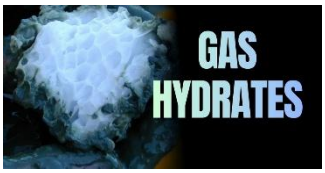
WHAT ARE GAS HYDRATES?



A reserve of natural gas bubbling from a cage of ice discovered on the ocean floor to the west of Greenland may be the deepest gas hydrate cold seep on record, and it happens to be teeming with animal life.

- Gas hydrates are **ice-like crystalline structures** that form when a **low-density gas**, **like methane,** ethane, or carbon dioxide, **combines but does not chemically bond with water and freezes into a solid under low temperature and moderate pressure.**
- **Most gas hydrates** are **formed from methane (CH_4),** which has led to the terms "**gas hydrate" and "methane hydrate" often being used interchangeably.**
- They are **classified as clathrates**, **compounds formed by** the **inclusion of one molecule within cavities in the crystal lattice of another.**
    - A unique property of clathrates is the **absence of chemical bonding,** which makes it possible to **separate them relatively easily.**
- For example, when methane hydrates are warmed or depressurized, it will revert back to water and natural gas.
- On Earth, **gas hydrates occur naturally** in some **marine sediment** and within and **beneath permafrost.**
- They are also speculated to form **on other planets.**
- Gas Hydrates are **important for a variety of reasons:**
    - Gas hydrate deposits may **contain roughly twice the carbon contained in all reserves of coal,** oil, and conventional natural gas combined, making them a potentially **valuable energy resource.**
    - **Their decomposition can release large amounts of methane,** which is a **greenhouse gas** that could impact Earth's climate.

- **Sudden release of pressurized methane gas may cause submarine landslides**, which in turn can **trigger tsunamis.**
- Gas hydrates in the ocean can be associated with unusual and possibly **unique biological communities** that **use hydrocarbons or hydrogen sulfide for carbon** and energy via a process known as **chemosynthesis**.

PINAKA LONG RANGE GUIDED ROCKET

- It is an **extended-range**, **precision-guided rocket** developed for the Indian Army's Pinaka **Multiple Launch Rocket System** (MLRS).
- It has been developed by the **Armament Research and Development Establishment** (ARDE) in association with the **High Energy Materials Research Laboratory**, Hyderabad-based Research Centre Imarat (RCI) and **Defence Research and Development Laboratory** (DRDL).

Features of Pinaka Long Range Guided Rocket:

- **Range:** Its maximum strike range of around **120 kilometres.**
- **Backward compatibility:** The rockets are backward compatible, meaning they **can fit into existing launch systems** without any significant structural changes.
- **Guidance system for improved accuracy:** It makes it highly effective in mountainous terrain, where precision is critical.
  - In the Guided Pinaka system, **launchers carry eight guided rockets** due to additional electronic components.
- It is equipped with a **guidance system** that significantly improves accuracy, enabling it to engage targets such as enemy artillery positions, command nodes and logistics installations at long distances.

INSV KAUNDINYA SETS SAIL, REVIVING INDIA'S MARITIME PAST

- INSV Kaundinya is a stitched sail ship inspired by a **5th century CE vessel** depicted in the paintings of the Ajanta Caves.
- It represents an effort to recreate India's early maritime traditions using historically authentic methods.
- **Traditional Construction and Craftsmanship**
    - After the keel laying in September 2023, the ship was built using the traditional stitching technique by a team of skilled artisans from Kerala, led by master shipwright **Babu Sankaran**.
    - Wooden planks forming the hull were stitched together with coir rope, coconut fibre, and sealed using natural resin. The vessel was launched in February 2025 at Goa. Navy formally inducted the naval sailing vessel in May 2025 at the Karwar Naval base, in Karnataka.
- **Indian Navy's Role and Interdisciplinary Design**
    - The Indian Navy played a central role by overseeing the vessel's design, technical validation, and construction.
    - With no surviving blueprints or physical remains, the design was extrapolated from two-dimensional artistic depictions.
    - The project required an interdisciplinary approach, combining archaeological interpretation, naval architecture, hydrodynamic testing, and traditional craftsmanship.
- **Dimensions, Crew, and Tankai Method**
    - INSV Kaundinya is about 19.6 metres long, 6.5 metres wide, with a draft of 3.33 metres.
    - Powered solely by sails, it is operated by a crew of around 15 trained sailors.
    - Construction follows the indigenous **Tankai method**, where the hull is stitched first and ribs are added later—completely avoiding the use of metal.

