of the Nile Branch:** The research team used radar **satellite imagery, historical maps, geophysical surveys, and sediment coring** to map the ancient river branch, now buried by sandstorms and a major drought.
3. The study suggests that this branch of the Nile likely **served as a waterway** for transporting not just stone blocks but also equipment and personnel, significantly easing the construction process.
4. The study showed that **several causeways leading from the pyramids** connected to inlets of this Nile branch, which may have functioned as riverine harbours.
5. The ancient Egyptians likely used **large ramps, possibly greased with water or wet clay, along with sledges, sturdy ropes, and levers** to move the stones from the harbours to the pyramid sites.
6. This discovery supports the theory that the logistical capabilities of the ancient Egyptians, including the **use of the river's natural flow**, reduced the human labor needed and optimized the construction process of the pyramids.
7. The study also revealed about the **advanced mathematical and architectural knowledge of the Egyptians**, as evidenced by the precise 52-degree gradient on each side and alignments in pyramid construction.
8. The archaeological findings of well-organized living quarters, bakeries, and food remnants near the pyramids indicate that the **laborers were well-provided for**, and that the entire construction effort was **managed by a centralized authority**.

#### UPSC Syllabus: Science and technology, World History