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The Analyst

CURRENT AFFAIRS Handout

20th April 2025

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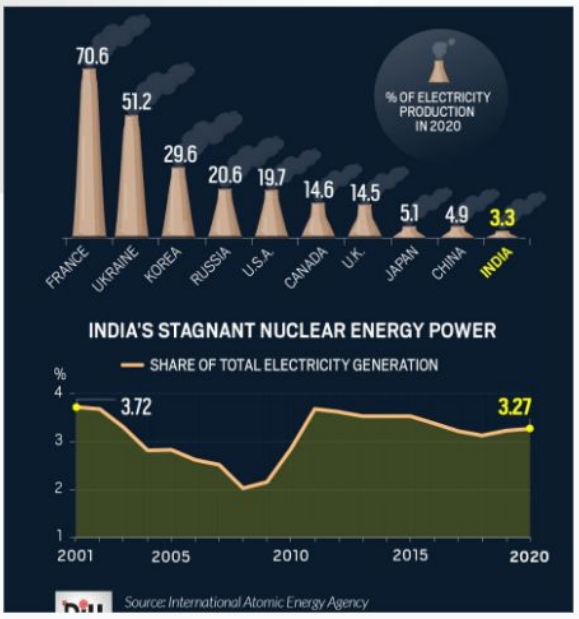
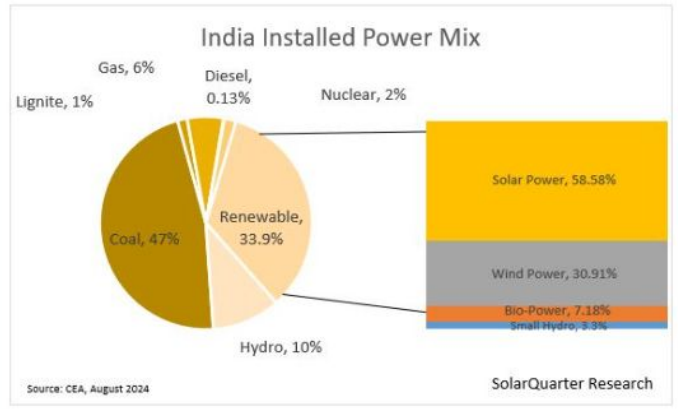
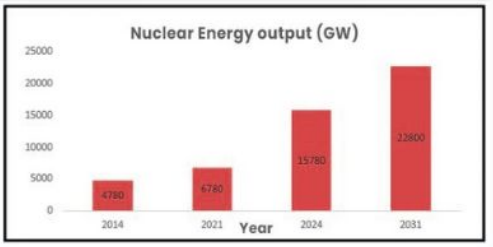
Nuclear Power & Energy Profile

CONTEXT: Prototype FBR will be commissioned next year.

