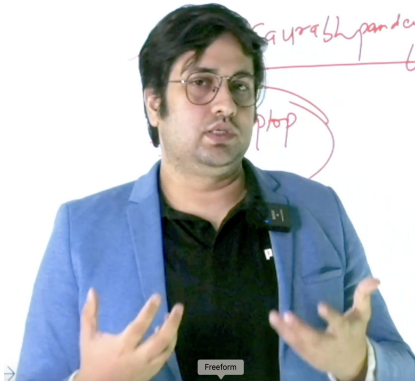
Topics - MINDS MAPS included (Daily current affairs 2nd & 1st December November 2024

- International Negotiations on Plastic Pollution
- The Bhopal Gas Tragedy: A Catastrophic Industrial Disaster
- Marine Carbon Dioxide Removal (mCDR)
- Shock Diamonds in Supersonic Flight
- The Sombrero Galaxy (M104)
- Aortic Stenosis
- Understanding Sound Waves
- MAINS



By saurabh Pandey

THE HINDU

Target Mains -2025/26 -

Q ‘Social pollution’ or ‘environment pollution’ is the culmination point of Anthropogenic factors. Examine

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Border management and internal security

Week -2 - International relations

Week -3 -Ethics and integrity

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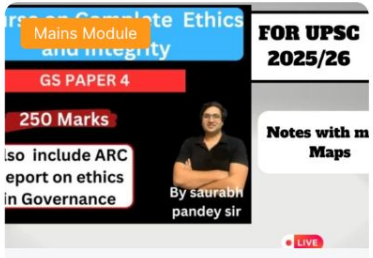

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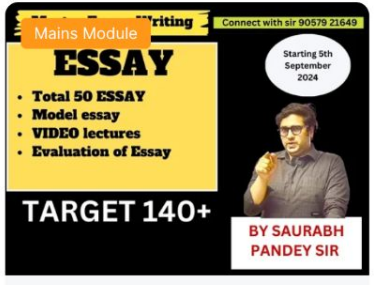

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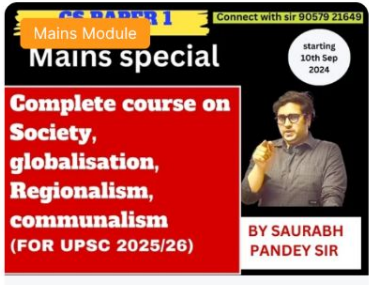

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Plastic treaty negotiations fail with countries split over production cuts

Jacob Koshy
NEW DELHI

Delegates pose for a group photo at the end of a member state press briefing during the fifth meeting of the INC in Busan. AFP

Delegates from nearly 170 countries who gathered in Busan, South Korea, failed to agree on a framework agreement to eliminate plastic pollution, despite a week of negotiations.

While this was the fifth and officially final round of talks of the Intergovernmental Negotiations Committee that began in 2022, ultimately the chasm between the blocs of countries – those that saw cutting plastic production as necessary to eliminate plastic waste and those that didn't – proved too wide to overcome. Countries, however, have decided to resume negotiations, likely sometime next year, under the tentative banner of INC-5.2.

As of Sunday evening, the assembly of countries in the final plenary expressed disappointment as well their reservations on several paragraphs in a text, which was synthesised by the Chair of the proceedings, Luis Vayas Valdivieso, following negotiations by countries in an attempt to cobble an agreement.

"We share the unhappiness we feel in this room with the limited amount of progress that we were able to make," said Hugo Schally, who spoke on behalf of the European Union at the closing plenary.

At the other end, other delegates saw proceedings as trying to reach "beyond" addressing plastic pollution. "Everyone is bringing their own lenses and turning it into a pretext for trade restrictions, economic agendas, and commercial competition disguised as environmental action," said Salman Al-Ajmi who spoke for Kuwait.

A long-standing sticking point, and vehemently opposed by countries such as Saudi Arabia whose economies are centred on petrochemicals and the production of plastic polymers, was the push to have countries set targets to cut virgin plastic polymer production. This position was also unacceptable to India.

"India would like to state its inability to support any measures to regulate the production of primary plastic polymers as it has larger implications in respect of the right to development of Member States," said Indian delegation leader Naresh Pal Gangwar of the Environment Ministry, at the plenary

