

# **UPSC Daily Current Affairs** | Prelimbits 19-06-2025

## **India Demonstrates Quantum Entanglement**

**Prelims: Science and technology Current events of National Importance** 

## Why in news?

Recently, Defence Research and Development Organisation (DRDO) and Indian Institute of Technology (IIT) Delhi successfully demonstrated quantum secure communication in India.

- India achieved **entanglement-based free-space quantum communication** over a **distance exceeding 1 kilometre**, marking a significant milestone in secure communication.
- **Quantum Entanglement** It is a **quantum phenomenon** where two particles (like photons) become linked such that **any change in one instantly reflects in the other**, regardless of distance.

#### **Communication through quantum entanglement**

- A pair of **entangled photons** is generated.
- $\circ\,$  One photon is sent to the **sender**, the other to the **receiver**.
- Characteristics of photons are **correlated**, allowing the generation of a **shared secret key** forming a state of quantum entanglement.
- If an outsider tries to intercept one photon, then the quantum state is disturbed and **intrusion is immediately detected**.
- **Free-Space communication** The **transmission of photons through open air**, not through optical fiber or cable.
- It enables secure links over short urban distances, remote areas, and satellite-ground communication.
- **Security** Based on the **laws of quantum physics**, any attempt to observe or intercept, changes the whole system's state.
- This makes the system **tamper-proof** and ensures that eavesdropping cannot go undetected.
- **Strategic Importance for India** It helps to secure military, financial, and governmental communications.
- It reduces dependence on foreign encryption technologies.
- It contributes to **Atmanirbhar Bharat** in the field of cyber and data security.
- Global context India now joins a list of elite countries like the USA, China, and members of the EU to demonstrate quantum communication and encryption technologies.
- It enhances India's position in the emerging quantum technology race.
- Future applications Forms the basis for Quantum Key Distribution (QKD)

networks.

- Opens avenues for satellite-based secure links and quantum internet.
- Potential use in banking, defence, space, and critical infrastructure.

#### Reference

India Today| India Demonstrates Quantum Entanglement

#### **Fossilized Leaves Discovered in Assam**

#### **Prelims: Current events of National Importance**

## Why in news?

Recently, 24-million-year-old fossilized leaves were found in Assam's Makum Coalfield, which revealed insights into ancient plant life and ecosystems.

• **Discovery of fossils** - The study was led by scientists from the **Birbal Sahni Institute of Palaeosciences (BSIP)**, Lucknow which is an autonomous body under the **Department of Science and Technology**.

The team used herbarium comparisons, cluster analysis, and CLAMP (Climate Leaf Analysis Multivariate Program) to reconstruct the past environment.

- **Plant species identified** Fossils were identified as the **oldest known record of the Nothopegia genus**, which no longer exists in Northeast India today.
- **Modern comparison** They are closely related to modern Nothopegia species found in the **Western Ghats**, located thousands of kilometres away.
- **Dating period** The fossils date back to the **late Oligocene epoch (24-23 million years ago)**, a period of significant climatic and geological change.
- Ancient climatic conditions Ancient Northeast India had a warm and humid climate, suitable for tropical species like Nothopegia similar to today's Western Ghats.
- **Geological impact** The **rise of the Himalayas** due to tectonic movements drastically changed Northeast India's climate, making it **inhospitable** for tropical plants which led to the disappearance of species.
- **Species migration** Nothopegia disappeared from Assam but survived in the Western Ghats, a climatically stable region that became its refuge.
- Ecological significance This shows how climate and geological forces can force species to migrate or vanish, affecting biodiversity over long periods.
- It also depicts that current climate change is much faster and human-driven, unlike slow ancient shifts.
- It also emphasizes the need to protect biodiversity hotspots like the Western Ghats, which act as climate refuges for ancient and rare species.

## Reference

## SIPRI Report 2025

#### **Prelims: Current events of National Importance**

## Why in new?

Recently the SIRPI Yearbook was release which is a comprehensive resource on world armaments and global security.

- SIPRI Stockholm International Peace Research Institute
- Established 19b66
- Headquarters Stockholm, Sweden
- It provides data, analysis, and recommendations on armed conflict, military expenditure, arms trade, disarmament, and nuclear forces.

## **Key Global Findings (2025 Yearbook)**

- **Global Nuclear Arsenal** Total **global nuclear warheads** is approximately 12,121 (including retired stock).
- **Countries with nuclear weapons -** 9 countries (USA, Russia, UK, France, China, India, Pakistan, Israel, North Korea).
- Russia & USA hold over 90% of global nuclear weapons.
- Russia 5,459 warheads
- USA 5,177 warheads
- **Deployment trends** Many countries are **modernising** their nuclear arsenals.
- **Dual-capable missiles** (conventional + nuclear) being developed or upgraded by Russia, China, India, Pakistan, North Korea.
- **MIRV Capability** MIRV means Multiple Independently Targetable Reentry Vehicles that allows a missile to carry several warheads.
- It is already deployed by USA, Russia, UK, France, China
- It is in development in India, Pakistan, North Korea.

