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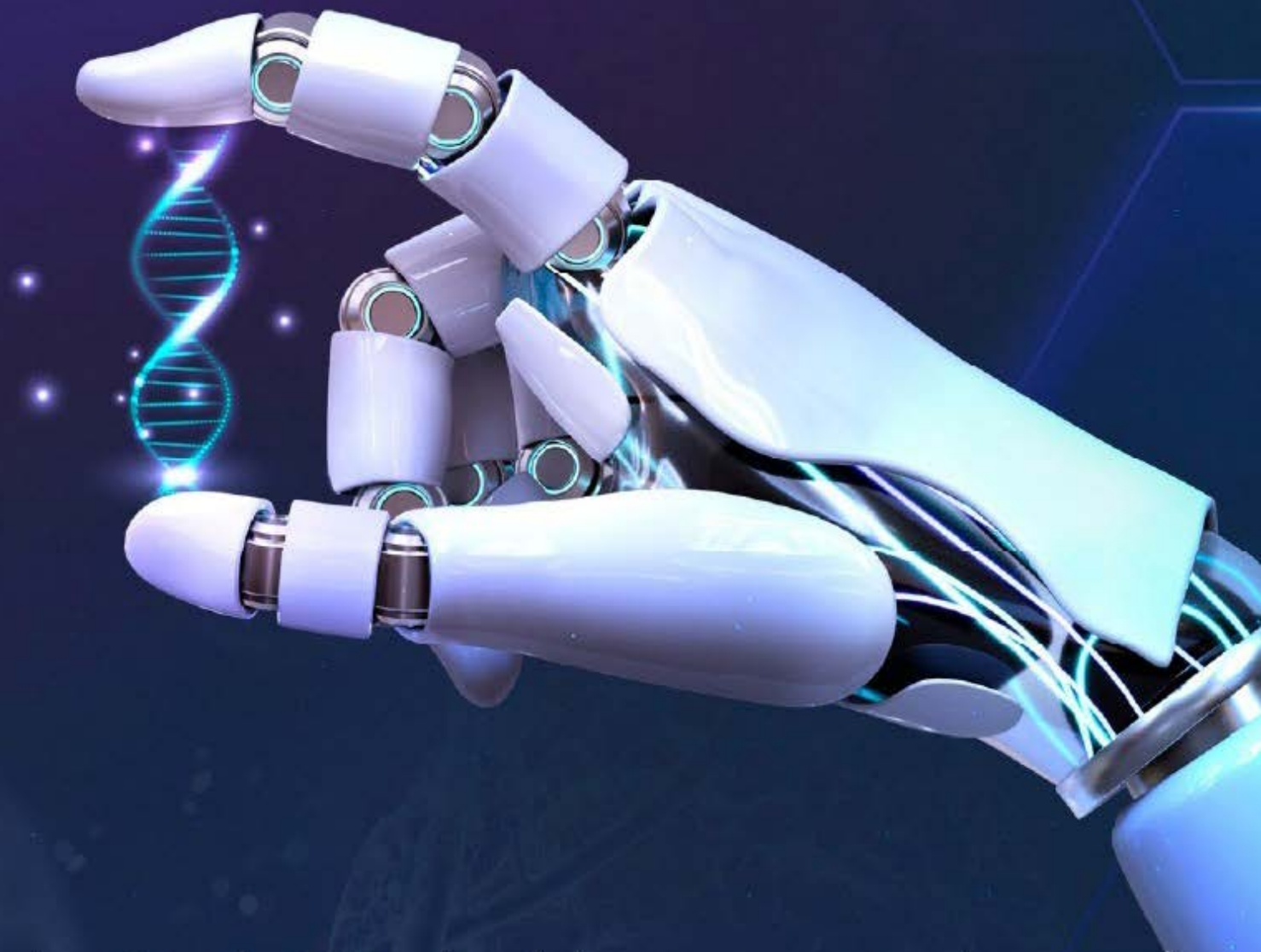
Mains 365