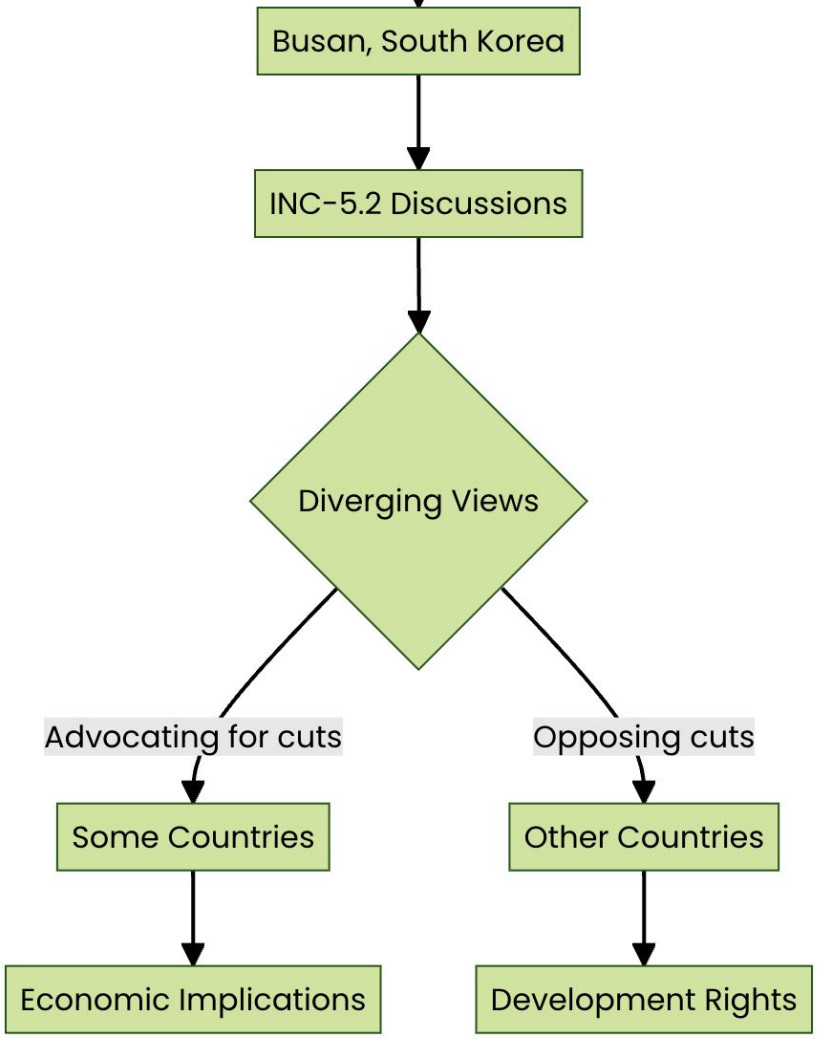
Topic → International Negotiations on Plastic Pollution

Overview of the Negotiations

🌍 Delegates from nearly 170 countries gathered in Busan, South Korea to discuss eliminating plastic pollution.
📅 This was the fifth and final round of talks for the Intergovernmental Negotiations Committee (INC), initiated in 2022.
😞 The assembly expressed disappointment over the limited progress, with concerns about the synthesized text by Chair Luis Vayas Valdivieso.

Diverging Views and Challenges

⚖️ Diverging views emerged, with some countries advocating for cutting plastic production, while others opposed due to economic implications and trade restrictions.
🏭 Countries like Saudi Arabia and India resisted proposals to set targets for reducing virgin plastic polymer production, emphasizing development rights.
💬 EU representative Hugo Schally expressed collective unhappiness over the lack of progress, while Kuwait's delegate criticized the negotiations for being influenced by economic agendas.


Busan, South Korea
INC-5.2 Discussions
Diverging Views
Advocating for cuts
Opposing cuts
Some Countries
Other Countries
Economic Implications
Development Rights

40 years after Bhopal gas tragedy, Union Carbide's toxic waste yet to be removed

Plan to dispose of 337 tonnes yet to be implemented; no plan for 11 lakh tonnes of contaminated soil plus mercury and waste dumps; Supreme Court and NGT orders ignored for years as groundwater contamination spreads; the Centre has released ₹126 crore to the Madhya Pradesh government

Nikhil M. Babu
NEW DELHI

Four decades after the Bhopal gas tragedy, hundreds of tonnes of toxic waste remains on the premises of Union Carbide India Ltd. (UCIL). Despite multiple court orders and warnings, government authorities have not disposed of the waste safely, officials confirmed to *The Hindu*.

The Union government has released ₹126 crore to the Madhya Pradesh government to carry out plans to dispose of 337 tonnes of the toxic waste, which was collected and kept on the premises of the factory in 2005, documents show.

However, a 2010 government-commissioned study showed that apart from this 337 tonnes of toxic waste, the factory premises contains about 11 lakh tonnes of contaminated soil, one tonne of mercury, and nearly 150 tonnes of underground dumps. The government has no plans yet on how to deal with this. The presence of waste dumps within the premises shows that the 2005 collection of waste was "incomplete", the 2010 report noted. It had then recommended excavation of the toxic waste from the dumps in order to remediate it. Subsequently, a "peer review committee", formed in 2010 to look into different government studies till that point, recommended a comprehensive assessment. Fourteen years later, however, a proper reassessment is yet to be done.

"Though ₹126 crore was released in March this year for disposing 337 tonnes of waste, the State government is yet to actually begin the process of disposing it on the ground. We understand that there are some administrative issues," a Union government official told *The Hindu*.

Children with congenital disabilities pay tribute to victims of Bhopal disaster in front of the abandoned Union Carbide factory. A.M.FARUQUI

Delayed reassessment

In June 2023, an oversight committee – which met 12 years after its last meeting on May 25, 2011 – had again recommended that the Madhya Pradesh government undertake fresh studies to quantify groundwater and soil contamination and the underground dumps of toxic waste.

Asked about the rest of the waste and the reassessment, the official said, "A proposal for reassessment of the toxicity after the 2010 study was also submitted to the State government about six months back, but that has also not made much headway. The government is first trying to deal with the 337 tonnes of waste and then look into the rest of it."

