JANUARY 2024 GES REPORTER

SAURABH PANDEY
CSE
(CIVIL SERVICES EXAMINATION)
FROM BASICS TO UPSC BRILLIANCE

For Civil services UPSC/IAS exam

By Saurabh Pandey Sir

January 2024

GES Reporter

Covers Geography, Environment, science Current Affairs for UPSC CSE civil services exams

Saurabh Pandey — *Mentor*

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GES Reporter

About Author

Saurabh Pandey established Saurabh Pandey CSE Channel an online learning platform. He has 8 years of experience in teaching for the UPSC/IAS exam in various renowned institutes like Vision IAS, Study IQ, and Unacademy. He qualified for many exams like NET JRF. He appeared for a UPSC interview and wrote 3 civil services mains exams. He is MA in public administration. He did B. Tech in biotechnology.

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Best Sources for UPSC CSE

THE HINDU

The Hindu

The Indian EXPRESS

The Indian Express

physics.org
Your guide to physics on the web

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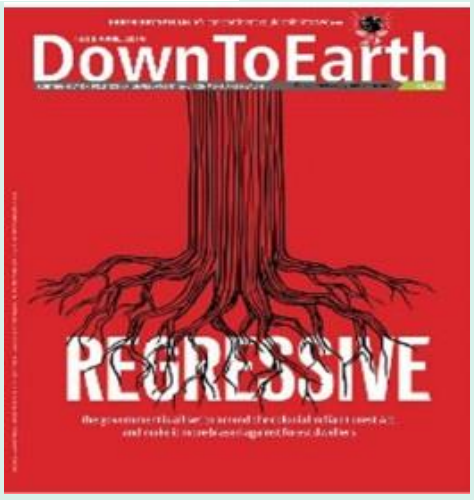

Down to Earth

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Upcoming Courses

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Contents

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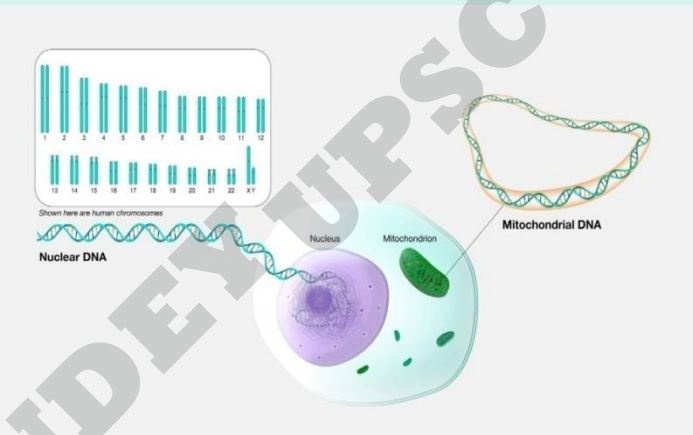
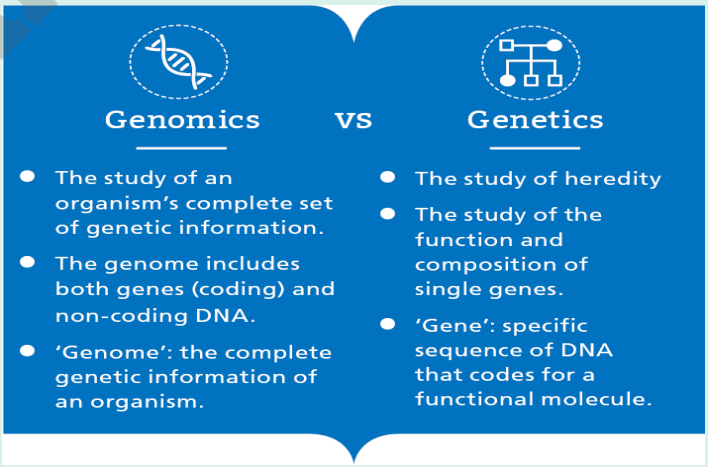
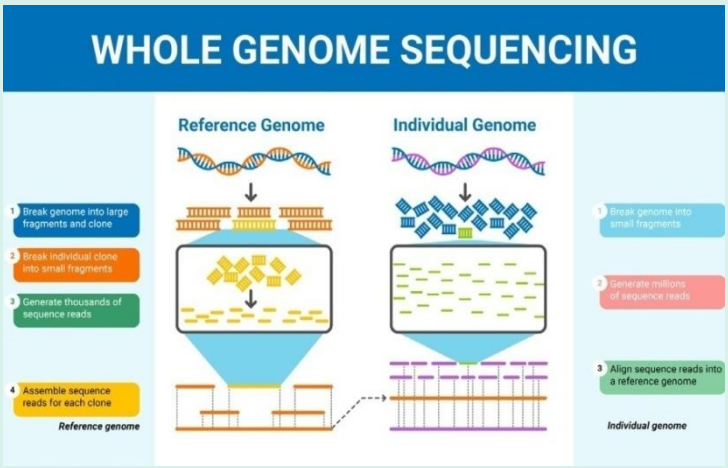
Genome sequencing AND HEALTH

- In the last two decades, the landscape of genomics and the utility of genetic information in healthcare have both undergone a revolutionary transformation, marked by the increasing affordability and accessibility of personal genomes.
- Today, it has turned mainstream, offering to empower individuals with unprecedented insights into their own genetic makeup.
- The lower costs associated with genome sequencing technologies particularly with advancements in next generation sequencing has played a pivotal role in this democratisation.
- This accessibility has catalyzed large scale initiatives and population- wide projects that try to harness the power of genetic data to improve healthcare. The convergence of technology and biology has also paved the way for more population scale whole genome sequencing endeavours.
- Personal genome sequencing in particular can help us tailor treatments to individual genetic profiles and predict individuals' susceptibility to specific diseases
- Researchers have been analyzing the prevalence of incidental and actionable genetic information via population scale genome sequencing programmes currently underway in many countries







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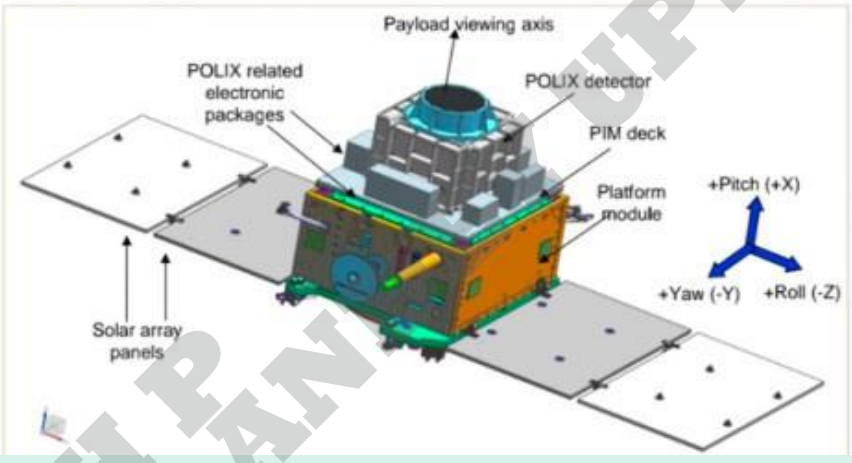
Xposat

XPoSat Mission Objectives

- To measure polarization (degree and direction) of X-ray photons from ~50 potential celestial sources of interest in the energy band of 5-30 keV.
- Mission Life – 5 years, Platform – Modified IMS-2 Bus
- Payload – Polarimeter Instrument in X-rays (POLIX) from Raman Research Institute
- Orbit – Circular LEO (500-700 km), Inclination ≤ 30°

Deployed View of XPoSat



X-ray POlarimeter SATellite (XPOSAT)

First mission devoted to X-ray polarisation studies since X-ray polarization studies of celestial objects has been minimal.

Polarimeter **I**nstrument in **X**-rays (**POLIX**) payload being developed by Raman Research Institute (RRI).

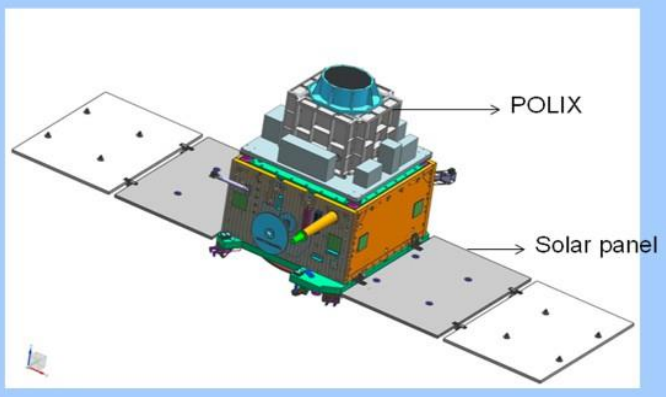
POLIX will study the degree and angle of polarization of bright X-ray sources (5-30 keV).

Modified IMS-2 bus

Pointing accuracy : 0.1degree

Slow rotation : 0.2 to 0.5 rpm

Low altitude orbit (~600 km) with a low inclination (< 30 degree)



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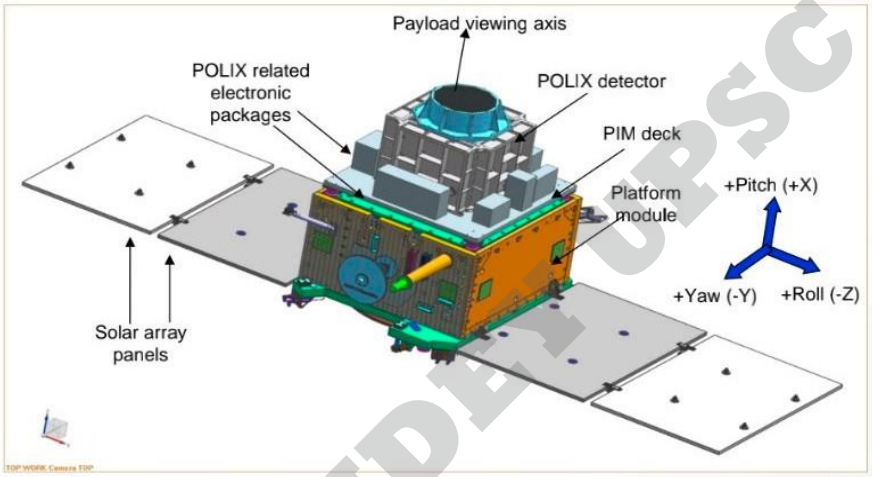
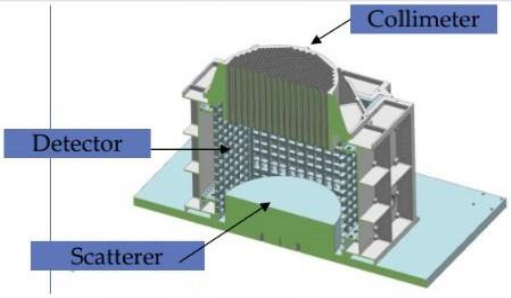


XPoSat Payload specifications

Photon collection area	640 cm^2
Energy range	5-30 keV
Detectors	Proportional counters
Total weight	~125 kg
Overall dimension	~ 650 x 650 x 600 mm^3 (excluding electronics)
Data generation rate	6 Gbits per day (maximum)
Scattering element	Beryllium / Lithium
Rotation (rate)	0.2 rpm
Pointing accuracy	0.1 deg



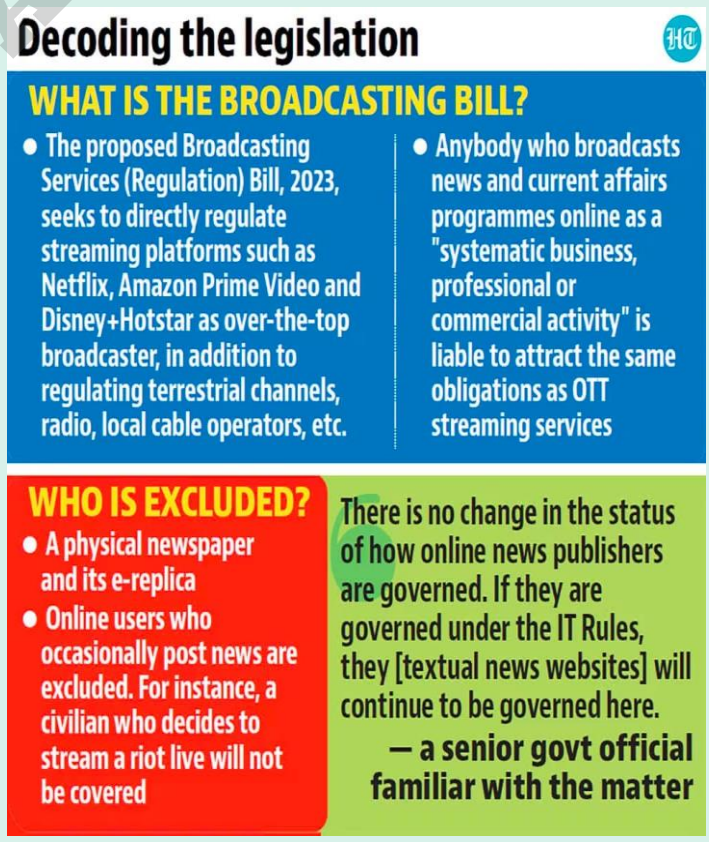
POLIX payload detector inner view

Broadcasting Regulation bill

- The Broadcasting Services (Regulation) Bill broadens regulation to cover OTT platforms and digital content, introducing mandatory registration and a three tier regulatory system.
- No person or broadcasting company can provide services or run a network without formal registration or intimation to the government.
- Cable and satellite operators must also gain approval to transmit programs.
- The Bill extends rules to internet based broadcasting services like IPTV and OTT platforms based on subscriber/viewer thresholds.
- A Content Evaluation Committee (CEC) is proposed for the certification of programs, and a self-regulatory framework involving committees and councils is outlined.
- The Bill allows government inspections without notice, and potential equipment seizures for violations, and mandates compliance within 30 days upon seizure.
- Critics fear potential censorship, its impact on free speech, and creativity, expressing concerns about excessive delegation of rule--making and its subjective nature impacting online content creators' freedom.

What are the main concerns?

- The broad scope of the Bill for traditional broadcasters, such as cable TV, and the evolving OTT space, which essentially has a different business model and content delivery mechanism, has drawn a mixed response from legal experts and advocates for digital freedom.



- Digital rights organisation Internet Freedom Foundation (IFF) has called for a cautious examination of the Bill due to the proposed codes' similarity to the Code applicable to cable TV and the increased censorship of TV programmes as a consequence.

- "This may affect the publisher's online free speech, freedom of journalistic expression and artistic creativity, & the citizen's right to access differing points of view because publishers will be compelled to only produce content which is palatable to the Union Government,".

- The group claims that exerting executive control over OTT content will lead to "over compliance and self-censorship" because platforms would aim to avoid the government's broad discretion when it comes to punishments.

- The IFF further notes that the Bill has left several provisions to be determined later by the Centre, arguing that such excessive delegation of rulemaking would create uncertainty for stakeholders.

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Psychoanalysis

- The Delhi Police said the six individuals accused in the Parliament breach incident underwent psychoanalysis at a government institute in the city in order to ascertain their motives.
- The term 'psychoanalysis' is usually restricted to the medical literature on mental health when it isn't provoking suspicious questions
- Psychoanalysis is a type of treatment based on the theory that our present is shaped by our past.
- The unacknowledged meaning of personal experiences can influence our mood and behaviour, and contribute to problems with relationships, work and self-esteem
- We are often unaware of how experiences can affect us.
- Painful feelings can remain in the unconscious mind and influence our current mood and behavior and contribute to problems with self-esteem, personality, relationships and work.
- Psychoanalysis helps a person take control of these influences by tracing them back to their origins and understanding how they have developed over time.

The unconscious mind

- According to psychoanalysis, the unconscious mind gives hints of the unacknowledged meaning of experiences in different ways. Such hints may include:
- Repetitive behaviour
- Topics that the person finds difficult to talk about
- Dreams
- Daydreams
- The nature of the patient–therapist relationship.

India in 2023

Developing countries, including India, asked rich nations to vacate carbon space by achieving negative carbon emissions, and not merely reaching net zero by 2050.

- India also submitted its third national communication to the U.N. Framework Convention on Climate Change on December 9.
- According to it, the country reduced GDP emission intensity by 33% between 2005 and 2019, achieving the target 11 years in advance.
- On the wildlife front: an estimation exercise found the number of tigers has gone up in the Shivalik Hills Gangetic Plains landscape, central India and the Sundarbans, but dwindled in the Western Ghats and the Northeast Brahmaputra Plains due to habitat loss, fragmentation, and poaching.
- The cheetah conservation project drew sharp criticism over the deaths of six of the 20 adults imported from Namibia and South Africa.
- India also launched the International Big Cat Alliance, to conserve the world's seven principal big cats: tigers, lions, snow leopards, leopards, jaguars, pumas, and cheetahs. The Alliance is open to 97 countries and organisations.
- The government also amended forest conservation and biodiversity laws, inviting sharp criticism from several state governments, policy experts, and conservationists.
- The Forest (Conservation) Amendment Act applies to land recorded as 'forest' in government records, exempting certain categories of land from its purview.
- Conservationists argue that limiting the applicability of the FCA would invalidate the Supreme Court's 1996 judgment in the T.N. Godavarman Thirumulpad case, which said the Act was applicable to land covered under the "dictionary meaning of forests" or "deemed forests" (forests not officially recorded as forests).The amended Act exempts forest land up to 10 ha for constructing security related infrastructure and the area falling within 100 km of international borders, Line of Control and Line of Actual Control for "strategic and security related projects of national importance".
- The government also introduced changes to the Biological Diversity Act to help protect plants and resources in India.
- The goal was to encourage growing medicinal plants instead of taking them from the wild, support traditional Indian medicine, make it easier for research and patents, and involve more foreign investments.

MOHAMMED Yunus

- Nobel peace laureate Muhammad Yunus was convicted on of violating Bangladesh's labour laws in a case decried by his supporters as politically motivated.
- Mr. Yunus, 83, is credited with lifting millions out of poverty with his pioneering microfinance bank but has earned the enmity of longtime Prime Minister Sheikh Hasina, who has accused him of "sucking blood" from the p
- "banker to the poorest of the poor", was awarded the Peace Prize in 2006 for his work loaning small cash sums to rural women, allowing them to invest in farm tools or business equipment and boost their earnings.
- Grameen Bank, the microfinance lender he

founded, was lauded for helping unleash breakneck economic growth in Bangladesh, and its work has since been copied by scores of developing countries

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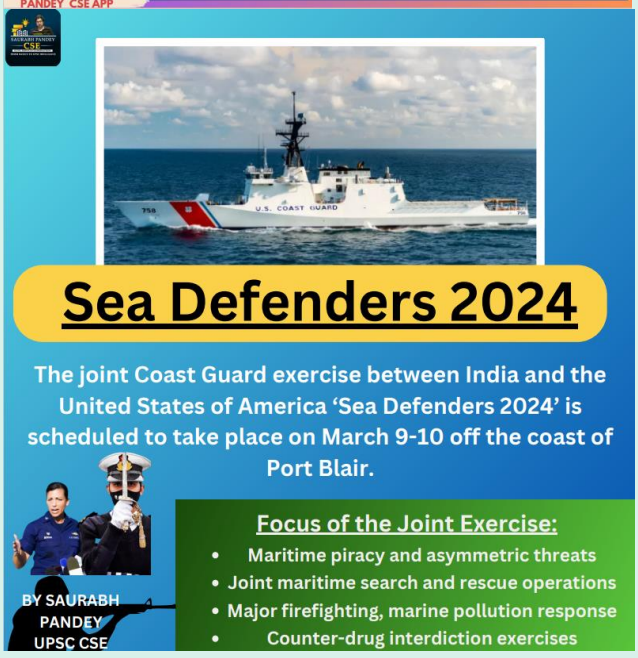
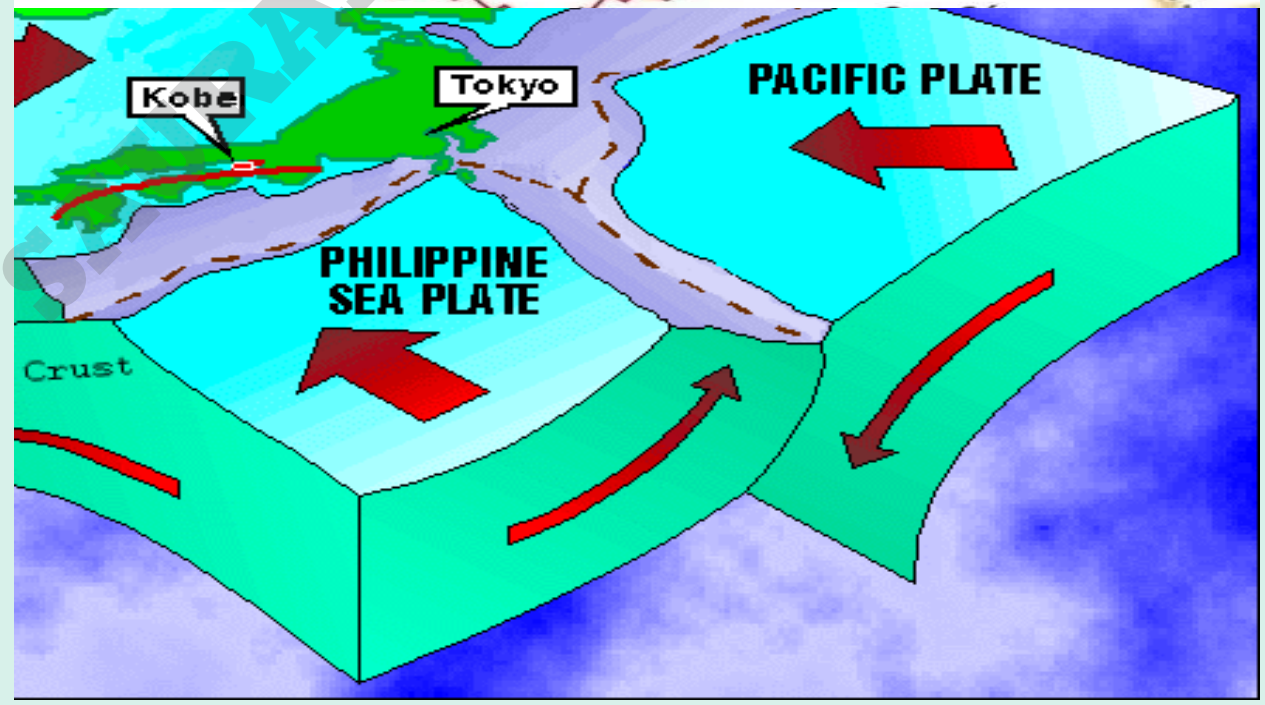


GES Reporter

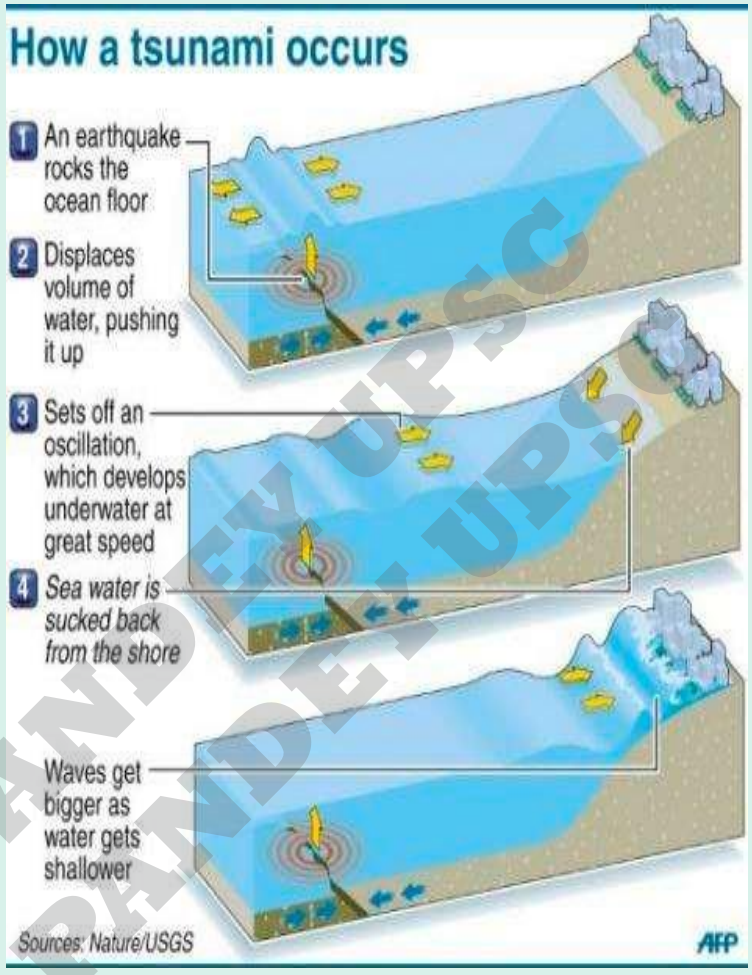
Why earthquakes in japan?

- Earthquakes are common in Japan, one of the world's most seismically active areas.
- The island nation sits on the so-called Pacific "Ring of Fire" a term coined to refer to the Circum-Pacific Belt.
- Simply put-- it is a path along the Pacific Ocean characterised by active volcanoes and frequent earthquakes. According to scientists, the majority of Earth's volcanoes and earthquakes take place along the "Ring of Fire".
- An earthquake occurs due to the stresses caused by the movements of tectonic plates that comprise the earth. Japan and earthquakes go hand in hand due to the country's position along the "Pacific Ring of Fire," where it lies across three tectonic plates, including the Pacific Plate under the Pacific Ocean and the Philippine Sea Plate.



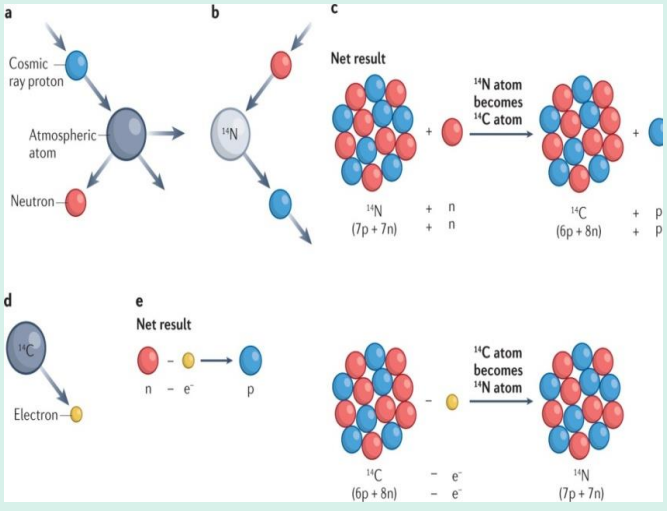
What is Tsunami

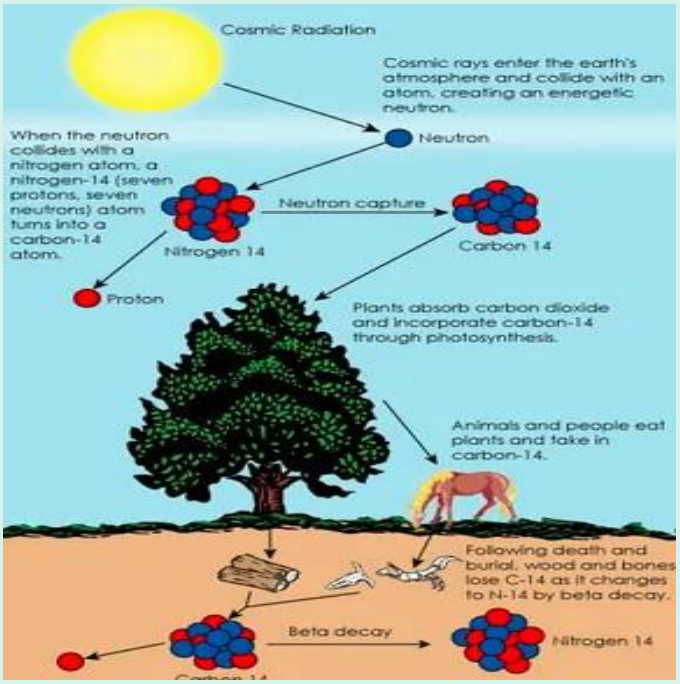
- According to the National Ocean Service, tsunamis are giant waves caused by earthquakes or volcanic eruptions under the sea.
- Out in the depths of the ocean, tsunami waves do not dramatically increase in height.
- But as the waves travel inland, they build up to higher and higher heights as the depth of the ocean decreases.
- The speed of tsunami waves depends on ocean depth rather than the distance from the source of the wave.
- Tsunami waves may travel as fast as jet planes over deep waters, only slowing down when reaching shallow waters.
- While tsunamis are often referred to as tidal waves, this name is discouraged by oceanographers because tides have little to do with these giant waves.



Carbon dating

- In the early 1940s, the American chemists Martin Kamen and Sam Ruben found a way to synthesize carbon 14 in the lab as well as that its half-life the time taken to decay to half its original mass was around 5,000 years, and not a few hours as expected.
- In 1939, the Finnish-American Physicist Serge Korff found that it's possible to produce carbon 14 by bombarding nitrogen 14 with neutrons – as cosmic rays do.
- Inspired by these findings, the American physical chemist Willard Libby is credited with conceiving
- The idea of using carbon 14 to date organic materials. Libby's idea made two assumptions that weren't exactly known to be true at the time.
- First, the concentration of carbon14 in the



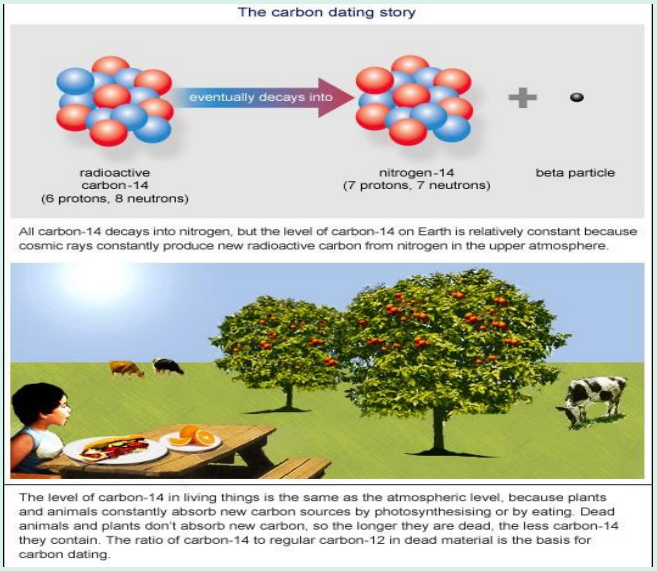


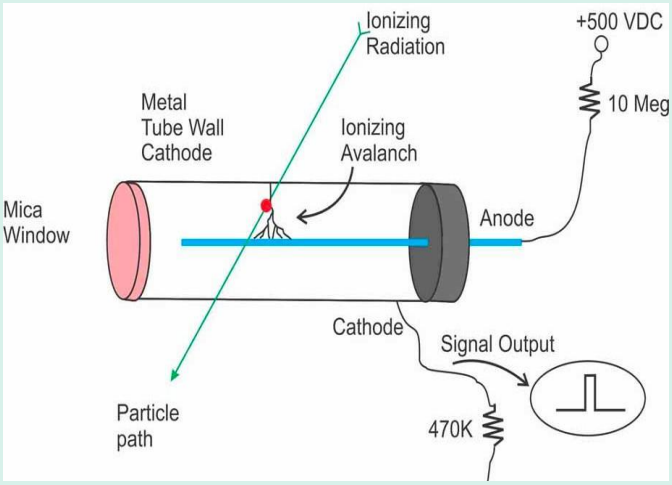
earth's atmosphere doesn't change across thousands of years. If it did, radiocarbon dating which dates organic materials by measuring the amount of carbon14 they contain wouldn't work.

- Second, carbon 14, in the form of carbon dioxide and other carbon compounds, would have to be able to diffuse into the earth's various ecosystems such that the concentration of carbon 14 in the atmosphere was comparable to the concentration of carbon 14 in the planet's other biospheres

What are the tools of radiocarbon dating?