# **India-Specific findings**

- Nuclear warhead count India has 180 nuclear warheads (as of January 2025)
  - $\circ$  Pakistan 170
  - $\circ~$  China 600
- Expansion & modernisation India slightly expanded its nuclear arsenal in 2024.
- It continued to focus on developing new types of nuclear delivery systems.
- Canisterised missiles India is developing canister-based missiles which,
  - $\circ\,$  Allow quick deployment.
  - $\circ\,$  Likely to carry multiple warheads in the future.
  - $\circ\,$  May shift India toward peacetime warhead-missile mating.
- Mature nuclear triad India possesses a nuclear triad,
  - $\circ\,$  Air-based Fighter aircraft

- $\circ\,$  Land-based Ballistic missiles
- Sea-based Nuclear submarines (SSBNs)
- **Strategic posture** India's nuclear policy primarily aimed at Pakistan, but growing emphasis on long-range deterrence against China.
- Increase in submarine patrols and operational readiness.
- India is increasingly seen as a **responsible nuclear power**, yet rapidly adapting to a **changing threat environment**.

#### Reference

The Indian Express| SIPRI report

## **DNA Identification Techniques**

#### **Prelims: Current events of National Importance**

#### Why in News?

After the Air India Boeing 787 Dreamliner crash in Ahmedabad, authorities are using DNA analysis to identify the remains of those killed in the accident.

- **DNA Identification** Every person <u>has a unique DNA</u> that is present in nearly every cell of their body except identical twins.
- DNA identification is the gold standard for identifying human remains, especially after mass fatality events in which bodies might not be easy to identify otherwise.
- As soon as an individual dies, their DNA begins to degrade.
- Over time, this degradation can make it difficult, even impossible, for the DNA to be analysed.
- The extent of degradation depends on the kind of tissue DNA is extracted from and the conditions in which the body is kept, among other factors.
- **Sample Collection & Storage** DNA survives much better in cold and dry conditions than in hot and humid conditions.
- So, samples must be collected as soon as possible, and once collected, stored in as cool and dry an environment as possible.
- They should ideally be *frozen at minus 20 degrees Celsius*, or, in the case of soft tissues (skin, muscles, etc.), they may be stored in 95% ethanol.
- DNA from soft tissues degrades much faster than that from hard tissues (bones and teeth).
- This is because cells in hard tissues are largely protected from the effects of putrefaction and decomposition, forensic investigators usually collect DNA from hard tissue.
- **Reference Matching** To identify who the collected DNA belongs to, reference samples are collected from biological relatives.
- Parents and children of the victim are ideal candidates for providing these samples, given that they share 50% of each other's' DNA.
- Analysis Methods After the samples are collected, the next step is to extract DNA

from them.

- Subsequently, depending on the quality of the collected DNA, scientists can choose between a number of different methods of analysis.
- Short tandem repeat (STR) analysis The method evaluates short tandem repeats, which are essentially short repeating sequences of DNA.
- STRs are used for DNA identification as they widely vary between individuals.
- Mitochondrial DNA (mtDNA) analysis This method is used when nuclear DNA is degraded or unavailable.
- Mitochondrial DNA is found within the cell's energy-producing organelles known as mitochondria.
- As mtDNA is present in multiple copies within the cell, it is easier to recover from human remains that are not well preserved.
- Y chromosome analysis Humans have two types of sex chromosomes, X and Y biological males typically have one X and one Y chromosome, and biological females typically have two X chromosomes.
- **Single nucleotide polymorphisms (SNPs) analysis** The method is typically used when the DNA to be analysed is highly degraded.
- A SNP is a variation in the DNA sequence where a single base -A, C, G, or T -at a specific location differs among people.
- Given that SNPs are unique to each person, they can be used for identification purposes with the help of reference samples taken from the victim's personal belongings such as a toothbrush and hairbrush.

## Reference

The Indian Express | How DNA identification works

# Portulaca bharat

## **Prelims: Current events of National Importance | Conservation**

## Why in News?

New plant species discovered in Aravali hills landscape near Jaipur.

- It is a *new species of flowering plant* named after Bharat serves as a symbolic reminder of India's rich and still-unfolding natural heritage.
- **Genus Portulaca** currently comprises about 153 species worldwide, primarily found in tropical and subtropical regions.
- These succulent plants are known for their toughness, water-storing tissues, and adaptation to extreme environments.
- In India, 11 species are currently known, including four endemics, mostly distributed in dry and semi-arid habitats.
- Habitat Discovered in the rocky and semi-arid landscape of Aravali hills.
- Appearance It has opposite and slightly conclave leaves and pale-yellow flowers becoming creamish-white towards apex, with the presence of glandular hairs on

stamen filaments and thick roots.

- It added to the list of India's endemics.
- The plant's narrow endemism and specific habitat requirements make it <u>highly</u> <u>vulnerable</u> to habitat degradation and climate change.
- It has been provisionally assessed as <u>"data deficient"</u> under the International Union for Conservation of Nature Red List guidelines.

#### Reference

The Hindu | Portulaca bharat