Another source privy to the development also said that reassessment is necessary as it has been 14 years since the 2010 study and the ground realities would have changed by now. "But there is no movement on this front as of now," the source added.

Water contamination

Over the years, various government and non-governmental studies have found groundwater in different residential areas outside the factory contaminated with heavy metals and other toxic substances, which could lead to cancer and other diseases. Now, experts say there are chances of the contamination spreading further.

On March 20 this year, the National Green Tribunal (NGT) pulled up the government for its inaction. "It is a known fact that the chemical waste where it is accumulated is creating leachate and further contaminating the surface water, underground water, and in the rainy seasons, by flow to the other places and water of the river bodies are also being contaminated by this chemical waste," it observed.

The Madhya Pradesh government did not respond to *The Hindu*'s queries.

The root cause of the problem is the solid, semi-solid, liquid and tarry wastes generated during the manufacture of pesticides and associated chemicals which were dumped by UCIL between 1969 and 1984 within the factory premises, which closed down after the gas leak tragedy which occurred on the intervening night of December 2 and 3, 1984.

In 2004, the Supreme Court noted, "The report (by a court-appointed committee) records that due to indiscriminate dumping of hazardous waste due to non-existent or negligent practices together with lack of enforcement by authorities, the ground water and, therefore, drinking water supplies have been affected/damaged."

In 2005, the Madhya Pradesh Pollution Control Board through a private company collected waste from the factory premises. A small portion was incinerated and the remaining 347 tonnes of waste was kept it in a shed within the factory premises. In August 2015, the Central Pollution Control Board (CPCB) incinerated around 10 tonnes of this waste on a trial basis at a facility in Pithampur and recommended the same for the rest of the waste.

In 2022, an NGT-appointed committee said there was a "possibility of contamination of soil" and suggested "speedy disposal" of the waste. In March 2022, citing the "serious unsatisfactory" state of affairs as well as "apathy" and "failure" of the authorities, the NGT ordered the State government and other agencies to take action within six months. The order was not followed.

Topic → The Bhopal Gas Tragedy: A Catastrophic Industrial Disaster

Overview

🏭 The Bhopal Gas Tragedy occurred on December 2-3, 1984, in Bhopal, India.
☠️ It stands as one of the world's worst industrial disasters, resulting in thousands of immediate deaths and long-term health effects for many survivors.
🌍 The incident was triggered by a gas leak at the Union Carbide pesticide plant, releasing methyl isocyanate (MIC) gas into the atmosphere.

Impact

🚑 Over 500,000 people were exposed to the toxic gas, leading to respiratory issues, eye problems, and other health complications.
⚖️ The disaster raised significant legal and ethical questions regarding corporate responsibility and safety regulations in industrial operations.

Aftermath

📉 The tragedy led to a decline in public trust in industrial safety and prompted changes in environmental laws and disaster management protocols in India.
🕊️ Commemorative events are held annually to honor the victims and raise awareness about industrial safety.

Summary

The Bhopal Gas Tragedy was a catastrophic industrial accident in 1984 that caused widespread health issues and raised critical safety concerns.

In our fight against climate change, could the seas turn the tide?

The open seas offer an immense opportunity to slow climate change if we invest now and do it right. The ocean has absorbed 25% of anthropogenic carbon dioxide emissions and more than 90% of the excess heat generated by greenhouse gases. Investing in sequestration within the wide-open expanse of the ocean is logical and inevitable

Pranay Lal

The ocean, the earth's vast blue lung, has long played a critical but underappreciated role in moderating the planet's climate. It has absorbed 25% of anthropogenic carbon dioxide emissions and more than 90% of the excess heat generated by greenhouse gases, buying humankind precious time against the worsening effects of climate change.

However, this seemingly boundless capacity comes at a cost: ocean acidification, disrupted biogeochemical cycles, pollution, and profound harm to marine ecosystems. Acidification, for instance, threatens calcifying organisms like coral and shellfish, while warming alters ocean circulation and deoxygenates vital marine habitats. These disruptions cascade through ecosystems, undermining the services they provide – from fisheries to carbon sequestration. The ocean's natural carbon and heat absorption processes, though crucial, are slow and carry ecological consequences.

A different suite of options

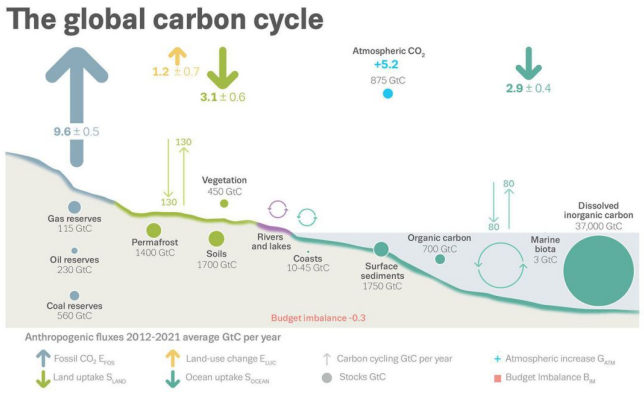
As we grapple with the dual imperatives of decarbonisation and climate resilience, attention is increasingly turning to marine carbon dioxide removal (mCDR) to complement emissions reductions and address lingering carbon dioxide burdens. The ocean's immense surface area and unique chemistry make it a tempting venue for natural and carefully engineered solutions. So far, all our efforts to fight climate change have been land-biased. We have invested heavily on land but ignored oceans, seas, lakes, and rivers. Several studies tell us that the land is saturated because soils and rocks are so severely damaged that they no longer support efficient carbon capture.