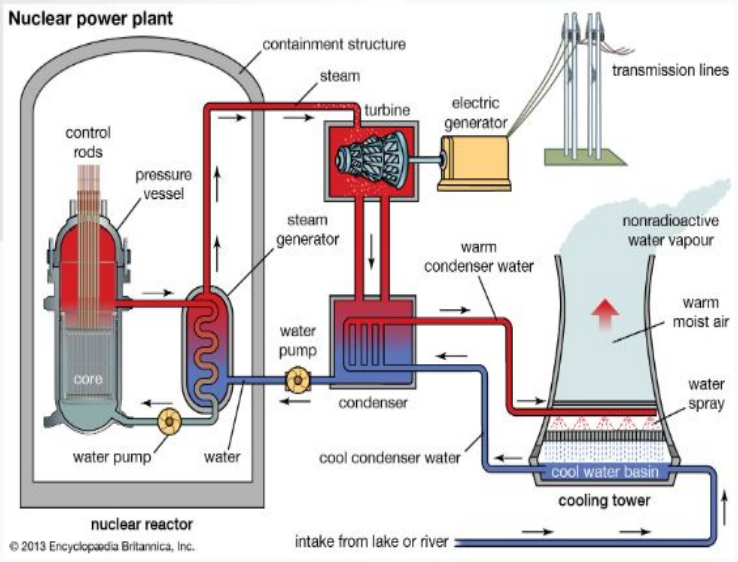
Nuclear Power in Energy Mix

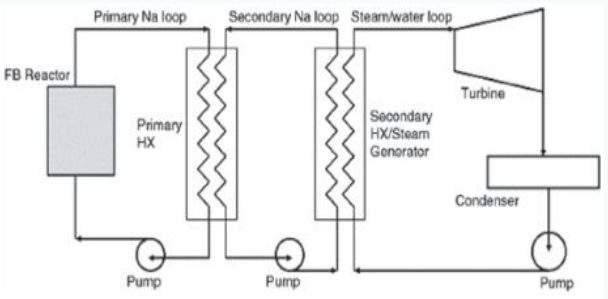






Working of PWHR & FBR





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Nuclear Power & Energy Profile

CONTEXT: Prototype FBR will be commissioned next year.

Why Nuclear Power?

- HDI
- Diversify sources
- Energy security
- GHG
- Costs are location-independent
- Solar/Wind: Intermittent, not base-load capable
- Balancing costs
- External Costs (environmental, health impacts)

Types of Nuclear Reactors

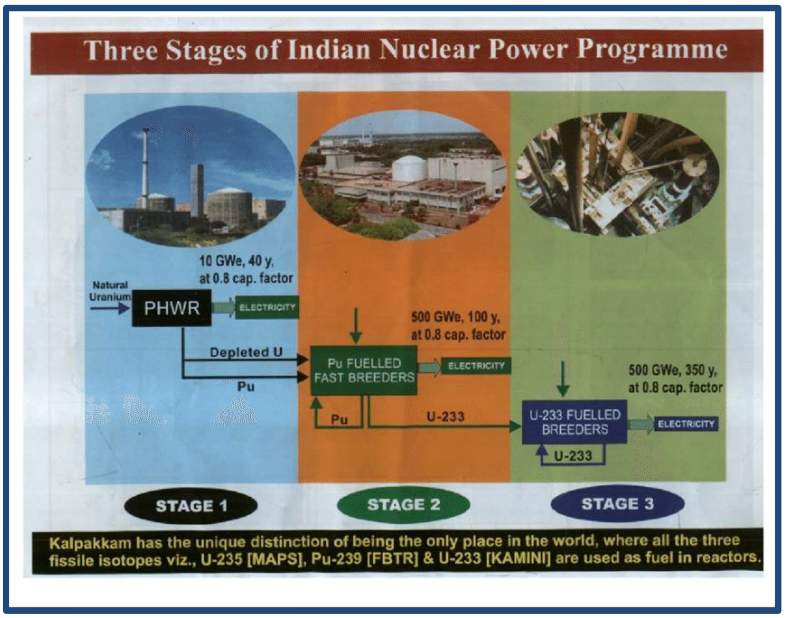
Thermal Reactors (Slow Neutrons)

1. **PWR**
   - light water as coolant & moderator
   - Requires enriched uranium (5% U-235)
2. **BWR**
   - Single coolant loop
   - Lower capital cost than PWR
   - Radioactivity in turbine
3. **PHWR**
   - Uses natural uranium (0.7% U-235)
   - Heavy water (D_2O)

Fast Reactors (High-Energy Neutrons)

4. **SFR**
   - No moderator, uses liquid Na coolant
   - High fuel efficiency (breeds Pu-239 from U-238)
   - Higher thermal efficiency (~38%)
   - For countries with limited Ur

3 Stage Nuclear Power Programme



Nuclear Power Challenges

- **International Collab**
  - Tarapur BWRs (US Collaboration, 1960s)
  - Rajasthan PHWRs (Canadian Collaboration)
- **Foreign Reactor Imports & Liability**
  - Kudankulam (Russia) Delays: 13+ years
  - Post-2008 Nuclear Deal Challenges
  - i. Liability Law (2010):
    - Supplier liability clause deterred vendors
    - NPCIL had to waive clauses for Kakrapar-3
- **Fuel Cycle & Reprocessing**
  - Front-End - Uranium Low-grade deposits (~0.15%)
  - Waste Management
    - i. Low-volume high-level waste
    - ii. Deep geological repositories preferred for long-term disposal
- **Safety, Stalled Projects**
  - Bankruptcies - AP1000 (USA)
  - Initial capital
  - Land Acquisition
- **Cheaper Alternatives**
- **Human Resources**
  - Training: BARC/NPCIL program, Underutilization