Quick Facts

Science & Technology



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ABHYAAS MAINS 2024

ALL INDIA MAINS

(GS + ESSAY + OPTIONAL)

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PAPER DATES

GS-I & II	GS-III & IV	ESSAY	OPTIONAL-I & II
24 AUG	25 AUG	31 AUG	1 SEPT

OPTIONAL SUBJECTS

ANTHROPOLOGY | GEOGRAPHY | HINDI | HISTORY | MATHS | PHILOSOPHY
PHYSICS | POLITICAL SCIENCE | PUBLIC ADMINISTRATION | SOCIOLOGY

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RANCHI | ROHTAK | SHIMLA | THIRUVANANTHAPURAM | VARANASI | VIJAYAWADA VISAKHAPATNAM

CONTENTS

Dear Students,

In the competitive landscape of the UPSC Mains examination, the significance of integrating data, facts, and examples into your answers cannot be overstated.

These elements serve as the backbone of a compelling and persuasive response, elevating your answer from a generic narrative to a well-substantiated argument.

To support you, we have distilled essential information from the VisionIAS Mains 365 resources which are renowned for their comprehensive coverage of current affairs.

For Science & Technology, this document provides a concentrated source of high-quality data, facts, initiatives, and applications. Given the demands of the UPSC Mains examination, it is crucial to be prepared with important data, applications, and facts that can enrich your answers.

For example, in the context of AI, this document includes relevant initiatives and applications that can be seamlessly integrated into your responses. This information is not limited to GS Paper 3 but is also helpful for essay and ethics answers.

The layout of this document is designed for quick reference and easy integration into your answer.

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IT, Computers, Robotics

Fourth Industrial Revolution

- Term coined by **Klaus Schwab,** founder of the WEF.
- **Key Initiatives:**
  - Centre for the Fourth Industrial Revolution (India)
  - Urban transformation, India Hub for Urban Transformation
  - Education 4.0
  - Smart Advanced Manufacturing and Rapid Transformation Hub (SAMARTH) - Udyog Bharat 4.0

Artificial Intelligence

- Expected to raise India's annual growth rate by 1.3 % by 2035.
- $1 trillion to India's economy by 2035 **(NITI Aayog).**
- **Key Initiatives:**
  - India AI Mission
  - National Strategy on Artificial Intelligence by NITI Aayog
  - Future Skills PRIME
  - New Delhi Declaration of GPAI

IndiaAI Mission

- Rs 10,300 crore for **IndiaAI Mission.**
- **10,000 GPUs** for advanced AI computing infrastructure
- **Funding:** Over **5 years** through PPP model.
- **Pillars of IndiaAI:**
  - AI in Governance
  - AI Computer & Systems
  - Data for AI
  - AI, intellectual property (IP) & Innovation,
  - Skilling in AI & AI Ethics & Governance

Ai And Agriculture

- **Applications of AI in agriculture:**
  - Intelligent crop planning **(E.g SENSAGRI),**
  - Smart Farming **(E.g. AgroStar Startup),**
  - Farmgate-to-fork **(E.g. Stellapps),**
  - Data-driven agriculture **(E.g. BharatAgri App).**

- **Key Initiatives:**
  - National Strategy for Artificial Intelligence
  - AI for Agriculture Innovation (AI4AI) initiative
  - Kisan-eMitra

AI and Health Care

- **Key Applications:**
  - Diagnosis and Treatment Planning **(E.g. S.A.R.A.H. Smart AI),**
  - Clinical research and discovery **(E.g. ProteinSGM),**
  - Workforce optimization **(E.g. Virtual Assistants & Chatbots).**
- **Key Initiatives:**
  - International Centre for Transformational Artificial Intelligence
  - Ethical Guidelines for Application of Artificial Intelligence in Biomedical Research and Healthcare.
  - **iOncology**.ai. by AIIMS Delhi