INSV Kaundinya: A Ship Built Without Engines or Metal

- INSV Kaundinya is a non-combat sailing vessel constructed entirely using a stitched shipbuilding technique dating back to at least the 5th century CE.
- Wooden planks are stitched together with coir rope made from coconut fibre and sealed with natural resins, cotton, and oils.
- This flexible hull design allows the vessel to absorb wave energy—an essential feature for ancient sailors navigating the Arabian Sea and Bay of Bengal.
- Hydrodynamic testing and stability studies were carried out with assistance from academic institutions, including **IIT Madras**, to ensure seaworthiness for open-ocean voyages.

Symbolism Embedded in INSV Kaundinya's Design

- INSV Kaundinya's structure incorporates culturally rich elements that reflect India's ancient maritime heritage.
- Her sails carry motifs of the **Gandabherunda** and the **Sun**, symbolising power and continuity, while the bow features a sculpted **Simha Yali**, a mythical guardian figure associated with strength and protection.
- A symbolic **Harappan-style stone anchor** placed on the deck evokes the subcontinent's early seafaring traditions.
- Named after **Kaundinya**, the Indian mariner who sailed across the Indian Ocean to Southeast Asia, the vessel stands as a living representation of India's long history of maritime exploration, trade networks, and cultural exchange, underscoring the civilisational depth of India's engagement with the seas.

Reviving Ancient Maritime Highways

- The Porbandar–Muscat route retraced by INSV Kaundinya was once a vital maritime corridor for trade in spices, textiles, and ideas across West Asia, Africa, and Southeast Asia.
- By sailing this route again, the vessel demonstrates the sophistication of ancient Indian shipbuilding and reaffirms India's identity as a historic maritime civilisation.

ARAVALLI HILLS AND ENVIRONMENTAL PROTECTION

- The Aravalli Mountain Range is one of the oldest surviving fold mountain systems in the world, with geological origins dating back nearly 1.5 billion years.
- Stretching over **690 km**, the range runs from **Gujarat through Rajasthan and Haryana to Delhi**, forming a crucial natural barrier in north-western India.
- Ecologically, the Aravallis play a vital role in:
    - Preventing the eastward expansion of the Thar Desert
    - Regulating regional climate and rainfall patterns
    - Recharging groundwater aquifers
    - Acting as a green buffer against air pollution, particularly for the Delhi-NCR region
- The hills host **tropical dry deciduous forests**, support diverse flora and fauna, and sustain rural livelihoods.
- Despite their importance, the Aravallis have faced severe degradation due to mining, urbanisation, and infrastructure expansion, making legal and policy protection critical.
- Over the years, multiple court orders and expert committees have attempted to define and protect the Aravallis, but **ambiguities in their legal definition** have remained a major challenge.

Legal Background to the Aravalli Definition Issue

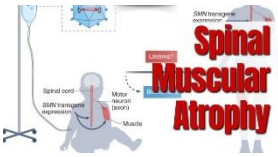
- Environmental protection of the Aravallis has largely evolved through judicial interventions rather than a single comprehensive statute. Courts have relied on:
    - The Environment (Protection) Act, 1986
    - Forest conservation principles
    - Earlier Supreme Court rulings restricting mining activities
- However, the absence of a scientifically precise and uniform definition of what constitutes the Aravalli range has led to disputes over which areas qualify for environmental protection.

- In November 2025, the Supreme Court upheld a government expert panel's definition that restricted the Aravallis to:
    - Hills with an elevation of **100 metres or more**
    - Hill clusters, slopes, and hillocks located **within 500 metres of each other**
- This definition significantly narrowed the geographical scope of the protected area.

News Summary

- In December 2025, the Supreme Court kept its own November judgment in abeyance, citing serious environmental and regulatory concerns. Key developments include:
    - The Court directed that no irreversible administrative or ecological actions should be taken based on the restrictive definition until further review.
    - Fresh or renewed mining leases in the Aravalli region were prohibited without prior approval of the apex court.
    - Widespread public concern was noted that the 100-metre elevation rule could exclude a large number of ecologically significant hills, particularly in Rajasthan, Haryana, Uttar Pradesh, and Delhi.
    - The Court observed that if lower hill ranges were excluded, it could create a "significant regulatory lacuna", enabling unregulated mining and environmental degradation.
- The Bench proposed constituting a **high-powered expert committee** to:
    - Reassess whether "regulated" or "sustainable" mining in newly excluded areas could still harm ecological integrity
    - Evaluate the short-term and long-term environmental impacts of the restrictive definition
    - Examine whether the 500-metre clustering rule creates a structural paradox, where ecologically contiguous hills remain unprotected due to technical gaps
- The Court emphasised that any final definition must be based on exhaustive scientific and geological assessment, ensuring holistic protection of the entire mountain system rather than fragmented pockets.