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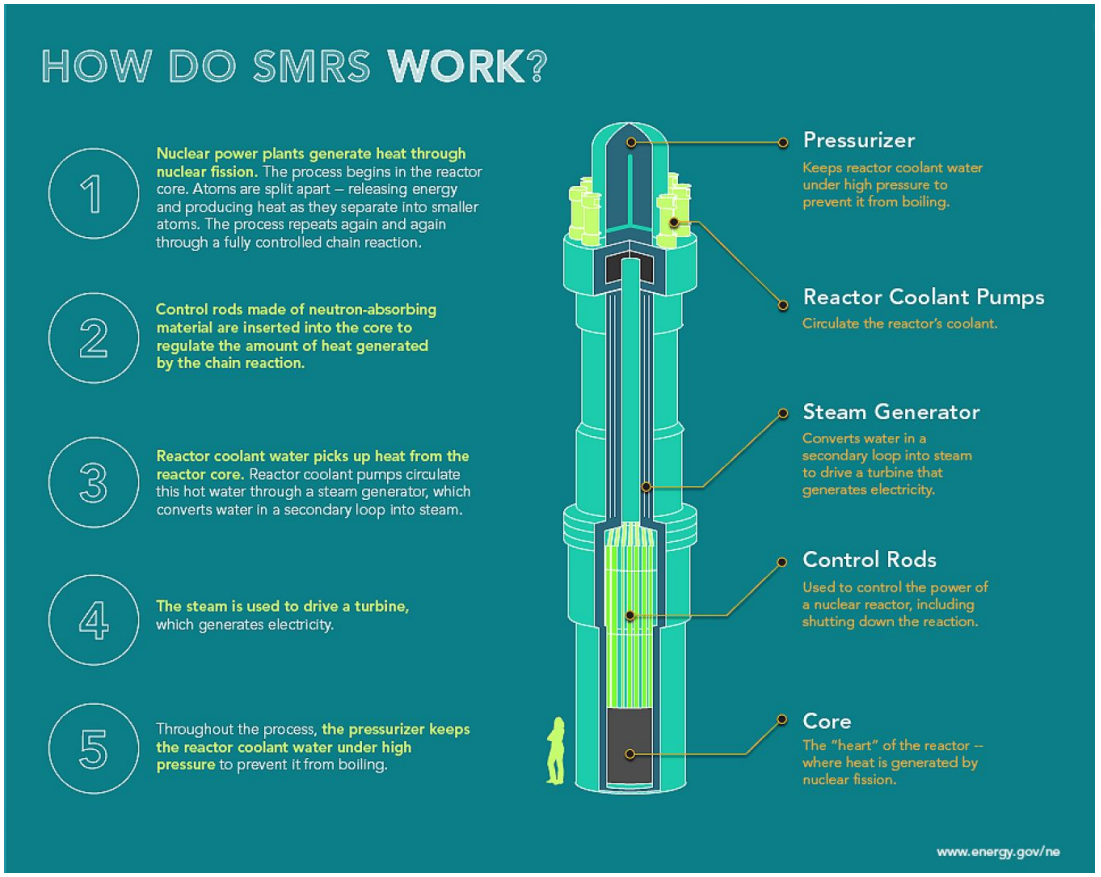
Nuclear Power & Energy Profile

CONTEXT: Prototype FBR will be commissioned next year.