AI and Defence

- **Key Applications:** Border Security, military robots, intelligence surveillance and reconnaissance & Military Robots.
- **Key Initiatives:**
  - Defence AI Council and Defence AI Project Agency
  - Defence India Startup Challenge (DISC)
  - Department of Defence Production earmarked Rs 100 crore/year
  - Unit for Digitization Automation, AI an App Networking (UDAAN)

Deepfakes

- **Regulatory measures applicable to deepfakes in India**
  - Section 66E of the IT Act of 2000
  - Section 66D of the IT Act of 2000
  - Indian Copyright Act of 1957

Quantum Technology

- **Applications:** Quantum communication, Quantum sensing and metrology, Quantum computing & Quantum simulation.
- **Key Initiatives:**
  - **National Quantum Mission**
  - **UN designates 2025** to be International Year of Quantum Science and Technology.
  - **National Mission on Quantum Technologies & Applications (NMQTA).**
  - **Quantum-Enabled Science and Technology (QuEST) initiative**
  - QSim - **Quantum Computer Simulator Toolkit**

National Quantum Mission

- **Mission Duration:** 2023 to 2031.
- **Mission objectives:**
  - Establishing a secure and high-bandwidth communication **infrastructure spanning 2,000 kilometres.**
  - Developing quantum computers with **a processing capacity of 1,000 qubits.**
  - Advancing the development of **highly sensitive magnetometers**
  - Synthesizing and characterizing novel quantum materials

Blockchain Technology

Initiatives

- **National Strategy on Blockchain,** 2021 (MeiTY)
- Design and Development of a Unified Blockchain Framework for offering National Blockchain Service and Creation of Blockchain Ecosystem' Project
- Telangana has conceptualized **India's first Blockchain District**

Web 3.0

- In 2022, India held 11% of the global Web 3.0 developer pool, ranked 3rd worldwide. **(Bharat Web3 Association)**
- **Significance/Applications**
  - Use of cryptocurrencies and decentralized finance (DeFi).
  - Secure and transparent health records.
  - Governance models E.g. Decentralised Autonomous Organisations (DAO)
  - Removing platform dependence and control by making digital activity platform transferable.

Internet of Things (IoT)

Initiatives

- Draft Policy on **IoT** by **MeitY**
- Centre of Excellence in Intelligent IoT Sensors has been established.
- MeitY in collaboration with NASSCOM has initiated a programme titled FutureSkills PRIME.

Robotic Technology

- India ranks 10th globally as per the World Robotics Report, 2022
- **Initiatives**
  - **Draft National Strategy for Robotics (NSR),** released by MeitY.
  - **Research & Development Centres:** ARTPARK & CAMRAS
  - **Capacity Building Initiative:** FutureSkills Prime
  - **Make-in-India Robots:** Manav, Daksha & Vyommitra

Robotics and Health Care

Initiatives

- **Draft National Strategy for Robotics (NSR)** emphasizes on domestic manufacturing of robots.
- India got its first urologic robotic installation at the AIMS, New Delhi, in 2006.
- **National Health Policy, 2017**

Brain-computer Interface (BCI)

- **Types of BCIs:**
  - **Non-Invasive:** E.g. Electroencephalography (EEG)
  - **Semi-invasive:** E.g. Electrocorticography (ECoG)
  - **Invasive:** E.g. Neuralink's Implant.
- **Applications of BCI**
  - Helping people with physical disabilities and ageing
  - **Treatment for diseases:** Parkinson's disease, epilepsy
  - Facilitate brain research
  - Improving human performance

3D Printing Technology

- India's first 3D-printed post office recently created in Bengaluru.

Initiatives

- **National Strategy for Additive Manufacturing,** 2022 by **MeitY**
  - Aspires to achieve 5% of Global AM market share and add nearly US$ 1Bn to the GDP by 2025.
- **National Institute of Electronics & Information Technology,** Aurangabad, has established a **3D printing lab.**
- In 2023, **National Centre for Additive Manufacturing,** set up by MeitY in collaboration with the **Telangana**.