Oceans, seas, rivers, and even lakes offer a different suite of options. Deep-water bodies retain the ability to remove excess carbon rapidly from the atmosphere. They also transport the carbon into depths where it mixes and binds with minerals. As on land, marine carbon capture strategies fall into two categories. (i) Biotic approaches take advantage of living systems like mangroves and macroalgae or of our rivers to carefully calibrate biomass burial at sea. (ii) Abiotic approaches manipulate physical or chemical properties, such as through ocean alkalinity enhancement (OAE), and are more complicated but are also becoming unavoidable. Both these methods promise to capture and store carbon for the long term and potentially transform countries' contributions to climate goals.

Biotic, or nature-based, solutions rely on the inherent potential of ecosystems to sequester carbon while supporting biodiversity conservation and coastal protection. They are also relatively well-established, with some already integrated into national climate plans. However, their carbon sequestration potential is modest – typically capped at less than one billion tonnes of carbon dioxide every year – and storage durations are limited to hundreds or at best thousands of years.

Abiotic techniques, by contrast, offer greater scalability and permanence. For example, biomass burial at sea, if done right, can sequester seven to 22 billion tonnes of carbon dioxide per year. Reducing the acidic nature of the seas through OAE is another option. Here, alkaline materials are added to sea water to neutralise its carbon dioxide content, locking the carbon away for tens of thousands of years in the form of dissolved inorganic molecules. This method could potentially sequester one to 15 billion tonnes of carbon dioxide per year, an order of magnitude higher than biotic methods.

To put this in perspective, if we wish to keep global warming below 1.5 C , all our efforts must collectively cap emissions at 570 billion tonnes of carbon dioxide and reach net zero by 2050. But at today's relentless pace, this carbon budget will vanish by 2031. Yet abiotic approaches face hurdles, including public scepticism, regulatory challenges, and the need for extensive energy inputs – particularly in cases involving mineral mining or electrochemical processes.



Schematic representation of the overall perturbation of the global carbon cycle caused by anthropogenic activities, averaged globally for the decade 2012-2021. The uncertainty in the atmospheric CO2 growth rate is very small (±0.02 billion tonnes per year) and is neglected for the figure. GLOBAL CARBON PROJECT

If we wish to keep global warming below 1.5C, all our efforts must collectively cap emissions at 570 billion tonnes of carbon dioxide and reach net zero by 2050. But at today's relentless pace, this carbon budget will vanish by 2031

Promise for deep carbon burial

Despite its promise, mCDR is fraught with uncertainties and potential side effects as well. Techniques like ocean iron fertilisation, which claims to stimulate phytoplankton blooms to capture carbon dioxide, can disrupt other ecosystems and lower the oxygen content of deeper waters. Macroalgae cultivation, another proposed solution, carries similar risks when decaying biomass alters the local chemistry. Even OAE, which experts have touted for its scalability, raises concern about its consequences for marine biodiversity and the energy-intensive processes it may require.

Public perception further complicates deployment. Measuring how much carbon is captured and stays buried also remains a challenge since the seas are expensive to monitor. Many people view abiotic techniques as unnatural or harmful and favour biotic approaches instead, like direct air capture. Overcoming this scepticism will require communication, rigorous assessments, and stakeholder engagement. Critically, mCDR is not a substitute for reducing emissions. It cannot offset the current scale of fossil fuel combustion. However, as the world transitions toward net-zero emissions, leveraging the oceans and the seas becomes indispensable.

The careful study of geological and ecological methods offers a chance to harness their power and vastness of oceans. Success hinges on rigorous science, robust governance, and societal trust. The Indian Ocean, with its vast arms holds untapped promise for deep carbon burial, potentially capturing 25-40% of the marine carbon dioxide. Harnessing these natural systems could provide a critical edge, turning the tide on runaway warming.

(Pranay Lal is a biochemist, a natural history writer, and the co-founder of the climate group Deep Carbon. pranaylal@gmail.com)

THE GIST

The capacity of oceans to absorb carbon comes at a cost: acidification, pollution, and harm to marine ecosystems. It causes disruptions that cascade through ecosystems

The ocean's immense surface area makes it a tempting venue for carefully engineered solutions. So far, efforts to fight climate change have been land-biased, but studies tell us that the land is saturated and can no longer support carbon capture

Marine carbon sequestration is not a substitute for reducing emissions. It cannot offset fossil fuel combustion. However, as the world transitions toward net-zero, leveraging the oceans becomes indispensable

Topic → Marine Carbon Dioxide Removal (mCDR)

🌊 Marine Carbon Dioxide Removal (mCDR): Focuses on the ocean's capacity for carbon capture as a complementary strategy to emissions reductions.

🌍 Land vs. Ocean Focus: Historically, climate efforts have targeted land-based solutions, often overlooking the potential of aquatic systems like oceans, seas, lakes, and rivers.

🌊 Deep-water Carbon Capture: Utilizes deep-water bodies to rapidly remove atmospheric carbon, transporting it to depths where it binds with minerals.