- The instrument of choice in Libby's time to study radioactive decay was the Geiger counter.
- It consists of a Geiger Muller tube connected to some electronics that interpret and display signals.
- The Geiger Muller tube contains a noble gas, such as helium or neon, and a rod passing through the centre.
- A high voltage is maintained between the tube's inner surface and the rod. The gas is insulating, so no current can pass between the two.
- But when energetic particles (including gamma radiation), such as those emitted during radioactive decay, pass through the gas, they can energise electrons in the gas's atoms and produce an electric discharge.
- The modern radiocarbon dating setup is more sophisticated, of course.
- For example, one of the most sensitive dating setups uses accelerator mass spectrometry (AMS), which can work with organic samples as little as 50 mg

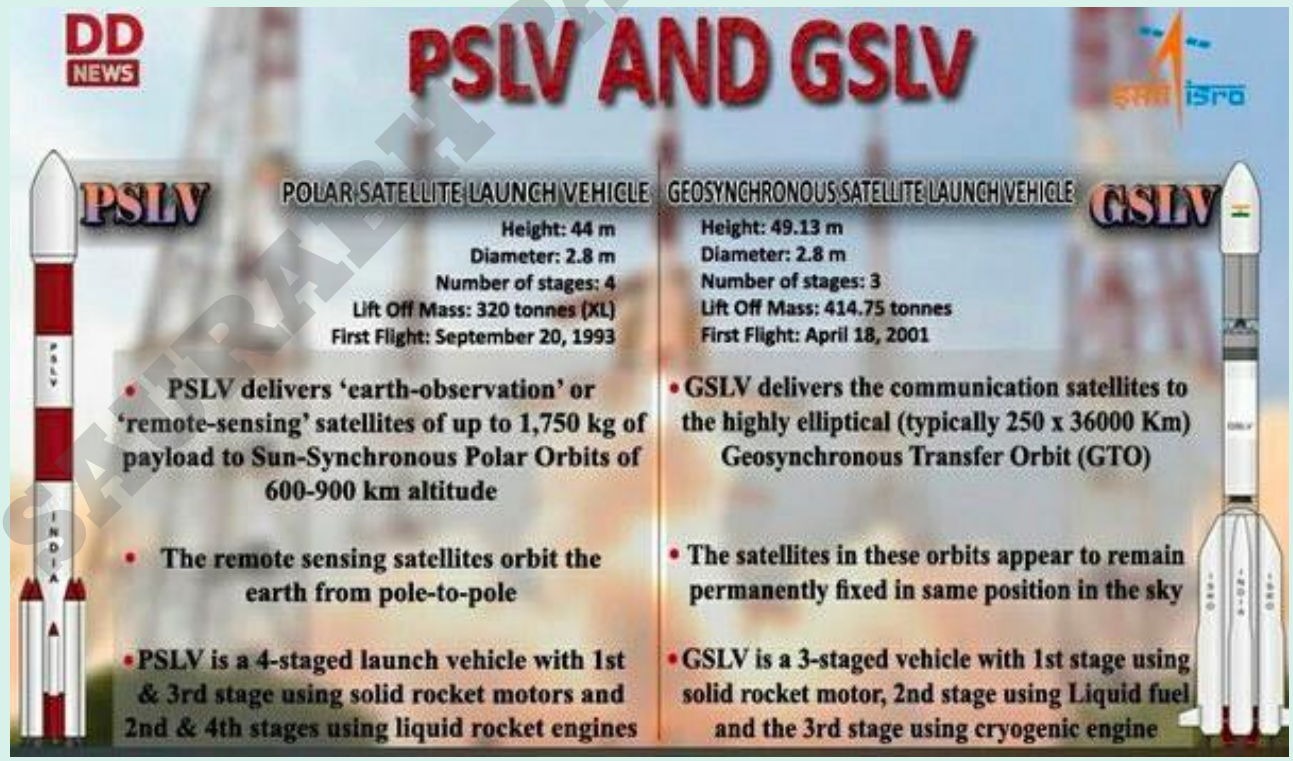




SLV


INDIA TODAY
PSLV vs SSLV
Height
44 m
Diameter
2.8 meter
No of stages
4
Liftoff Mass
320 tonnes
Payload capability
1,750 kg to 600 km
Turnaround time
Over 60 days
First flight:
September 20, 1993
Height
34 m
Diameter
2 meter
No of stages
3
Liftoff Mass
120 tonnes
Payload capability
10–500 kg to 500 km planar orbit
Turnaround time
72 hours
First flight:
August 7, 2022
PSLV C2
SSLV
INDIA


PSLV
Lift-off weight : 295 tonne
Payload : 1600 Kg into 620 KM Polar Orbit, 1060 Kg into Geosynchronous Transfer Orbit (GTO)
Height : 44 Metre
GSLV Mk I & II
Lift-off weight : 414 tonne
Payload : 2 to 2.5 tonne into GTO
Height : 49 Metre
GSLV-Mk III
Lift-off weight : 629 tonne
Payload : 4 tonne into GTO
Height : 42 Metre
SLV-3
Lift-off weight : 17 tonne
Payload : 40 Kg to Low Earth Orbit (LEO)
Height : 22 Metre
ASLV
Lift-off weight : 39 tonne
Payload : 150 Kg (LEO)
Height : 23.5 Metre


DD NEWS
PSLV AND GSLV
isro
PSLV
POLAR SATELLITE LAUNCH VEHICLE
Height: 44 m
Diameter: 2.8 m
Number of stages: 4
Lift Off Mass: 320 tonnes (XL)
First Flight: September 20, 1993
GEOSYNCHRONOUS SATELLITE LAUNCH VEHICLE
GSLV
Height: 49.13 m
Diameter: 2.8 m
Number of stages: 3
Lift Off Mass: 414.75 tonnes
First Flight: April 18, 2001
• PSLV delivers 'earth-observation' or 'remote-sensing' satellites of up to 1,750 kg of payload to Sun-Synchronous Polar Orbits of 600-900 km altitude
• The remote sensing satellites orbit the earth from pole-to-pole
• PSLV is a 4-staged launch vehicle with 1st & 3rd stage using solid rocket motors and 2nd & 4th stages using liquid rocket engines
• GSLV delivers the communication satellites to the highly elliptical (typically 250 x 36000 Km) Geosynchronous Transfer Orbit (GTO)
• The satellites in these orbits appear to remain permanently fixed in same position in the sky
• GSLV is a 3-staged vehicle with 1st stage using solid rocket motor, 2nd stage using Liquid fuel and the 3rd stage using cryogenic engine

Global nuclear order

- The global nuclear order (GNO) was no exception but, today, it is under strain.
- The GNO was created in the shadow of the Cold War, with the U.S. and the U.S.S.R., leading the western and the Socialist blocs, respectively.
- Following the 1962 Cuban Missile Crisis, when the two came perilously close to launching a nuclear war, both U.S. President John F. Kennedy and General Secretary Nikita Khrushchev understood two political realities.
- First, as the two nuclear superpowers, they needed bilateral mechanisms to prevent tensions from escalating to the nuclear level.
- And, second, nuclear weapons are dangerous and, therefore, their spread should be curbed. This convergence created the GNO.The third element of the global nuclear order came into existence in 1975.
- India had chosen not to sign the NPT, and in 1974, stunned the world by conducting an underground peaceful nuclear explosive, or PNE
- Today's nuclear world is no longer a bipolar world. The U.S. faces a more assertive China, determined to regain influence, regionally and globally.
- This rivalry is different from the Cold War because both economies are closely intertwined and further, and China is an economic and technological peer rival.
- Changing geopolitics has taken its toll on the treaties between the U.S. and Russia. In 2002, the U.S. withdrew from the Antiballistic Missile (ABM) Treaty and in 2019, from the Intermediate- Range Nuclear Forces (INF) Treaty on grounds that Russia was violating it.

The only remaining agreement, New START, will lapse in 2026; its verification meetings were suspended during the COVID-19 outbreak and never resumed.

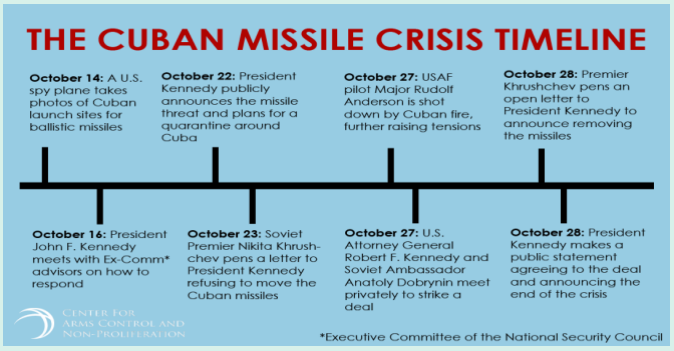
Strategic stability talks began in 2021 following the Geneva meeting between Presidents Joe Biden and Vladimir Putin, but collapsed with the Ukraine war.

Last year, Russia de-ratified the CTBT to bring it on a par with the U.S., raising concerns about the resumption of nuclear testing.

During the Cold War, the U.S.'s nuclear umbrella tied its European allies closer. Today, domestic compulsions are turning the U.S. inwards, raising questions in the minds of its allies about its 'extended deterrence' guarantees, especially in East Asia.

Japan, South Korea, and Taiwan have the technical capabilities to develop an independent nuclear deterrent within a short time, given political will.

It is only a matter of time before U.S. pragmatism reaches the inevitable conclusion that more independent nuclear deterrent capabilities may be the best way to handle the rivalry with China.



Hydrography - India and Maldives

- The recent decision by the Maldives to revoke an agreement with India for joint hydrographic surveys in Maldivian waters has caused considerable dismal in Indian media and strategic circles.

- The move by Male, in mid-December 2023, came a few weeks after the archipelagic state formally asked New Delhi to withdraw its Indian military presence from its shores.

- Since the election of Mohamed Muizzu as Maldivian President in November 2023, there has been a deliberate, if predictable, attempt by Male to create a distance with New Delhi.

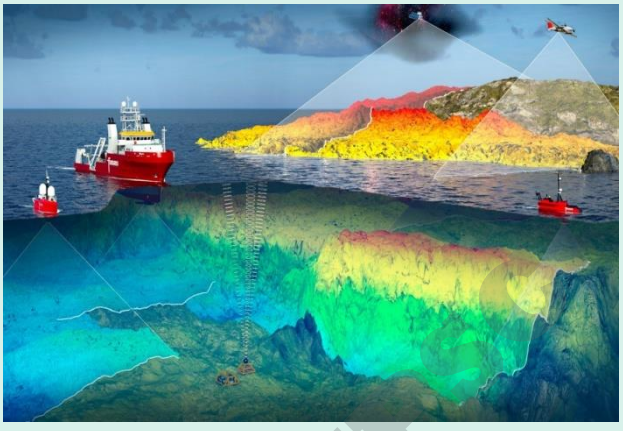
- The Maldives would like the world to believe that terminating the hydrography pact is a way of asserting its autonomy and agency.

- It is not. Far from balancing ties with India, Male has thrown in its political lot with China.

- It is worth noting that hydrographic data inherently has a dual nature in that the information collected from the seas can be used for civilian and military purposes.

- Marine scientists maintain that the data that helps advance non-military objectives, such as ensuring navigational safety, marine scientific research, and environmental monitoring, can also be used to facilitate military aims such as surveillance of a nation's vital coastal installations and war-fighting assets.

- Even so, China is unique in using its marine and seabed surveys to advance a largely strategic agenda



- Indian observers point out that China's ocean surveys play an important part in enhancing China's antisubmarine warfare capabilities.

- The United Nations Convention on the Law of the Sea (UNCLOS) does not explicitly authorise a coastal state to regulate hydrographic surveys or military surveys conducted beyond its territorial sea; a littoral state may only regulate marine scientific research in its exclusive economic zone (EEZs).

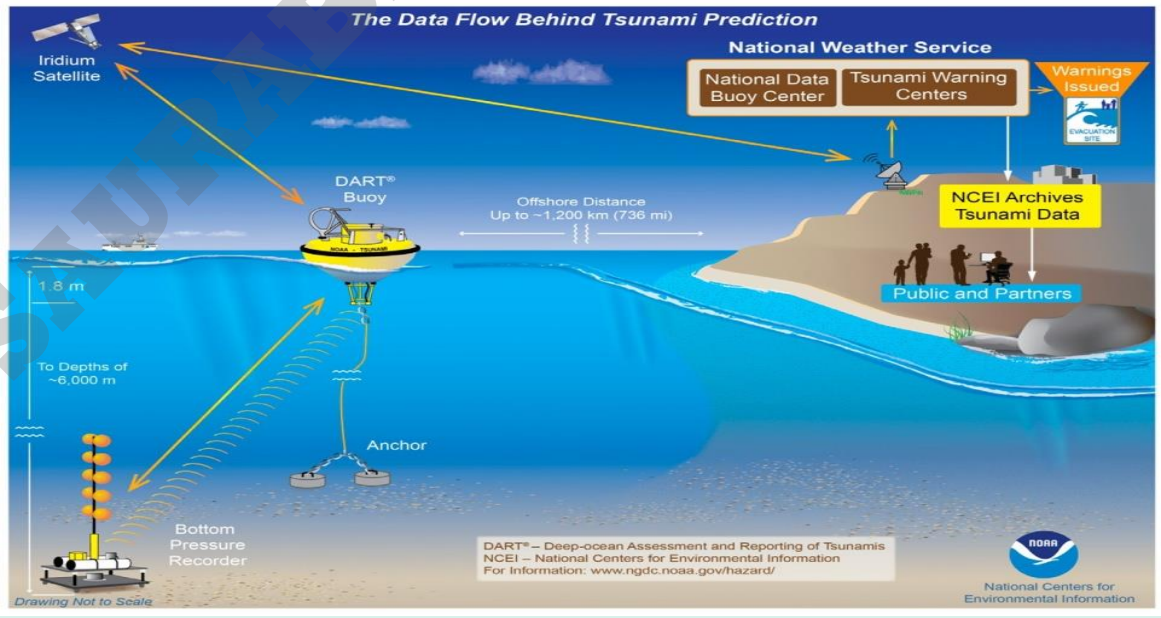
- By implication, foreign maritime agencies conducting hydrographic surveys are free to

Do You Know?

map the seas outside a coastal state's territorial waters. It is this prospect that Male finds problematic.

Tsunami and ndma Guidelines

- After the 2004 Indian Ocean Tsunami, India has now developed a state-of-the art Tsunami Early Warning System in the country.
- The critical gaps that now remain are the lack of public awareness on tsunami risk and vulnerability in the coastal areas, the weak enforcement and compliance of town planning byelaws, development control regulations and building codes in the coastal areas, and the challenges in implementation of appropriate technologies to disseminate and communicate the early warning to the coastal inhabitants located in the near vicinity of a near source tsunami.
- Tsunami Hazard Assessment
- Tsunami Vulnerability Assessment
- Geographic Information Systems (GIS)
- Role of the Indian Naval Hydrographic Department (INHD): INHD shall regularly provide bathymetry information to authorized agencies for drawing the inundation maps
- Use of Satellite Imageries in Monitoring:
- Guidelines
- Preparedness
- Warning System Components and Instruments
- Decision Support System and Standard Operating Procedures
- Tsunami Bulletins and Warning Categorization
- Tsunami Early Warning Dissemination
- Coordination Mechanisms
- Research and Development Efforts
- There is a need to develop high-resolution models for tsunami wave propagation in the Indian Ocean.
- Public Awareness
- Medical Preparedness



Structural Mitigation Measures

Need for New Standards for Protection of Structures against Tsunami

- Bureau of Indian Standards (BIS) will develop other necessary standards for the safety of natural habitats against tsunami and storm surge.
- BIS will also periodically review the standards and codes prepared by them and wherever necessary.
- Shelters for Storm Surges and Tsunamis

Tsunami Mitigation Measures

- Construction of large-scale submerged sand barriers in water depths of about 6 to 8 meters.
- Developing sand dunes along the coast with seaweeds or shrubs or casuarinas trees for stabilization of the dunes. Regulation and Enforcement of Techno-Legal Regime.
- Emergency Tsunami Response
- Tsunami Response Requirement

Land Use

- Coastal land use should be so designed so as to incur minimal losses to life and property due to these events.

Bio-Shields

- Mangrove forests constitute provide biological mechanisms for protecting coastal communities from the fury of cyclones, coastal storms, tidal waves and tsunamis., which also safeguards the ecological and livelihood security of fishing and farming communities living in the coastal zone

Monitoring Shelterbelt Plantations and Mangrove Regeneration Zones

- A coordinated and effective response system would be required for management of tsunami at central, state, district and community levels

Community-Based Disaster Response

- A number of organisations, like NGOs, Self Help groups, Community Based Organisations, youth organisations, women's groups, volunteer agencies, civil defence, home guards, etc. normally volunteer their services in the aftermath of any disaster.

Tsunami and ndma Guidelines

- The 1,643-km-long India-Myanmar border, which passes through Mizoram, Manipur, Nagaland and Arunachal Pradesh, currently has FMR. It was implemented in 2018 as part of India's Act East policy.

  The Free Movement Regime (FMR), which allows people residing close to the India-Myanmar border to venture 16 km into each other's territory without visa, will be ended soon

  The Free Movement Regime is a pact between India and Myanmar that allows tribes living along the border on either side to travel up to 16 km inside the other country without a visa.

  FMR is being seen as a part of the India's Act East policy.

Rationale behind FMR

- The boundary between India & Myanmar was demarcated by the British in 1826.
- This effectively divided people of the same ethnicity and culture into two nations without seeking their opinion.
- Hence the, need was felt to enable ethnically similar communities living across the borders to move freely without the need of a visa.
- The FMR was supposed to provide impetus to local trade and business.
- However, it has been criticized for unintentionally aiding illegal immigration, drug trafficking, and gun-running

WHY FMR TO END?

- The idea is to not only to stop the misuse of FMR, which is used by insurgent groups to carry out attacks on Indian side and flee towards Myanmar, but also put a halt to influx of illegal

immigrants, and paralyses drugs and gold smuggling networks.

- Tendering for an advanced smart fencing system for 300 km of the India-Myanmar border is already in pipeline and the work will be started very soon
- Manipur shares around 390 km of porous border with Myanmar and only about 10 km has been fenced so far.
- Besides, Mizoram has seen an influx of anti-Junta rebels in thousands since the military coup in Myanmar on February 1, 2021
- Mizoram shares a 510-km-long porous border with Myanmar. Arunachal Pradesh shares a 520-km border with Myanmar while Nagaland shares a 215-km border with the country.

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1. Europa Clipper

- NASA will launch Europa Clipper, which will explore one of Jupiter's largest moons, Europa.
- Europa is slightly smaller than the earth's moon, with a surface made of ice.
- Beneath its icy shell, Europa likely harbours a saltwater ocean, which scientists expect contains

over twice as much water as all the oceans here on Earth combined.

- With Europa Clipper, scientists want to investigate whether Europa's ocean could be a suitable habitat for extraterrestrial life

2. Artemis II launch

- The Artemis programme, named after Apollo's twin sister in Greek mythology, is NASA's plan to go back to the moon.
- It will send humans to the moon for the first time since 1972, including the first woman and the first person of color.
- Artemis also includes plans for a longer-term, sustained presence in space that will prepare NASA for eventually sending people even farther to Mars.
- Artemis II is the first crewed step in this plan, with four astronauts planned to be on board during the 10-day mission.
- The mission builds upon Artemis I, which sent an uncrewed capsule into orbit around the moon in late 2022.
- Artemis II will put the astronauts into orbit around the Moon before returning them home. It is currently planned for launch as early as November 2024.

3. VIPER to hunt water on the moon

- VIPER, which stands for Volatiles Investigating Polar Exploration Rover, is a robot the size of a golf cart that NASA will use to explore the moon's south pole in late 2024.
- This robotic mission is designed to search for volatiles, which are molecules that easily vaporize, like water and carbon dioxide, at lunar temperatures.
- These materials could provide resources for future human exploration on the moon.
- The VIPER robot will rely on batteries, heat pipes and radiators throughout its 100-day mission, as it navigates everything from the extreme heat of lunar daylight.

4. Lunar Trailblazer and PRIME-1

- NASA has recently invested in a class of small, low-cost planetary missions called SIMPLEx, which stands for Small, Innovative Missions for Planetary Exploration.
- These missions save costs by tagging along on other launches as what is called a rideshare, or secondary payload.
- One example is the Lunar Trailblazer.
- Like VIPER, Lunar Trailblazer will look for water on the moon.
- But while VIPER will land on the moon's surface, studying a specific area near the south pole in detail, Lunar Trailblazer will orbit the moon, measuring the temperature of the surface and mapping out the locations of water molecules across the globe.
- PRIME-1 will drill into the moon — it's a test run for the kind of drill that VIPER will use. But its launch date will likely depend on whether earlier launches go on time.

5. JAXA's Martian Moon eXploration

- The JAXA MMX mission concept to study Phobos and Deimos, Mars' moons.
- The Japanese Aerospace Exploration Agency, or JAXA, has a robotic mission in development called the Martian Moon eXploration, or MMX, planned for launch around September 2024.

- The mission's main science objective is to determine the origin of Mars' moons.
- Scientists aren't sure whether Phobos and Deimos are former asteroids that Mars captured into orbit with its gravity or if they formed out of debris that was already in orbit around Mars.

6. ESA's Hera mission

- Hera is a mission by the European Space Agency to return to the Didymos -Dimorphos asteroid system that NASA's DART mission visited in 2022. But DART didn't just visit these asteroids, it collided with one of them to test a planetary defence technique called "kinetic impact."
- DART hit Dimorphos with such force that it actually changed its orbit.
- The kinetic impact technique smashes something into an object in order to alter its path.
- This could prove useful if humanity ever finds a potentially hazardous object on a collision course with Earth and needs to redirect it.

Project tiger

The origins of Project Tiger

- In 1972, India enacted the Wildlife (Protection) Act (WLPA), which introduced new spaces within notified forests called 'National Parks', where the rights of forest -dwellers were removed and vested with the State government.
- It also created 'Wildlife Sanctuaries', where only some permitted rights could be exercised. Project Tiger was the result of this development.
- There were nine tiger reserves in 1973 over 9,115 sq. km; today there are 54 in 18 States, occupying 78,135.956 sq. km.
- Critical Tiger Habitats (CTH) cover 42,913.37 sq. km, or 26% of the area under National Parks and Wildlife Sanctuaries.
- in September 2006, Parliament amended the WLPA to create the National Tiger Conservation Authority (NTCA) and a tiger conservation plan.
- To ensure that CTHs remained inviolate; the Act only modified forest dwellers' use of the forest mostly tribals and planned to relocate them if required.
- Four months later, the government also enacted the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006, also known as the FRA.
- The FRA recognised all customary and traditional forest rights on forest land, including in tiger reserves.
- Under the Act, the habitation- level Gram Sabha was to democratically determine and demarcate the forest rights that the FRA recognised.
- The Gram Sabhas became the authority to protect, conserve, and manage forests, wildlife, and biodiversity within their customary and traditional boundaries.
- As a result, the FRA secured the livelihoods of at least 20 crore Indians in 1.79 lakh villages.
- Importantly, the FRA introduced a 'Critical Wildlife Habitat' (CWH), like the CTH under WLPA, with one difference once a CWH had been notified, it couldn't be diverted for non-forest purpose.

India's basis for CTHs

Originally, tiger reserves were to be created in a democratic process and "on the basis of scientific and objective criteria".

The tiger conservation plan was similarly required to "ensure the agricultural, livelihood, development and other interests of the people living in tiger bearing forests or a tiger reserve."

The basis for the CTH is evidence of the irreversible damage to wildlife that human activities have wrought. With this in mind, the Indian government has a responsibility to ascertain whether forest- dwellers and tigers could reasonably coexist.

If not, it needs to modify the forest- dwellers' rights accordingly and relocate them if necessary. Only then can a CTH be established without affecting "the rights of the Scheduled Tribes or such other forest dwellers".

Similarly, the Buffer Area outside the CTH is to promote human- animal coexistence while recognizing the livelihood, developmental, social, and cultural rights of the local people.

Its geographical limits are to be determined based on objective criteria with inputs from the concerned Gram Sabha as well as an expert committee.

Relocation and rehabilitation

The WLPA only allows "voluntary relocation on mutually agreed terms and conditions" satisfying requirements in the law. Once the FRA recognises people's rights under it, the State acquires those rights according to the terms of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (LARR) Act 2013. No relocation can happen without the consent of the affected communities.

The LARR also requires the rehabilitation package to provide financial compensation as well as secure livelihoods to those relocated.

Under the LARR, the government needs to compensate relocated people by paying them twice the market value of the land, the value of assets attached to the land including trees and plants, a subsistence allowance for a year, and a one-time financial assistance for relocation.

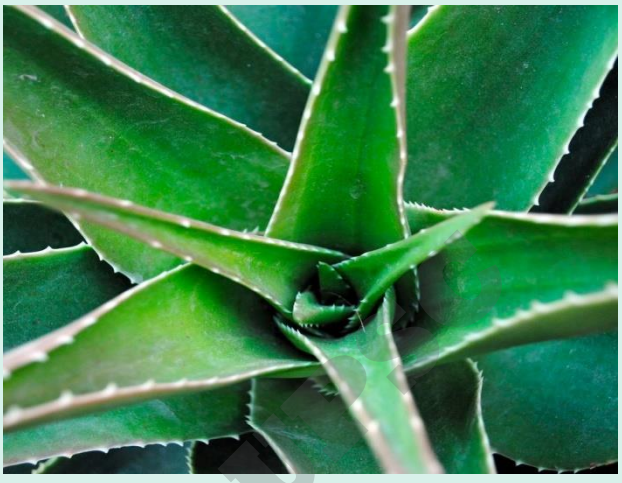
It also needs to provide building materials, belongings, cattle, and a one- time resettlement allowance. Each family is to be provided land and a house.

The resettlement plan also includes the provision of alternative fuels, fodder, and non -timber forest produce resources on non-- forest land, electric connections, roads, drainage and sanitation, safe drinking water, water for cattle, grazing land, ration shops, panchayat buildings, post offices, a seed- cum fertilizer storage facility, basic irrigation, burial or cremation ground, anganwadis, schools, health centres, veterinary service centres, community centre, places of worship, and separate land for tribal institutions.

However, the Union and State governments have limited themselves to provisions in the 2008 Revised Guidelines for the Ongoing Centrally Sponsored Scheme of Project Tiger 2008 and subsequent guidelines. This entails a compensation of ₹10 lakh revised in April 2021 to ₹15 lakh as a cash or relocation/rehabilitation 'package'.

Sisal leaves

- The ancient Aztec and Mayan civilizations were perhaps the first to begin making paper out of sisal leaves. Since then, the stiff, green sword-like leaves have been used to make twine, cloth, and carpets.
- The plant itself is also used to make mezcal, a distilled alcoholic beverage.
- Now, in a move to make menstrual hygiene products more environmentally sustainable, scientists at Stanford University have reported a method to produce from sisal leaves a "highly absorbent and retentive material".
- As a result, the researchers posit in their Nature Communications Engineering paper, the material can potentially replace cotton, wood pulp, and chemical absorbents in sanitary napkins.
- The absorption capacity of the material is higher than those found in commercial menstrual pads, they add.
- One key barrier in making menstrual hygiene products, like sanitary napkins, accessible is the rising cost of raw materials and distribution. The absorbent material in sanitary napkins is often a combination of wood pulp and synthetic superabsorbent polymers (SAPs). The latter are materials that can absorb a large amount of fluid relative to their own mass.



The Einstein Probe (EP)

- Meta said it was tightening up content restrictions for teens on Instagram and Facebook as it faces increased scrutiny that its platforms are harmful for young people.
- The changes come months after dozens of U.S. States accused Meta of damaging the mental health of children and teens, and misleading users about the safety of its platforms.
- Restricted goods on Instagram include tobacco products and weapons as well as alcohol, contraception, cosmetic procedures and weight loss programs, according to its website.
- Leaked internal research from Meta, including by the Wall Street Journal and whistle -blower Frances Haugen, has shown that the company was long aware of dangers its platforms have on the mental health for young people.

Kinmen

Kinmen, which lies 200 kilometres from Taiwan but only seven kilometre from China, was a battlefield front line for the nationalists who fled to Taiwan in 1949, and the target of frequent bombardments up until 1979.

China's bombardments of Kinmen only stopped in 1979 when the U.S. switched diplomatic recognition from Taiwan to Beijing.

This is a position maintained today even as Washington becomes Taipei's most important ally and its key weapons provider.

Camptothecin (CPT)

Researchers at the Indian Institutes of Technology Madras and Mandi have metabolically engineered plant cells to increase production of anti-cancer drug camptothecin (CPT).

The allopathic medicine is produced using Nathapodytes nimmoniana, a native, endangered plant. It requires nearly 1,000 tonnes of plant material to extract 1 tonne of CPT.

Camptothecin is a molecule procured from nature and then (in a) one-step derivative it is produced as drug.

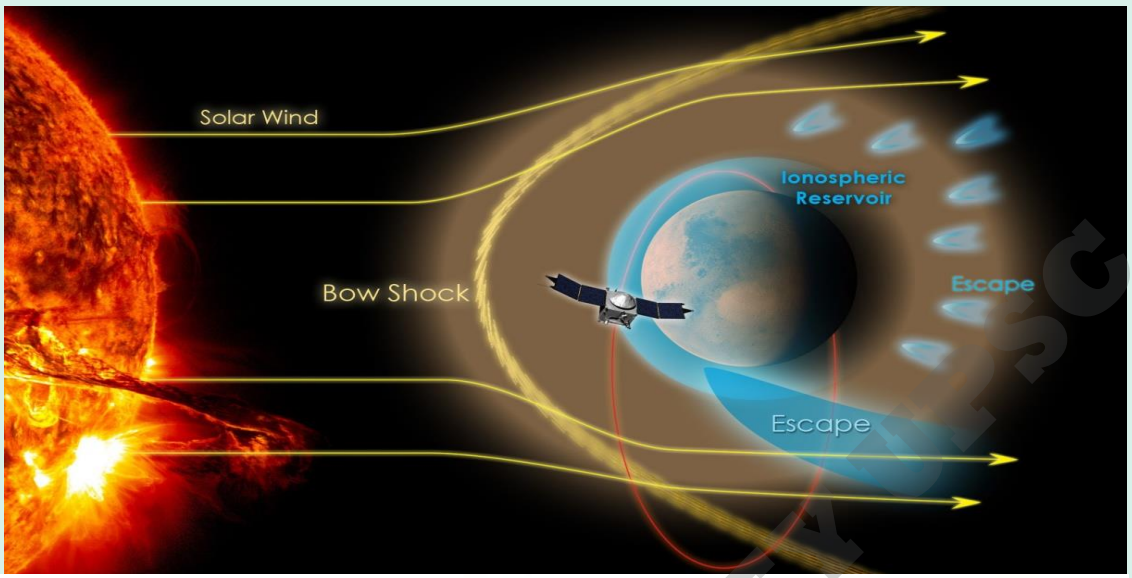
We have provided a more sustainable way of producing camptothecin as it is majorly procured from plants. We have isolated the plant cell of Nothapodytes nimmoniana, which is native to India."

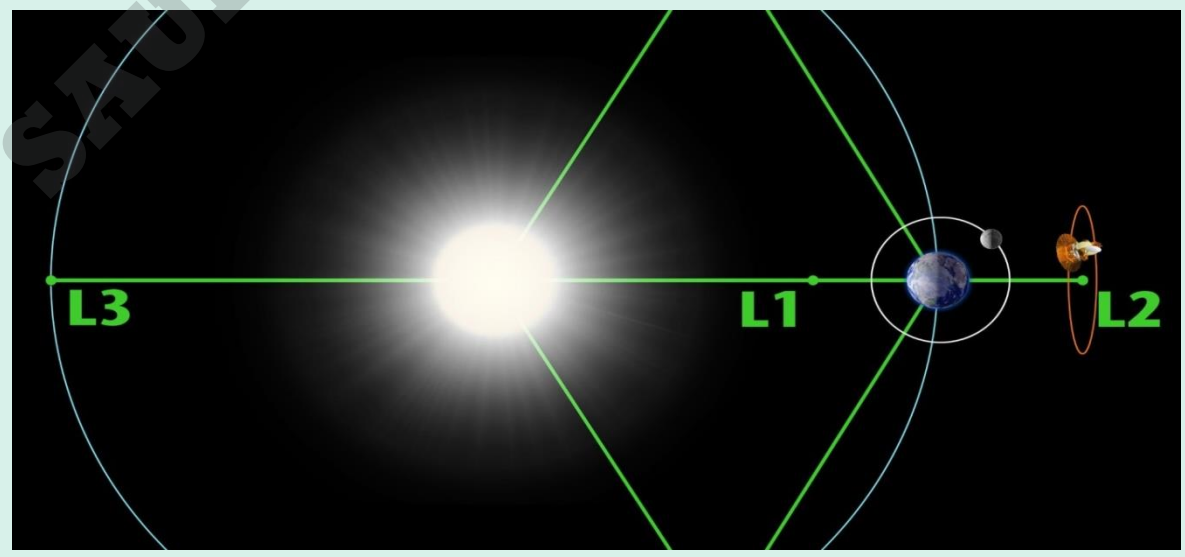
Camptothecin is majorly produced in southeast Asian region, with the plant being largely found only in China and India.