Critical Tech Sectors

Collaborations with countries for Promoting critical sectors:

- **U.S.-India initiative on Critical and Emerging Technology (iCET)**
- **India and Australia signed the Framework Arrangement on Cyber and Cyber – Enabled Critical Technology Cooperation,** 2020.
- **India and EU** signed intent of cooperation in area of High-Performance Computing in 2022.
- In 2023, **India and Japan** entered into **Memorandum of Cooperation (MoC) on semiconductor supply chain** partnership.

Biotechnology, Nanotechnology And Issues Relating To Intellectual Property Rights

Biotechnology

- India ranked **12th globally**
- Market is targeted to reach $150 Bn by 2025 and $300 Bn by 2030. **(India Bio-economy Report 2023)**

Initiatives

- **Biotechnology Industry Research Assistance (BIRAC)**
- **Biological Research Regulatory Approval Portal (BioRRAP)**
- **National Biopharma Mission (NBM)**
- **Atal Jai Anusandhan Biotech Mission by DBT**
- **DBT Intellectual Property (IP) Guidelines 2023**

Biotechnology and Agriculture

Significance/Applications

- **Increased crop productivity:** E.g. **DMH 11 Mustard**
- **Enhanced crop protection:** E.g. **GM Cotton**
- **Improved nutritional value:** E.g. **Golden Rice**
- **Environmental benefits:** E.g. **BT brinjal**
- **Nutritional benefits:** For example, **golden rice**

Biotechnology and Biopharmaceuticals

Significance/Applications

- Prevention and early detection: **E.g. ELISA, Biosensors**
- Personalization medicine: **E.g. Pharmacogenomics**
- Curative therapies: **E.g. Gene Therapy**
- Precision intervention & **Present fewer side effects**

Gene Editing

- **Three-stage complex mechanism** of unwinding, cleaving and rewinding of DNA

Genome Sequencing

- **Human genome:**3.2 billion nucleotides and 23,500 genes.

Initiatives

- IndiGen programme
- Global Alliance for Genomics and Health **(GA4GH)**
- GenomeIndia Project: Inspired by **Human Genome Project (1990)** and launched by DBT.

Genetically Modified Organism

Applications:

- **Industrial Use:** Biofuels (use of GM algae), Bioplastics **(Genetically engineered microbes),** etc.
- **Medical:** Production of Pharmaceuticals **(Insulin)**, Xenotransplantation **(GM Pig kidney)**, Gene therapy, etc.
- **Agriculture:** Pest Resistance (Bt Cotton), Herbicide Tolerance & Enhanced Nutritional Content **(e.g. Golden Rice)**, Cloned animal **(e.g. Dolly Sheep)** etc.
- **Environmental:** Bioremediation **(Oilzapper)**

Regulation

- Environment Protection Act 1986
- Genetic Engineering Appraisal Committee
- Biological Diversity Act, 2002

Nanotechnology

- India secured third position in global ranking through its contribution to Nanoscience and technology publications (Department of Science and Technology).

Initiatives

- Nano Science and Technology Initiative **(NSTI), 2002**
- Mission on Nano Science and Technology **(Nano Mission), 2007**
- **Nano-electronics Innovation Council** set up by MeitY
- Indian Nanoelectronics Users Programme-Idea to Innovation.
- Institute of Nano Science and Technology **(INST), Mohali, Punjab.**

Nanotechnology and Agriculture

- Significance/Applications
  - Nanofertilizers: E.g. Di-ammonium Phosphate (DAP)
  - Nanopesticides: E.g. Nano Silver
  - Nanobiosensors: Monitors soil conditions
  - Nanomaterials for Soil Improvement: Nanoparticles of clay & Nanomagnets
  - Nanotechnology in Crop Breeding: Enables precise manipulation of plant genes at nanoscale.