🌱 Biotic vs. Abiotic Approaches:

- Biotic: Involves living systems (e.g., mangroves, macroalgae) for carbon sequestration.
- Abiotic: Manipulates physical properties (e.g., ocean alkalinity enhancement) for scalability and permanence.

📉 Carbon Sequestration Potential:

Biotic: Sequesters less than 1 billion tonnes of CO_2 annually.

Abiotic: Captures between 1 to 22 billion tonnes per year.

⚖️ Challenges for Abiotic Techniques: Faces public skepticism, regulatory hurdles, and high energy requirements.

⏳ Urgency of Action: To limit global warming to 1.5°C, emissions must be capped at 570 billion tonnes by 2050, with the current pace potentially exhausting this budget by 2031.

🌊 Promise of mCDR: Offers potential for deep carbon burial but comes with uncertainties and risks.

🐠 Ecosystem Disruption: Techniques like ocean iron fertilization can disrupt marine ecosystems and reduce oxygen levels in deeper waters.

🌱 Risks of Macroalgae: Cultivating macroalgae may alter local chemistry when decaying, posing similar ecological risks.

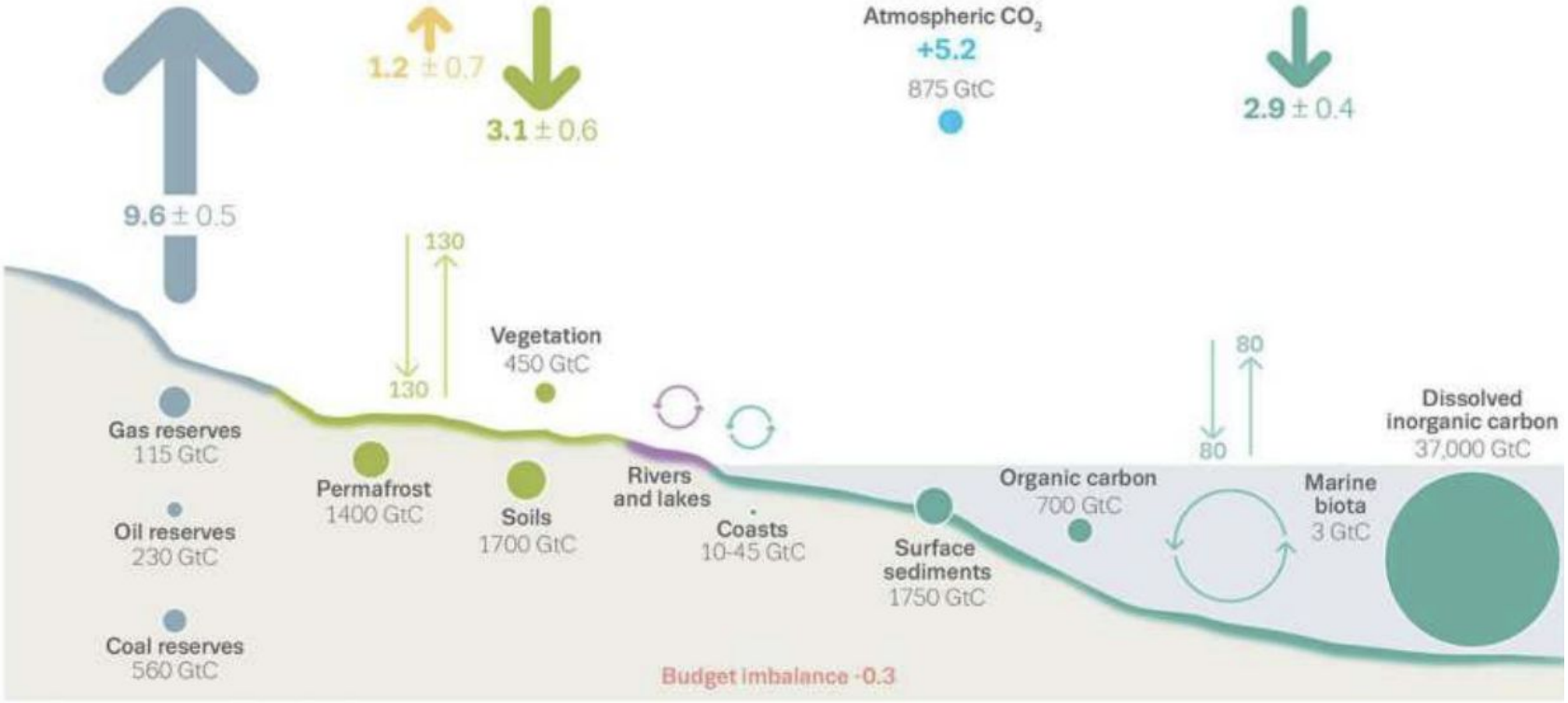
📉 Public Perception: Skepticism exists towards abiotic carbon capture methods, with a preference for biotic approaches like direct air capture.

🔍 Monitoring Challenges: Accurately measuring carbon capture and burial in the ocean is difficult and costly.