The Chinese variety of the plant used to extract the cell is listed as critically endangered

GES Reporter

Aditya L1 - what is L1?'

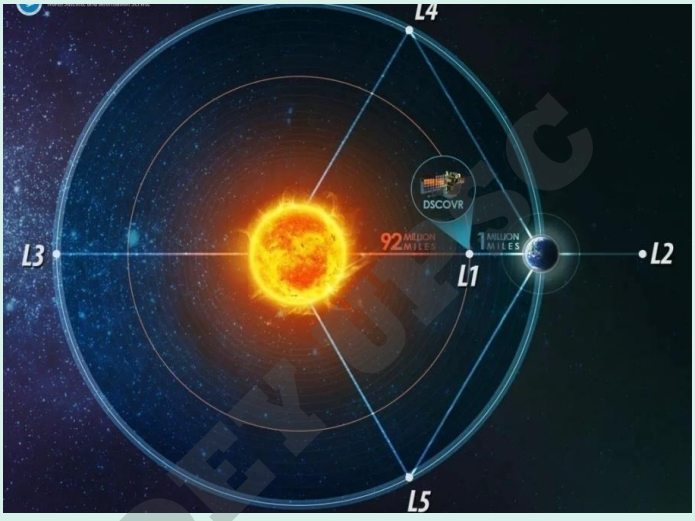




GES Reporter

What is Lagrange points?

Lagrange Points are positions in space where the gravitational forces of a two body system like the Sun and the Earth produce enhanced regions of attraction and repulsion.



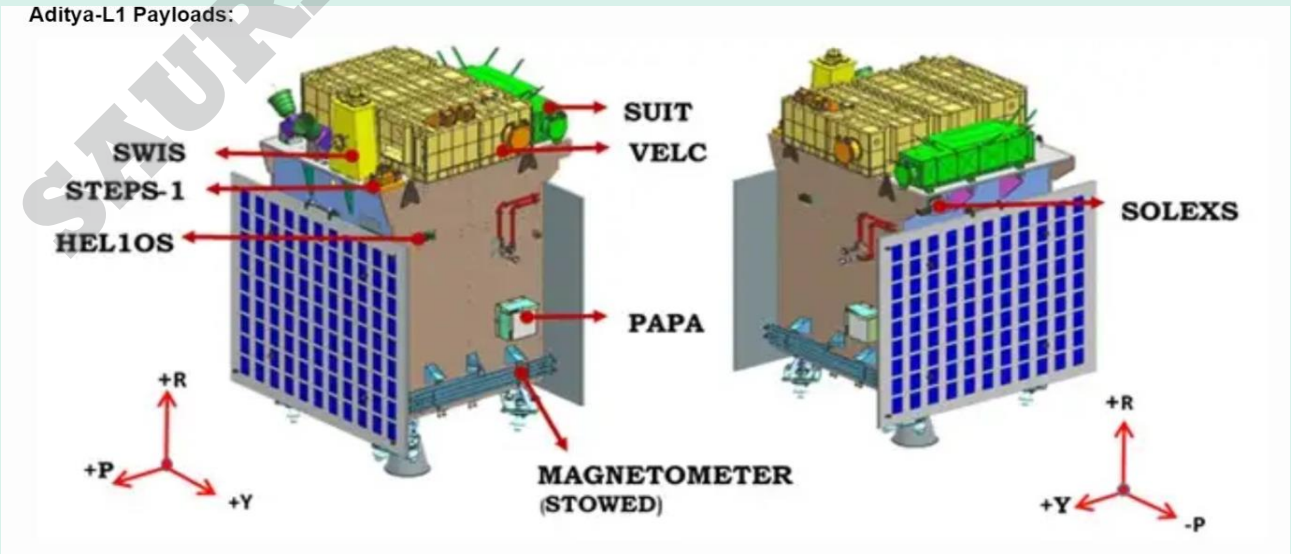
These can be used by spacecraft to reduce fuel consumption needed to remain in position.

Lagrange points are named in honor of Italian-French mathematician Josephy-Louis Lagrange.

Aditya L1 will be ISRO's 2nd space-based astronomy mission after AstroSat, which was launched in 2015.Aditya 1 was renamed as Aditya-L1. The Aditya 1 was meant to observe only the solar corona.

Aditya L1 is the first space-based Indian mission to study the Sun from a halo orbit around the Lagrangian point 1 (L 1) of the Sun-Earth system.

This mission with seven payloads on board to observe the photosphere, chromosphere and the outermost layers of the Sun (the corona) will provide greater advantage of observing the solar activities and its effect on space weather, according to officials of Indian Space Research Organisation (ISRO).



Type	Sl. No.	Payload	Capability
Remote Sensing Payloads	1	Visible Emission Line Coronagraph(VELC)	Corona/Imaging & Spectroscopy
	2	Solar Ultraviolet Imaging Telescope (SUIT)	Photosphere and Chromosphere Imaging- Narrow & Broadband
	3	Solar Low Energy X-ray Spectrometer (SoLEXS)	Soft X-ray spectrometer: Sun-as-a-star observation
	4	High Energy L1 Orbiting X-ray Spectrometer(HEL1OS)	Hard X-ray spectrometer: Sun-as-a-star observation
In-situ Payloads	5	Aditya Solar wind Particle Experiment(ASPEX)	Solar wind/Particle Analyzer Protons & Heavier Ions with directions
	6	Plasma Analyser Package For Aditya (PAPA)	Solar wind/Particle Analyzer Electrons & Heavier Ions with directions
	7	Advanced Tri-axial High Resolution Digital Magnetometers	In-situ magnetic field (Bx, By and Bz).

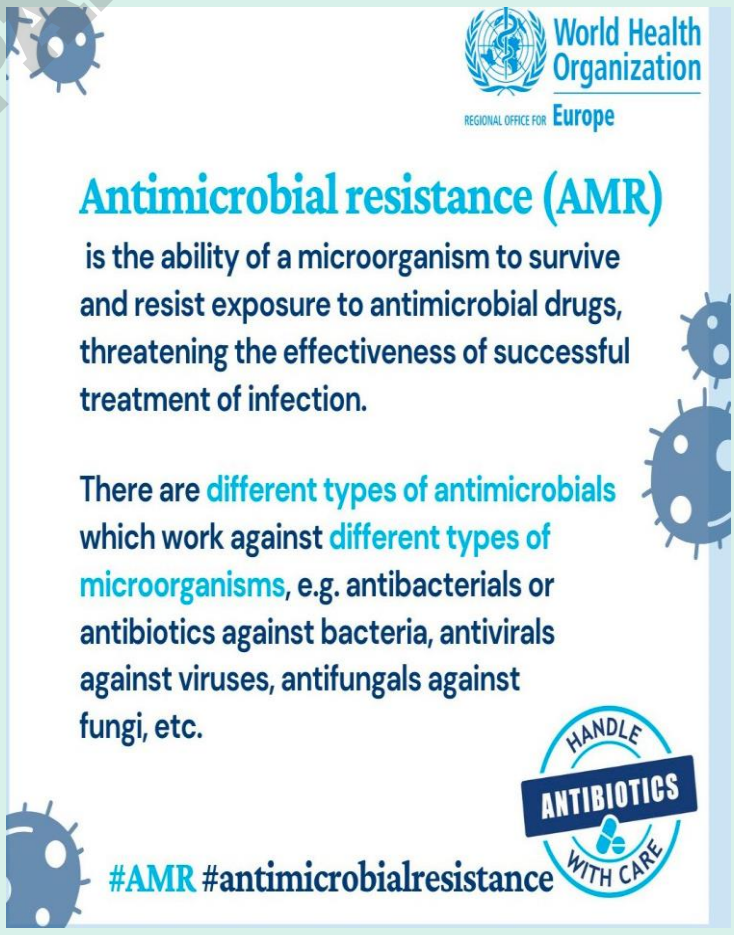
Antimicrobial resistance

The 'First Multicentric Point Prevalence Survey of Antibiotic '

Over 70% of the patients in tertiary- care hospitals across 15 States and two Union Territories were prescribed antibiotics; over 50% of antibiotics prescribed have the potential to cause AMR.

But the most crucial reveal was that 55% of the patients surveyed were prescribed antibiotics as prophylaxis (The term prophylaxis means preventive.), or as a preventive; only 45% were prescribed antibiotics to actually treat infections; of this, only 6% were prescribed the drugs after identifying the specific bacteria.

AMR occurs when pathogens evolve, fortifying themselves against drugs, and stop responding to antimicrobial drugs.



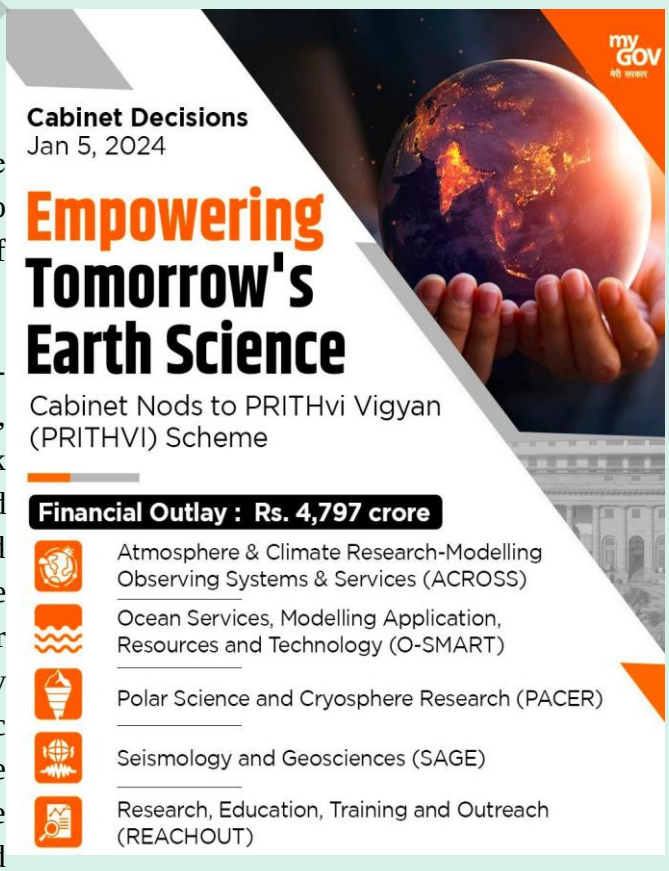
While it is the nature of pathogens to evolve, this ever- increasing crisis is constantly being exacerbated by unsound medical, and animal husbandry practices.

- It is precisely the sort of misuse and overuse of antimicrobials, as revealed by the survey, which cause the development of drug- resistant pathogens that in turn pose great risk to life and exacerbate morbidity.
- The World Health Organization (WHO) estimates that bacterial AMR was directly responsible for 1.27 million global deaths in 2019 and contributed to 4.95 million deaths.
- AMR invalidates the multiple gains that modern medicine has achieved over years, makes infections harder to treat, but also renders other medical procedures and treatments such as surgery, caesarean sections and cancer chemotherapy, much riskier, WHO warns.
- Rational prescription of antibiotics, and curbs on the use of drugs to promote growth in animals and plants. It is also clear that there is an antibiotic research and development pipeline crisis, and urgent measures are required to develop new drug candidates, and more equitable access to them.
- The role of doctors and the government in regulating use of drugs is crucial in this battle, but more so the latter. Patients too are impatient with the medical process, expecting immediate relief to ailments; but medical science offers no magical remedy.

PRITHVI programme

The Union Cabinet cleared a ₹4,797-crore programme called 'Prithvi' (Earth) that is expected to subsume five existing schemes of the Ministry of Earth Sciences (MoES).

These programmes are to improve and increase long-term observations of the atmosphere, ocean, geosphere, cryosphere, and solid earth to track changes in the planet; develop models to understand and predict weather, ocean and climate hazards, and understand the science of climate change; explore polar and high- seas regions of the earth to discover new phenomena and resources; develop technology for exploration and sustainable harnessing of oceanic resources for societal applications; and translate knowledge and insights from earth system science into services for societal, environmental, and economic benefit.



"A major component of the Ministry is the Deep Ocean Mission or DOM [one of whose objectives is to send a manned submersible 6,000 metres into the Indian Ocean].

The Prithvi programme broadly subsumes all of our other major activities,

The research and development and operational (services) activities of the Ministry are carried out by its 10 institutes.

They are the India Meteorological Department, the National Centre for Medium Range Weather Forecasting, the Centre for Marine Living Resources and Ecology, the National Centre for Coastal Research, the National Centre for Seismology, the National Institute of Ocean Technology, the Indian National Centre for Ocean Information Service, the National Centre for Polar and Ocean Research, the Indian Institute of Tropical Meteorology, and the National Centre for Earth Science.

Maritime security

India's steps for maritime security

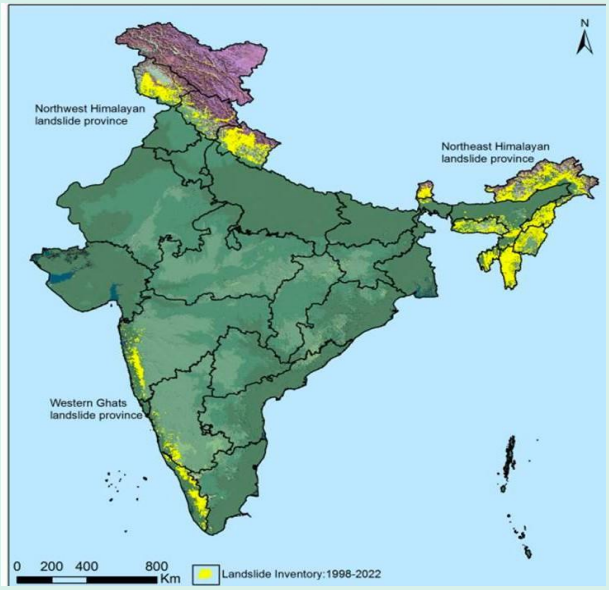
- The Government has taken a number of measures to strengthen coastal, offshore and maritime security.
- Broadly, these measures include capacity augmentation of maritime security agencies for surveillance and patrol of the nation's maritime zones; enhanced technical surveillance of coastal and offshore areas; establishment of mechanisms for inter-agency coordination; increased regulation of activities in the maritime zones; as also integration of the fishing and coastal communities.
- Indian Naval ships and aircraft are regularly deployed on 'Mission Based Deployments' in Indian Ocean Region to enhance maritime security. It also undertakes surveillance to enhance Maritime Domain Awareness and address contingencies that may arise.
- These are in consonance with Government of India's vision of Security and Growth for All in the Region (SAGAR) and the Maritime Security Strategy to build its role as the 'Preferred Security Partner' in our extended maritime neighborhood.
- Besides this, India proactively engages with regional Navies to enhance friendship/cooperation and promote maritime security in the Indian Ocean Region (IOR).
- Operational interactions with friendly foreign countries include activities like Joint Exclusive Economic Zone (EEZ) Surveillance, Coordinated Patrols on annual / bi-annual basis along the International Maritime Boundary Line (IMBL), Maritime Exercises, etc.
- India also exchanges Maritime Information bilaterally with Friendly Foreign Countries to create Maritime Domain Awareness in IOR.
- This includes information on military and naval assets of hostile / adversarial countries; assessment of maritime activities of mutual concern and activities related to transnational maritime based threats.
- Besides these, India also participates in regional frameworks such as Association of Southeast Asian Nations Regional Forum (ARF), East Asia Summit (EAS) and the ASEAN Defence Ministers Meeting Plus (ADMM Plus) to expand its cooperation and exchanges with the Indo-Pacific region.

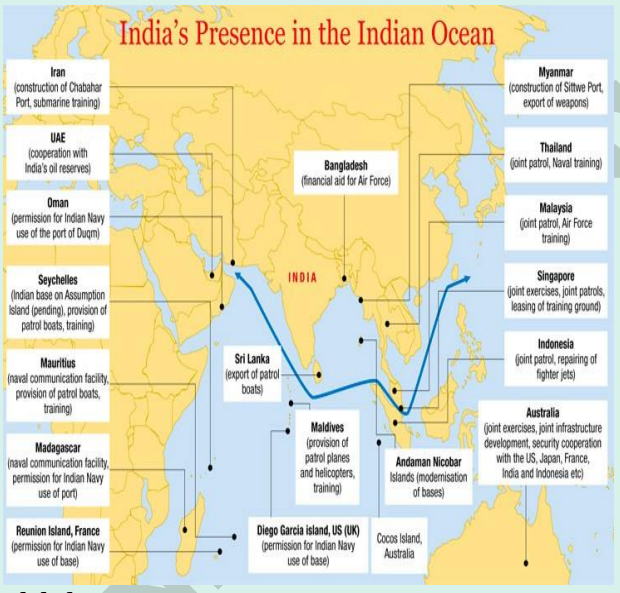
Landslide and technology

- Landslides are a unique and deadly problem.
- They are less widespread and harder to track and study with satellites.
- Landslides happen in localised areas and affect only about 1-2% of the country.

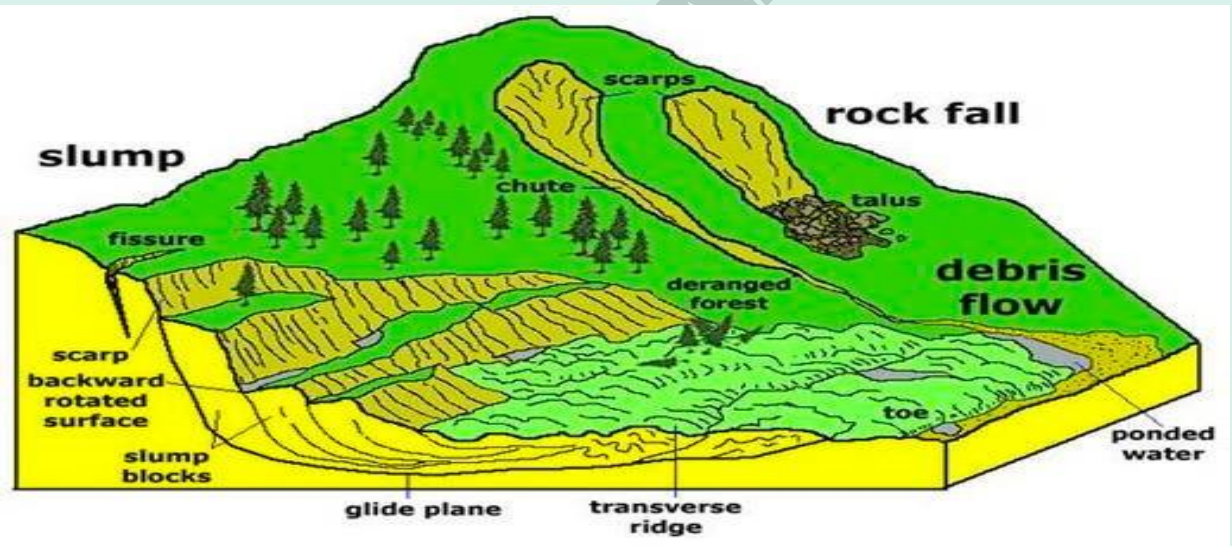
- As a result, there is much less data of sufficient quality for typical machine- learning models to work with

Researchers prepared two elements for analysis: 150,000 data points for known landslide events and





16 factors that rendered an area susceptible to landslides.



Information about these factors was collected for the whole country. Machine learning models were used to make projections for all areas for which there wasn't any landslide data. That is, even if a landslide had not occurred at a particular place, the ensemble could estimate its susceptibility to one

After all the analyses, and with the help of GSI's (geographical survey of India) extensive collection of landslide data, they developed a high- resolution landslide susceptibility map. The map acknowledged some well- known regions of high landslide susceptibility, like parts of the foothills of the Himalayas, the Assam- Meghalaya region, and the Western Ghats.

Panspermia

- The question of how life began has invited numerous hypotheses.
- One that has prevailed since ancient Greece is panspermia.
- It was first posited by the Greek philosopher Anaxagoras (500--428 BC), who coined the term and first articulated life's potential to travel as 'seeds' between planets.
- While this concept found echoes in the thoughts of other philosophers of his time,
- Some of the more important studies demonstrated that microorganisms could endure the extreme conditions that come with being ejected from a planet, navigating the rigours of interplanetary travel, and withstanding the impact of reaching a new world.
- Nineteenth -century researchers, including Swedish scientist Svante Arrhenius, also contributed to this discourse by suggesting mechanisms – like radiation pressure from the Sun – that microorganisms could be propelled by through space.
- In its modern version, the idea of panspermia advances three stages: escape from a planet, transit through interplanetary space, and landing on another planet.
- But because panspermia simply attributes the origin of life on one planet to a different planet, it doesn't explain how life came to be.

Voice cloning

Voice cloning through Artificial Intelligence (AI) was just a phenomenon of mild amusement.

AI -generated songs by famous artistes like Drake and Ariana Grande were floating around online.

However, fears around the AI software were

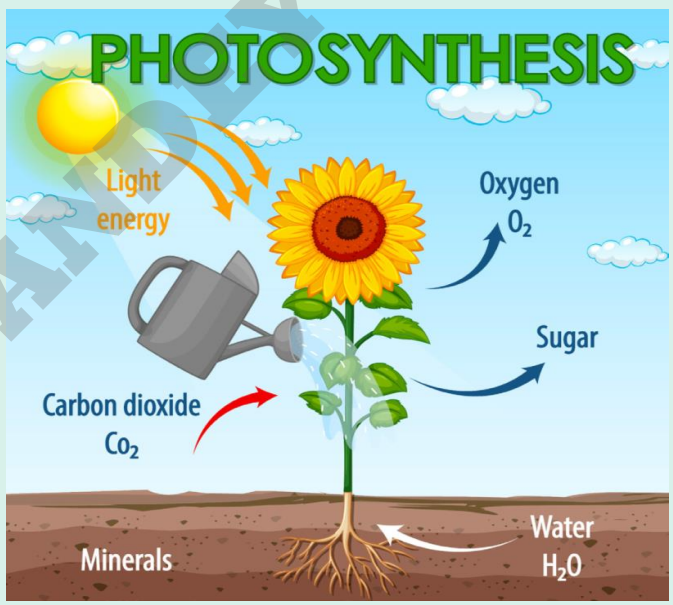
realised when AI voice cloning- related scams burgeoned.

Indians have been found to be particularly vulnerable to scams of this nature.

According to McAfee, 66% of Indian participants admitted that they would respond to a voice call or a phone call that appeared to be from a friend or family member in urgent need of money, especially if the caller was supposedly a parent (46%), spouse (34%) or their child (12%).

The report stated that messages that claimed the sender had been robbed (70%), involved in a car accident (69%), lost their phone or wallet (65%) or needed financial aid while travelling abroad (62%) were the most effective excuses

Photosynthesis



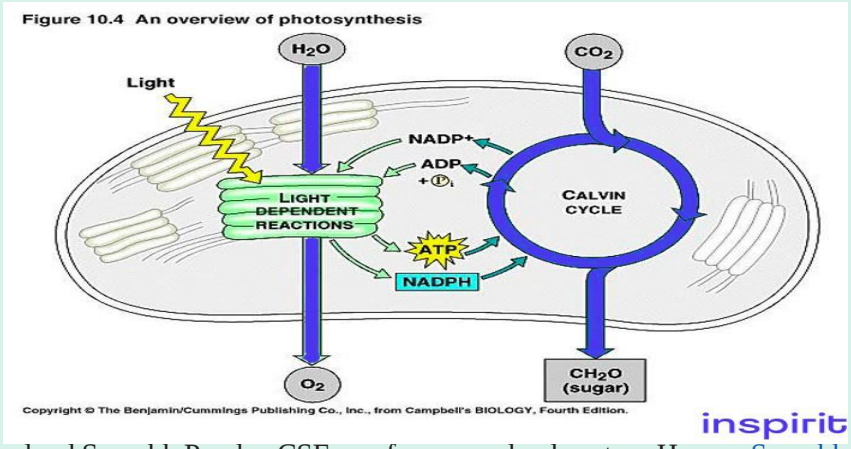
The oldest evidence of photosynthetic structures reported to date has been identified inside a collection of 1.75-billion-year- old microfossils, a paper published in the journal Nature reveals.

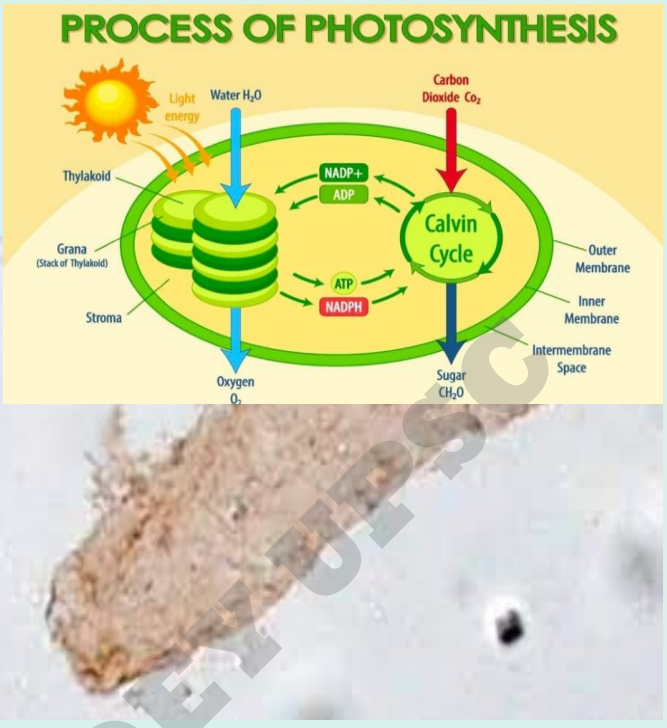
The discovery helps to shed light on the evolution of oxygenic photosynthesis.

Oxygenic photosynthesis, in which sunlight catalyses the conversion of water and carbon dioxide into glucose and oxygen, is unique to cyanobacteria and related organelles within eukaryotes. Cyanobacteria had an important role in the evolution of early life and were active during the Great Oxidation

What is great Oxidation event??

The accumulated oxygen started escaping into the atmosphere, where it reacted with methane.

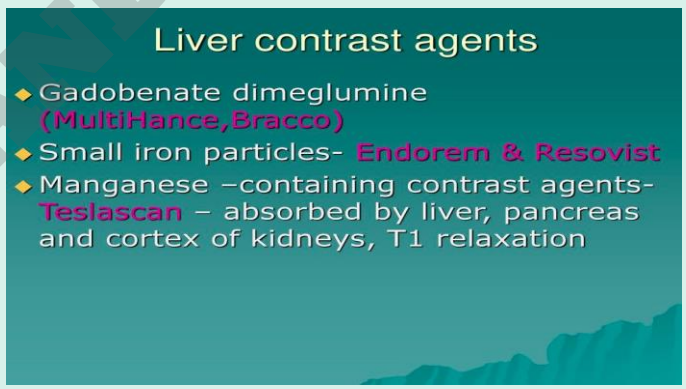




As more oxygen escaped, methane was eventually displaced, and oxygen became a major component of the atmosphere.

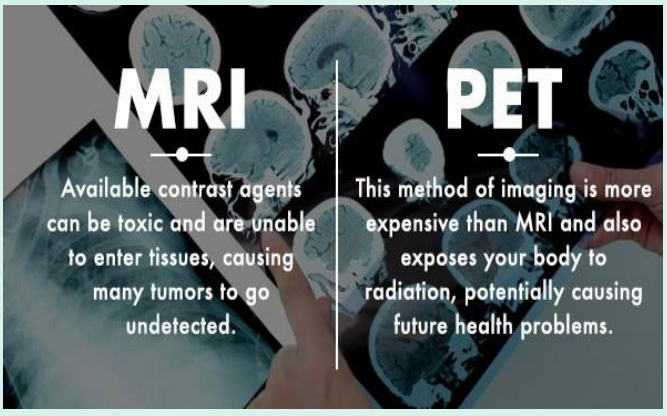
This event, known as the "Great Oxidation Event," occurred sometime between 2.4 – 2.1 billion years ago direct evidence of fossilised photosynthetic structures from Navifusa majensis. The microstructures are thylakoids; membrane- bound structures found inside the chloroplasts of plants and some modern cyanobacteria. N. majensis is presumed to be a cyanobacterium. The discovery of thylakoids in a specimen of this age suggests that photosynthesis may have evolved at some point before 1.75 billion years ago.

It does not, however, solve the mystery of whether photosynthesis evolved before or after the Great Oxidation Event.



Thylakoids represent direct ultrastructural evidence for oxygenic photosynthesis metabolism. Thylakoid membranes are dense, mostly galactolipid, protein-containing bilayers in which photosynthesis occurs in photosynthetic organisms. "

MRI



A team of researchers has designed a 'living contrast' agent for MRI of the brain, allowing them to detect episodes of mild traumatic brain injury more effectively in a large animal model.

Their imaging agent is based on micro patches that capture immune cells that tend to infiltrate the brain after traumatic brain injury, and could provide a powerful diagnostic tool for clinical monitoring and therapeutic research.

- Nearly 60-90% of mild traumatic brain injury cases currently go undiagnosed.

What are contrast agents?

- Air and carbon dioxide gas are common examples of negative contrast agents used in radiology.
- These agents are often used to visualize specific areas, such as the gastrointestinal tract, where the simple presence of gas can provide valuable diagnostic information.

Environmental enteric dysfunction (EED)

Scientists have discovered promising treatment strategies for a gut condition that commonly afflicts malnourished children in developing countries, according to a new study involving mice and data from 115 children in Zambia. By identifying key signatures of environmental enteric dysfunction (EED), their study suggests that a high protein diet, supplementation of a coenzyme, or a bile acid sequestrant (or a combination thereof) could reverse the disorder's damaging effects on the intestines' Environmental enteric dysfunction (EED) refers to an incompletely defined syndrome of inflammation, reduced absorptive capacity, and reduced barrier function in the small intestine. It is widespread among children and adults in low- and middle-income countries.

Long-lived plasma cells (LLPCs)

By examining the effects of a SARS-CoV-2 vaccine in large animals, scientists have developed a pipeline to isolate and study long -lived plasma cells that produce antibodies. Their technique provides a means to detect these rare cells and could inform studies of the immune system.

Long -lived plasma cells originate in germinal centres and usually take up residence in the bone marrow. There, they secrete antibodies and help protect against pathogens over long periods.

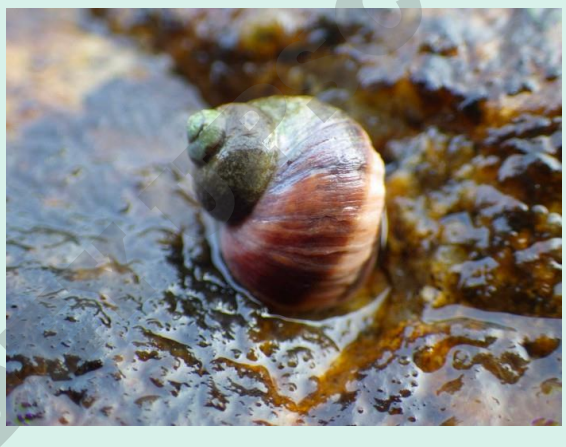
Long-lived plasma cells (LLPCs)??

Long-lived plasma cells (LLPCs) are a distinct subset of plasma cells that play a crucial role in maintaining humoral memory and long-term immunity.

Plasma cells, also called plasma B cells or effector B cells, are white blood cells that originate in the lymphoid organs as B cells and secrete large quantities of proteins called antibodies in response to being presented specific substances called antigens.

They continuously produce and secrete high-affinity antibodies into the bloodstream, conversely to memory B cells, which are quiescent and respond quickly to antigens upon recall long-lived plasma cells fulfill the criteria of memory cells as they continuously secrete the antibodies independently of their precursor cells (B cells), T cell help and antigen presence.

L. saxatilis



The seaside marine snail Littorina saxatilis is the most misidentified creature in the world.

Although live bearing is the only trait that distinguishes L. saxatilis from its egg -laying relatives, L. saxatilis did not seem to form a single evolutionary group.

"We were able to identify 50 genomic regions that together seem to determine whether individuals lay eggs or give birth to live young,"

Littorina saxatilis is commonly known as the Rough Periwinkle.

It is native to the North Atlantic with a range spanning from the Arctic Ocean to Virginia (in the West Atlantic) and the Iberian Peninsula (in the East Atlantic)

Dietary diversity

Reduction in "dietary diversity" influences the quality of our diets. Eating food from many different food groups improves nutrition. But the practice of monoculture growing one crop or vegetable on large tracts of land only reduces "agricultural biodiversity".

One alternative, to transport food groups from distant regions, raises costs and carries a heavy environmental penalty. A wide variety of Farmers with small holdings, Shepherds on pastoral lands, and tribal populations that practice agroforestry are major contributors to nutritional variety in our country. The indigenous people of Northeast India practiced a form of agriculture, called Jhum, in which about 20 different food crops would be grown on the same piece of land.