SPINAL MUSCULAR ATROPHY



- It is a rare and **progressive neuromuscular disorder** that leads to muscle weakness and can cause life-threatening complications.
- It is a debilitating genetic condition which **affects motor neurons** that control movement, and leads to progressive muscle weakening.
- **Cause:** Most forms of SMA are caused by **mutations of the survival motor neuron 1 gene** (SMN1) on the fifth chromosome, resulting in insufficient expression levels of the **SMN protein.**
- **Types of SMA:** There are five subtypes of **SMA- type 0, 1, 2, 3, 4.** Healthcare providers classify them based on the age of onset, as well as the severity and life expectancy.
- **Symptoms of Spinal Muscular Atrophy:**
  - Its symptoms vary and may be mild or disabling, but **involve a weakness** of the muscles that **control movement.**
  - The weakness in SMA tends to be **more severe in the muscles** that are **close to the center of your body** than in the muscles farther away from your body's center.
- **Treatment:** There **isn't a cure for SMA**. Treatment for SMA mainly seeks to manage symptoms and prevent complications.

OL CHIKI SCRIPT

- It was invented in 1925 by **Pandit Raghunath Murmu,** a writer and teacher from Mayurbhanj state (now in Odisha) in India.
- **Other names:** Ol Chiki is also known as **Ol Cemet', Ol Ciki, Ol** or the Santali alphabet.
- The Ol Chiki script itself is uniquely structured to **suit the Santali language.**
- It **consists of 30 letters** and is fully phonetic, with each letter corresponding to a distinct sound.

- The script was **first publicized in 1939** at the Mayurbhanj State exhibition.
    - **Pandit Raghunath** Murmu published various books in Santali in the Ol Chiki script, including novels, poetry, drama, grammars, dictionaries and other information about the language and script.
- It was created as a way to **promote Santali culture.**

Key facts about Santali Language:

- It is spoken mainly in **Jharkhand and West Bengal** states in northern India, and also in northwestern Bangladesh, eastern Nepal and Bhutan.
- It was included in the **Eighth Schedule of the Indian Constitution** in 2003, with Ol Chiki recognised as its official script, giving the language constitutional status.

PENCH TIGER RESERVE

- **Location:** It is located in the **southern reaches of the Satpura hills** in the Seoni and Chhindwara districts in **Madhya Pradesh** and **shares the southern boundary with Maharashtra.**
- It has been declared a National Park and a tiger reserve.
- It **derives its name** from its life line-**the River Pench** which flows from North to South.
- It comprises the **Indira Priyadarshini Pench National Park**, **the Pench Mowgli Sanctuary**, and a buffer.
- **Vegetation:** The forests in Pench tiger reserve are classified into three types:
    - South Indian **Tropical Moist Deciduous** (slightly moist)
    - Southern **Tropical Dry Deciduous Teak Forests** and
    - Southern **Dry Mixed Deciduous Forest**
- **Flora:** The reserve boasts a diverse range of flora, including **teak, saag, mahua**, and various grasses and shrubs.
- **Fauna:** The area is especially famous for large herds of **Chital, Sambar, Nilgai, Gaur** (Indian Bison), and wild boar.

MAGNETIC LEVITATION TECHNOLOGY

- It is a transportation technology which **uses electromagnets** to lift, guide and propel trains without wheels, allowing the cars to levitate slightly above the tracks.
- It is achieved through **magnets in the guideway walls** interacting with magnets on the train, move the train forward in an **almost frictionless environment.**
- **Working of Magnetic Levitation Technology**
- Maglev trains operate using two key electromagnetic principles: **magnetic attraction and repulsion.**
- The system typically consists of **three main components:**
    - **Levitation:** Magnets lift the train above the track, ensuring there is no physical contact. This minimizes wear and tear while providing a smooth ride.
    - **Guidance:** Electromagnets stabilize the train laterally, keeping it centered on the track.
    - **Propulsion:** Linear **motors generate magnetic fields** that push and pull the train along the track. This replaces the need for traditional engines or fuel.
- The tracks, known as guideways, are **embedded with powerful electromagnets**, while the trains themselves contain superconducting magnets or electromagnets.
- By carefully controlling the magnetic fields, maglev trains achieve levitation and propulsion with minimal energy loss.
- **Benefits of Magnetic Levitation Technology:**
    - **Reduced Friction:** With no physical contact between train and track, maglev systems have significantly **lower maintenance costs** and **higher energy efficiency.**
    - **Eco-Friendly:** Maglev trains **produce zero direct emissions** and can be powered by renewable energy sources, making them a sustainable alternative to fossil fuel-based transport.