Budget 2025 – SMRs



Recent Developments

- New deposit in India's oldest Uranium Mine, the Jaduguda Mines
- PHWR at Kakrapar
- First Prototype FBR 500MW
  - Primary Sodium filling in Main Vessel
  - commissioning of Sodium pumps
  - Core loading
- ASHVINI - JV
- Kovvada in Srikakulam - USA coop - 6 x 1208 MW nuclear power plant
- RAPP criticality

Recommendations

- Uranium Mining: Resolve local protests
- Reprocessing: Accelerate PHWR spent fuel plants for FBR Pu supply
- Fleet Procurement: Bulk orders
- Thorium R&D: Build 10 MWt MSR prototype
- Retired Expertise: Formalize advisory roles
- Independent Nuclear Regulatory Authority

MAINS PRACTISE QUESTION

As India aspires for energy security and low-carbon growth, nuclear power offers a critical alternative. Examine the need for nuclear power in India. Discuss the major challenges in its expansion and suggest measures to overcome them.

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India Saudi Arabia

CONTEXT: PM Modi is going to visit KSA.

Significance

- Strategic
  - Delhi Declaration 2006
  - Riyadh Declaration - security, Counter Terror, defense, ML, traffic
  - Joint exercise - Sada Tanseeq
  - Protection of Oil Routes
- Economic
  - Remittances - $11bn
  - India's 4th Trade Partner - $43bn in FY24
  - Energy Security - 18% crude, 3rd in FY23
  - MoU in Green/Clean Hydrogen, Grid Interconnection, Supply Chains
  - Saudi's Vision 2030
  - FDI
- Geo Political
  - Regional leader in ME, Chinese influence
- P2P
  - Expats - >2.7mn
  - Bilateral Haj Agreement 2024 - 1.75lac annually

Challenges

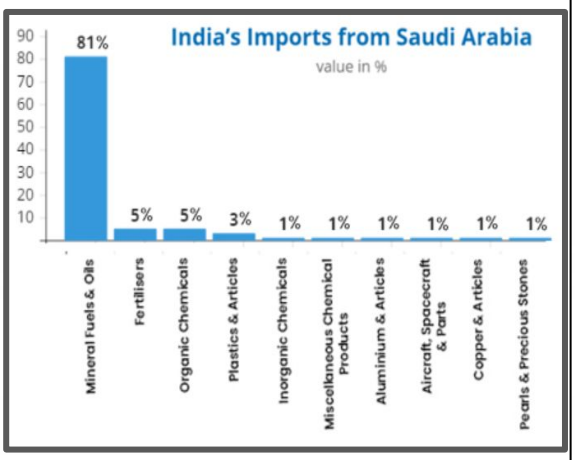
- Nitaqat Law
- Asian Premium
- Trade Imbalance - $20bn deficit in FY24
- Pakistan problem
- Regional Rivalries
- Remittance Shift from GCC to AEs
  - Economic Slowdown in GCC
  - Nationalization policies
  - Skilled jobs, Better wages in AEs

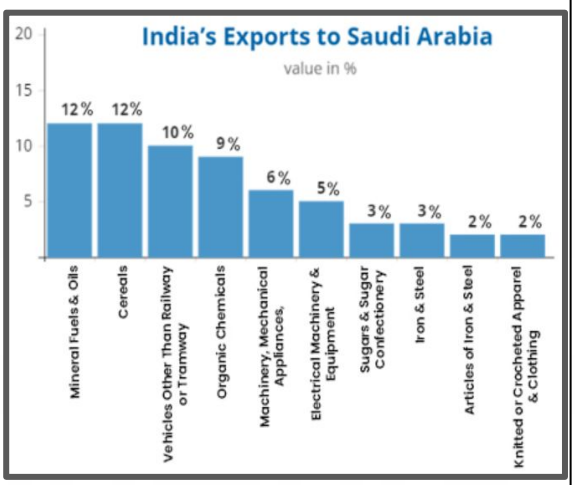
Suggestions

- Economic Integration
  - Export IT, pharma, agri
  - Beyond Oil - RE, digital healthcare
- Multilateral Coop - CC, globalization
- Constructive Diplomacy, Labour Rights of Indian Diaspora, Cultural & Edu Exchanges

MAINS PRACTISE QUESTION

India–Saudi Arabia relations have evolved into a multifaceted partnership encompassing energy, trade and strategic dimensions. Examine the significance of this bilateral relationship. Discuss the key challenges that hinder its full potential and suggest measures to strengthen the ties further.