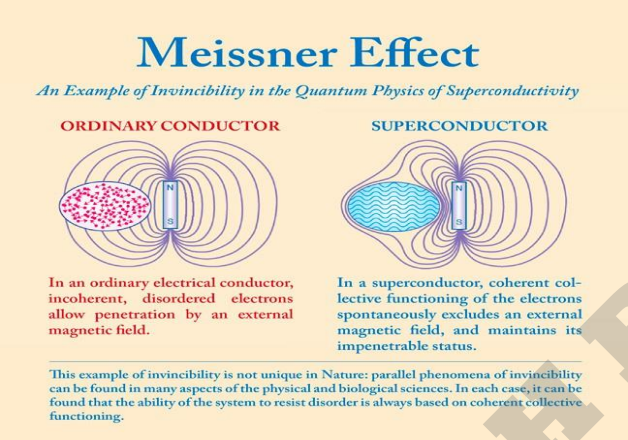
This form of cultivation is a total antithesis of modern agricultural practices but offers plenty of diversity in their diets. Sadly, this form of cultivation is losing ground.

Superconductivity & Meissner effect

A group of scientists affiliated with research institutes in China and Japan has reported finding a sign of superconductivity in a material that was at the center of a controversy last year over similar claims.

What is the Meissner effect?

It is one of a few 'effects' certain materials exhibit when they're able to conduct electric currents without any resistance i.e. when they become superconductors.



The researchers have reported in their paper that they observed the Meissner effect in a compound called copper- substituted lead apatite.

Scientists know many types of materials that become superconducting in different conditions metals, metallic compounds, ceramics, hydrides, etc.

The Meissner effect is the expulsion of a magnetic field from a superconductor during its transition to the superconducting state when it is cooled below the critical temperature. This expulsion will repel a nearby magnet

They all have one thing in common: they become superconducting either when they're cooled to extremely low temperatures or when they're subjected to extremely high pressures.

Many scientists are looking for a material that becomes superconducting at room temperature and pressure (RTP).

Aside from scientific curiosity, such a material would have applications worth several billion dollars.

It could be used to make wires that transport electricity with zero loss; such transmission losses are the largest source of electric energy loss in the world today.

The material will also have uses in medical diagnostics, computing, power generation, advanced electronic circuits, and many other fields.

For example, the water- absorbing properties of modern diapers were first tested with particle accelerators, which use superconducting magnets to work.

South Korean researcher

Another set focused on a material called LK-99 that, a South Korean research group claimed, was an RTP superconductor. Independent studies soon found that when LK-99 was prepared the way the South Korean group had indicated (albeit not clearly), it didn't become a superconductor.

Instead, it acquired an impurity whose presence the group hadn't accounted for, and which distorted measurements of the material's heat capacity and magnetism in a way an actual superconductor would have, misleading the scientists.

Lunar economy & ULA

News

The first American spacecraft to attempt to land on the Moon in more than half a century is poised to blast off early Monday but this time, private industry is leading the charge.

A brand new rocket, United Launch Alliance's Vulcan Centaur, lifted off from Cape Canaveral Space Force Station in Florida for its maiden voyage, carrying Astrobotic's Peregrine Lunar Lander

Vulcan Centaur is a two-stage-to-orbit, heavy-lift launch vehicle developed by United Launch Alliance (ULA). It is principally designed to meet launch demands for the U.S. government's National Security Space Launch (NSSL) program for use by the United States Space Force and U.S. intelligence agencies for national security satellite launches.

It will replace both of ULA's existing launchers (Atlas V and Delta IV Heavy) in this role, as these launchers are retiring. Vulcan Centaur will also be used for commercial launches, including an order for 38 launches from Kuiper Systems.

TERMS

A two-stage-to-orbit (TSTO) or two-stage rocket launch vehicle is a spacecraft in which two distinct stages provide propulsion consecutively in order to achieve orbital velocity.

A heavy-lift launch vehicle is an orbital launch vehicle capable of generating a large amount of lift to reach its intended orbit. Heavy-lift launch vehicles generally are capable of lifting payloads between 20,000 to 50,000 kg (44,000 to 110,000 lb) (by NASA classification) or between 20,000 to 100,000 kilograms (44,000 to 220,000 lb) (by Russian classification) into low Earth orbit (LEO).

As of 2023, operational heavy-lift launch vehicles include the Long March 5, the Proton-M and the Delta IV Heavy.

United Launch Alliance, LLC, commonly referred to as ULA, is an American aerospace manufacturer, defense contractor and launch service provider that manufactures and operates rocket vehicles that launch spacecraft into orbits around Earth and other bodies in the Solar System. ULA also designed and builds the Interim Cryogenic Propulsion Stage for the Space Launch System (SLS).

Significant steps were moved by the private sector into the wider space exploration domain

(in lunar exploration, in Space Resources Utilisation, or in the commercial exploitation of Low Earth Orbit)

In 2015, NASA partnered with GM to develop a faster, more dexterous and more technologically advanced robot, Robonaut 2. In 2016, PTS partnered with Audi to help build and launch a 3D printed rover.

In 2019, JAXA and Toyota announced their collaboration on international space exploration.

Mining Sector

Remote-operating systems to minimize the danger in hazardous environments on Earth or in space. Mining technology and drills can be used to extract space resources.

Technology transfer between the space sector and the O&G industry mainly for: robotics, advanced sensors, and AI.

Construction Sector

The construction industry is expected to support the development of modern techniques that would enable building lunar habitats and structures in space while simultaneously facilitating the terrestrial industry in advancing 3D printing (additive manufacturing) capabilities

Energy Sector

OxEon Energy worked with the Colorado School of Mines to integrate an electrolysis technology to process ice and separate the hydrogen and oxygen on the Moon.

The molecules could then be cooled to produce fuel for cislunar transport.

Robotics Sector

The energy industry and the robotics industry will also play vital roles in investing and developing lunar exploratory activities.

Nanotechnology and its helping in health sector

Nanotechnology refers to the manipulation of matter on an atomic, molecular, and supramolecular scale, typically ranging from 1 to 100 nanometers. At this scale, materials often exhibit unique and advantageous properties compared to their bulk counterparts, leading to various applications in fields like electronics, materials science, energy production, and medicine.

In the health sector, nanotechnology has shown great potential in several ways:

Drug Delivery: Nanoparticles can be engineered to carry drugs to specific target sites in the body, enhancing drug efficacy while minimizing side effects. This targeted drug delivery allows for lower drug doses and reduces the risk of systemic toxicity.

Diagnostic Tools: Nanotechnology has enabled the development of highly sensitive diagnostic tools for detecting diseases at earlier stages. Nanoparticles can be functionalized to bind to specific biomarkers, enabling the detection of diseases such as cancer or infectious diseases with high accuracy.

Therapeutics: Nanomaterials can be used directly as therapeutic agents. For instance, gold nanoparticles can be employed in photothermal therapy to selectively destroy cancer cells when exposed to near-infrared light.

Tissue Engineering and Regenerative Medicine: Nanotechnology plays a crucial role in

designing biomaterials for tissue engineering and regenerative medicine. Nanoscale scaffolds can mimic the extracellular matrix, providing structural support and cues for cell growth and differentiation.

Medical Imaging: Nanoparticles are used as contrast agents in various imaging techniques such as MRI, CT scans, and ultrasound. These contrast agents enhance the visibility of tissues and improve diagnostic accuracy.

Diagnostics and Sensors: Nanotechnology facilitates the development of highly sensitive and portable diagnostic devices and biosensors for detecting various biomolecules, pathogens, and environmental contaminants.

Overall, nanotechnology offers promising solutions to many challenges in healthcare, including improving drug delivery, early disease detection, and developing advanced therapeutics and medical devices, thereby revolutionizing the diagnosis, treatment, and prevention of diseases.

Nanotechnology plays a significant role in various sectors due to its ability to manipulate matter at the nanoscale, leading to unique properties and applications. Some of the key sectors where nanotechnology has made an impact include:

Electronics and Photonics: Nanotechnology has enabled the miniaturization of electronic components, leading to more powerful and energy-efficient devices. Nanomaterials like carbon nanotubes and quantum dots are used in transistors, displays, and sensors. Nanotechnology also contributes to the development of high-performance batteries and photovoltaic cells.

Materials Science: Nanotechnology has revolutionized materials science by providing new materials with enhanced properties. Nanocomposites, which consist of nanoparticles dispersed in a matrix material, exhibit superior mechanical, thermal, and electrical properties. These materials find applications in aerospace, automotive, construction, and other industries.

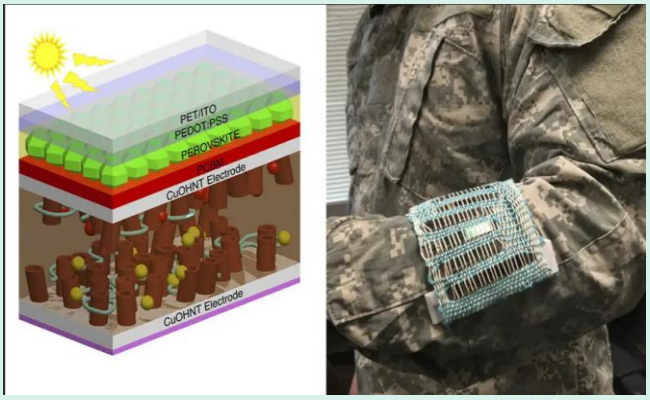
Energy: Nanotechnology has implications for both energy production and storage. Nanomaterials are utilized in solar cells to improve efficiency and reduce costs. Additionally, nanotechnology contributes to the development of fuel cells, hydrogen storage systems, and advanced battery technologies, which are crucial for renewable energy integration and electric vehicles.

Healthcare and Medicine: As discussed earlier, nanotechnology offers numerous applications in healthcare, including drug delivery, diagnostics, therapeutics, tissue engineering, and medical imaging. These advancements have the potential to revolutionize disease treatment, improve patient outcomes, and enhance the efficiency of healthcare delivery.

Environmental Remediation: Nanotechnology is used in environmental remediation efforts to remove pollutants and contaminants from air, water, and soil. Nanomaterials such as nanoscale iron particles are employed for groundwater remediation, while photocatalytic nanoparticles can degrade organic pollutants in wastewater treatment.

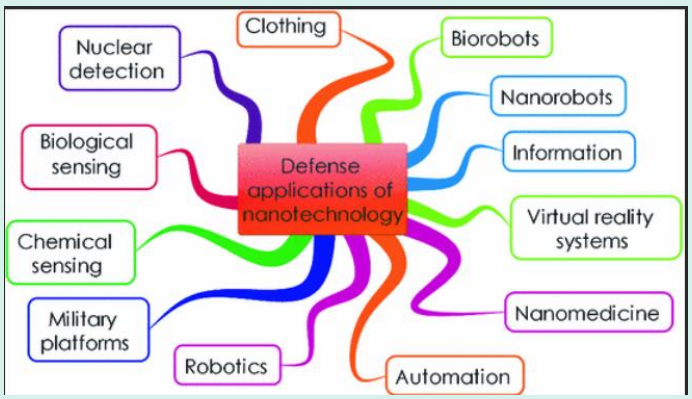
Agriculture: Nanotechnology is being explored in agriculture to improve crop productivity, enhance nutrient delivery, and mitigate environmental impact. Nanoscale pesticides and fertilizers can be precisely targeted, reducing waste and minimizing environmental contamination. Nano sensors are also used for monitoring soil health and crop conditions.

Textiles and Apparel: Nanotechnology has introduced innovative functionalities to textiles and apparel, such as stain resistance, antimicrobial properties, UV protection, and moisture management. Nanoparticles and Nano coatings are applied to fabrics to impart these properties, resulting in more durable and functional textiles.



Defence and Security: Nanotechnology plays a role in the development of advanced materials for lightweight Armour, stealth coatings, and sensors for chemical and biological threat detection. Nanoscale materials also contribute to the miniaturization of electronic devices used in surveillance and communication systems.

Overall, nanotechnology's interdisciplinary nature and ability to manipulate matter at the nanoscale make it a transformative technology with applications across various sectors, driving innovation and addressing complex challenges.



UPSTREAM		MIDSTREAM		DOWNSTREAM	
Manufacturing and testing	Launch	Transportation to Moon orbit	Landing	Operation and Transmission	Data & signals processing
Development of orbiters, landers, rovers for the Moon	Launch from the Earth and injection into transfer orbit	Transportation and injection into Moon orbit	For landers and rovers, descent module to the surface	Operation of rovers, acquisition of payload data, transmission of telemetry	Processing of payload data and communication signals, provision of end products

Figure 1 - Value chain for Lunar transportation market

Warm vaccine

Why in the news??

A heat- tolerant vaccine developed by the Indian Institute of Science (IISc.) researchers is said to be effective against all current strains of SARS-CoV-2 besides having the potential to be quickly adapted for future variants as well.

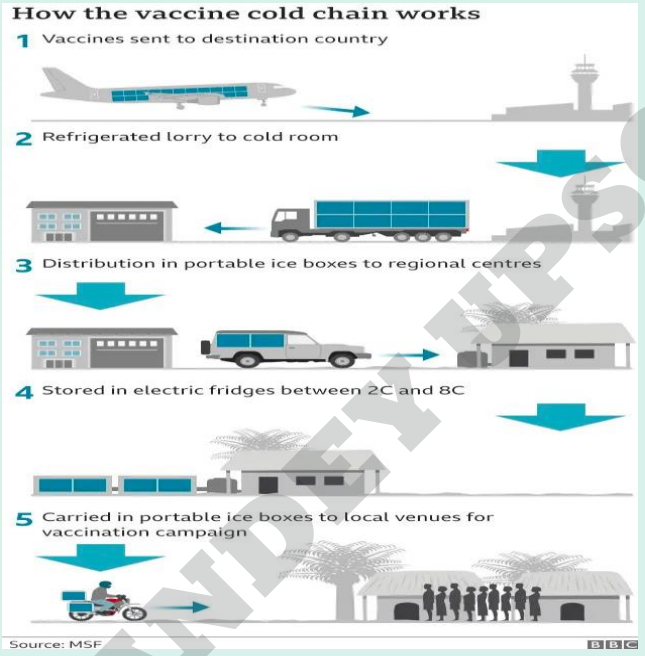
The 'warm' vaccine developed by the Bengaluru-based Mynvax laboratories, a company incubated at the Indian Institute of Science Bangalore, is unique among existing vaccines in that it can be stored at 37 degrees Celsius for four weeks and at 100 degrees Celsius for up to 90 minutes

Nearly all vaccines need to be transported and distributed between 2C and 8C in what comprises the so-called cold chain.

And most of the COVID-19 vaccines under development, according to the World Health Organisation (WHO), will need to be refrigerated at temperatures well below 0C, the freezing point of water.

"warm" or a heat-stable vaccine, they claim, can be stored at 100C for 90 minutes, at 70C for about 16 hours, and at 37C for more than a month and more.

Only three offering protection against meningitis, human papillomavirus (HPV) and cholera are licensed and approved by WHO for use at temperatures up to 40C. These vaccines can be deployed quickly in hard- to-reach communities, and reduce pressures on healthcare workers.



Warmest year

- Last year was the planet's hottest on record by a substantial margin and likely the world's warmest in the last 1,00,000 years, the European Union's Copernicus Climate Change Service (C3S) said on January 9.
- Scientists had widely expected the milestone after climate records were repeatedly broken. The world has not breached that target which refers to an average global surface temperature of 1.5 degrees over decades but C3S said the fact that temperatures had exceeded the level on nearly half of the days of 2023 set "a dire precedent".

➢ Despite the proliferation of governments' and companies' climate targets, CO2 emissions remain stubbornly high. The

world's CO2 emissions from burning coal, oil and gas hit record levels in 2023.

- Last year, the concentration of CO2 in the atmosphere rose to the highest recorded, of 419 parts per million, C3S said.
- It was also the first year in which every day was more than 1C hotter than pre-industrial times.
- Alongside human caused climate change, temperatures were boosted by the El Niño weather phenomenon, which warms the surface waters in the eastern Pacific Ocean and contributes to higher global temperatures, in 2023.
- Each fraction of temperature increase exacerbates extreme and destructive weather disaster.

Cosmic rays

- Cosmic rays are streams of energetic particles and clusters of particles coming from outer space and the sun. They include protons and alpha particles (nuclei of helium atoms). Only low-intensity cosmic rays reach the earth's surface.
- Their energy is mostly lost in the atmosphere itself, as they smash into atoms of the atmospheric gases and produce a shower of other particles. Otherwise life wouldn't have been possible on the earth.
- From the 1930s, studies of cosmic rays led scientists to discover many then-unknown subatomic particles

How much energy?

- Data collected by the Telescope Array Project indicated the Amaterasu cosmic ray had an energy of 240 exa- electron-volt (EeV).
- The electron-volt (eV) is a unit of energy, like joules, used to measure the energy of subatomic particles.
- The energy of 1 eV is approximately 1.6 × 10-19 joules. One joule is the energy required to light a one- watt bulb for one second.
- The light- particles in sunlight have an energy of about 1.6-3.1 eV, for example. When one deuterium nucleus and one tritium nucleus undergo fusion, they release one helium atom, one neutron, and 17.6 million eV of energy.
- The mass -energy of a single Higgs boson particle, which is considered 'heavy', is 125.1 billion eV. Cosmic rays typically range in energy from about one billion eV to about 100 billion billion eV. The Amaterasu cosmic ray had an energy of 240 EeV or 240 billion V. This is extremely high.

What do cosmic- ray energies tell us?

- Ultra -high- energy cosmic rays (UHECRs) are subatomic particles from extragalactic sources with energies greater than 1 EeV.
- Scientists have observed UHECRs more energetic than 100 EeV.
- But typically, cosmic rays with more energy than around 60 EeV don't 'survive' beyond a certain distance in space.

- **Where did Amaterasu come from?**
- An amazing feature of the Amaterasu particle is that if you look along the direction it came, towards its point of origin, there is nothing to be seen meaning it appears to have come from an empty part of the universe
- **How can Amaterasu help?**
- Cosmic rays can be divided into two types: those originating from beyond our solar system, called galactic cosmic rays (GCR), and high- energy.
- Particles emitted by the sun, called solar cosmic rays, that are mainly protons. Solar cosmic rays originate primarily in solar flares.
- In modernity, the particles in these rays have come to be called solar energetic particles.
- By tracking these cosmic rays, scientists have found that the mass ratio of helium to hydrogen nuclei that is, the ratio of the total masses of hydrogen and helium present is about 28:100, meaning there are about 28 grams of alpha particles for every 100 grams of protons in cosmic rays.

Why Fog in North India?

What is fog?

- A fog is a collection of small droplets of water produced when evaporated water has cooled down and condensed.
- "Fog is nothing but a thick cloud, but very close to the earth's surface. For a thick fog to form, temperatures should be lower, and abundant moisture should be available near the surface."
- Fog materializes whenever there is a temperature disparity between the ground and the air.
- This happens frequently during Indian winters fog is created when the temperature drops at night and in the early morning, aerosols present in the atmosphere condense.
- High humidity, combined with an ample presence of water vapor or moisture, encourages foggy conditions.
- The process by which it cools plays a pivotal role in the formation of fog.
- One primary mechanism contributing to fog formation is called infrared cooling.
- It typically occurs when the weather is transitioning from summer to winter.
- In the summer, the ground absorbs radiation from the sun, becomes warmer, and moistens the air passing over it.

- When cooler weather kicks in, this mass of warm, moist air comes in contact with processes that cool it.
- The 'collision' prompts the water vapour in the air to condense rapidly, giving rise to fog.

➢ Another type of fog, known as radiation fog, is prevalent and occurs when an unseasonably warm day with high humidity is followed by rapidly dropping temperatures.

➢ The specific type of fog, its duration, and its effects are contingent on various environmental conditions.

➢ Why is northern India prone to fogging?

➢ "The entire Indo- Gangetic plains are prone to the formation of fog during the winter season, as all the conditions low temperatures, low wind speed, moisture availability and plenty of aerosols are present in this region,"

➢ "Moisture incursion into this region can happen once a Western Disturbance, a precipational pattern that brings rain to north India during winter months, moves across northern parts.

➢ Sometimes, moisture incursion can happen from the Arabian Sea Also Tornadoes Formation

➢ Severe weather battered the U.S., spinning off tornadoes and reportedly killing three people in the South as high winds and blizzards buffeted the North causing a power blackout

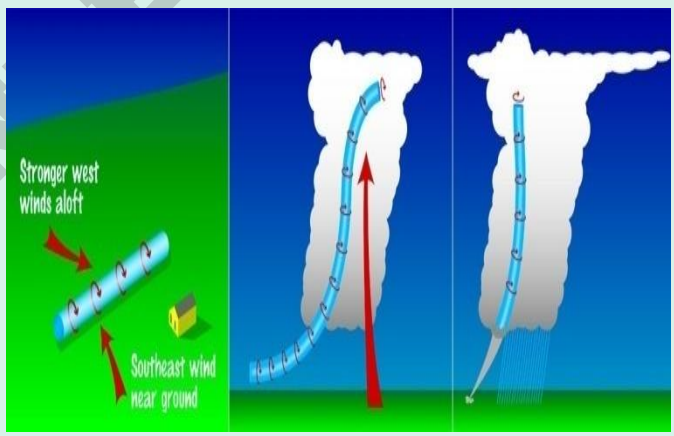
✓ About tornadoes

✓ **Tornado** - A violently rotating column of air touching the ground, usually attached to the base of a thunderstorm.

✓ Tornadoes are nature's most violent storms.

✓ Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds.

✓ Winds of a tornado may reach 300 miles per hour



➢ A tornado forms from a large thunderstorm.

➢ Inside thunderclouds, warm, humid air rises, while cool air falls--along with rain or hail. These conditions can cause spinning air currents inside the cloud.

➢ Although the spinning currents start out horizontal, they can turn vertical and drop down from the cloud--becoming a tornado.

➢ Conditions are ripe for tornadoes when the air becomes very unstable, with winds at different altitudes blowing in different directions or at

different speeds a condition called wind shear. The first result is a large thunderstorm.

- Inside the huge thundercloud, warm and humid air is rising, while cool air is falling, along with rain or hail.
- All these conditions can result in rolling, spinning air currents inside the cloud.
- Although this spinning column of air starts out horizontal, it can easily go vertical and drop down out of the cloud.
- When it touches the ground, it's a tornado.

AI and global economy

- False and misleading information supercharged with cutting- edge artificial intelligence that threatens to erode democracy and polarized society is the top immediate risk to the global economy, the World Economic Forum
- In its latest Global Risks Report, the organization also said an array of environmental risks pose the biggest threats in the longer term.
- The report listed misinformation and disinformation as the most severe risk over the next two years, highlighting how rapid advances in technology also are creating new problems or making existing ones worse.

The authors worry that the boom in generative AIchatbotst like ChatGPT means that creating sophisticated synthetic content that can be used to manipulate groups of people won't be limited any longer to those with specialized skills

- "Societies could become further polarized" as people find it harder to verify facts, she said.
- The rise of AI brings a host of other risks, she said. It can empower "malicious actors" by making it easier to carry out cyberattacks, such as by automating phishing attempts or creating advanced malware.

What led to the 'India out' campaign during Solih's administration?

- The Maldives is a key maritime neighbours of India in the Indian Ocean Region (IOR). The country's location holds significant strategic importance to India, especially amid China's growing engagements in the region. Although Maldives -India ties have been mostly cordial over the years, there was a noticeable tilt towards China during the presidency of

Progressive Party of Maldives (PPM) leader Abdulla Yameen from 2013 to 2018.

- It was under Mr. Yameen that China included the Maldives as a part of its Belt and Road Initiative (BRI).
- Bilateral ties improved when Ibrahim Mohamed Solih of the Maldivian Democratic Party (MDP) took over the reins from Mr. Yameen in 2018.
- Aiming to reset ties with "one of its closest bilateral partners," Mr. Solih adopted an 'India first' foreign policy to establish a closer relationship with India in the areas of defense, security, and economics.
- the growing proximity between New Delhi and Male and high- level military exchanges sparked concern in certain quarters, leading to an 'India out' campaign spearheaded by the Opposition.
- The critics of the Solih administration alleged that the government was compromising the sovereignty of the island nation and "allowing Indian boots on the ground."
- The Opposition sharpened its attack after the government signed the Uthuru Thila Falhu (UTF) deal with India in 2021 to jointly develop the National Defence Force Coast Guard Harbour.
- The anti-- India campaign emerged as the main poll plank in the 2023 presidential race under the leadership of former pro-China Maldivian President Yameen.
- The first signs of a shift in foreign policy emerged when the new Maldivian President skipped India and instead travelled to Turkiye in November on his first official visit.
- The Ankara trip marked a departure from a long tradition of Maldivian heads visiting New Delhi first.

Why did the decision to

revoke the survey pact with India cause a stir in political circles?

The Muizzu government caused a stir in political and strategic circles with its decision to revoke a key 2019 agreement with India for conducting surveys in Maldivian waters.

The Memorandum of Understanding (MoU) for hydrographic surveying, signed during PM Modi's state visit to the islands when President Ibrahim Solih was in power, backed the commitment of the two countries to maintain close cooperation in defence and maritime security.

Critics of the Solih government, however, had claimed that it harmed national security.

Alternative route to Red sea

While shippers face delays in sending cargo to Europe and vice- versa due to the Red Sea

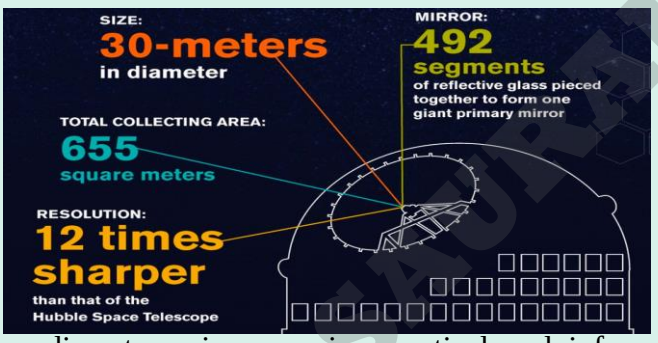
crisis, Israeli logistics start-up Trucknet has a solution move cargo by road between Dubai and the Adani-run Haifa port in Israel.

Cargo will move through Saudi Arabia and Jordan to reach Haifa port and proceed to Europe by sea. Though the start-up cannot match the high volume that is moved by sea, it has a solution to move emergency goods such as medicines,

- This means cargo from Mumbai or Mundra can be sent to Jebel Ali, from where it could be sent by road to Haifa, and then via ships to reach ports in Europe or the U.S

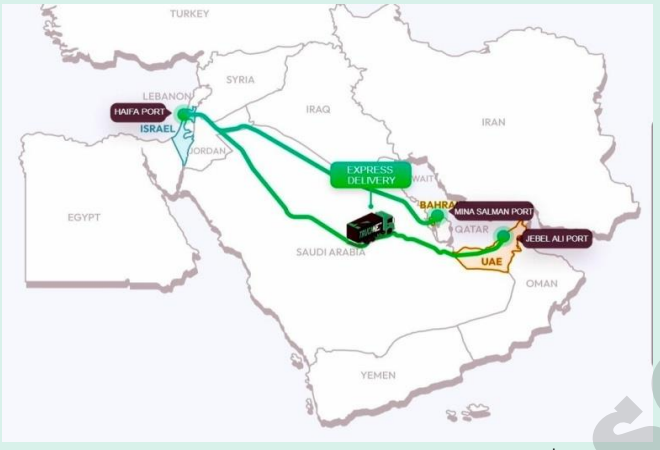
Thirty Meter Telescope (TMT) project

- In a signal of renewed enthusiasm for a global scientific project, an official delegation from the Department of Science and Technology visited Mauna Kea, an inactive volcano on the island of Hawaii in the U.S., to discuss "challenges" to the Thirty Meter Telescope (TMT) project, a press release said.
- The TMT has been conceived as a 30-metre



diameter primary -mirror optical and infrared telescope that will enable observations into deep space.

- It is proposed as a joint collaboration involving institutions in the U.S., Japan, China, Canada, and India. Indian participation in the project was approved by the Union Cabinet in 2014.
- India expects to be a major contributor to the



project and will provide hardware worth $200 million. Mauna Kea hosts multiple telescopes.

Maunakea

Maunakea is a truly unique place.

- The clarity and stability of the atmosphere above Maunakea allows incredibly detailed visual observations of the night sky. It is one of the best places on earth for TMT to capture the precise data needed to test fundamental theories

of physics and detect the faint signatures of life on far-off worlds.

The Thirty Meter Telescope (TMT)

The Thirty Meter Telescope (TMT) is a planned extremely large telescope (ELT) that has become controversial due to its location on Mauna Kea, on the island of Hawai‘i.

The TMT would become the largest visible-light telescope on Mauna Kea.

TMT's Science and Technology

- TMT is an extraordinary international scientific endeavor that will revolutionize our understanding of the universe and our place within it. Its unprecedented design will feature unique capabilities for the exploration of black holes, dark matter, and the possibility of life outside the solar system.
- TMT will explore some of the most important questions facing astronomers:
- **What is the nature and composition of the universe?**
- **When did the first galaxies form and how did they evolve?**
- **What is the relationship between black holes and galaxies?**
- **How do stars and planets form?**
- **What is the nature of extrasolar planets?**
- **Is there life elsewhere in the universe?**

Aakash missile

- The Defence Research and Development Organisation (DRDO) conducted a successful flight test of the new generation Akash surface-to -air missile (SAM) from the Integrated Test Range (ITR), Chandipur, off the coast of Odisha, on Friday.
- "The flight test was conducted against a high-speed unmanned aerial target at very low altitude. The target was successfully intercepted

by the weapon system and destroyed.

Optical- 8 satellite

- Japan successfully launched a rocket carrying a government intelligence- gathering satellite on Friday on a mission to watch movements at military sites in North Korea and to improve responses to natural disasters.
- The H2A rocket, launched by Mitsubishi Heavy Industries Ltd., lifted off from the Tanegashima Space Center in southwestern Japan, carrying the optical satellite as part of Tokyo's reconnaissance effort to rapidly build up its military capability. Optical8 satellite can capture detailed images, though its capability is limited in severe weather. Japan began the satellite programme after a North Korean missile flew over Japan in 1998. Japan aims at setting up a network of 10 satellites, including those carrying radars that can operate at night or in severe weather, to spot and provide early warning for possible missile launch.

Panama Canal

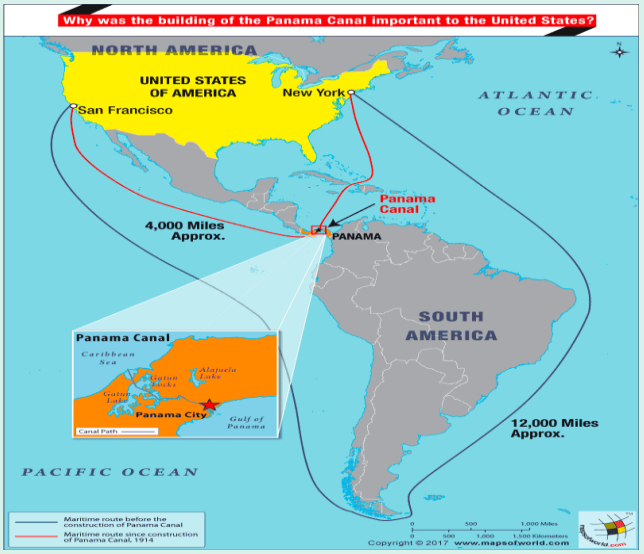
- With the Red Sea crisis paralyzing the global shipping industry, there is more trouble for the sector due to the severe shortage of water in the Panama Canal. The artificial 82- kilometre waterway connects the Atlantic Ocean with the Pacific Ocean.
- The Canal's locks at each end lift ships up to Gatun Lake, an artificial freshwater lake 26 metre above the sea level created by damming the Chagres River and Lake Alajuela to reduce the amount of excavation work required for the canal, and then lower the ships at the other end.
- An average of 20,00,00,000 litre of fresh water is used during the single passage of a ship.
- based on the current and projected water levels in Gatun Lake, the Panama Canal Authority had to make reductions to the amount and weight of vessels that can pass through the canal. The Panama Canal cuts across the Isthmus of Panama and is a key conduit for international maritime trade.

Pollen dating & Gigantopithecus blacki

- The extinction of the largest known primate, a giant ape from China, resulted from its struggle to adapt to environmental changes, as per a paper published in Nature.
- These findings fill a key gap in our understanding of why this species failed to survive where other, similar primates persisted.
- Gigantopithecus blacki was a species of great ape found in China between 2 million and 330 thousand years ago, after which the species became extinct.

What is pollen dating?

- Pollen dating is done by comparing the pollen zones in different rock layers or strata, comparing older, deeper layers to newer ones on top.