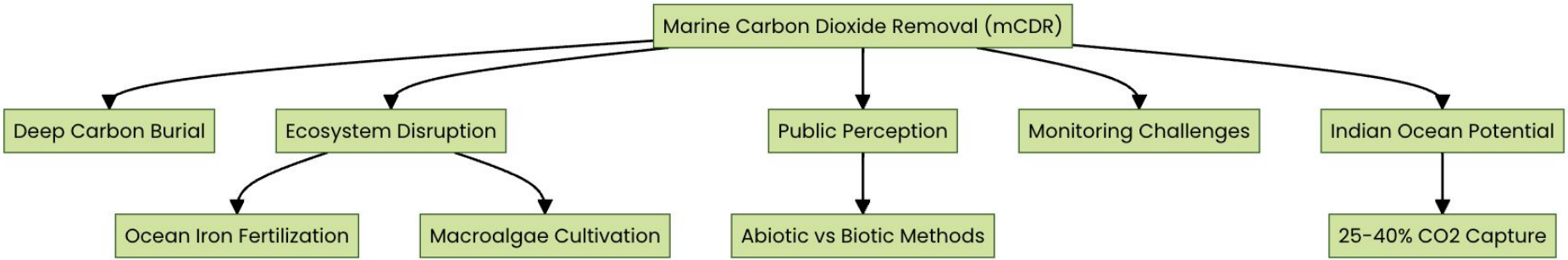
⚖️ Not a Substitute: mCDR cannot replace the need for reducing fossil fuel emissions; it is a complementary strategy in the transition to net-zero.

🌍 Indian Ocean Potential: Could capture 25-40% of marine CO2, highlighting the importance of studying geological and ecological methods

The global carbon cycle



Conceptual Overview:



Target UPSC PRELIMS

Q. With reference to the Moiré material consider the following statements. (The Hindu)

1) A moiré material formed by twisting two layers of tungsten diselenide ($tWSe_2$) by a small angle, creating a unique electronic structure with flat energy bands.

2) Driven by strong electron-proton interactions and half-band filling it exhibits a semiconductor capacity.

Which of the given statements is/are incorrect.

A) 1 Only

B) 2 Only

C) Both 1 and 2

D) Neither 1 or 2

WHAT IS IT?

Shock diamonds: supersonic heat nuggets

Sometimes when a rocket or a jet takes off, its exhaust has an alternating pattern of light and dark patches (see image). The bright patches in this formation are called shock diamonds, a.k.a. Mach diamonds. Shock diamonds are formed when an engine releases its exhaust into the atmosphere at a supersonic speed.

Just as it leaves the engine, the exhaust can be at a lower pressure than atmospheric pressure at the same altitude. As the exhaust flows out, the atmosphere compresses it until the two pressures are equal. It's also possible that the exhaust becomes over-compressed, at which point it will expand outward again to drop its pressure. This seesawing process may repeat itself multiple times until the exhaust pressure is close to the atmospheric pressure. This entire process generates waves in the exhaust plume, leading to the formation of shock diamonds.

When the atmospheric pressure bears down on the plume, it causes exhaust that's diverging outward to bend inward instead, before its pressure causes the exhaust to bend outward again and so on. When it flows inward, the pressure in that portion increases, hiking the temperature there and causing any fuel passing through that area to burn. The combustion creates a bright spot at that location, i.e., a shock diamond. The bending of the exhaust outward and inward produces shock waves that flow through the plume, creating the shock diamond pattern throughout.

An SR-71 Blackbird takes off from the Dryden Flight Research Centre, California, on March 9, 1993. Shock diamonds are visible in its exhaust. NASA

- Vasudevan Mukunth

Topic → Shock Diamonds in Supersonic Flight

🚀 Shock Diamonds

Definition: Bright patches in rocket or jet exhaust, also known as Mach diamonds, formed during supersonic flight.

🌬️ Pressure Dynamics

Initial Pressure: Exhaust exits at a lower pressure than the surrounding atmosphere.
Interaction: Leads to complex interactions as the exhaust expands and compresses.

🔄 Seesawing Process

Cycles: Exhaust undergoes multiple cycles of compression and expansion.
Pressure Alignment: Continues until the exhaust pressure aligns with atmospheric pressure.

🌊 Wave Generation

Pressure Changes: Create waves in the exhaust plume.
Contribution: These waves contribute to the formation of shock diamonds.

🔥 Combustion Effects

Inward Bending: Exhaust bends inward, increasing pressure.
Temperature Rise: Higher pressure raises temperature, igniting fuel and creating bright spots.

📈 Temperature Increase

Local Temperature: Inward flow raises local temperatures.
Visibility: Enhances the visibility of shock diamonds.

🌌 Shock Wave Production

Alternating Bending: Generates shock waves.
Propagation: Shock waves propagate through the plume, establishing the diamond pattern.

Summary: Shock diamonds are bright patterns in jet and rocket exhaust formed by the interplay of pressure and temperature during supersonic flight.

BIG SHOT

The Mid-Infrared Instrument (MIRI) of the James Webb Space Telescope captured this brilliant new view of the famous Sombrero Galaxy (officially M104). The core of the galaxy is dim in this view, revealing a smooth inner disk as well as details of how the clumpy gas in the outer ring is distributed. Its name comes from an image by the Hubble telescope, where, together with its prominent core, it appeared like the broad-brimmed hat. NASA

Topic → The Sombrero Galaxy (M104)

Overview

- 🌌 Designation: The Sombrero Galaxy is officially known as M104.
- 🌠 Location: It resides in the Virgo constellation.
- 🔭 Distance: Approximately 28 million light-years from Earth.
- 🌟 Features: Notable for its bright nucleus and prominent dust lane.
- 📏 Size: The galaxy spans a diameter of about 50,000 light-years.
- 🌍 Cluster: Part of the Virgo Cluster, which includes numerous other galaxies.
- 🪐 Photography: Known for its striking appearance, making it a popular subject for photography.