Initiatives

- Guidelines for evaluating nano-agri inputs and products
- National Agricultural Innovation Project (NAIP)
- Skill development training programme on nanotechnology
- Nano Fertilizer Plant established by IFFCO at Phulpur

Traditional Knowledge and Genetic Resources in India

Measures by Government to Protect India's TK and GRs

- Traditional Knowledge Digital Library (TKDL)
- India's Patent Act, 1970
- Requirements (PDR) mechanism for the disclosure of involved GRs and TK in the claimed patent.
- Biological Diversity Act, 2002
- Ministry of AYUSH: Dedicated ministry for traditional medicine.

Awareness in the Field of Space

Chandrayaan-3

Payloads:

- **Lander payloads:** ChaSTE; ILSA & Rambha-Langmuir Probe (LP).
- **Rover payloads:** Alpha Particle X-ray Spectrometer (APXS) and Laser Induced Breakdown Spectroscope (LIBS)

Key findings made by Chandrayaan-3

- **Temperature Profile of Moon's Surface:** It is 70 degrees centigrade.
- **Elements on moon:** Probe confirmed presence of sulphur near South Pole.
  - **Other elements** like Aluminum (Al), Calcium (Ca), Iron (Fe), Chromium (Cr), etc. were also detected.
- Thin **plasma** on the surface of the moon.
- **Natural seismic activity**

Aditya-L1

- **Scientifc objectives of the mission**
  - Study of **Solar upper atmospheric (chromosphere and corona) dynamics,** Study of **chromospheric and coronal heating,** physics of the partially ionized plasma, initiation of the **coronal mass ejections (CMEs),** and solar flares.
  - Identify the **sequence of processes that occur at multiple layers** (chromosphere, base and extended corona) which eventually leads to solar eruptive events.
- **Other Missions to study Sun**
  - Parker Solar Probe **(NASA)**

- Solar Orbiter **(NASA/ESA)**
- Interface Region Imaging Spectrograph **(NASA)**
- Solar and Heliospheric Observatory **(NASA/ESA/JAXA)**

Gaganyaan Mission

Status of Gaganyaan programme

- **Design of systems and sub-systems for Gaganyaan** completed.
- Human-rated **L110-G VIKAS engine** successfully tested.
- **Astronaut training facility commissioned** in Bengaluru.
- ISRO is indigenously developing **Environmental Control And Life Support System (ECLSS).**
- Gaganyaan's **first Flight Test Vehicle Abort Mission-1 (TV-D1)**

Private Sector in Space

- In 2023, size of India's space economy is **estimated at $8 billion (around 2-3% of global space economy),** which has potential of USD 100 billion by 2040. **(Arthur D Little Report)**
- Space Start-ups increased to **nearly 200 in 2024 from 1 in 2022.**

Initiatives

- **Indian Space Policy 2023** enables end-to-end participation of Non-Governmental Entities.
- **Indian National Space Promotion and Authorization Centre (IN-SPACe),** an independent nodal agency under Department of Space for allowing space activities.
- **New Space India Limited** to promote private sector participation.
- Budget 2024–25 announced **Rs 1,000 crore venture capital fund.**

Space Debris

- **Reports highlights that:**
  - Since beginning of Indian space era, **127 Indian satellites** have been launched till December 2023.
  - There have been **five major on-orbit break-up events** in 2023, resulting in addition of **69 fragmented objects** to space debris.

Initiatives

- **Debris Free Space Missions (DFSM) 2030**
- **ISRO System for Safe and Sustainable Operations Management (IS4OM)**
- **Space Situational Awareness Control Centre (SSACC)**
- **Inter-Agency Debris Coordination Committee (IADC)**
- **UN Space Debris Mitigation Guidelines**
- **Project NETRA by** ISRO
- **Zero Debris Charter** signed by **12 countries**

Outer Space Governance

About Artemis Accords

- **Established** In 2020 by **NASA**,
- **Objective:** It sets common **non-binding principles** to govern civil exploration and use of outer space, the moon, Mars, comets, and asteroids, for peaceful purposes.
- **India is also a signatory** to this Accord.
- **Key International Space Treaties:**
  - Outer Space Treaty 1967, Rescue Agreement 1968, Liability Convention 1972, Registration Convention 1976, Moon Agreement 1979.
  - India is a signatory to all five of these treaties but has ratified only four.