- The pollen zone is the particular time frame

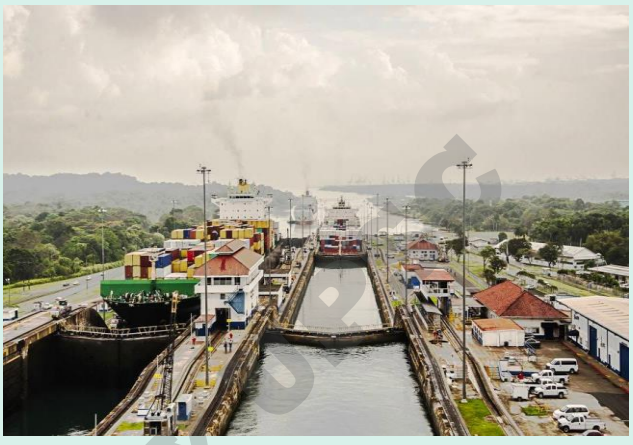
where specific species of plants release more pollen into the air than others.

- Using this, archeologists can determine climate changes, deforestation, or changes in the use of land hundreds of years ago such as the association between European settlement in North America and an increase in the amount of ragweed pollen found.
- Specific locations can even be determined as the origins for many rare or uncommon pollens. Pollen can come in a variety of distinct shapes and sizes depending on the plant it is coming from.
- These microscopic grains are incredibly sturdy with outer shells made from sporopollenin, an incredibly inert substance.

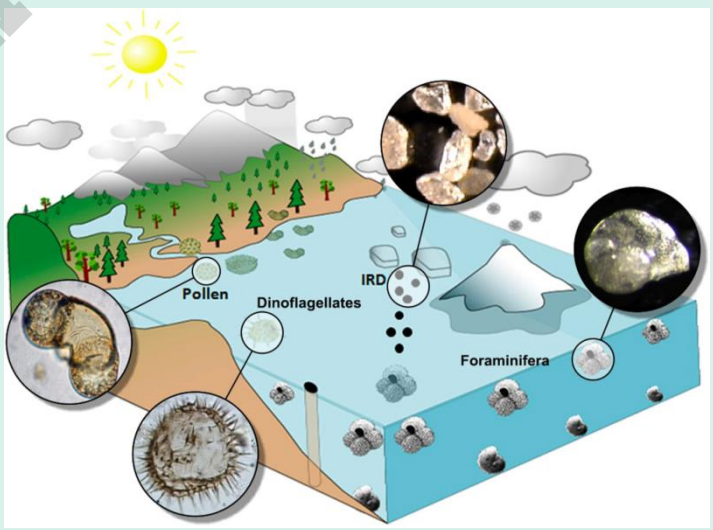
Biodiversity hotspot and trees extinction

- A comprehensive analysis of tree species' conservation statuses across Atlantic Forest trees reveals high extinction risks.
- According to the study, roughly two -thirds of the 4,950 tree species living in this biodiversity hotspot are threatened with extinction.
- This includes 82% of endemic species, which have quite limited geographic ranges.
- The researchers suggest that the conservation status of tropical forests may be worse than previously believed.
- Biodiversity hotspot are places on Earth that are both biologically rich and deeply threatened.

To qualify as a biodiversity hotspot, a region must meet two strict criteria:



- It must have at least 1,500 vascular plants as endemics — which is to say, it must have a high percentage of plant life found nowhere else on the planet.

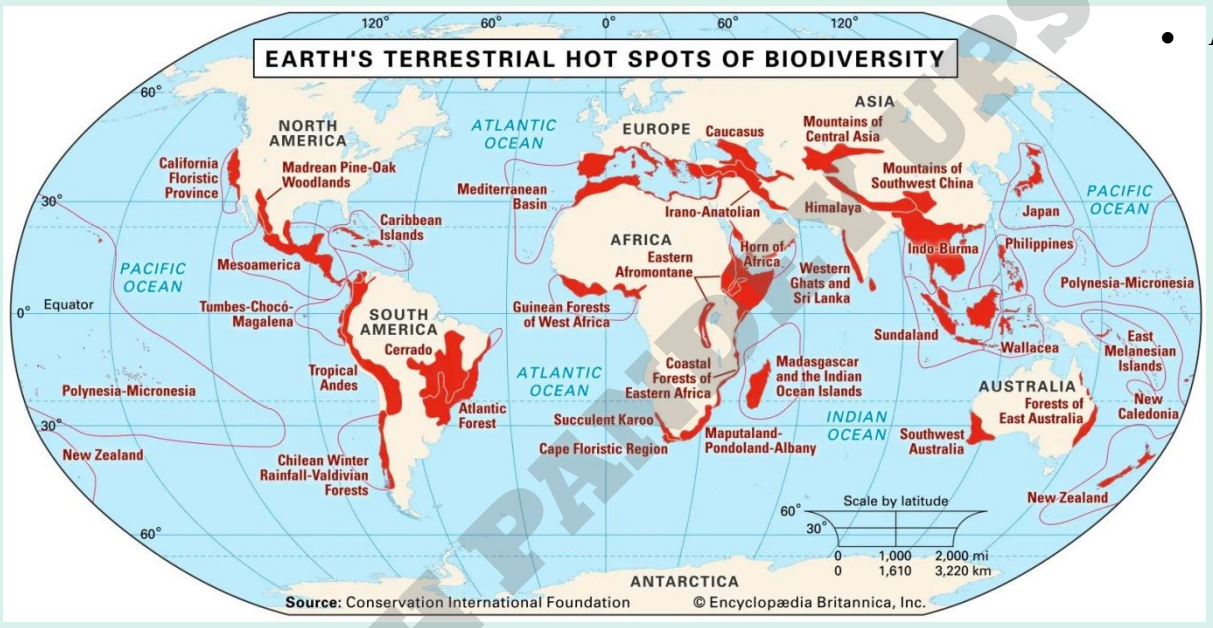


- A hotspot, in other words, is irreplaceable.
- It must have 30% or less of its original natural vegetation. In other words, it must be threatened.

Arctic seal survival

- Arctic seals have evolved many adaptations to cope with their frosty environment.
- Researchers report that these structures help the seals retain heat and moisture as they breathe in and out.
- the seals' ability to warm and moisten air during inhalation and to reduce heat and moisture loss during exhalation.
- In cold, dry environments, animals lose heat and moisture just by breathing.
- Most mammals and birds have complex bones called maxillo turbinates inside their nasal cavities that help to minimise this risk.
- These porous, bony shelves are covered with a vascularized layer of mucosal tissues that humidify inhaled air, which is important for lung function and reduces the amount of heat and moisture lost during exhalation.
- Modern computers and qubits

- Modern computers use semiconductor transistors to build circuits that function as bits.



- A semiconductor chip hosts more than 100 million transistors on 1 sq. mm. Imagine how small an individual transistor is and how close it is to adjacent transistors.
- As transistors become smaller, they become more susceptible to quantum effects A fundamental limitation of conventional computing architecture is that each bit can exist in only one of the two states, 0 or 1.
- But according to quantum physics, a qubit can also be in a superposition of its two states at the same time

- To perform one calculation that requires 16 different inputs, a classical computer requires a total of four bits and sixteen computations.
- But with four qubits in superposition, a quantum computer could generate answers corresponding to all 16 inputs in a single computation.

Gate in computing

- A bit is the smallest piece of information storage (it is a portmanteau of binary digit).
- Often, a large number of bits is required to convey meaningful information.
- With the advent of modern semiconductor technology, we routinely speak of household computers having a few terabytes (8 trillion bits) of information storage.
- One terabyte can store 500 hours of high definition video content. In a computer, a bit is a physical system with two easily discernible configurations, or states – e.g. high and low voltage.
- These physical bits are useful to represent and process expressions that involve 0s and 1s: for instance, low voltage can represent 0 and high voltage can represent 1. A gate is a circuit that changes the states of bits in a predictable way.
- The speed at which these gates work determines how fast a computer functions.
- The quantum gate Modern computers use semiconductor transistors to build circuits that function as bits.
- A semiconductor chip hosts more than 100 million transistors on 1 sq. mm.
- Imagine how small an individual transistor is and how close it is to adjacent transistors.
- As transistors become smaller, they become more susceptible to quantum effects...
- Moore's law, announced in 1965, states that computing power increases tenfold every five years.
- This law no longer holds as we have already slowed to a two-fold increase every five years.
- But this doesn't have to mean we are nearing the end of computing development: the quantum revolution is coming.
- The most basic unit of a quantum computer is a quantum bit, or qubit.
- Like in a conventional computer, it is a physical object that has two states.
- A quantum gate is a physical process or circuit that changes the state of a qubit or a collection of qubits.
- In the quantum- computing context, if particles or superconducting qubits are the physical qubits, the gate is often an electromagnetic pulse.

What gates do??

- In quantum computers, quantum gates act on qubits to process information.
- according to quantum physics, a qubit can also be in a superposition of its two states at the same time

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Global surgery

What is global surgery?

- Global surgery focuses on equitable access to emergency and essential surgery.
- While it predominantly focuses on low- and middle-income countries (LMICs), it also prioritizes access disparities and under-served populations in high-income countries (HICs).
- These "surgeries" include essential and emergency surgeries such as surgery, obstetrics, trauma, and anaesthesia (SOTA).
- Despite small differences, there is largely a consensus across multiple international groups on about thirty procedures that fall under the umbrella of emergency and essential surgery.

Regulating online gaming

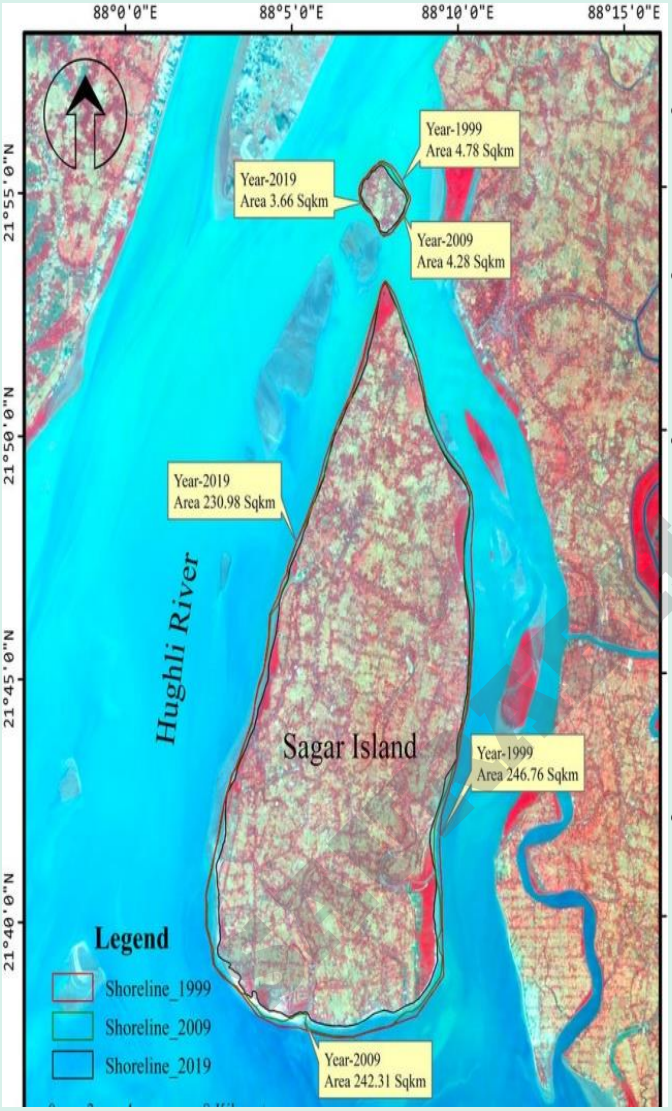
- With a staggering 692 million Internet users, India has the world's second- largest Internet user base and ranks eighth globally in terms of time spent on mobile apps.
- The average daily mobile app usage has surged to 4.9 hours, a 32% increase since 2019.
- Notably, a significant 82% of usage is dedicated to media and entertainment with social media accounting for roughly half of this engagement.
- While this trend has generated significant benefits to people, it has also created new concerns.
- For instance, the Internet has been inundated with AI- generated deep fake videos of celebrities. These technologically advanced simulations have blurred the lines between what's real and what's not.

The online gaming

- The online gaming industry in India is predominantly a home-grown start-up ecosystem growing at 27% CAGR.
- It is widely estimated that AI and online gaming can add up to $300 billion to India's GDP by 2026--27.
- , the meteoric rise of online gaming has brought with it an array of concerns such as addiction, mental illness, suicides, financial frauds, privacy and data security concerns.
- Money laundering and national security concerns are other realities.
- The situation is further exacerbated by the growth of illegal offshore gambling and betting markets wherein the volume of digital transactions provides fertile ground for financial malpractices.
- In July 2023, the Parliamentary Standing Committee on Finance, of which I am a member, identified four major trends in cybercrime.
- Notably, one includes the use of international online betting sites for purposes such as money laundering.
- No mechanism exists for individuals to differentiate between legitimate gaming platforms and illegal gambling/betting sites.
- In addition, in the absence of a specialised regulatory authority, enforcement is lacking. As a result, the number of illegal operators is multiplying by the day.
- the inherent cross border nature of the Internet makes enforcing such a ban almost impossible, leading to the unintended consequence of

legitimate, regulated platforms being replaced by unregulated and potentially harmful ones.

- In this context, the Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021 marked a commendable step towards oversight.
- According to the International Monetary Fund, a combination of high taxes and a weak, discretionary approach to regulatory enforcement creates the most fertile ground for the proliferation of a shadow economy — an environment in which the Indian online gaming industry is operating.
- Therefore, establishing a strict regulatory framework is an urgent need, not just for protecting our digital nagriks and national interests, but also to ensure responsible growth of the online gaming sector.



Mount Marapi

- Mount Marapi, an active volcano located in the Padang Highlands of western Sumatra, Indonesia.
- The mountain is part of the Ring of Fire a long, horseshoe-shaped, seismically active belt that rings the Pacific Ocean.
- The highest peak among several volcanoes in the highlands, Mount Marapi rises to 9,485 feet (2,891 meters) above sea level.
- Its summit contains the Bancah caldera which has a diameter of 0.9 mile (1.4 km) and is characterized by a series of overlapping craters.
- Mount Marapi is often confused with a similar active volcano called Mount Merapi, which is located near the center of the island of Java, Indonesia.

Ganga Sagar Mela

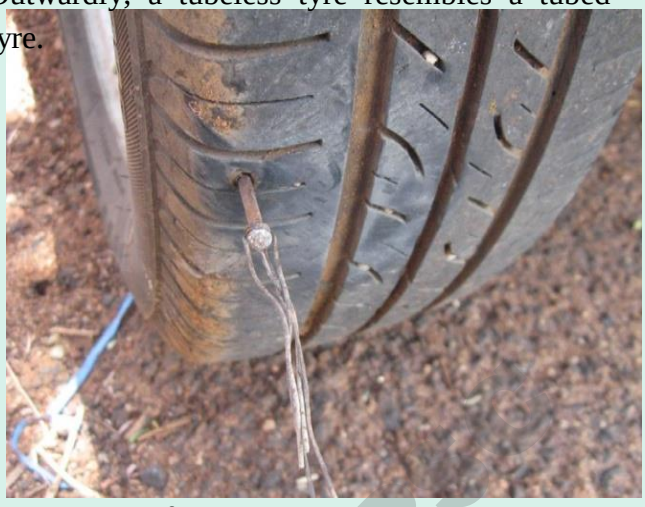
- Rising sea level and erosion of the beach in front of the Kapil Muni temple on Sagar Island are turning out to be a damper on the Ganga Sagar Mela as the West Bengal government is desperately seeking a “national fair” status for the annual religious congregation.

Sagar Island

- Sagar Island is an island in the Ganges delta, lying on the continental shelf of Bay of Bengal about 100 km (54 nautical miles) south of Kolkata.
- This island forms the Sagar CD Block in Kakdwip subdivision of South 24 Parganas district in the Indian State of West Bengal.
- Although Sagar Island is a part of Sundarbans, it does not have any tiger habitation or mangrove forests or small river tributaries as is characteristic of the overall Sundarban delta.
- This island is a place of Hindu pilgrimage.
- Every year on the day of Makar Sankranti (14 January), hundreds of thousands of Hindus gather to take a holy dip at the confluence of river Ganges and Bay of Bengal and offer prayers (puja) in the Kapil Muni Temple.

Tubeless tyre

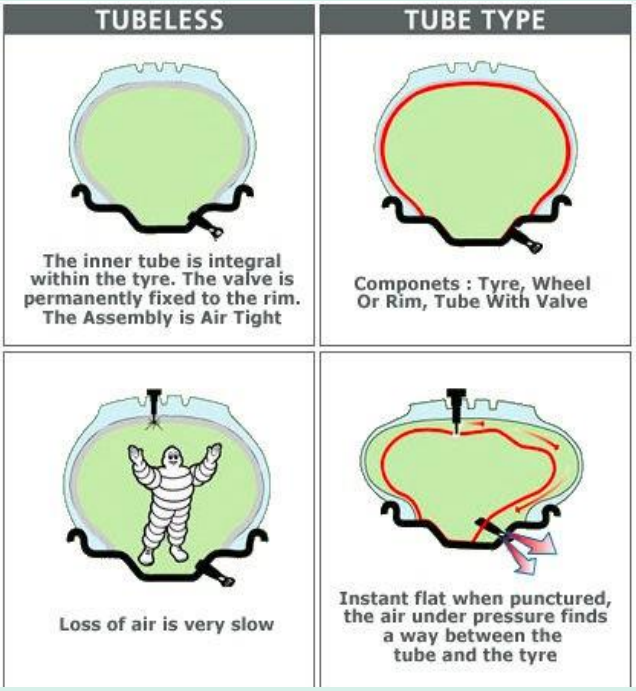
- Tubeless tyres are not popular in India for two reasons.
- First, rusting of rims, which leads to air leaks, is a perennial problem in a tropical climate.
- Second, fitment of such tyres needs special tools and presses and so they cannot be repaired in roadside shops.
- In conventional tubed tyres, the load is carried by a volume of air held inside a tube, which is closeted to the inside of the rim at the bottom and to a tyre over the remaining area. In tubeless tyres, the tyre itself holds the air.
- Outwardly, a tubeless tyre resembles a tubed tyre.



The inside of a tubeless tyre has an airtight lining extending beneath the bead the part of the tyre that anchors it to the rim when inflated.

- In order to provide perfect sealing, a special coat of rubber is provided to the inside wall of the tyre which is fitted to the rim using rubber seals.

- The special bead seating (on the rim) also prevents air leak.



- There is no need for a flap and so a valve is fitted to the rim itself for inflating or deflating the tyre.

PN diode

- The 21st century will be lit by LED lamps."
- The occasion was the awarding of the Nobel Prize for physics for that year, for an achievement that paved the way for light-emitting diodes (LEDs), to succeed incandescent bulbs and fluorescent lamps, as the world's light source of choice.

What are diodes?

- A diode is an electronic component about 5 mm wide. It has two points of contact, or terminals, called its anode and cathode.
- A diode's primary purpose is to allow current to flow in only one direction. It achieves this using a p-n junction.
- A p-n junction is made of two materials laid next to each other. One material is a p-type material: its primary charge- carriers are holes.
- The other is an n type material: its primary charge- carriers are electrons. Electrons: they are 'places' inside atoms that carry negative charge.
- A hole denotes a 'place' in an atom or a group of atoms where there could be an electron but isn't.

  Thus, a hole is an electron placeholder but without the electron, so it has a positive charge.
- A p--n junction is an interface where the surface of a p-type material and the surface of an n- type material meet.
- At this interface, electrons can pass easily from the n- type material to the p- type material but can't go the other way.

What is an LED?

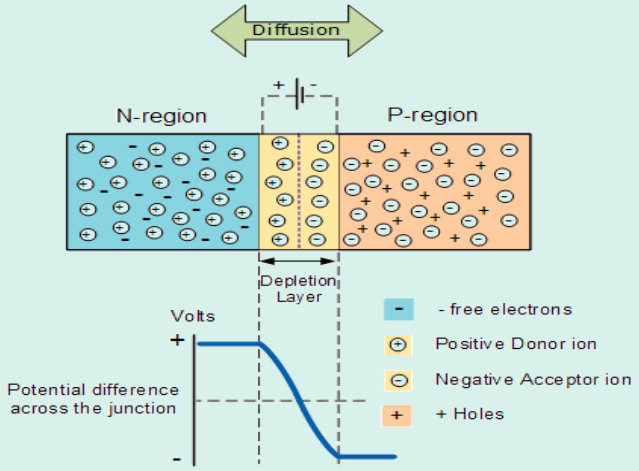
- An LED is a diode that emits light.
- Inside the diode's p-n junction, the electrons have more energy than the holes. When an electron meets and occupies a hole, it releases energy into its surroundings.
- If the frequency of this energy is in the visible part of the electromagnetic spectrum, the diode will be seen to emit light. The overall phenomenon is called electroluminescence.
- The energy of a wave is proportional to its frequency. So making sure the light emitted by an LED is visible light is a matter of making sure the electron -hole recombination releases a certain amount of energy, not more and not less.
- **What is the band gap?**

- Particles like electrons can only have specific energy values. They can occupy only particular energy levels.
- When a group of electrons comes together in a system they're required to follow some rules.
- One of them is that no two electrons can occupy the same energy level at the same time. These electrons generally prefer to have lower energy, and thus prefer to occupy the lowest available energy level.
- If that level is taken, they occupy the next available level. Sometimes they can acquire more energy, tear free from their atoms, and flow around the material. In these circumstances, we say the material is an electrical conductor. When the electrons don't have enough energy to flow around, the material is an insulator.
- Electrons can acquire such extra energy when an electric field is applied to the material. The field will accelerate the electrons and energise them, and the electrons will be 'kicked' from lower to higher energy levels.
- It's the reason why electrons in these materials can't conduct an electric current unless they receive a minimum amount of energy the energy required to jump across this gap. This gap is called the band gap. In LEDs, the energy emitted when an electron and a hole recombine is the energy of the band gap.
- By carefully choosing the materials that make up the p--layer and the n--layer, researchers can engineer the composite p-n junction to have a band gap that corresponds to visible light.

What colours can an LED produce?

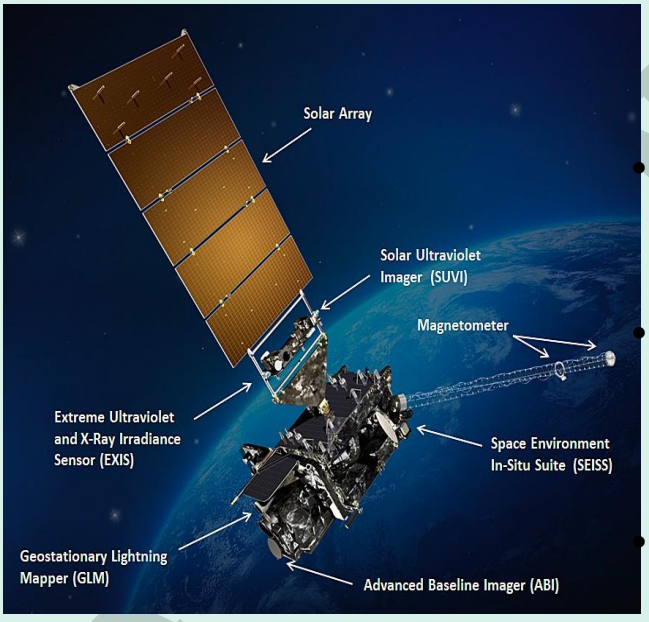
- Since LEDs can produce all three primary colours red, green, and blue different LEDs can be combined on a display board to produce a large variety of colours.
- The reason: scientists had identified a compound, gallium nitride, that was electroluminescent and whose band gap could yield blue light.
- What are the advantages of LEDs?
- According to Moore's law, specified by American engineer Gordon Moore in the 1970s, the number of transistors on a chip would double every two years.
- Similarly, improvements to LEDs since 1970 have followed Haitz's law.
- Named for scientist Roland Haitz, it states that for a given frequency of light, the cost per unit of light of an LED will drop 10x and the amount of light it produces will increase 20x every decade.
- But even before Haitz's law, researchers prized LEDs because they were more efficient than incandescent bulbs and fluorescent lamps.
- Per watt of power consumed, LEDs can produce up to 300 lumens (amount of visible light emitted per second) versus incandescent bulbs' 16 lumen and fluorescent lamps' 70 lumen.
- Together with their greater durability and light contrast, LEDs' advantages translated to higher cost savings and less material waste.
- LEDs have several applications in industry, consumer electronics, and household appliances: from smartphones to TV screens, signboards to 'feeding' plants light in

greenhouses, barcode scanners to monitoring air quality.



How do satellites track weather?

- The IMD has accompanied weather alerts with

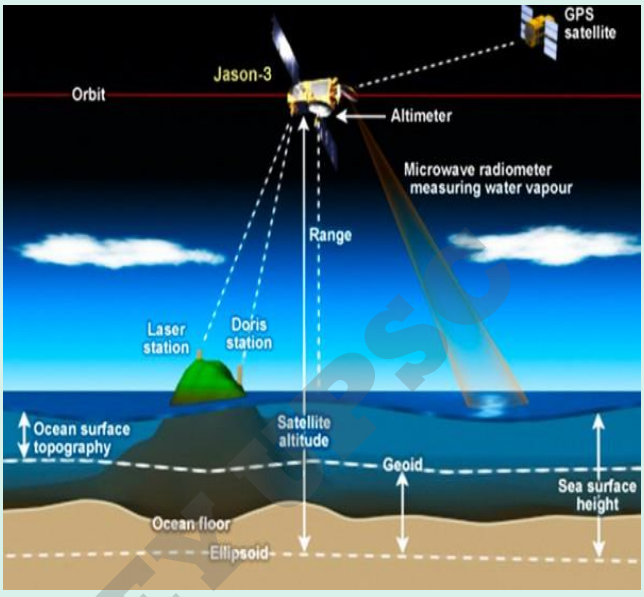


maps from the INSAT 3D satellite, and sometimes from the INSAT 3DR satellite.

How does one read the maps? What do the colours represent?

- At the bottom right of a map from 2021 (map 1) is a clue 'Night Microphysics'.

- According to a paper published by IMD scientists in February 2019, the INSAT 3D



satellite has a red- green- blue, or RGB, imager whose images' colours are determined by two factors: solar reflectance and brightness temperature.

- Solar reflectance is a ratio of the amount of solar energy reflected by a surface and the amount of solar energy incident on it.

- Brightness temperature has to do with the relationship between the temperature of an object and the corresponding brightness of its surface.

- The INSAT 3D's 'day microphysics' data component studies solar reflectance at three wavelengths: 0.5 micrometres (visible radiation), 1.6 micrometres (shortwave infrared radiation) and 10.8 micrometres (thermal infrared radiation).

- The strength of the 0.5 micrometre visible signal determines the amount of green colour; the strength of the 1.6 micrometre shortwave infrared signal, the amount of red colour; and the strength of the 10.8 micrometre thermal infrared signal, the amount of blue colour.

- This way, the INSAT 3D computer determines the colour on each point of the image.

How does the satellite track snow?

- According to the paper, "the major applications of this colour scheme are an analysis of different cloud types, initial stages of convection, maturing stages of a thunderstorm, identification of snow area, and the detection of fires."
- While the solar reflectance of snow and that of clouds is similar in the visible part of the spectrum, snow strongly absorbs radiation of wavelength 1.6 micrometre, that is the shortwave infrared.
- As a result, when the satellite tracks snow, the red component of the colour scheme becomes very weak.

How are the colours determined?

- The satellite's 'night microphysics' component is a little more involved.
- Here, two colours are determined not by a single signal but by the strength of the difference between two signals.
- The computer determines the amount of red colour according to the difference between two thermal infrared signals 12 micrometre and 10 micrometre.
- The amount of green colour varies according to the difference between a thermal infrared and a middle infrared signal 10.8 micrometre and 3.9 micrometre. The amount of blue colour is not a difference but is determined by the strength of a thermal infrared.
- By combining day and night microphysics data, atmospheric scientists can elucidate the presence of moisture droplets of different shapes and temperature differences over time, and in turn track the formation, evolution and depletion of cyclones and other weather events.
- For example, taking advantage of the fact that INSAT 3D can produce images based on signals of multiple wavelengths,

How do the satellites collect weather data?

- Both INSAT 3D and INSAT 3DR use radiometers to make their spectral measurements.
- A radiometer is a device that measures various useful properties of radiation, typically by taking advantage of radiation's interaction with matter, for example in the form of temperature or electrical activity. Both satellites also carry atmospheric sounders.
- These are devices that measure temperature and humidity, and study water vapour as a function of their heights from the ground.

What weather satellites does India have?

- According to the INSAT 3DR brochure, its radiometer is an upgraded version of the very-high-resolution radiometer (VHRR) that the Kalpana 1 and INSAT 3A satellites used (launched in 2002 and 2003, respectively.
- For meteorological observation, INSAT-3A carries a three channel Very High Resolution Radiometer (VHRR) with 2 km resolution in the visible band and 8 km resolution in thermal infrared and water vapour bands."

- The Kalpana 1 and INSATs 3A, 3D, and 3DR satellites aided India's weather monitoring and warning services with the best technology available in the country at the time, and with each new satellite being a better equipped version of the previous one.
- The INSAT 3D and 3DR satellites are currently active in geostationary orbits around the earth, at inclinations of 82 degrees and 74 degrees' east longitudes respectively

HPV

- Human papillomavirus infection (HPV infection) is caused by a DNA virus from the Papillomaviridae family.
- Many HPV infections cause no symptoms and 90% resolve spontaneously within two years.
- depending on the site affected, increase the risk of cancer of the cervix, vulva, vagina, penis, anus, mouth, tonsils, or throat.
- Nearly all cervical cancer is due to HPV, and two strains HPV16 and HPV18 account for 70% of all cases.
- HPV vaccines can prevent the most common types of infection.
- To be most effective, inoculation should occur before the onset of sexual activity, and are therefore recommended between the ages of 9–13 years.

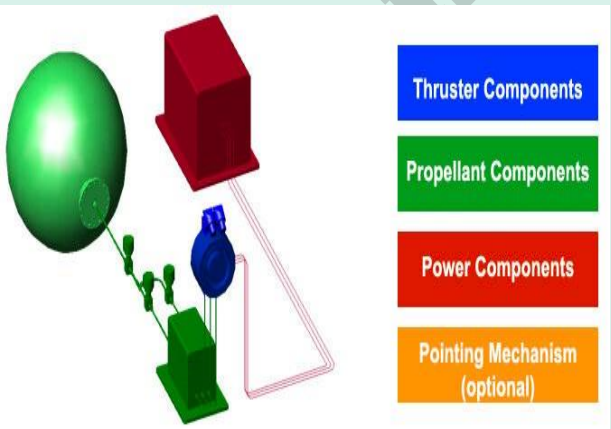
Electric propulsion system

- One key area where London and New Delhi are cementing cooperation is in electrical propulsion to power aircraft carriers.
- The Indian Navy's carriers, at present, are not powered by electric propulsion technology.
- The Queen Elizabeth Class aircraft carriers of the Royal Navy (RN) use electric propulsion and the RN has mastered this technology.
- The advantage of using electric propulsion is that warships integrated with this capability produce a low acoustic signature by removing the link between the principal mover and propulsion.
- There is also the added advantage of enhanced electrical power generation for subsystems in major warships of the Indian Navy's surface fleet.
- The establishment of a joint working group dubbed the "India- UK electric propulsion capability partnership" first met in February 2023 and thereafter a delegation- level discussion was held.

Electric Propulsion (EP)

- Electric Propulsion (EP) is a class of space propulsion which makes use of electrical power to accelerate a propellant by different possible electrical and/or magnetic means.
- The use of electrical power enhances the propulsive performances of the EP thrusters compared with conventional chemical thrusters.

- Unlike chemical systems, electric propulsion requires very little mass to accelerate a spacecraft.
- The propellant is ejected up to twenty times faster than from a classical chemical thruster and therefore the overall system is many times more mass efficient.
- Electric Propulsion, when compared with chemical propulsion, is not limited in energy, but is only limited by the available electrical power on-board the spacecraft.
- Therefore, EP is suitable for low-thrust (micro and milli-newton levels) long-duration applications on board spacecraft's.
- The propellant used in EP systems varies with the type of thruster and can be a rare gas (i.e. xenon or argon), a liquid metal or, in some cases, a conventional propellant.



Electric Propulsion System components

- An Electric Propulsion System is composed by four different building blocks:
- The thruster components,
- The propellant components or fluidic management system. The power components, which includes the PPU. The pointing mechanisms (optional)

Electric Propulsion

Applications and type of thrusters

- The different applications which currently make or may make use of Electric Propulsion Systems in the future, are:
- LEO (e.g. Earth Observation, Earth Science, constellations)
- MEO (e.g. Navigation)
- GEO (e.g. Telecommunications)

- Space Transportation (e.g. launcher kick stages, space tugs)
- Space Science, Interplanetary, and Space exploration.