Summary: The Sombrero Galaxy (M104) is a prominent spiral galaxy in Virgo, recognized for its bright nucleus and dust lane, located 28 million light-years from Earth

A flutter

Bird society: A Eurasian blue tit (*Cyanistes caeruleus*) leaves with a seed in its beak at the feeding ground called 'Smurfs' Village' for birds and squirrels built by Hungarian artist Tamas Kanya using organic materials in Budakalasz. AFP

Topic → Blue Tit: A Fascinating European Bird

🐦 The blue tit is scientifically known as Cyanistes caeruleus.

🍃 The text mentions "leaves," indicating a potential focus on the blue tit's habitat or diet.

🌍 Blue tits are commonly found across Europe and parts of Asia.

🥜 They are known for their acrobatic feeding habits, often seen hanging upside down to access food.

🎶 Blue tits have a distinctive song and are known for their vocalizations.

🏡 They typically nest in tree holes or artificial nest boxes.

🌱 The blue tit plays a role in the ecosystem by helping to control insect populations.

Summary: The blue tit (Cyanistes caeruleus) is a European bird known for its acrobatic feeding and distinctive vocalizations, often associated with leaves in its habitat.

Inching closer towards human spread

A highly pathogenic avian influenza virus has been spreading across the world since late 2020 driven by a new virus lineage — 2.3.4.4b

- Recent human H5N1 cases in British Columbia, Canada and California have increased concerns about the adaptability of the virus and possible mutations that could facilitate human-to-human transmission
- These two cases have no exposure to H5N1 infected animals
- The British Columbia teenager diagnosed with H5N1 in November 2024 initially experienced conjunctivitis and fever, which rapidly progressed to acute respiratory distress syndrome
- Genomic sequencing revealed that the virus belonged to the 2.3.4.4b clade, genotype D1.1, consistent with strains found in wild birds
- Health officials suspect that the virus may have evolved after infecting the teenager
- Genome sequencing identified the PB2-E627K mutation in the teenager's sample
- This mutation is linked to faster replication in human cells and greater severity of illness

Common heart valve disease linked to insulin resistance

A large population study indicates that insulin resistance may be an important risk factor for the development of heart valve disease – aortic stenosis. Data from over 10,100 Finnish men aged 45 to 73 years old, all initially free of aortic stenosis were analysed. After an average follow-up period of 10.8 years, 116 men (1.1%) were diagnosed with aortic stenosis. Several biomarkers related to insulin resistance (fasting insulin, proinsulin, and serum C-peptide) were associated with increased aortic stenosis risk.

Topic → Aortic Stenosis: Understanding the Condition

Overview

🫀 Aortic stenosis is a condition marked by the narrowing of the aortic valve opening.
⚠️ This narrowing can result in reduced blood flow from the heart to the rest of the body.

Symptoms and Diagnosis

🩺 Common symptoms include chest pain, fatigue, and shortness of breath during physical activity.
🔬 Diagnosis is typically made through echocardiograms and physical examinations.

Treatment and Management

💊 Treatment options may involve medication, lifestyle changes, or surgical procedures such as valve replacement.
📈 The condition is more prevalent in older adults, especially those with a history of heart disease.
🏥 Regular monitoring is crucial for managing the condition and preventing complications.

Summary

Aortic stenosis is a serious condition that requires careful management to prevent heart-related complications

Loud noise and the heavy toll on ears

SPEAKING OF SCIENCE

D. Balasubramanian

The festival of Deepavali is behind us now. All our festivals bring us joy, and the festival of light is also accompanied by a great deal of sound. There are pleas for the use of green crackers to bring down harmful emissions such as sulfur dioxide, and to reduce the noise created when they are ignited. These have been mandated by the Supreme Court, with detailed specifications such as a ban on the manufacture and sale of firecrackers that are joined into long rows. But every passing year, their loud sounds continue to be heard in festival seasons.

Public attention is focused on the resultant air pollution, but of equal concern is the damage that very loud sounds can do to our hearing. Going beyond firecrackers, the year-round noise levels also get less attention than other forms of pollution. It is as if noise is more easily accepted as part of our surroundings, and acceptance is even easier when you are yourself creating the noise.

Sound travels in waves that carry energy. The more energy, the more intense the wave, and the louder the sound. The decibel scale is used to measure the loudness of sound. It is a logarithmic scale, so when the sound level is measured to have risen by10 dB, the sound is ten times more intense. On the decibel scale, the threshold of human hearing is set at 0 dB. A whisper measures 30 dB, and normal speech is 60 dB. A loud firecracker, measured from 10 feet away, has an intensity of 140 dB. This can easily damage the hair cells in the cochlea of the ear, which receive vibrations from the eardrum and convert them to nerve signals. Damage to these hair cells makes them less sensitive to sound. As a result, louder sounds are required before a hair cell can respond and nerve impulses are sent to the brain. The hair cells can recover somewhat from moderately loud sounds. However, unlike our skin cells, these cells are incapable of regeneration. Repeated assaults can make recovery difficult, resulting in noise-induced hearing loss.