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Impact of Rare Earth Curbs

SYLLABUS : GS Paper 3: Indian Economy **GS Paper 1:** Distribution of Key Natural Resources across the world
Newspaper : The Hindu **Page Number :** 10

Background

- 15 lanthanide elements + scandium, yttrium
- high density, high melting point, high conductivity and high thermal conductance
- found in low concentrations
- **Concerns**
  - Rare Earth Dilemma
  - Health Concerns - ores with radioactive Th, Ur
  - Chinese Monopoly

Applications

- Permanent Magnets - Neodymium - electric windows
- Electronics - smartphones, diodes, displays
- Lanthanum as a catalyst for petroleum refining
- Cerium in catalytic converters

Current Situation

- Only 2,270 tonnes imported in 2023–24 (pre-China export curbs)
- So no major disruptions in domestic supply chains

Why Limited Direct Impact

- Manufacturing sectors requiring REEs (advanced electronics, defence) in early or setup stages
- Semiconductor fabrication under development (Tata in Hosur)
- Most imports for research, experiments, not large-scale production
- Chips from U.S., Europe

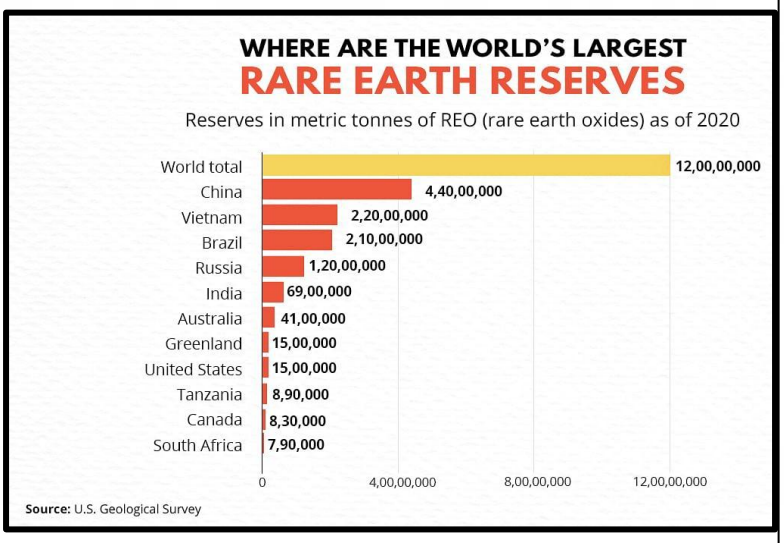
Govt Response

- Learning from COVID's lessons on diversification
- National Critical Minerals Mission
- Future measures:
  - Streamline exploratory permissions
  - Fund research
  - more mineral block auctions

SEVENTEEN RARE EARTH ELEMENTS

Rare earth name	Discovery year	Atomic name & number	Light/heavy REE	Critical/ Uncritical
Yttrium	1788	Y-39	Heavy	Critical
Cerium	1803	Ce-58	Light	Excessive
Lanthanum	1839	La-57	Light	Uncritical
Erbium	1842	Er-68	Heavy	Critical
Terbium	1843	Tb-65	Heavy	Critical
Ytterbium	1878	Yb-70	Heavy	Excessive
Holmium	1878	Ho-67	Heavy	Excessive
Scandium	1879	Sc-21	Heavy	Critical
Samarium	1879	Sm-62	Light	Uncritical
Thulium	1879	Tm-69	Heavy	Excessive
Praseodymium	1885	Pr-59	Light	Uncritical
Neodymium	1885	Nd-60	Light	Critical
Dysprosium	1886	Dy-66	Heavy	Critical
Europium	1886	Eu-63	Heavy	Critical
Gadolinium	1886	Gd-64	Heavy	Uncritical
Lutetium	1907	Lu-71	Heavy	Excessive
Promethium	1947	Pm-61		