Vikram Sarabhai Space Centre (VSSC)

- **Lead Centre** of Indian Space Research Organisation (ISRO)
- **Virtual Launch Control Centre (VLCC)** at VSSC played an important role in launch of LVM3 vehicle carrying Chandrayaan-3 spacecraft.
- VLCC **remotely carries out system checks on launch vehicle** prior to mission.

Developmental Role of ISRO

- **Food security and Agriculture:** FASAL Project & CHAMAN Project
- **Rural Development:** Monitoring of IWMP, **GeoMGNREGA** etc.
- **Urban Development:** Use of geospatial data in AMRUT scheme.
- **Water Management:** Satellite with ARGOS and ALTIKA (SARAL)

Health

Antimicrobial Resistance

- **High prevalence of antibiotic usage: 71.9%** of patient surveyed.
- It is among **top 10 public health threat (WHO).**
- 75% of administered antibiotics are excreted unmetabolized.
- AMR will result in **US$ 1 trillion to 3.4 trillion annual losses to GDP** by 2030. (World Bank)
- 1.27 million deaths in 2019 by bacterial AMR)

Initiatives

- National Program on AMR containment
- National Action Plan on AMR (NAP – AMR), 2017

- National AMR surveillance network of state medical college labs (NARS-Net)
- Drugs and Cosmetics Rules, 1945

Tuberculosis (TB)

India's Initiatives

- National Tuberculosis Elimination Programme (NTEP)
- Pradhan Mantri TB Mukt Bharat Abhiyan
- Nikshay Poshan Yojana
- TB Mukt Panchayat Initiative
- Mission Indradhanush
- **Other:** Tribal TB Initiative, National TB Call Centre – Ni-kshay SAMPARK, etc.

E-cigarettes

- **Children 13–15 years old** are using e-cigarettes at rates higher than adults.
- India has banned e-cigarettes under PECA 2019.

Issues

- **Health Risks:** Nicotine exposure in pregnant women can limit the brain development of the foetus.
- **Enforcement issues:** Easily available in tobacco shops and online.
- **Less Regulated:** Around 74 countries have no regulations in place.
- **Aggressively marketed:** E-cigarettes target children through social media and influencers.

Active Pharmaceutical Ingredients (APIs)

- India **3rd largest pharmaceutical industry** by volume in world
- Primarily dependent on bulk drug **import particularly from China.**

Initiatives

- **Production-linked incentive (PLI) scheme**
- The Scheme for **Promotion of Bulk Drug Park.**
- **Scheme for Strengthening of Pharmaceuticals Industry (SPI)**
- **Government has allowed 100% FDI in the pharma sector**

Generic Drugs

- **Reduces healthcare costs** due to its relatively cheaper pricing.
- India accounts for 20-22% of generic drug exports globally. (Invest India)

Steps taken by government to promote GD

- Pradhan Mantri Bhartiya Janaushadhi Pariyojana
- Free drug initiative of National Health Mission
- Production Linked Incentive **(PLI) Scheme** by Ministry of Chemicals and Fertilizers

Digital Health

Initiatives related to Digital Health

- **Ayushman Bharat Digital Mission (ABDM), Digital Health Incentives Scheme (DHIS)** has been implemented under it.
- **eSanjeevani**
- **Tele-MANAS**
- **Nikshay 2.0 portal**
- **Poshan Didi, a chatbot-based for nutrition** counselling service
- **Covid Vaccine Intelligence Network (CoWIN) system**

Cervical Cancer

- **Second most common cancer** among **females in India.**
- Occurs **most often in women over age 30**
- Around 67,000 women dying from the disease each year.

Initiatives for prevention

- **Cervical Cancer Elimination Initiative (by WHO):** Outlined the **'90-70-90' targets for each country by 2030-**
- **Vaccination to prevent Cervical Cancer**

Traditional Medicine

- Around 80% of the world's population is estimated to use TM. (WHO)
- Around 40% of pharmaceutical products today have a natural product basis, including aspirin, etc.