Hard to hear: A loud firecracker, measured from 10 feet away, has an intensity of 140 dB. FILE PHOTO

Loud bangs are a serious hazard for the sensitive ears of young children, because even moderate hearing loss can impair their ability to learn. The acoustic trauma of overexposure to noise often leads to tinnitus, a ringing in your ears. This 'sound' is a sign of anomalous electrical activity from damaged hair cells. The ringing usually subsides, but prolonged exposure to noise events can make it a permanent feature of your life. Of course, tinnitus can also be present in the elderly, arising from age-related wear-and-tear.

Occupational noise

Long exposures to moderate-intensity sound levels can lead to hearing loss as surely as loud bangs will. Road traffic in Indian cities has been measured to range from 60 to 102 dB in a day. A 2008 study in the *Indian Journal of Occupational and Environmental Medicine* on Hyderabad city traffic policemen with five years of service has found varying degrees of hearing loss in all of them, as reported by Subroto Nandi and Sarang Dhatrak in their survey of occupational noise in India.

Preventive measures, such as the wearing of earplugs, help reduce the risk of hearing loss. Some professions, such as the construction industry, have been adopting these where required, but the practice needs to be more widespread. Perhaps, even before green crackers prevail, earplugs will someday be a common sight on festival nights.

(The article was written in collaboration with Sushil Chandani, who works in molecular modelling. sushilchandani@gmail.com)

Topic → Understanding Sound Waves and the Decibel Scale

Overview of Sound Waves 🌊

Travel in Waves: Sound travels as waves that carry energy.

Energy Intensity: More energy results in more intense waves and louder sounds.

Key Points

Sound intensity is measured in decibels (dB).

The decibel scale is logarithmic, meaning every increase of 10 dB represents a tenfold increase in intensity.

Decibel Thresholds

0 dB: Threshold of hearing.

30 dB: Whisper.

60 dB: Normal conversation.

140 dB: Intensity of a loud firecracker

Question Corner

Launching seeds

How does the squirting cucumber squirt?

The squirting cucumber (*Ecballium elaterium*) is named for the ballistic method the species uses to disperse its seeds. When ripe, the fruits detach from the stem and eject the seeds explosively in a high-pressure jet of mucilage. Through mathematical models and by conducting a variety of experiments, researchers have elucidated the key components of the plant's dispersal strategy. In the weeks leading up to seed dispersal, the fruits become highly pressurised due to a build-up of mucilaginous fluid. In the days before dispersal, some of this fluid is redistributed from fruit to stem, making the stem longer, thicker, and stiffer. This causes the fruit to rotate from being nearly vertical to an angle close to 45 degrees, a key element needed for successful seed launch. In the first hundreds of microseconds of ejection, the tip of the stem recoils away from the fruit, causing the fruit to counter-rotate in the opposite direction. Due to the components above, the seeds are ejected with an exit speed and launch angle that depend on their sequence.

Readers may send their questions / answers to questioncorner@thehindu.co.in

Topic → Squirting Cucumber: Explosive Seed Dispersal 🌱💥

Explosive Seed Dispersal Mechanism

🌱 The squirting cucumber (*Ecballium elaterium*) uses a ballistic method to disperse its seeds explosively.
💥 When ripe, the fruits detach from the stem and eject seeds in a high-pressure jet of mucilage.
🔬 Researchers have studied the plant's dispersal strategy through mathematical models and various experiments.
📈 Prior to seed dispersal, the fruits build up pressure from mucilaginous fluid, which is redistributed to the stem.

📏 This redistribution makes the stem longer, thicker, and stiffer, allowing the fruit to rotate a 45-degree angle for effective seed launch.

🔄 In the initial microseconds of ejection, the stem recoils, causing the fruit to counter-rotate, enhancing seed ejection dynamics.

🎯 The exit speed and launch angle of the seeds depend on their sequence during the ejection process.

Summary: The squirting cucumber employs a unique explosive mechanism for seed dispersal, involving pressure buildup and strategic fruit rotation

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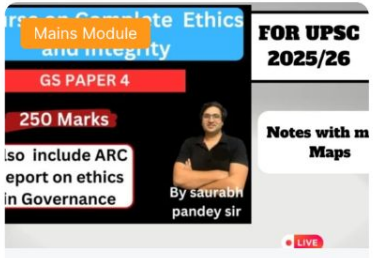

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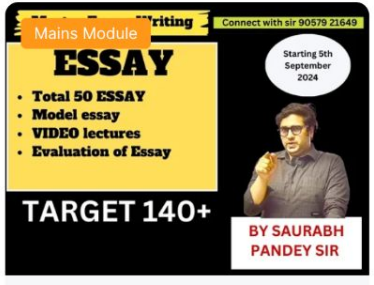

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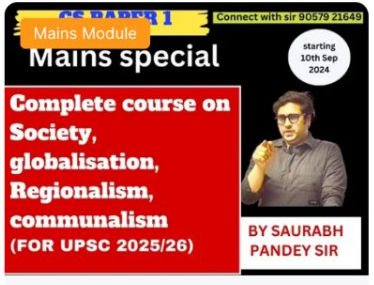

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