Source: Author



Challenges & Future Concerns

- **Global supply vulnerabilities** due to geographical concentration (e.g., China's antimony export curbs in 2023, Russia-Ukraine war)
- **Indirect risks**: restricted supplies to U.S. or Europe => India's tech manufacturing bottlenecks

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Criminalisation of Civil Disputes

SYLLABUS : GS Paper 2: Governance
Newspaper : The Hindu **Page No** : 12

Debu Singh and Anr v. State of Uttar Pradesh, 2025

- civil disputes (e.g., cheque bounce, property, contracts) cannot be treated as criminal offences
- trend "absurd" and a "complete breakdown of the rule of law"

Modus Operandi of Such Cases

- Accusations of fraudulent intent in civil agreements (e.g., loans, contracts)
- *Example*: A lender claims borrower never intended repayment, invoking Section 420 IPC (cheating)
- Police complaints filed to pressure the opposing party, with influence, bribes

Reasons Behind the Trend

- Perception that civil courts are slow and ineffective (>1 crore pending civil cases)
- Criminal cases seen as a faster way to force settlements
- 76% of pending cases in district courts are criminal (3.44 crore out of 4.52 crore)

Judicial Warnings & Precedents

- **G. Sagar Suri vs State of UP (2000):**
  - SC cautioned against giving civil disputes a "cloak of criminal offence"
- **C. Subbiah vs The SP (2024):**
  - SC noted misuse of criminal law in land disputes despite partial civil settlements
- **Indian Oil Corp. vs NEPC India Ltd. (2006):**
  - Courts should hold complainants accountable for frivolous criminal cases
  - Use **Section 250 CrPC** (compensation for false accusations) more frequently

Other Case Laws

- **Govind Prasad Kejriwal Vs. State of Bihar, 2020**
  - inquiry under Section 202 of CrPC, Magistrate required to consider whether even a prima facie case
  - whether criminal proceedings initiated are an abuse of process of law
- **Binod Kumar v. State of Bihar**
  - criminal proceedings ≠ shortcut for civil remedies

Way Forward

- Courts must differentiate
- Impose penalties on those misusing
- Encourage ADR to reduce backlog and misuse

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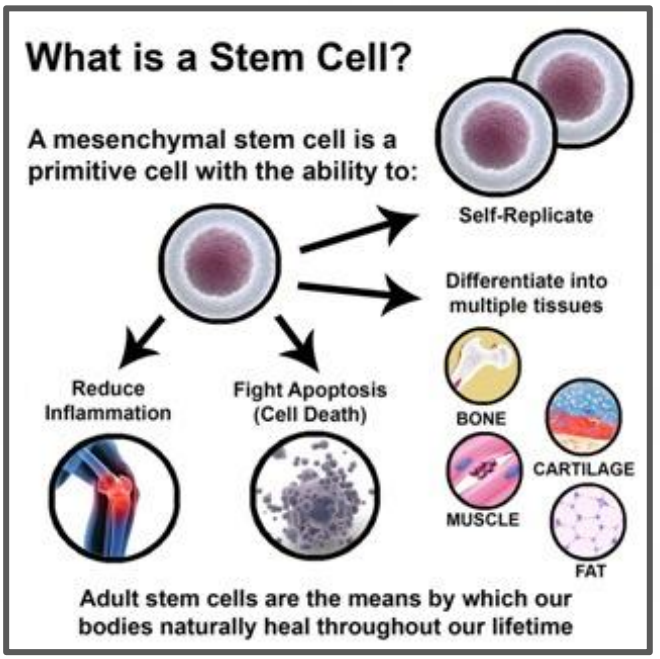
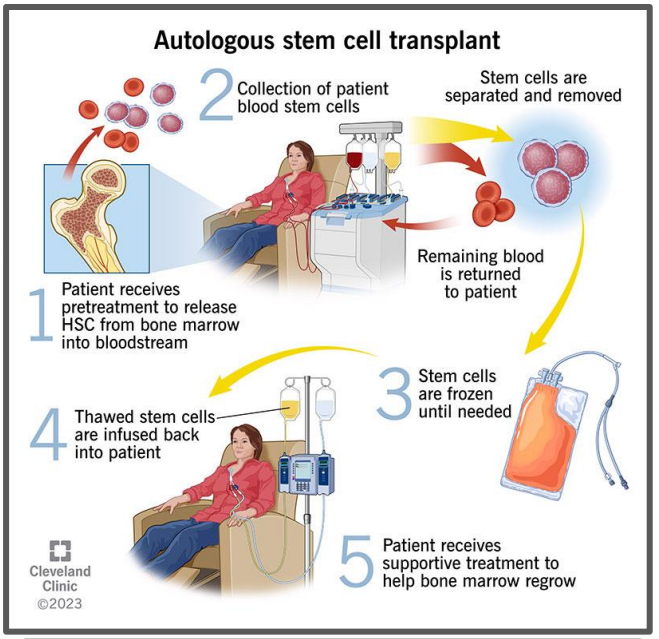
Stem Cell Therapy