Steadfast Defender 2024

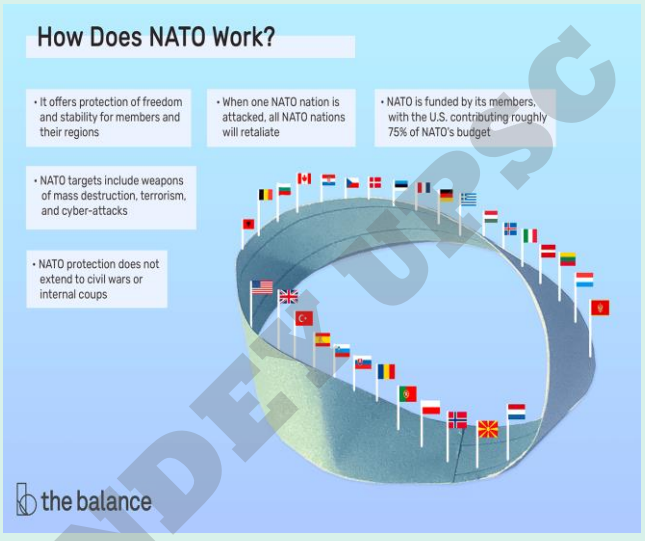
- The Steadfast Defender 2024 exercise, which will be held from next week to May, will involve about 90,000 troops from NATO-member states and Sweden.

- "Steadfast Defender 2024 will demonstrate NATO's ability to rapidly deploy forces from North America,"

- The last exercises of a similar scale were the Reforger drills during the Cold War in 1988 with 125,000 participants and the Trident Juncture ones in 2018 with 50,000 participants.

Yanomami and gold mining

- The Yanomami are the largest relatively isolated tribe in South America.



- They live in the rainforests and mountains of northern Brazil and southern Venezuela. The Yanomami Indigenous group are again facing a severe humanitarian crisis blamed on illegal gold miners.

- Like most tribes on the continent, they probably migrated across the Bering Straits between Asia and America some 15,000 years ago, making their way slowly down to South America. Today their total population stands at around 38,000.

- At over 9.6 million hectares, the Yanomami territory in Brazil is twice the size of Switzerland. In Venezuela, the Yanomami live in the 8.2-million-hectare Alto Orinoco Casiquiare Biosphere Reserve. Together, these areas form the largest forested Indigenous territory in the world.

India science management

- India's low overall expenditure on research and development (around 0.7% of GDP, compared to 3.5% for the United States and 2.4% for

China) is but one aspect constraining its scientific outcomes.

- In 2022, the Indian Space Research Organisation stood a distant eighth on launch numbers, with foreign startups racing ahead on key technologies such as reusable rockets. Likewise, the lead in nuclear energy has been frittered away, being latecomers to small modular reactors; thorium ambitions remain unrealized.
- On critical science and technology themes such as genomics, robotics, and artificial intelligence, the situation is even more alarming.
- The direction and organization of science is inconsistent, even unfit, for the vital role which science must play going ahead. India's science is dominated by the public sector.
- Generic irritants associated with governmental bureaucracy, such as tardiness in approving crucial time- dependent funding, or equitable decision-making across different funding levels, are known problems.

Challenges

- The basic assumption behind the outsized role played by scientists in Indian science administration is that a good scientist will also be a good science administrator.
- the lack of comprehensive training in selecting which particular metrics are appropriate under what circumstances leads to absurdities such as an entire project getting derailed due to a single invoice or acquisition
- The fact that there is no system of all -India transfers of both scientists and science administrators only magnifies institutional capture and factionalism.
- Poverty forced the country to concentrate high-end equipment in a handful of institutions, primarily the Indian Institutes of Technology in the 1960s.
- Since only these institutions had exclusive access to certain equipment, a system of gatekeepers emerged.
- These gatekeepers slowly began to capture positions, government patronage and institutional power on the back of their monopoly over critical equipment.

Step

- Even the U.S., with labs being embedded in the university ecosystem and run by scientists, selects scientists for an administrative role quite early on in their careers.
- Such selected science administrators, by and large, only carry out administrative tasks thereon, and are groomed for the task, with very few of them ever going back to active science.

OpenAI and challenges

- The New York Times (NYT) sued OpenAI and Microsoft for copyright infringement.
- The IT industry was shaken recently by the brief ousting and swift reinstatement of OpenAI's outspoken chief executive officer, Sam Altman, but the fierce conflict between the providers of information used to train Artificial Intelligence systems and the operators went unaddressed.
- The NYT claimed that these companies use information from multiple sources to develop AI products.
- OpenAI argues that since using copyrighted content to train GenAI models "serves a new

'transformative' purpose", their actions should be permitted under "fair use"

- An epic battle pits push-button information generated by AI against labour- intensive human newsgathering.
- From a legal perspective, it is a classic case of established law lagging behind new technology. The victory of Big Tech might deter human content producers.
- However, if The NYT prevails, GenAI companies might be required to compensate content producers for their use, which would significantly increase the cost of GenAI models.

Indian meteorological department

It was established in 1875.

- It is the National Meteorological Service of the country and the principal government agency in all matters relating to meteorology and allied subjects.
- To take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities like agriculture, irrigation, shipping, aviation, offshore oil explorations, etc.
- To warn against severe weather phenomena like tropical cyclones, norwesters, dust storms, heavy rains and snow, cold and heat waves, etc., which cause destruction of life and property.
- To provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation-building activities.
- To conduct and promote research in meteorology and allied disciplines.

Analysis

- the India Meteorological Department (IMD), entered the 150th year of its existence.
- While at present, it analyses the entire spectrum of climate and weather, from cyclones to fog, it was conceived, in colonial times, to probe the mysteries of the southwest monsoon.
- The British administration, concerned about revenues, was intimately aware of the influence of the monsoon on harvests and thus extremely invested in determining whether past observations of wind, rain and sunshine could be used to predict future torrents and droughts.
- In the years since then, the IMD has collected gargantuan stores of meteorological data that underlie its forecasts of the monsoon.
- One such analysis of this data by researchers at the Council on Energy, Environment and Water (CEEW) examines monsoon trends at the sub divisional (tehsil) level, from 1982-2022.
- This finds that monsoon rainfall is increasing in more than half, or 55%, of India's roughly 4,400 tehsils.
- About 11% of them saw decreasing rainfall.
- In those tehsils, about 68% experienced reduced rainfall in all four monsoon months, while 87% showed a decline during the June and July crucial for the sowing of kharif crops.
- The southwest monsoon accounts for nearly 76% of India's annual rainfall, with about 11% from the north-east monsoon.

- That India's monsoons are increasingly prone to long, dry spells and punctuated by torrential wet spells is well documented though how much of it can be explained by natural variability and how much from global warming is an active area of research.
- While revenue extraction guided colonial interest in weather at the regional levels, such analyses have a new, contemporary relevance.
- This is to make region-specific plans to improve climate resilience and channel necessary funds and resources.
- Prioritizing regional and sub- district forecasts over national ones, would be a commendable step forward by the government.

SLIM

- The Smart Lander for Investigating Moon (SLIM) is a Japanese Aerospace Exploration Agency (JAXA) mission designed to demonstrate accurate lunar landing techniques by a small explorer, with the objective of acceleration of the study of the Moon and planets using lighter exploration systems.
- SLIM is a small-scale exploration lander designed for pinpoint landings on the Moon's surface, reduction in the size and weight of equipment used in Moon landings, and investigation into the Moon's origins.
- It will also test technology fundamental to exploration in low-gravity environments, an important requirement for future scientific investigation of the solar system.
- The techniques demonstrated by this mission will pave the way for future lunar sample return missions. SLIM launched on 6 September 2023 and landed on the Moon on 19 January 2024 (

SLIM Mission Objectives

- Following are the SLIM mission objectives thereby JAXA endeavors to contribute to future missions to explore the moon and other planets;
- Demonstration of the accurate lunar landing techniques embodied in a small explorer
- Acceleration of the study of the moon and other planets using the lighter exploration system
- Future solar science exploration will demand the level of navigation accuracy that JAXA is in the quest for through the SLIM mission.

Spacecraft and Subsystems

- SLIM is an irregularly shaped cuboid 2.4 meters in height, 2.7 meters across, and 1.7 meters deep, with a dry mass of 190 kg and a fully loaded mass of 710 kg.
- The body is built around the propellant tank as the structural element. Power is provided by thin-film solar cells and lithium ion batteries.
- SLIM will carry a landing radar for the final descent and a multiband camera for mineralogical exploration of the surface, as well as a small laser retroreflector array. The landing system uses a crushable aluminium foam base to absorb impact.
- Opioids and non-steroidal anti-- inflammatory drugs (NSAID). The sensation of pain, while universal, can also be influenced by culture.
- Though there is progress in understanding new pathways on how pain is processed at a bio-chemical level in the body, the current class of painkillers that consist of opioids and non-steroidal anti--inflammatory drugs (NSAID) will remain the mainstay of treatment for a long time, said David Julius, biochemist,

molecular physiologist and co- recipient of the 2021 Nobel Prize in Physiology.

Antibody-dependent enhancement (ADE)

- Antiviral antibodies constitute an important component of the host immune response against viral infections and serve to neutralize and reduce infectivity of the virus.
- However, these antibodies, intended to protect the host, may sometimes prove beneficial to the virus, by facilitating viral entry and replication in the target cell. This phenomenon, known as antibody-dependent enhancement (ADE) of infection, is a result of interaction of virus–antibody immune complexes with Fcγ and/or complement receptors on certain types of host cells and promotes viral entry into the host cells.

SERUM PROTEIN

- Analysis of blood samples from patients with Long Covid a debilitating condition with unknown causes has revealed serum protein changes as the likely culprit.
- The findings highlight potential biomarkers for Long Covid diagnosis and could yield insights into treating the condition.
- Serum is the fluid and solvent component of blood which does not play a role in clotting. It may be defined as blood plasma without the clotting factors, or as blood with all cells and clotting factors removed
- Serum proteins are classified as albumin or globulins. Albumin is the most abundant protein in the serum.
- It carries many small molecules. It is also important for keeping fluid from leaking out from the blood vessels into the tissues.
- Serum total protein, also known as total protein, is a clinical chemistry parameter representing the concentration of protein in serum. Serum contains many proteins including serum albumin, a variety of globulins, and many others.

Evolution of stars

- Researchers who used a telescope in South Africa report discovery of an object in the Milky Way that could either be the most massive mass between 2.09 and 2.71 solar masses neutron star ever observed, or the least massive black hole.
- There is a substantial gap between the masses of the heaviest measured neutron star and the lightest measured black hole the most massive neutron stars generally range between 2.2 to 2.5 solar masses, while black holes of less than 5 solar masses are rare.

Simian -human immunodeficiency virus

- Three different antibodies have been isolated and tested, which can each shield large animals from infections with simian human immunodeficiency virus (SHIV), a chimera of SIV and HIV.
- The antibodies directed against the HIV fusion peptide provided almost complete protection against challenges with SHIV, adding further evidence that the fusion peptide can be targeted with neutralising antibodies for HIV.
- The simian immunodeficiency viruses (SIVs) are a genetically diverse group of viruses that

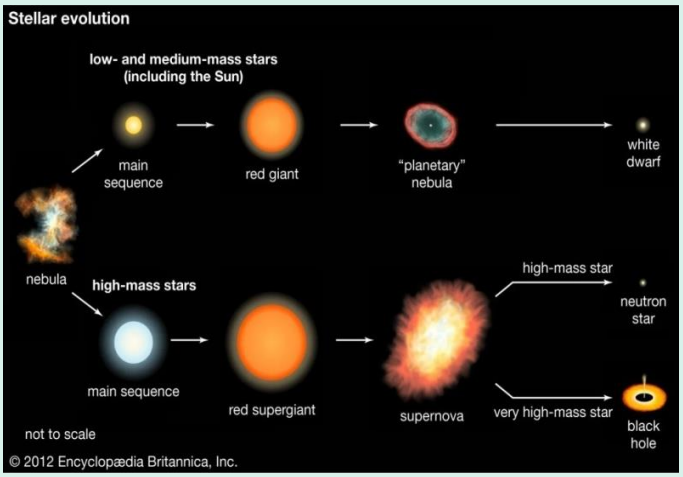
naturally infect a wide range of African nonhuman primates and are the source of the human immunodeficiency viruses (HIV-1 and HIV-2).

Urbanisation and climate change

- More than half of the world's population now resides in the cities and are thus vulnerable to urban climate change such as increased heat stress and extremes.
- Globally, cities contribute to more than 80% of the global GDP and 75% of all greenhouse gases/carbon emissions.
- Thus, they are both contributors to climate change and also potential agents for tackling it.
- However, their representation in Nationally Determined Contributions (NDCs) and National Adaptation Plans is inadequate.
- Nevertheless, in recent times, the inclusion of the 11th sustainable development goal (SDG) exclusively focusing on cities and the formation of groups like the U-20 under the G-20 umbrella have acknowledged the need for city- level action plans.
- The ministerial meeting on urbanisation and climate change at COP- 28 stressed the importance and role of cities in achieving climate change mitigation and adaptation targets.
- These initiatives show the importance attached to cities and their role in global affairs including climate change mitigation and adaptation.
- Bhubaneswar, a tier- II city in the eastern State of Odisha, is rapidly urbanizing in recent times.

IMPACT

- It was quantified that almost 60% of the overall warming observed over the city is due to local activities/changes.
- In addition to the warming due to climate change, there is additional warming due to the trapping of heat by the concrete and asphalt



materials used to build the city.

- The decreased evapotranspiration due to the replacement of natural surfaces with artificial impervious surfaces is also contributing to the observed warming.
- reduction in the wind speeds by about 0.2 metres per second, in the eastern fringes of the city, limiting dispersion of heat.
- Microclimate play a significant role in shaping winter urban surface temperatures, highlighting the complex interplay between urbanisation and climate.

- Urban planning to mitigate or adapt to these changes require systematic scientific explorations

Steps needed

- different mitigation strategies like cool roofs, highly reflective pavements, and blue green infrastructure (water bodies and green spaces).
- building climate resilient smart cities is important to ensure the health, safety, and comfort of the ever-increasing urban population

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Gambusia

- The western mosquitofish (Gambusia affinis) is a North American freshwater fish, also known commonly, if ambiguously, as simply mosquitofish or by its generic name, Gambusia, or by the common name gambezi.
- Its sister species, the eastern mosquitofish (Gambusia holbrooki) is also referred to by these names.
- The eastern mosquitofish is native to the eastern and southern United States from Florida to Pennsylvania and inland to Alabama and Tennessee, while the western mosquitofish has a larger distribution throughout the United States.
- The name "mosquitofish" was given because the fish eats mosquito larvae, and has been used more than any other fishes for the biological control of mosquitoes.
- Gambusia typically eat zooplankton, beetles, mayflies, caddisflies, mites, and other invertebrates; mosquito larvae make up only a small portion of their diet.
- Mosquitofish were introduced directly into ecosystems in many parts of the world as a biocontrol to lower mosquito populations which in turn negatively affected many other species in each distinct bioregion.

- Mosquitofish in Australia are classified as a

noxious pest and may have exacerbated the mosquito problem in many areas by outcompeting native invertebrate predators of mosquito larvae.

- In 1928, Gambusia was first introduced in India during British rule.
- Later, various governmental organisations, such as the ICMR, the National Institute of Malaria Research (NIMR), local municipal corporations, the Fisheries Department, and the Health Department, alongside other private

organisations in India, took over as part of their efforts to combat malaria.

- The idea of this scheme was that the newly introduced species would prey on or compete with mosquito larvae, reducing the latter's population.
- Wildlife biologists and conservationists consider mosquitofish to be among the hundred most detrimental invasive alien species.
- Aside from their resilience, these fish also have voracious feeding habits and have demonstrated aggressive behaviour in habitats to which they are introduced.
- in Australia, introduced mosquitofish have led to the local extinction of the red-finned blue-eye (Scaturiginichthys vermeilipinnis), an endemic fish species. They have also been observed preying on the eggs and larvae of native fish and frogs.
- The World Health Organisation stopped recommending Gambusia as a mosquito control agent in 1982.
- In 2018, the National Biodiversity Authority of the Government of India also designated G. affinis and G. holbrooki as invasive alien species.
- But both government and non-governmental organisations in India have continued to introduce these species for mosquito- control.

Mpemba effect

- The Mpemba effect, named after Tanzanian student Erasto Mpemba, who brought attention to this counterintuitive phenomenon in 1969, makes for curious observation.
- The effect is that hot water can freeze faster than cold water in similar conditions.

Air pollution and geopolitics

- The air smells burnt in Lahore, a city in Pakistan's east that used to be famous for its gardens but has become infamous for its terrible air quality.
- Toxic smog has sickened tens of thousands of people in recent months.
- Lahore is in an airshed, an area where pollutants from industry, transportation and other human activities get trapped because of local weather and topography so they cannot disperse easily.
- Airsheds also contribute to cross- border pollution. Under certain wind conditions, 30%

of pollution in the Indian Capital New Delhi can come from Pakistan's Punjab province, where Lahore is the capital.

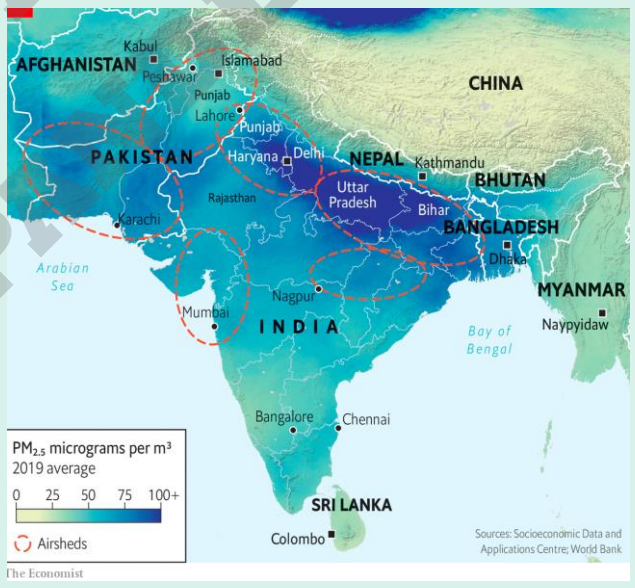
- Regional and international forums offer opportunities for candid discussions about air pollution, even if governments are not working together directly or publicly
- Airshed management needs a regional plan," he said.
- According to the World Bank, a regional airshed management policy would involve countries agreeing to set common air quality targets and measures that everyone can implement, meeting regularly to share their experiences and, if possible, setting common air quality standard

What is Airshed??

- An airshed is generally described as an area where the movement of air, and air pollutants, can be hindered by local geographical features such as mountains, and by weather conditions.
- Delineation of an airshed has three basic steps:
- First, emission quantification to prepare a multi-pollutant emission inventory; second, analysis of meteorological data to evaluate variations and similarities at the local and regional levels; and third, performing air quality modelling to understand the pollution
- Studies by the Pew Research Center and Common Sense Media suggest constant connectivity through messaging apps can lead to increased digital distraction, potentially affecting cognitive abilities and focus among young individuals.
- Research heavily covered in the journal 'Computers in Human Behavior' highlights a potential link between heavy use of messaging apps like WhatsApp and shortened attention spans, which may impact intellectual engagement and learning.
- There's also a negative impact on memory.

Cannabis & Antimicrobial resistance

- Cannabis has the potential to make a dent in India's fight against the escalating threat of antibiotic resistance.
- Scientists at CSIR-Indian Institute of Integrative Medicine (IIIM), Jammu, have found that phytocannabinoids, a class of compounds found in the cannabis plant, possess some hitherto unexplored antibiotic properties.
- Antimicrobial resistance (AMR) is a major health concern worldwide.



- It refers to when bacteria, viruses, fungi, and parasites no longer respond to medicines used to treat them.
- According to Sanghapal D. Sawant, a senior principal scientist at the CSIR -National Chemical Laboratory (NCL), Pune, bacteria have developed certain sophisticated 'shields'

over many decades to resist the effects of antibiotic medications.

- These include the formation of biofilms thin sheets of bacterial colonies that are more resistant to antibiotics than when separated and cellular mechanisms called efflux pumps that flush drugs out from cells.
- The resulting AMR increases the risk of disease spread, severe illness, and death.

What is India's AMR burden?

- According to one estimate, India reported 2.97 lakh deaths in 2019 that could be attributed to AMR and 10.42 lakh others that could be associated with AMR. Reports have also flagged the overuse of antibiotics in India, their misuse in animal husbandry, and poor waste disposal for engendering AMR and potentially rendering India the "AMR capital of the world".
- For these reasons, medical researchers are keen to tamp down AMR and find new drugs that fight AMR pathogens.
- In the new study, published in the journal ACS Infectious Diseases, IIIM researchers tested the antibacterial properties of tetra hydro cannabidiol (THCBD), a semisynthetic phytocannabinoid, against Staphylococcus aureus, the bacteria responsible for the second most number of deaths due to AMR worldwide.

Need for 'alternative solutions'

- Antibiotics are chemical compounds isolated from one microorganism and used to kill another.
- They have saved millions of lives since their discovery but are falling short against AMR bacteria.
- "S. aureus includes a strain known as MRSA, for methicillin- resistant S. aureus, resistant to the last line of antibiotics called methicillin,".
- The study revealed THCBD obtained from cannabis could fight MRSA.

How is THCBD made?

- Cannabinoids are a class of compounds found in the cannabis plant
- The researchers extracted cannabidiol from a cannabis plant and made it react with hydrogen, using palladium as a catalyst.
- This process yielded a mixture of molecules with the same composition and order of atoms but different structures. One of them was THCBD.

Why so many cyclones in UK?

- Tens of thousands of people across the U.K. and Ireland were without power on Monday after Storm Isha lashed the countries with strong winds and heavy rain, disrupting travel networks.
- Gusts of 159 kmph were recorded in northeast England as the whole of the U.K. was subject to weather warnings for its ninth named storm since September.

Why are storms named?

- In the UK, a storm is given a name when it has the potential to cause disruption or damage as a result of strong winds, heavy rainfall or snow,

leading to amber or red weather warnings being issued.

- The UK storm season begins at the end of the summer in September and ends in August the following year. In Europe there are three storm naming groups, and each September there is a new alphabetical list of names issued for the upcoming storm season.
- In Western Europe the list is created by the Met Office in collaboration with the Irish and Dutch weather services.
- This coincides with when we expect to experience extreme storms, due to low pressure weather systems that occur in the autumn and winter months.
- Storms can impact many countries at once, and to avoid confusion, the UK adopts a storm name if another European weather service has already named it.

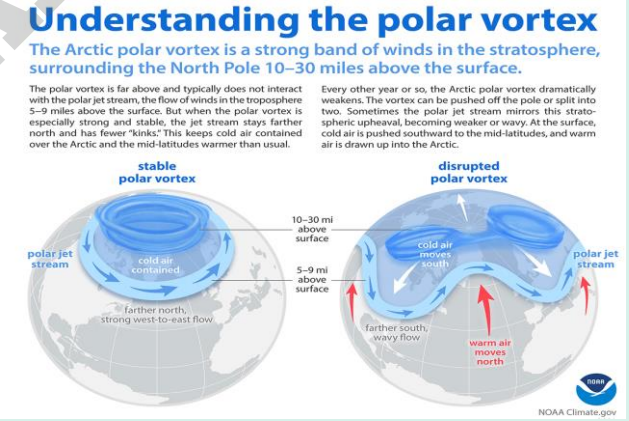
What causes extreme storms in the UK?

- Wind is the movement of air in our atmosphere. Air is forced to move by differences in atmospheric pressure, and the Earth's rotation means that the wind circulates around areas of lower pressure, known as a cyclone. If there is a greater difference in pressure, this causes stronger winds around the cyclone.
- Storms often bring heavy rainfall that may lead to flooding. Storms move moisture around the atmosphere, which forces warm and moist air to rise.
- Wherever the warm, moist air rises, clouds are formed. The formation of clouds also releases energy which can further intensify the storm.

The UK is renowned for being stormy, but why?

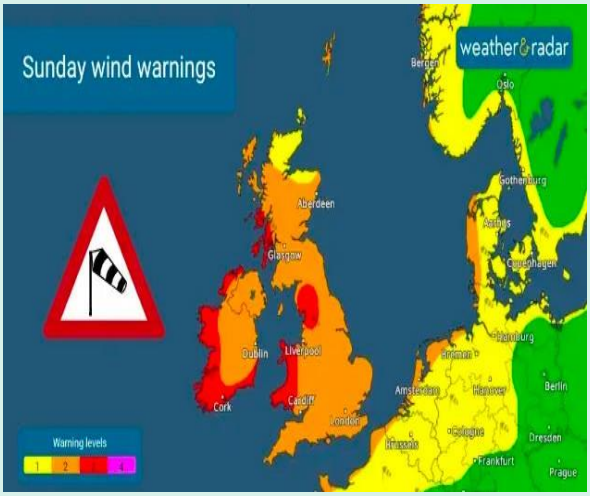
- The jet stream a core of strong winds around 8-11 km above the Earth's surface, blowing from west to east directs weather systems, such as storms, across the Atlantic to the UK.

Will extreme storms become more intense and frequent?



- links between human-caused global warming and storms should be expected.
- A warming atmosphere is linked with heavier rainfall, because the air is able to hold more moisture and leads to clouds containing a greater number of larger raindrops.

- As the climate continues to warm, the effect will



increase, and storms with heavy rain are expected to become more common.

- Additionally, the extra release of energy by clouds will likely lead to an increased rate of storms that rapidly intensify and a strengthening of the most extreme storms.

- But while a warmer world is likely making the most extreme storms more intense, the change in the overall number of storms is more uncertain and remains a subject of ongoing scientific research.

What are sting jets?

- "Sting jets are narrow jets of air that accelerate as they descend and that can cause extremely strong and damaging surface winds in a relatively small area of the storm, "

- "They are called sting jets as they descend from the tip of the hooked cloud that gradually wraps around the area of low pressure at the centre of the storm. The presence of a sting jet can make intense storms, with strong surface winds, even more damaging."

Polar vortex and cold US climate

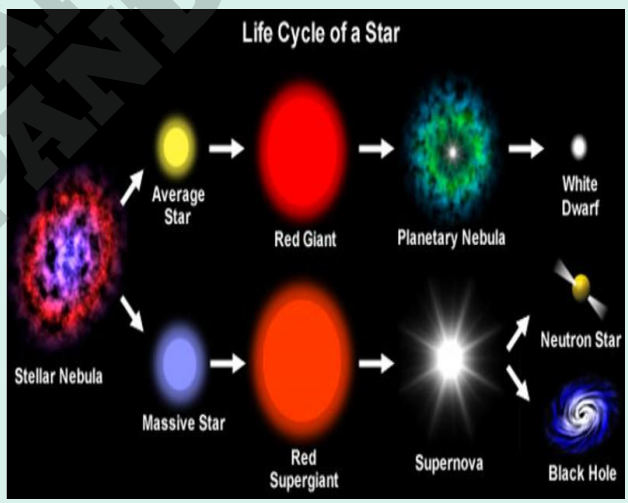
- The polar vortex is a low pressure area a wide expanse of swirling cold air that is parked in polar regions.

- During winter, the polar vortex at the North Pole expands, sending cold air southward.

- This happens fairly regularly and is often associated with outbreaks of cold temperatures in the United States.

How can the polar vortex cause extremely cold temperatures in the US?

- Sometimes this low-pressure system, full of arctic air, can weaken and travel from its usual

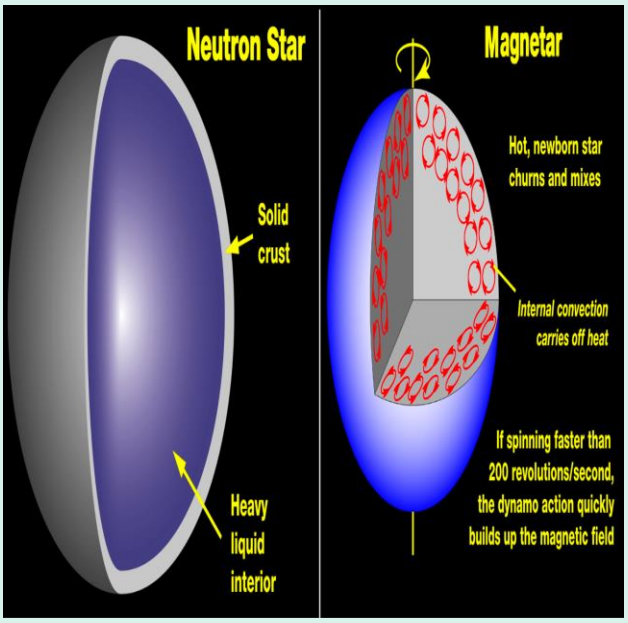


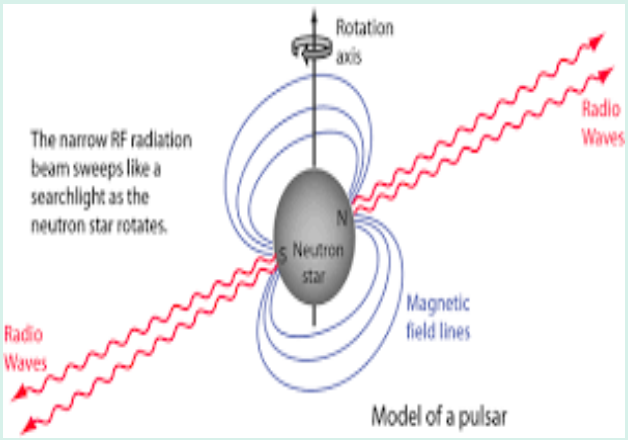
position.

- As this system weakens, some of the cold, arctic air can break off and migrate south, bringing plenty of cold air with it.

- Areas as far south as Florida may experience arctic weather as a result.

- When the low-pressure system is strong and healthy, it keeps the jet stream traveling around Earth in a circular path.

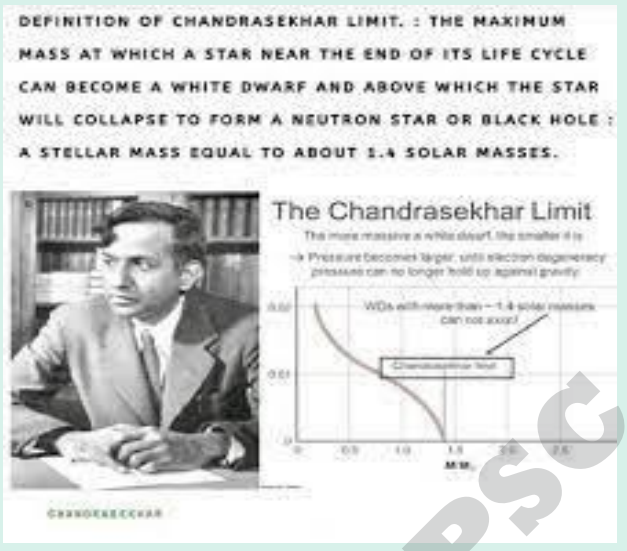




- The jet stream is a band of reliably strong wind that plays a key role in keeping colder air north and warmer air south.

Neutron star and pulsar

- When heavy stars die, their cores implode.
- If they're heavy enough, they become black holes; but if not, they collapse just enough to form a ball of neutrons, with gravity not being strong enough to overwhelm their outward pressure.
- This compact, super dense object is called a neutron star. Radio signals emitted from near the poles of such a star would form a narrow cone that sweeps past the earth with every rotation
- The fact that the signals came from a very small

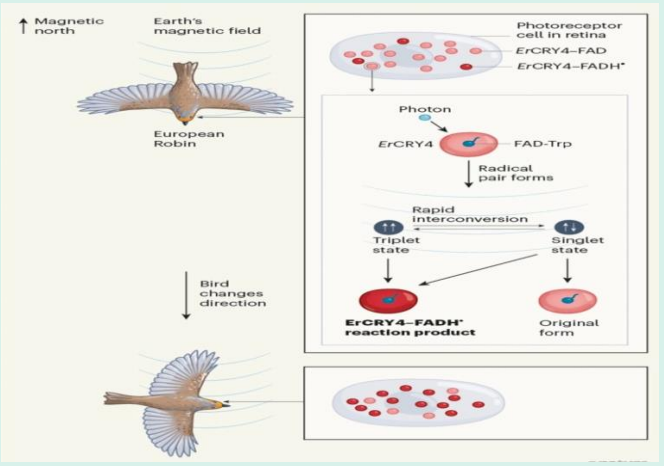


patch of the sky and that they repeated frequently led scientists to identify pulsars as rotating neutron stars

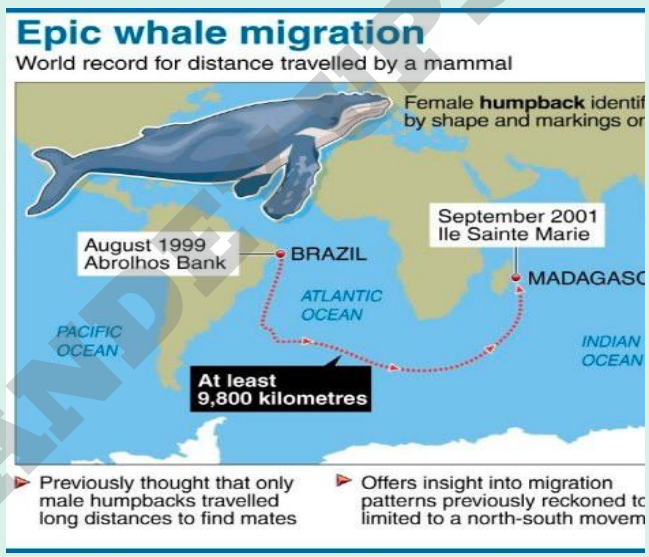
- The rotation of these neutron stars slowed over time; physicists found that the energy 'saved' by reducing the rotation rate was used to accelerate electric charges outside the star, producing the radio signals.