SYLLABUS : **GS Paper 3:** Science and Technology- Developments and their Applications and Effects in Everyday Life
Newspaper : The Hindu **Page Number :** 11

Background :

- undifferentiated biological cells that can differentiate into specialized cells and can divide to produce more stem cells
- **Sources**
  - **Embryonic Stem Cells**
    i. from early-stage embryos
    ii. Can become any cell type in body
    iii. ethically debatable
  - **Adult Stem Cells**
    i. in specific tissues and organs
    ii. tissue maintenance and repair
  - **Induced Pluripotent Stem Cells:**
    i. adult cells reprogrammed to behave like embryonic stem cells
    ii. generated from a patient's own cells, reducing the risk of rejection
- Stem cell therapy is a form of regenerative medicine designed to repair damaged cells
- **Applications**
  - Regenerative Medicine: heart muscle, cartilage, or nerve cells
  - Treatment of Chronic Diseases: Parkinson's disease, Alzheimer's disease, and spinal cord injuries
  - Immune Disorders
  - Orthopedics
  - Cosmetic Procedures: facial rejuvenation





The Hindu Bureau

Two independent clinical trials demonstrate the safety of stem cell therapies for Parkinson's disease. The papers, published in *Nature*, investigate the use of cells derived from human induced pluripotent stem cells and human embryonic stem cells, respectively.

Parkinson's disease is a neurodegenerative disease characterised by the progressive loss of neurons that produce dopamine, a neurotransmitter. Cell therapy, specifically replenishing dopamine-producing neurons (dopaminergic) in the brain, could provide a potentially more effective treatment with fewer adverse effects.

To examine the safety and potential side effects of cell therapy for Parkin-

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Premium Income of Insurer

SYLLABUS : GS Paper 3: Indian Economy
Newspaper : The Indian Express **Page Number :** 13

Decoding the News

- Gross premium income: ₹3.07 lakh crore (FY25) vs. ₹2.89 lakh crore (FY24)
- Growth rate declined to 6.21% (FY25) from 12.77% (FY24)
- Slowdown attributed to economic sluggishness, premium hikes

Health Insurance Segment Under Stress

- Growth rate fell sharply - 8.98% (FY25) from 20.25% (FY24)
- Government health schemes - 12.17% decline

Reasons for Declining Growth

1. **High Premiums & Claim Rejections**
   - Raised premiums as medical inflation (~14%)
   - Senior citizen policies 50-100% hikes (IRDAI now caps increases at 10%)
   - Rising claim rejections deterred
2. **Economic Pressures**
   - Inflation and stagnant incomes = cut discretionary spending
   - delayed or avoided health insurance
3. **Post-Pandemic Normalization**
   - COVID-driven demand surge faded
4. **Hospital & Medical Cost Inflation (15% YoY)**
   - Advanced medical technology
   - Higher labour costs
   - Increased lifestyle disease claims (30%+ of total)

Other Insurance Segments

- Motor Insurance growth - 7.94% from 12.92%
- Crop Insurance declined by 1.98%
- Fire Insurance dropped 5.3%

Industry Concerns & Outlook

- Insurers favoring younger, low-risk customers for profitability
- Regulation needed for hospitals to control premium hikes
- Economic recovery & affordability

Way Forward

- Customer-Centricity
- Insurance awareness & Penetration
- Product Innovation & Customization
- Promote Micro Insurance
- Strong Regulatory Framework

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Planet K2-18b

SYLLABUS : GS Paper 3: Science and Technology
Newspaper : The Hindu Page **Number :** 12

Decoding the News

- Possible signs of habitability on K2-18b
- exoplanet 124 light-years away in Leo
- similar past claims retracted
- Discovered in 2015 by the Kepler telescope
- 5.2x wider, 9x more massive than Earth
- Atmosphere: Hydrogen-rich, with traces of water vapor (2019, Hubble), CO_2 & methane (2023, JWST)

Possible Nature of the Planet

- Potential Hycean world (hydrogen-rich atmosphere over a liquid water ocean)
- Computer models suggest:
  - A stratosphere with carbon oxides & cyanide
  - Surface conditions near runaway greenhouse threshold (like Venus)

Signs of Possible Life?

- JWST detected dimethyl sulphide (DMS) or dimethyl disulphide (DMDS)
  - On Earth, DMS is produced by phytoplankton & bacteria
  - However, abiotic sources (e.g., comets) can also produce DMS
- Uncertainty remains:
  - JWST could not distinguish between DMS & DMDS
  - Some models - may be a gas-rich mini-Neptune, not an ocean world

Scientific Debate & Challenges

- Conflicting Studies:
  - 2023: Hint of DMS detected
  - 2024: Reanalysis found methane but no strong evidence of CO_2 or DMS
  - 2024 U.S. study: Data could fit a non-habitable mini-Neptune model
- Detection Limitations:
  - JWST may miss compounds below its detection threshold
  - Unknown non-biological processes could mimic life signatures

Future Exploration

- Direct detection of life needed for confirmation
- More advanced telescopes & models required to verify habitability
- Scientists remain cautious due to past false alarms (e.g., TRAPPIST-1, WASP-12b)

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Daily Quiz

Q1. Consider the following statements regarding types of nuclear reactors:

1. Pressurised Heavy Water Reactors (PHWR) use natural uranium and heavy water as moderator and coolant.
2. Boiling Water Reactors (BWR) have a single coolant loop and lower capital cost than Pressurised Water Reactors (PWR).
3. Sodium-cooled Fast Reactors (SFR) use light water as a coolant and require enriched uranium.

Which of the statements given above are correct?

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2, and 3

Answer: a

Q2. Consider the following statements regarding India–Saudi Arabia relations:

1. The *Riyadh Declaration* focused on enhancing cooperation in security, counter-terrorism, and defense.
2. Saudi Arabia is India's largest crude oil supplier, accounting for over 50% of imports.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Answer: a

Q3. Consider the following statements regarding Rare Earth Elements (REEs):

1. The group of REEs includes the 15 lanthanides along with scandium and yttrium.
2. Rare earth elements are typically found in high concentrations, making extraction cost-effective.
3. Health concerns associated with rare earth mining arise due to the presence of radioactive elements like thorium and uranium.

Which of the statements given above are correct?

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2, and 3

Answer. c

Q4. Consider the following statements regarding stem cells:

1. Embryonic stem cells are derived from early-stage embryos and can differentiate into any cell type in the body.
2. Adult stem cells are pluripotent and found throughout the body in undifferentiated form.
3. Induced pluripotent stem cells (iPSCs) are adult cells reprogrammed to function like embryonic stem cells, often reducing the risk of rejection.

How many of the statements given above is/are correct?

a) Only One
b) Only Two
c) All Three
d) None

Answer. b

Q5: Consider the following statements regarding the exoplanet K2-18b:

1. K2-18b, discovered in 2015, is located around 124 light-years in the constellation Leo.
2. Observations suggest that K2-18b may be a Hycean world with a hydrogen-rich atmosphere and potential subsurface oceans.
3. The James Webb Space Telescope (JWST) has detected carbon dioxide and methane in its atmosphere, supporting possibilities of life.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) 1, 2 and 3

Answer: d

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