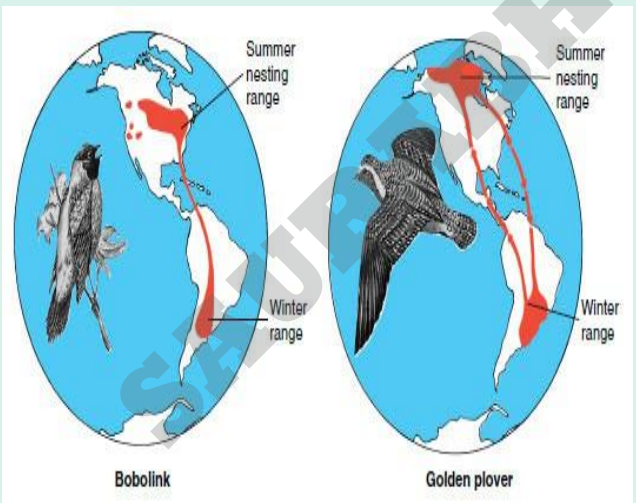
Navigation by birds

- **How do birds find their way home after long journeys?**
- A1: There are many theories explaining this capability of birds.
- According to one of them, the sun's rays and the direction of winds help them navigate.
- Birds' extrasensory capabilities assist them in this task and direct them with the help of the earth's magnetic field.

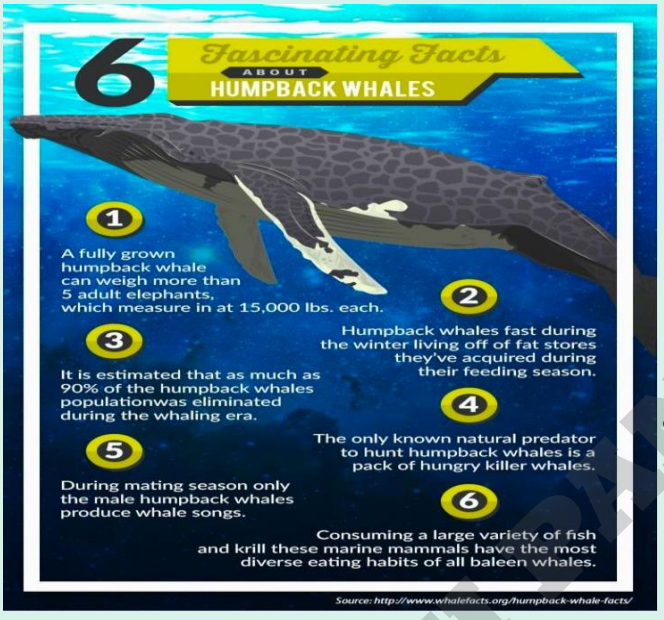


- Another theory suggests these winged wonders 'read' and understand star maps well enough to find their way.
- A2: Birds have the ability to detect changes in atmospheric pressure, weather, and the earth's magnetic field. Based on these, they locate specific regions and find their home.
- But the most important navigational aid is said to be an internal magnetic compass they are said to possess in their brains.
- The compass works in relation to the earth's magnetic field. The magnetic currents generated here are turned into flight paths.





Humpblack whale



Semiconductor industry

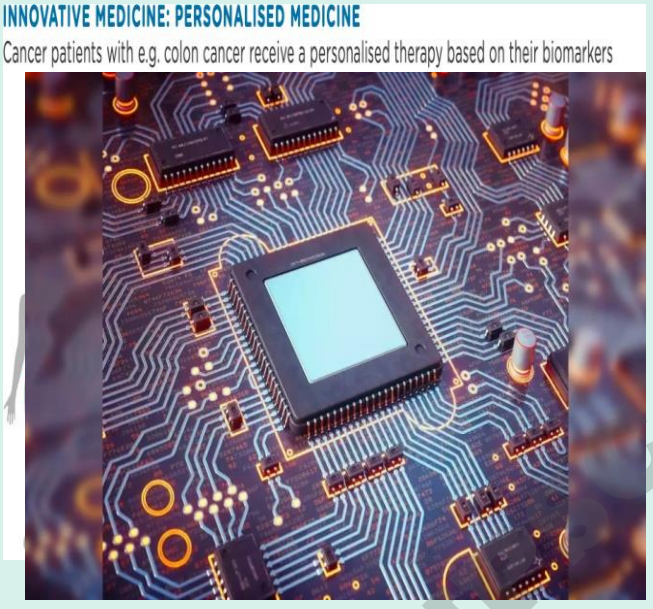
Semiconductor Design-Linked Incentive (DLI) scheme

- There are three goals of India's semiconductor strategy. The first is to reduce dependence on semiconductor imports, particularly from China, and especially in strategic and emerging sectors, ranging from defence applications to Artificial Intelligence development.
- The second is to build supply chain resilience by integrating into the semiconductor global value chain (GVC).
- The third is to double down on India's comparative advantage: India already plays host to the design houses of every major global semiconductor industry player and Indian chip design engineers are an indispensable part of the semiconductor GVC.

- These goals will help cement India's status as a semiconductor powerhouse.
- However, resources are limited.
- Therefore, priorities for industrial policy should ensure that we reap disproportionate benefits from our investments.
- Stimulating the design ecosystem is less capital-intensive than the foundry and assembly stages of the semiconductor GVC.
- Bolstering this stage can help establish strong forward linkages to an up- and- coming fabrication and assembly industry in India.

Issues with the scheme Prima facie,

- The DLI scheme fares well with its focus on providing access to design infrastructure, such as electronic design automation (EDA) tools, alongside financial subsidies for different steps of the chip design process.
- But there has been lackluster uptake of the scheme. First, the scheme mandates that beneficiary start-ups maintain their domestic status for at least three years after receiving incentives, and for this they cannot raise more than 50% of their requisite capital via foreign direct investment.
- This is a significant barrier. Costs for semiconductor design startups are also significant.
- Semiconductor R&D usually only pays off in the longer term, and the funding landscape for chip startups in India continues to be challenging.
- The primary aim of the DLI scheme should be to cultivate semiconductor design capabilities in India, with the understanding that home -grown IP will organically evolve as local talent fosters the creation of indigenous companies over time.



- The Centre for Development of Advanced Computing's role as the nodal agency appraising proposals by applicants under the DLI scheme merits a re-look too.

Personalised medicine

- Warfarin is a powerful blood thinner and a leading drug for cardiovascular disease worldwide.
- But in South Africa, it is among the top four drug varieties leading to hospitalisations from adverse drug reactions.

Understudied populations

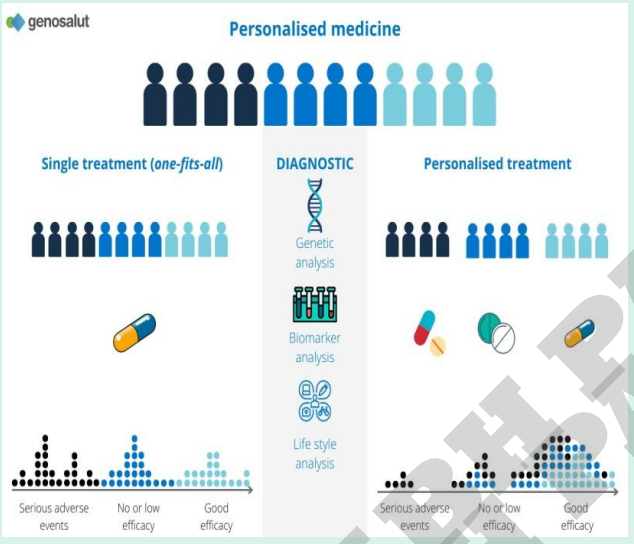
It's astonishing how powerful our genetics can be in mediating medicines.

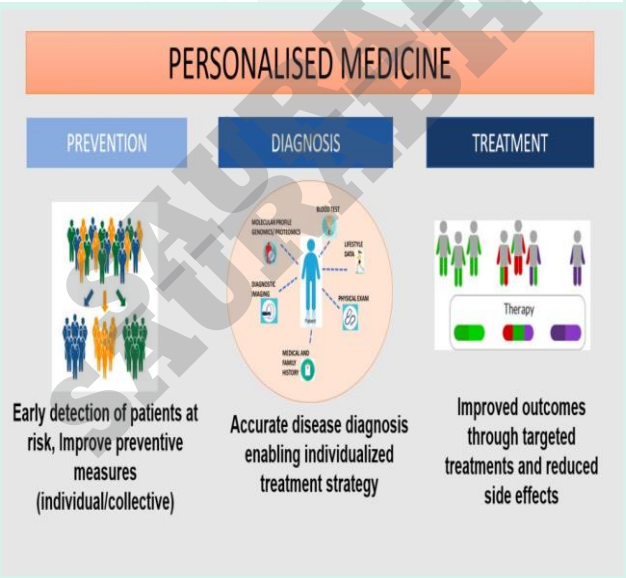
- Take the gene CYP2D6, which is known to play a vital role in how fast humans metabolise 25% of all the pharmaceuticals on the market.

- If you have a genetic variant of CYP2D6 that makes you metabolise drugs more quickly, or less quickly, it can have a huge impact on how well those drugs work and the dangers you face from taking them.

Hydropower from glacial lake

High in the Himalayas, two villages near Nepal's border with Tibet are getting power from an unusual source: a threatening glacial lake. In this high- altitude region, climate



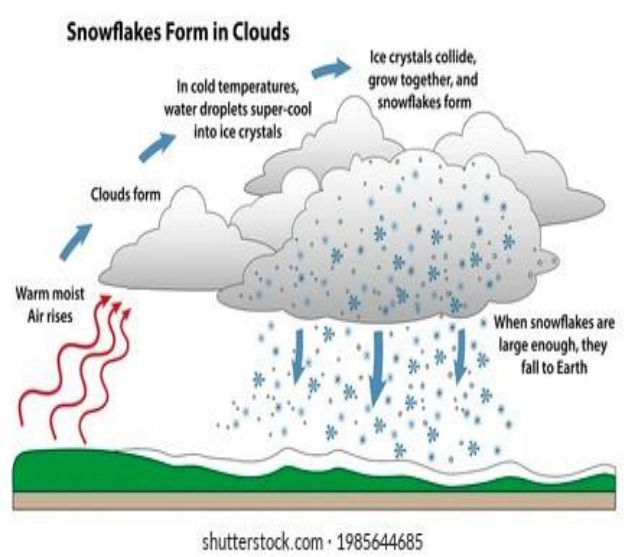


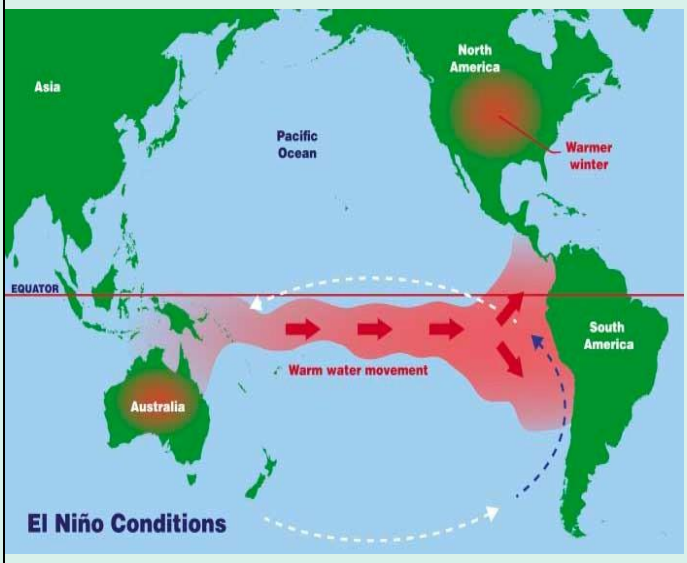
change is accelerating the melting of mountain ice, with villages located below fast- filling glacial lakes facing a risk of catastrophic flooding.

- But efforts to drain some of the excess water building up in the lakes, to lower disaster risk, also present an opportunity to boost clean power production, by installing small hydropower generators in the drainage channel.

- Channeling water out of the lake to hydropower generating equipment, could produce 50 megawatts (MW) of electricity year- round, he said, and lower the lake's water level by five to 10 metres. "When the water level is reduced, we don't have to worry about the lake bursting.

Why no snowfall in Kashmir?





What is the reason for the lack of snowfall?

- Snowfall requires adequate moisture as well as atmospheric temperatures to be zero degrees or less.
- Temperatures were fairly low since December.
- An analysis by the IMD in mid -January reported that maximum temperatures are running 5--8°C 'below normal' over the plains of north India since December 29.
- Minimum temperatures were also below 4 degrees Celsius at many stations of northwest India for most of January. This also resulted in a very dense fog persisting over the plains of northwest India.

- While moisture and high aerosol loads contribute to fog, there were three major reasons behind the lack of snowfall and consequently intensifying cold waves over north India.
- These were a drastic fall in Western Disturbances (WDs) over northwest India; prevailing El-Nino conditions; and the absence of a strong jet stream.

How do these three factors influence snowfall?

- Western Disturbances are storms that originate in the mid-latitude regions and travel thousands of kilometres to bring rains to northern India.
- Such WDs in the winter dissipate fog and increase the sunshine incident on the ground raising temperatures.
- They also, when the temperatures are low, result in snowfall and water being available as snow melts.

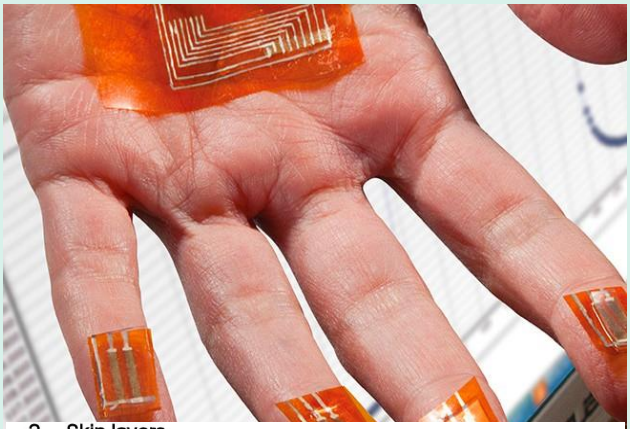
- The melting glaciers contribute to the water available in the Ganga, Indus and Yamuna. On the other hand, they can also bring in hail, which is destructive to standing wheat crop.
- Usually, 5-7 WDs impact northwest India during December to January. But this winter there have been none.
- There were two WDs in this period, but their impact was mainly confined to Gujarat, north Maharashtra, east Rajasthan and Madhya Pradesh.
- As a result of the lack of these rains, the Western Himalayan Region got 80% less rain than normal.
- Prevailing El- Nino conditions over the equatorial Pacific Ocean, or warmer ocean temperatures, may also have had a role to play.
- However, irrespective of El Nino, or the converse, La Nina, the number of WDs in December and January have been on a decline.

What role do the jet streams play?

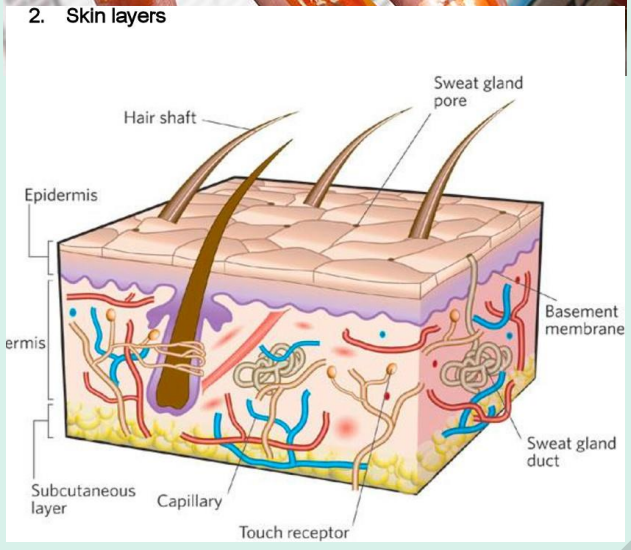
- Jet streams are powerful winds, ranging from 250-320 kmph, travelling at about 12 km above mean sea level.
- They are carriers of the western disturbances but the lack of moisture means that so far, they have been contributing to the subsidence of cold air thereby enhancing the cold over north India.
- The jet streams set in after the withdrawal of the monsoon are also able to draw in moisture from the Arabian Sea. In recent years, the jet stream has been shifting northwards.
- This, emerging research suggests, is a consequence of a warming in the Arctic seas that affects the natural gradient of temperature necessary to ensure the strength and direction of the jet streams.

Artificial skin

- Dr. Coclite and her team had succeeded in developing a three- in- one “smart skin” hybrid material, which closely resembles human skin by simultaneously sensing pressure, moisture and temperature and converting them into electronic signals.
- With 2,000 individual sensors per square millimetre, the hybrid material is more sensitive than a human fingertip, giving it its reputation, and, at 0.006 millimeters thick, many times thinner than human skin.
- Artificial skins are a series of materials that try to emulate the functionality of our skin. Artificial skin projects try to emulate at least some of the function.
- One is a piezoelectric material which when compressed or stretched, generates an electric current.
- This type of material for example, is the one that allows the artificial skin to sense force or pressure.
- The other material that is also very fundamental in this is the smart polymer that changes thickness depending on humidity and temperature, and in particular, these two materials have been combined in various nano rods.
- One area of practical application that really excites her and the team is prosthetics.



2. Skin layers



- "The artificial skin could cover the prosthetics and help the patient with the amputation regain sensation.

Cold waves and community

- With temperatures hitting record lows, communities grapple with a spectrum of physical health challenges.
- Prolonged exposure to extreme cold can lead to hypothermia, a condition where the body loses heat faster than it can generate it, resulting in shivering, confusion, and potentially life-threatening consequences.
- Respiratory issues come to a head as cold air irritates the airways, worsening conditions like asthma and bronchitis.
- Cardiovascular health is not exempt, as the heart

works overtime to maintain a stable internal temperature.

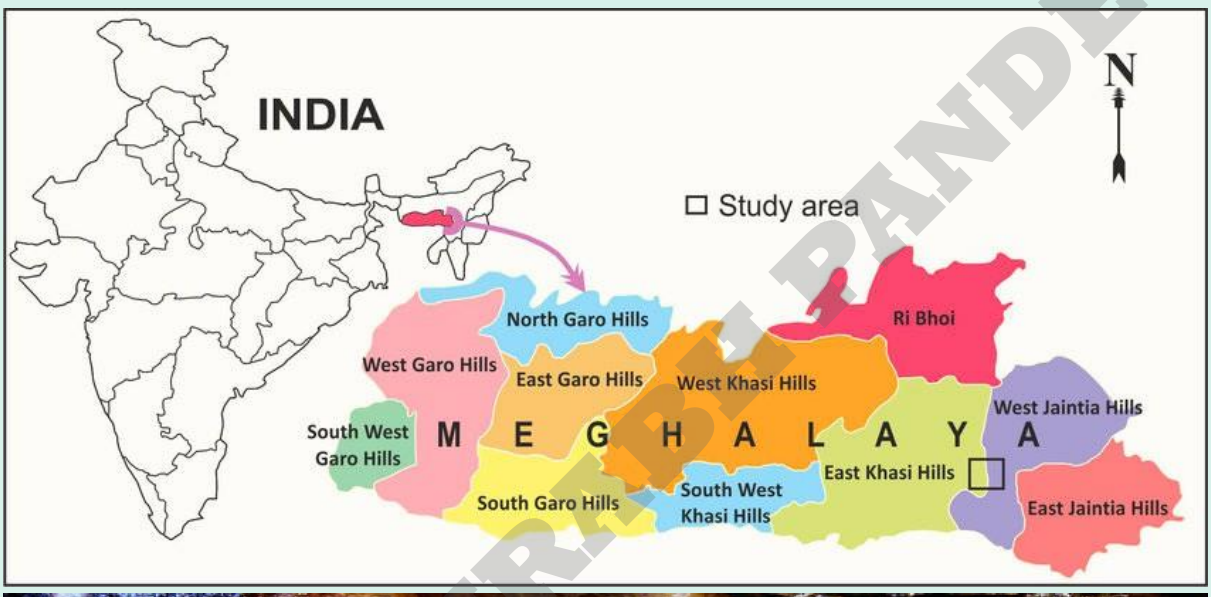
- Elevated blood pressure and heart rate become commonplace, posing additional risks for those with underlying cardiovascular issues.
- The convergence of cold waves and flu seasons heightens risks,
- The psychological toll is substantial. Reduced social interaction during cold spells affects psychological well- being.
- Seasonal Affective Disorder (SAD) can set in when low visibility and weather -related mobility restrictions lead to a lack of sunlight and limited movement.
- Sleep disruptions further compound the mental toll, as the discomfort of cold temperatures interferes with achieving restful sleep.
- The cumulative effects of physical discomfort and mental strain create a challenging environment for individuals during the winter season.

Rat hole mining

- A rat-hole mine is made by digging pits ranging from 5 to 100 metres into the ground to reach the coal seam.
- Thereafter, tunnels are made sideways into the seam to extract the coal.
- Coal seams are reached by excavating the side edge of the hill slopes after which, coal is extracted through a horizontal tunnel.
- These rat-hole mines are spread throughout Meghalaya, but are mostly concentrated in the Jaintia Hills, the South Garo Hills around the towns of Baghamara and Nangalbibra, and the area around Nongjri and Shallang in the West Khasi Hills.
- On April 17, 2014, the National Green Tribunal (NGT) banned illegal rat-hole mining after the All Dimasa Students Union and the Dima Hasao District Committee filed a petition that highlighted the unscientific and unregulated rat-hole coal mining operations in the Jaintia Hills.
- However, following protests by the mining lobby, the tribunal allowed the transport of already-mined coal

Moon sniper

- The country became the fifth to put a spacecraft on the moon when its so-called "Moon Sniper" lander touched down on the lunar surface.
- The Japan Aerospace Exploration Agency [JAXA] said it had received all data about the



landing of its Smart Lander for Investigating Moon (SLIM) probe

- The mission aimed to land within 100 metres (328 feet) of its target, bettering the conventional accuracy figure of several kilometres.
- The target was a crater where the moon's mantle, a deep inner layer, is believed to be exposed on the surface.
- JAXA also published its first colour images from the mission depicting the aircraft sitting at a slight angle on the moon's rocky grey surface, with rising slopes in the distance.
- JAXA said saying SLIM's solar panels have been unable to generate electricity likely because they were angled wrong, expressing hope that a change in the sunlight's direction could power it up again.
- Its probe is part of several new lunar missions launched by governments and private companies, five decades' years after the first human moon landing.
- Japan has been expanding its space activities, even forging partnerships with the US to address China's burgeoning military and technological influence.
- The country is an active participant in NASA's Artemis programme and aims to send one of its astronauts to the moon.
- JAXA has faced multiple setbacks, including a launch failure in March of the new flagship rocket H3 that was meant to be competitive against others like SpaceX.

Nitrogen hypoxia

What is nitrogen hypoxia?

- Prison officials strapped a mask to Smith's face and administered the pure nitrogen gas.
- The gas itself is not poisonous - nitrogen makes up more than three-quarters of the earth's atmosphere.
- But in pure concentrated form, breathing in the gas chokes off oxygen to the brain, a process called nitrogen hypoxia.
- The use of nitrogen gas in executions has been approved by three states, including Alabama in 2018, and has withstood various legal challenges since.

Liquefied natural gas

What is liquefied natural gas?

- Liquefied natural gas (LNG) is natural gas that has been reduced to a liquid state, through a process of cooling.

- Natural gas is a 'traditional' source of energy that is already used for a range of functions, from heating our homes and businesses to cooking and transport.

How is LNG made?

- LNG is created by transforming natural gas into a liquid state, by cooling it to -161oC (-259F).
- The process reduces it to 1/600th of its original un-liquified volume and to half the weight of water.

Why is LNG cleaner than other natural gases?

- LNG produces 40% less carbon dioxide (CO2) than coal and 30% less than oil, which makes it the cleanest of the fossil fuels.
- It does not emit soot, dust or particulates and produces insignificant amounts of sulphur dioxide, mercury and other compounds considered harmful to the earth's atmosphere.
- Clear, odourless and colourless, LNG is typically 85-95% methane, which contains less carbon than other forms of fossil fuels.
- It also contains tiny amounts of ethane, propane, butane and nitrogen; the exact composition varying depending on its source and processing.

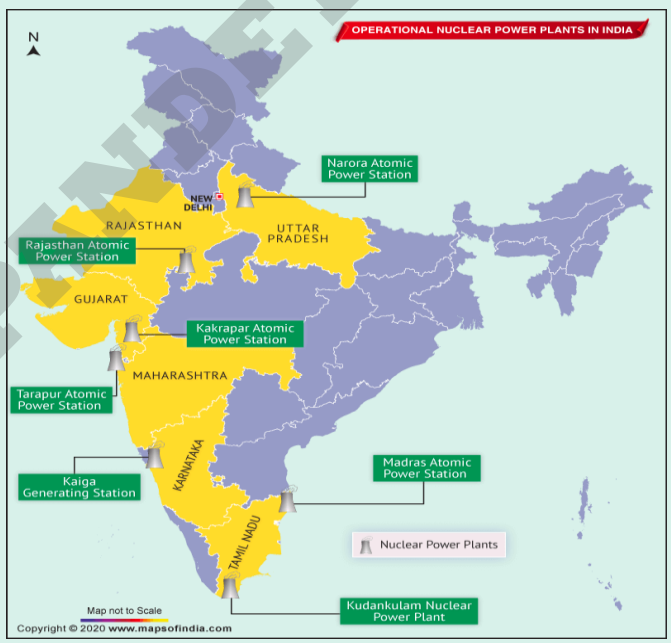
Why is LNG important for the transition to net zero?

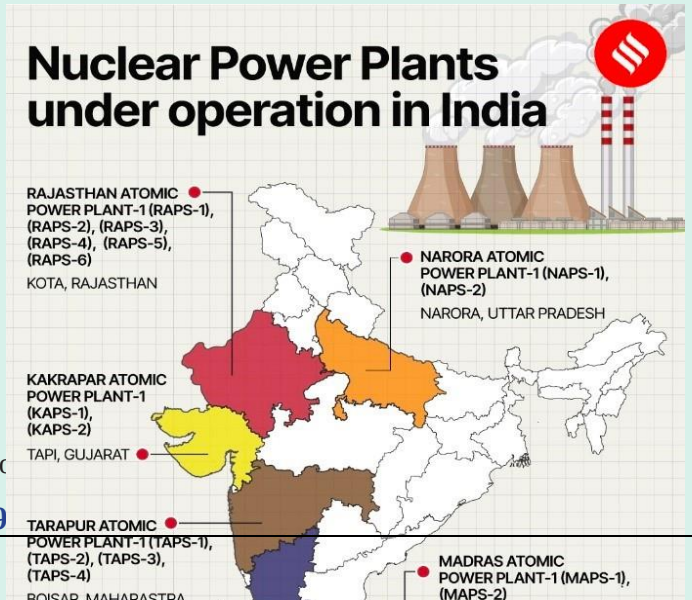
- LNG helps with what's known as the 'energy trilemma', which refers to finding a balance between three key requirements in our energy choices: we want affordable energy; we want our energy supply to be secure; and, we want to drive down our carbon emissions to net zero.

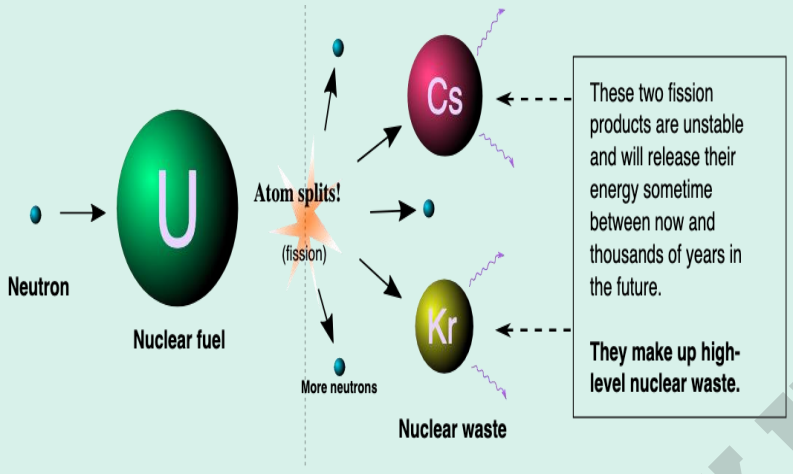
LNG as part of our energy future

- Natural gas may be a fossil fuel, but it's making the transition to green energy possible– successfully helping renewables to become the UK's largest source of power.
- And LNG has other uses in the race to net zero.
- It can act as the 'feedstock' for low-carbon hydrogen a net zero process as it captures the carbon emissions during the manufacturing process meaning it has the potential to become part of a new hydrogen economy.

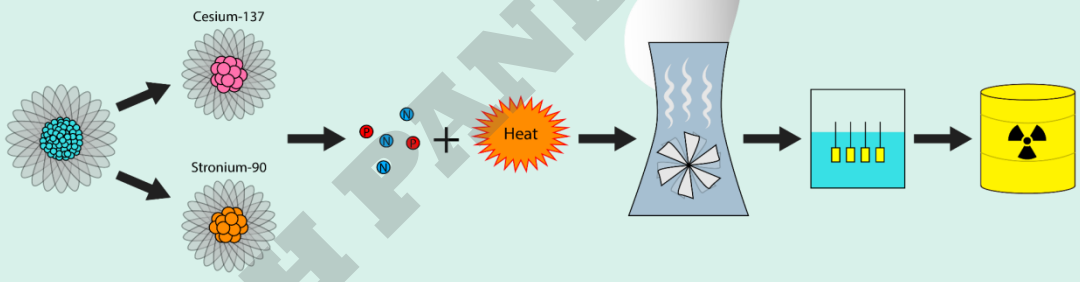
Nuclear power plants and related issues



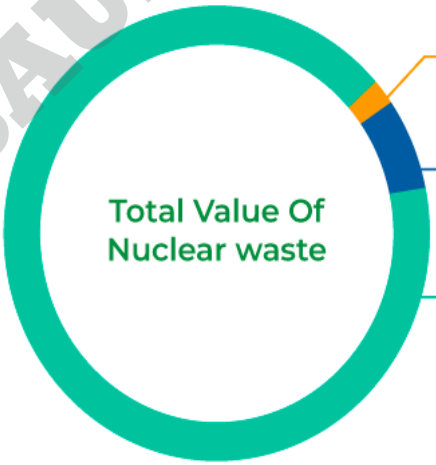




The Lifecycle of Nuclear Fuel



Types of Nuclear Waste



3% High-level Waste
Spent fuel containing 95% of radioactivity in the nuclear waste

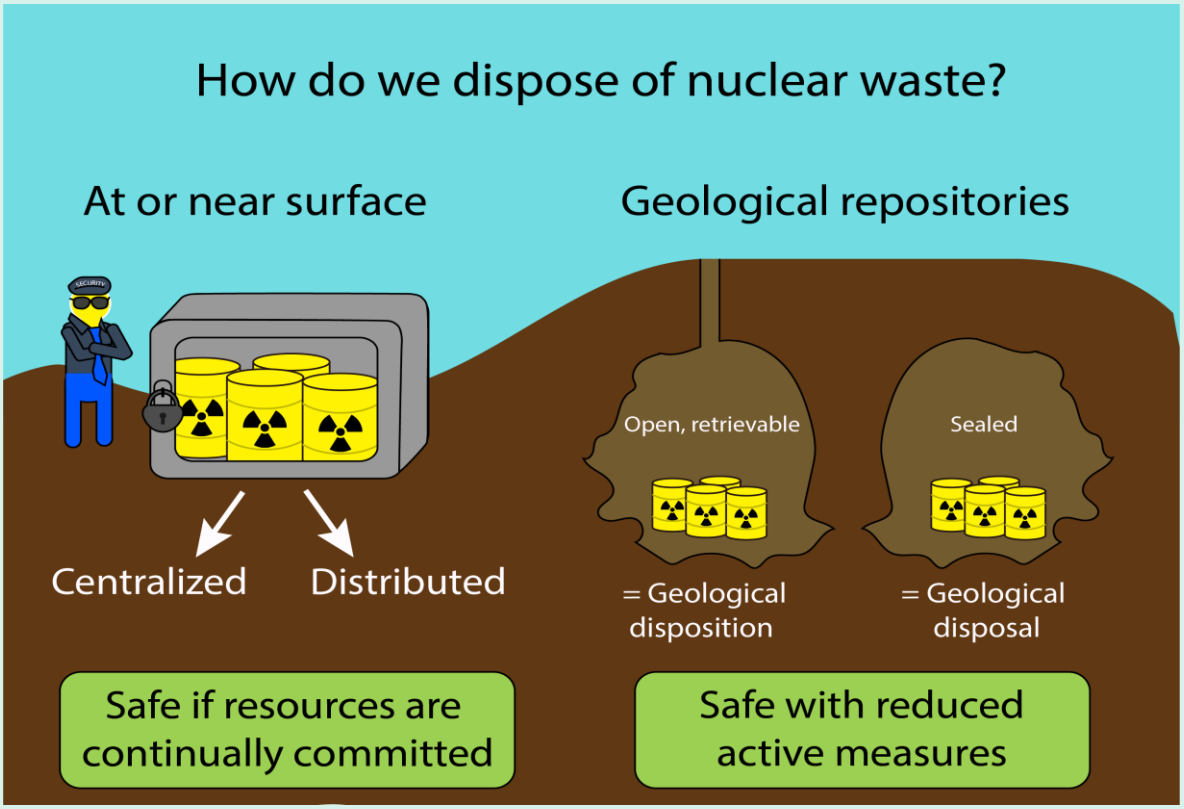
7% Intermediate-level Waste
Used filters, steel components from within the reactor & some effluents from reprocessing containing 4% of radioactivity in the nuclear waste

90% Low-level Waste
Lightly-contaminated items like tools & work clothing containing only 1% of radioactivity in the nuclear waste.

No reason to worry

Minimal public doses underscore the safe operation of Indian nuclear power plants

- Radiological data of 20 years (2000-2020) from six Indian nuclear power plants were analysed; for the Kudankulam Nuclear Power Station, the data were from 2013 to 2020
- The study focussed only on the concentrations of fission products and neutron-activated nuclides values within 5 km of each nuclear plant; the monitored values were "insignificant" beyond 5 km radius
- Fission product noble gases, Argon 41, radioiodine, particulate radionuclides —cobalt-60, strontium-90, caesium-137 — and tritium released as gaseous waste were studied
- The liquid discharge consists of fission product radionuclides — radioiodine, tritium, strontium -90, caesium-137 — and activation products like cobalt-60
- In air particulates, the average radionuclides and the average iodine-131 activity concentration were below 1 mBq per cubic metre. For caesium-137 and strontium-90, the average concentrations were below 10 mBq per cubic metre
- In rivers and lakes, caesium-137 and strontium-90 concentrations were below 5 mBq per litre; the concentration was less than 50 mBq per litre in sea water near the nuclear plants



Mutualism

- On December 20, 2023, the International Health Regulations National Focal Point (IHR NFP) in Argentina alerted the Pan American Health Organization/World Health Organization (PAHO/WHO) of a human case of Western Equine Encephalitis Virus (WEEV) infection.

About Western Equine Encephalitis Virus

- WEE is a rare mosquito-borne disease caused by a virus of the same name, which belongs to the genus Alphavirus of the Togaviridae family, to which the EEE and VEE viruses also belong.
- The main reservoir hosts of EEE and WEE viruses are passerine birds.
- In humans, the WEE virus can cause disease ranging from subclinical or moderate symptoms to severe forms of aseptic meningitis and encephalitis.
- The virus has the potential to spread to other areas through the migration of infected birds or even through the movement of people and animals carrying the virus.
- Given that birds act as a reservoir, they can act as amplifying hosts for viral dissemination to other countries.

WHO Risk Assessment

- The primary mode of WEE virus transmission is through the bites of infected mosquitoes, which act as vectors.
- The principal vector is Culex tarsalis; however, there are multiple vectors that contribute to transmission, including Aedes melanimon, Aedes dorsalis, and Aedes campestris.
- These vectors maintain the circulation of the virus in wild enzootic cycles where birds act as reservoirs of the virus.
- Humans and equines act as the final reservoirs of the virus, incapable of transmitting the virus to mosquitoes.
- People engaged in outside work or activities are at greater risk because of exposure to mosquitoes.
- Outbreaks of WEE in humans generally present as isolated cases with moderate symptoms and most infections are asymptomatic.
- Neurological manifestations include meningitis, encephalitis, or myelitis.
- Similar to other arboviral encephalitis, the encephalitis caused by WEE is characterised by fever accompanied by altered mental status, seizures, or focal neurological signs including movement disorders.

Owl micro fringe

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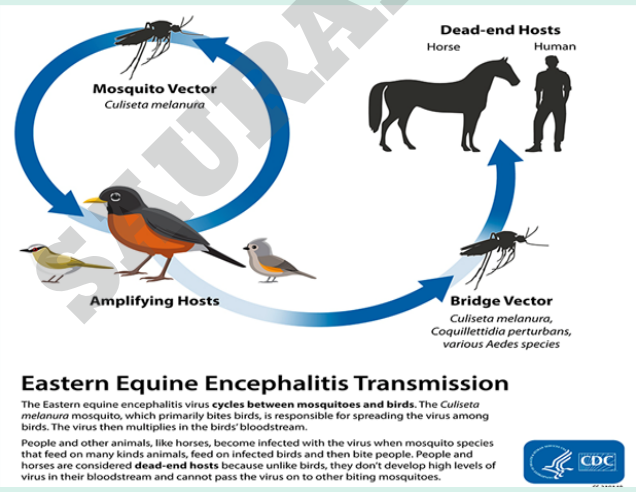

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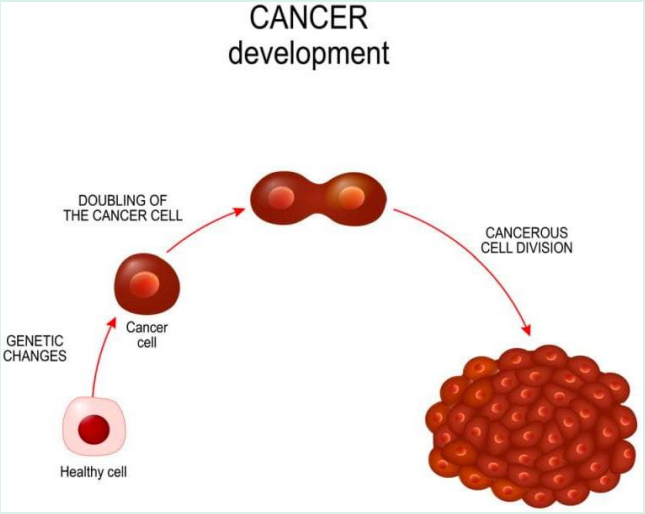
Genomic medicine

- Cancer is a disease of the genome.
- It is caused by changes in genes that cause some cells to divide in an uncontrolled way.
- These changes can be inherited or acquired. Inherited genetic variants form the basis of many hereditary cancers, including breast and ovarian cancer.



- Advancements in genomic technologies have improved our understanding of the molecular underpinnings of cancer, which in turn have

yielded a new generation of therapies that target molecular defects

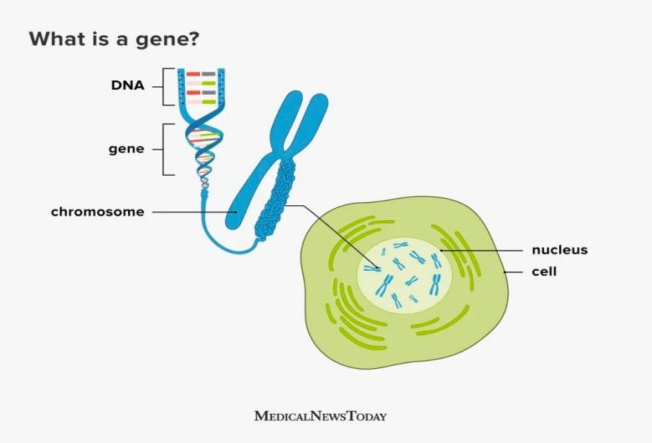
- Such therapies are called precision oncology therapies. Their eligibility in a given setting is determined by molecular tests
- Of the 200- odd therapies the U.S. Food and Drug Administration has approved, almost a third have a DNA -based test as a biomarker.
- And while scientists are discovering new biomarkers for cancers, the focus of late has been shifting to understanding how genomic tests could become the mainstay of cancer treatment in clinical settings.
- In the U.K. researchers sequenced and analysed the genomes of people with different types of cancers; the genomes came from blood and tumour tissues.
- Their analysis revealed details that the researchers have said can be applied in clinical settings to guide treatment strategies for cancer patients.

Terms - personalised /Genomic medicine

- Personalized medicine, also referred to as precision medicine, is a medical model that separates people into different groups with medical decisions, practices, interventions and/or products being tailored to the individual patient based on their predicted response or risk of disease.
- Genomic medicine is an emerging medical discipline that involves using genomic information about an individual as part of their clinical care (e.g. for diagnostic or therapeutic decision-making) and the health outcomes and policy implications of that clinical use.

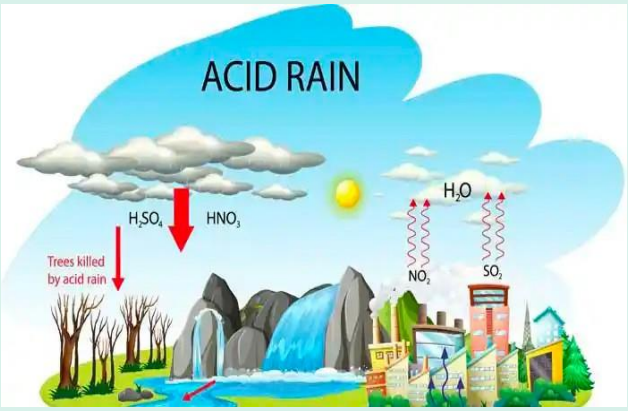
Acid rain

- Acid rain is rain that is acidic.
- When fossil fuels that contain sulphur are combusted, their emissions include sulphur dioxide (SO2). When such combustion happens at a higher temperature, like inside the engine of a car, the combustion products also include nitrogen oxide and nitrogen dioxide (collectively called NOx).
- Both SO2 and NOx are also produced naturally, such as when volcanoes erupt or when lightning passes through the atmosphere, but in and around cities, their principal source is the use of fossil fuels for transport and power generation.
- Once SO2 and NOx rise into the air, they react with water and oxygen molecules to produce sulphuric acid (H2SO4) and nitric acid (HNO3), both of which are corrosive. When these molecules dissolve in water droplets and the droplets precipitate, we have acid rain, acid snow, and even acid fog.



- The typical pH of acid rain is around 4.2-4.4. When acid rain flows into rivers and lakes, it can render the water inhospitable to some species; in soil, it destroys some bacteria.
- These effects can in turn adversely affect forests and other large ecosystems in complex ways.

- To mitigate these effects, coal power plants have been able to reduce the SO, content in their atmospheric emissions by more than 90% using flue- gas desulphurization.
- Many governments around the world have also been working together to minimise acid rain; an example in Asia is the Acid Deposition Monitoring Network in East Asia (EANET).



Encryption

What is encryption?

- Fundamentally, encryption is the act of changing some consumable information into an inconsumable form based on some rule.

What is E2E encryption?

- E2E is encryption that refers to particular locations between which information moves.
- **messaging app.**
- When you send a message, it first goes to a server maintained by the company that built the app; based on its instructions, the server routes the message to your friend.
- In this setup, two important forms of encryption are encryption- in- transit and E2E encryption.
- Encryption- in- transit means before a message is relayed from the server to you (or vice versa), it is encrypted.
- This scheme is used to prevent an actor from being able to read the contents of the message by intercepting the relay.
- In E2E encryption, the message is encrypted both in transit and at rest.One broad distinction is between symmetric and asymmetric encryption.
- In symmetric encryption, the key used to encrypt some information is also the key required to decrypt it.
- DES is a famous example of a symmetric encryption protocol.
- In asymmetric encryption, if the message “ice cream” is encrypted using the key “motorcycle”, it can be decrypted using a different key that corresponds to “motorcycle” in a predetermined way.
- Asymmetric encryption will work as long as the private key and the correspondence between the public key and the private key are kept secret.

Humboldt’s enigma

What is Humboldt’s enigma?

- The world’s tropical areas receive more energy from the Sun because of the earth’s angle of inclination.
- So the tropics have greater primary productivity, which then facilitates greater diversity: more ecological niches become available, creating more complex ecosystems and greater biological diversity.

- The proponents of Humboldt's enigma have held that the earth's tropical areas by themselves don't contain all the biodiverse regions, that many areas outside the tropics are highly biodiverse.
- These places are mountains. Indeed, while we expect diversity to decrease away from the tropics, mountains have been an important exception.
- A simple way to think of Humboldt's enigma in India is to consider the biodiversity in our tropical areas, south of the Tropic of Cancer passing through Madhya Pradesh and Chhattisgarh.
- These areas are supposed to be the most diverse in the country.
- The Western Ghats plus Sri Lanka biodiversity hotspot lies in this zone.
- However, the eastern Himalaya are much more diverse.

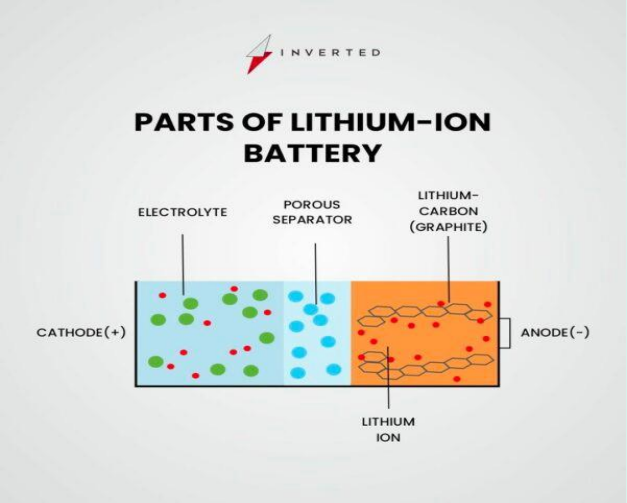
What drives biodiversity?

- The history of the earth, its geography, and the climate are the main drivers of mountain diversity.
- And different biodiversity at different locations is the result of changes in how these factors have intermingled over time and space. We know mountains host two processes that generate biodiversity.
- First: geological processes, like uplifts, result in new habitats where new species arise, so the habitats are 'cradles'.
- Second: species on some climatologically stable mountains persist there for a long time, so these spots are 'museums' that accumulate many such species over time. Coastal tropical sky islands (mountains surrounded by lowlands), like the Shola Sky Islands in the Western Ghats, are a good example.
- Here, old lineages have persisted on the mountain tops as climates and habitats fluctuated around them in the lower elevations.
- This is the reason some of the oldest bird species in the Western Ghats, such as the Sholicola and the Montecincla, are housed on the Shola Sky Islands.
- The northern Andes range including Chimborazo is considered the most biodiverse place in the world.
- Another critical force in biodiversity formation is geology.
- national programmes are trying to address these gaps, including the National Mission on Himalayan Studies, the National Mission for Sustaining the Himalayan Ecosystem, and the National Mission on Biodiversity and Human Wellbeing. They need to be strengthened, bolstered by the will to support basic research on diversity.

Li-battery

- All EVs on the road today are powered by lithium- ion batteries.
- It consists of two electrodes (an anode and a cathode) separated by a liquid electrolyte.
- Lithium atoms in the anode give up electrons which travel to the cathode through an external wire this stream of electrons provide the current which powers the motor of the vehicle.

- Simultaneously, lithium ions (now positively



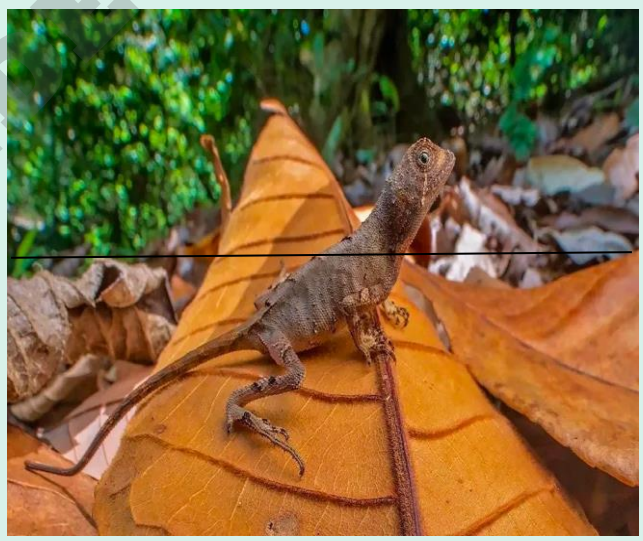
charged from loss of an electron) travel through the electrolyte to reach the cathode.

- During charging, the process is reversed with lithium ions being forced to travel back through the electrolyte to the anode.
- There is a good reason why lithium is the material of choice for EV batteries. Lithium, the lightest solid element known to man, has a high propensity to give up its electron. Its small size enables the lithium ion to efficiently travel between electrodes through the electrolyte.
- This translates to lighter and smaller batteries with an ability to store large amounts of energy.
- However, today's Li- ion batteries still leave a lot to be desired. Its energy density while high compared to earlier battery technologies, pales in comparison to petrol.
- Batteries are still slow to charge (compared to the few minutes it takes to fill petrol at a pump).
- There is a need to make batteries more affordable and increase their lifespan.

- The Paraguay River is a major river in south-central South America, running through Brazil, Bolivia, Paraguay and Argentina.
- It flows about 2,695 kilometres (1,675 mi) from its headwaters in the Brazilian state of Mato Grosso to its confluence with the Paraná River north of Corrientes and Resistencia.

Northern kangaroo lizard

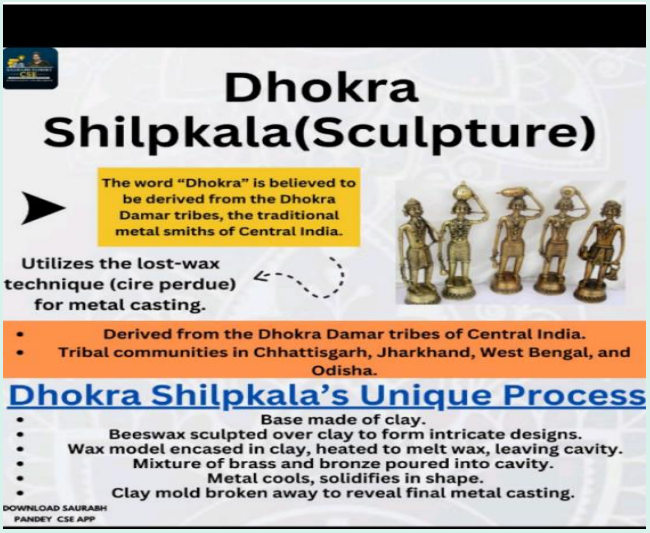
- The biodiverse forests of the Western Ghats have thrown up yet another marvel of evolution a new species of tiny lizards, which researchers have described as "diminutive dragon".

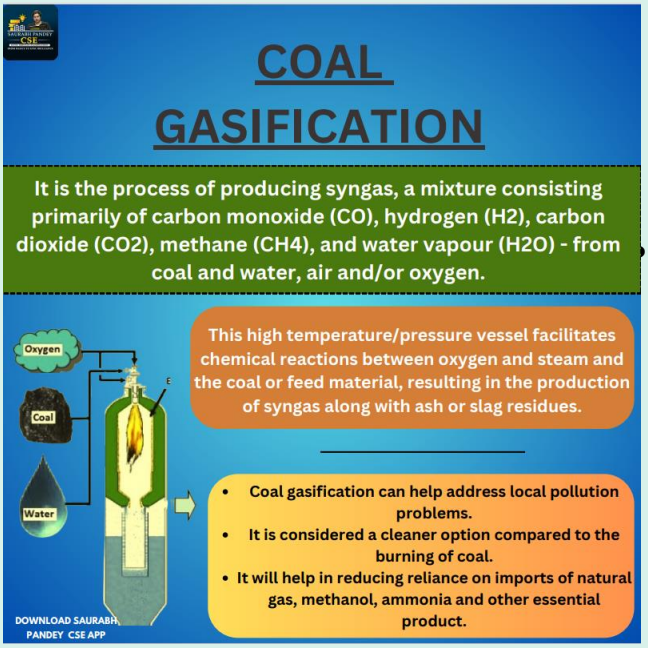


- Agasthyagama edge or northern kangaroo lizard, which belongs to the Agamidae family, is known to have a maximum snout vent length of 4.3 cm.
- The species is the second one of the Agasthya Gama genus after A. beddomii or Indian kangaroo lizard that has been previously reported from the Sivagiri hills in Tamil Nadu.
- A reduced fifth toe makes these reptiles poor climbers and hence do not climb trees like other lizards. Instead, they are mostly terrestrial and

found in areas with dense leaf litter cover. While they feed on small insects, this variety of kangaroo lizard runs fast and hides within dry leaves to evade predators.

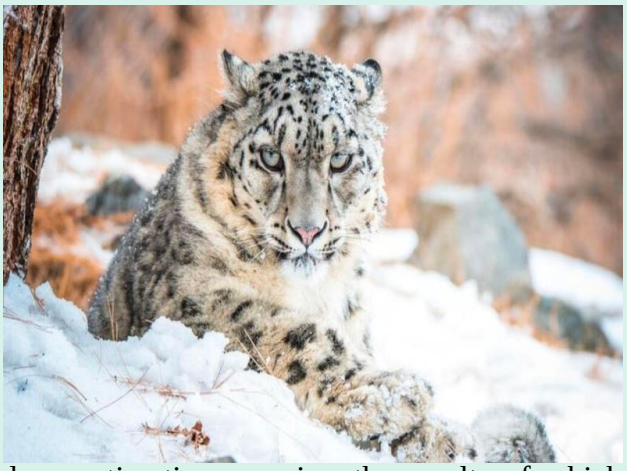
- The findings have been reported in Vertebrate Zoology, a scientific journal published by the Senckenberg Museum in Germany.





Snow Leopard

India has an estimated 718 snow leopards in the wild, according to a first- of- its kind, four- year



-long estimation exercise, the results of which

were made public.

- The snow leopard is known to be an elusive cat and located in mountainous terrain that is hard to access, and the exercise for the first time marks a base threshold for the animal's numbers in India.
- The highest number of cats was estimated to be in Ladakh (477), followed by Uttarakhand (124), Himachal Pradesh (51), Arunachal Pradesh (36), Sikkim (21), and Jammu and Kashmir (nine).
- The current estimate puts the number of Indian snow leopards between 10% and 15% of the global population.

About snow leopard

- The snow leopard's powerful build allows it to scale great steep slopes with ease.
- Its hind legs give the snow leopard the ability to leap six times the length of its body.
- A long tail enables agility, provides balance and wraps around the resting snow leopard as protection from the cold.
- For millennia, this magnificent cat was the king of the mountains. The mountains were rich with their prey such as blue sheep, Argali wild sheep, ibex, marmots, pikas and hares.
- The snow leopard's habitat range extends across the mountainous regions of 12 countries across Asia: Afghanistan, Bhutan, China, India, Kazakhstan, Kyrgyz Republic, Mongolia, Nepal, Pakistan, Russia, Tajikistan, and Uzbekistan.
- The total range covers an area of close to

772,204 square miles, with 60% of the habitat found in China.

- It is listed as Vulnerable on the IUCN Red List.

Maratha Military Landscapes

- India has nominated the "Maratha Military Landscapes", a network of forts that showcase the strategic military powers of Maratha rule, for inclusion on the UNESCO World Heritage List for 2024-25.
- The 12 forts included in this nomination are the forts of Salher, Shivneri, Lohagad, Khanderi, Raigad, Rajgad, Pratapgad, Suvarnadurg, Panhala, Vijaydurg and Sindhudurg in Maharashtra and Gingee in Tamil Nadu.

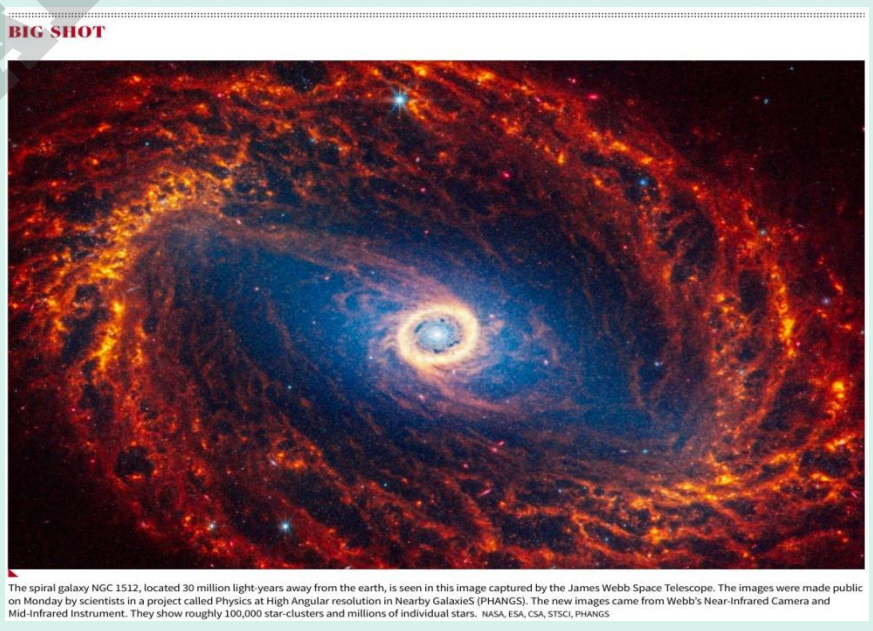
- The "Maratha Military Landscapes", which developed between 17th and 19th centuries, represent an extraordinary fortification and military system envisioned by the Maratha rulers.

- This extraordinary network of forts, varying in hierarchies, scales and typological features, is a result of integrating the landscape, terrain and physiographic characteristics distinctive to the Sahyadri mountain ranges, Konkan Coast, Deccan Plateau and Eastern Ghats in the Indian Peninsula.
- They are distributed across diverse geographical and physiographic regions and showcase the strategic military powers of the Maratha rule, the Union Culture Ministry said on Monday.
- The inception of the Maratha military ideology dates back to 17th century during the reign of the Shivaji Maharaj from 1670 and continued through subsequent rules until the Peshwa rule till 1818 CE

Supermassive balckhole

- Star cluster NGC 1851 that spotted what appears to be a pair of stars offering a new view into the extremes of matter in the universe.
- The system is composed of a millisecond pulsar, a type of rapidly spinning neutron star that sweeps beams of radio light across the cosmos as it spins, and a massive, hidden object of unknown nature.
- The massive object is dark, meaning it is invisible at all frequencies of light from the radio to the optical, X- ray and gamma- ray bands.
- In other circumstances this would make it impossible to study, but it is here that the millisecond pulsar comes to our aid. Millisecond pulsars are akin to cosmic atomic clocks.
- Their spins are incredibly stable and can be precisely measured by detecting the regular radio pulse they create.

- Although intrinsically stable, the observed spin changes when the pulsar is in motion or when its signal is affected by a strong gravitational field.
- By observing these changes, we can measure the properties of bodies in orbits with pulsars.
- the NGC 1851E system weighs almost four times as much as our Sun, and that the dark companion was, like the pulsar, a compact object much denser than a normal star.
- The most massive neutron stars weigh in at around two solar masses, so if this were a double neutron star system (systems that are well-known and studied) then it would have to contain two of the heaviest neutron stars ever found.
- To uncover the nature of the companion, we would need to understand how the mass in the system was distributed between the stars.
- Again using Einstein's general relativity, we could model the system in detail, finding the mass of the companion to lie between 2.09 and 2.71 times the mass of the Sun.
- The companion's mass falls within the "black hole mass gap" that lies between the heaviest possible neutron stars, thought to

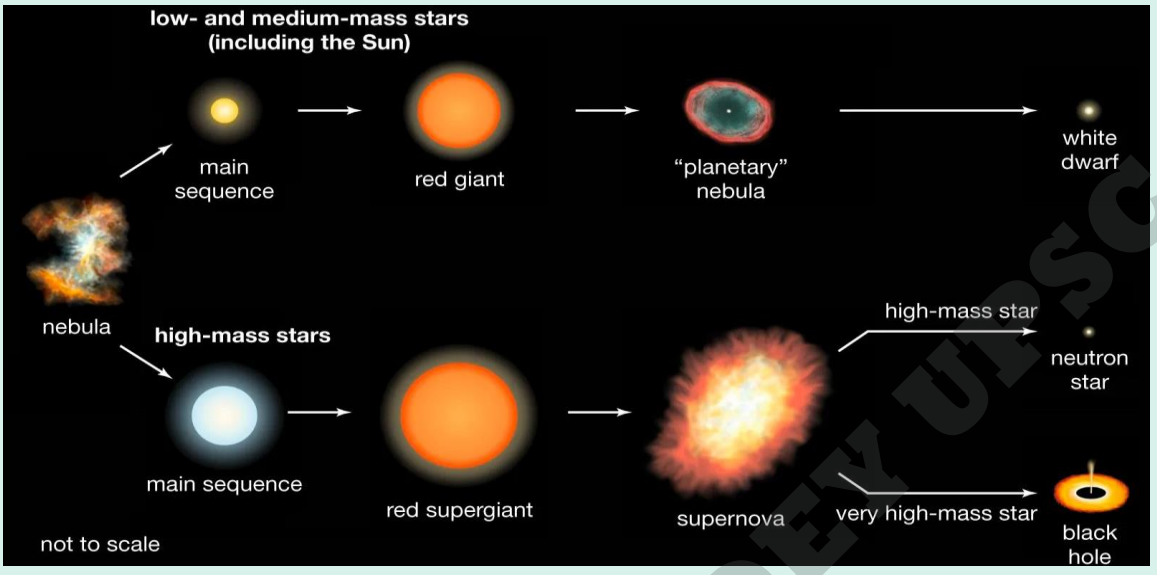


be around 2.2 solar masses, and the lightest black holes that can be formed from stellar collapse, around 5 solar masses.

- At the boundary between neutron stars and black holes there is always the possibility that some new, as yet unknown, astrophysical object might exist.

Water drops formation

- Many windblown drops can be forced together to form what weather reporters call 'sheeting rain', but rain is always born as minuscule drops of condensed water vapour, according to the book Clouds and Weather by John A. Day and Vincent J. Schaefer.
- The formation of these droplets depends on the right amount of water vapour at the right pressure and temperature, but it also requires the presence of tiny solid particles of matter in the air on which the water vapour can gather and condense.
- These bits of dust and salt are called cloud condensation nuclei.
- Salt starts collecting vapour at about 80% relative humidity, while bits of clay begin to take on water molecules at 100% relative humidity.
- As the water molecules slowly collect and condense on the particles, cloud droplets form.
- They are a million times the volume of the original particle but are still very tiny.
- It takes perhaps 3,000 droplets to form a small raindrop.
- The drops in a heavy shower are the size of around 6,000 droplets, according to The New York Times.
- The droplets can grow into drops by several processes.
- First, they can slowly continue to attract vapour. Second, larger droplets fall faster than small ones and collide with them, sometimes joining into larger drops.
- Finally, evaporating droplets may collect on ice crystals in clouds.
- The crystals may warm and melt into rain drops or they may grow 'branches' and fall as snowflakes.
- The spiral galaxy NGC 1512, located 30 million light- years away from the earth, is seen in this image captured by the James Webb Space Telescope.
- The images were made public by scientists in a project called Physics at High Angular resolution in Nearby Galaxies (PHANGS).



Kangla fort

- The Kangla, officially known as the Kangla Fort, is an old fortified palace at Imphal in the Manipur state of India.
- It was formerly situated on both sides (western and eastern) of the bank of the Imphal River, now remaining only on the western side in ruined conditions.
- Kangla means "the prominent part of the dry land" in old Meetei.
- It was the traditional seat of the past Meetei rulers of Manipur.
- Kangla (Imphal) was the ancient capital of pre-modern Manipur.
- The Kangla is a revered spot for the people of Manipur, reminding them of the days of their independence. It is a sacred place to the Meiteis.