Initiatives

- **National Ayush Mission,**
- **Gujarat Declaration by WHO**
- **Global Centre for Traditional Medicine (Gujarat)** by MoA and WHO
- **Traditional Knowledge Digital Library (TKDL),**
- WHO's **Module 2** of International Classification of Diseases 11 (ICD-11)
- **Other: AYUSH** Visa for foreign nationals, **Ayurveda Gyan Naipunya Initiative (AGNI),** SMART 2.0'

Ultra-processed Food

- **Huge hidden cost of over $7 trillion/year** on health and environment.
- **India's UPF sector grew** at an annual growth rate of **13.37%.**

Initiatives to curtail Ultra-Processed food

- FSSAI has put a **cap on at 2% or less** from 2022.
- **Food Safety and Standards (Advertising and Claims) Regulations, 2018** aims to hold food businesses accountable for their claims/advertisements.
- **Food Safety and Standards (Safe Food and Healthy Diets for School Children) Regulations, 2020**

- Campaign like **'Eat Right India' movement, 'Aaj Se Thoda Kam'**
- Aerated beverages are taxed at 28% GST and additional 12% compensation cess.

Rare Diseases(Orphan Diseases)

- 80% of rare diseases are **genetic and 1.4% of newborn children are affected.**
- Less than 5% of rare diseases have therapies available to treat them.

Initiatives

- **National Policy for Rare Diseases (NPRD),** 2021
- **Production Linked Incentive (PLI) Scheme for Pharmaceuticals Ministry of Health and Family Welfare** recently introduced generic drugs for rare diseases such as Tyrosinemia-Type 1, Gauchers Disease, Wilson's Disease, etc.
- **National Registry** by the ICMR for collecting epidemiological data.
- **Digital Portal for Crowd funding** for Patients.

Indian Scientist and their Contribution

Prafulla Chandra Ray

- Established **the first Indian research school in chemistry.**
- Popularly known as **Father of Indian Chemistry**
- Research on **platinum, iridium and sulphides of organic substances.**

Srinivasa Ramanujan

- Contributed to several **mathematical concepts** like **infinite series**, continued fractions, number theory and mathematical analysis.
- Introduced a **summation**, now known as the **Ramanujan sum** which is currently used in **signal processing**.
- Also credited for his work in **'Modular functions'** which are used to reveal properties of **Black Holes** by astrophysicists.
- In his famous letter to Hardy in 1919, he introduced the **"mock theta functions"** which are used today in **'String Theory'** in theoretical physics.
- Discovered Hardy Ramanujan number i.e., 1729 which is the smallest number which can be expressed as the sum of two cubes in two different ways- **1729 = 13 + 123 = 93 + 103.**
- Discovered a long list of new ideas for solving many challenging mathematical problems that have given great impetus to the **development of game theory.**

C. V. Raman

- In 1922, he published his work on the **'Molecular Diffraction of Light'**, which ultimately led to his discovery of **'Raman Effect'** in 1928.
- He was honoured with Nobel Award for Raman Effect.
  - Raman effect refers to change in **wavelength of light** that occurs when a **light beam is deflected by molecules.**
- Postulated, **Raman spectroscopy**, to understand composition of structures, crystallographic orientation of the sample and change in vibrational frequency for chemical bond in **Ramanujan number** Raman effect.

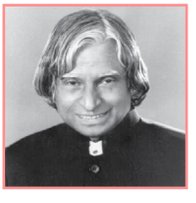
Homi Jehangir Bhabha

- As a student, he worked with a Nobel Prize winner, Niels Bohr in Copenhagen and played a major role in the development of the **Quantum Theory**.
- Published papers on the **Absorption of Cosmic Radiation, electron-positron scattering** (later renamed **Bhabha scattering**).
- Chief architect of India's nuclear energy program by taking several initiatives such as:
  - First chairman of the **Atomic Energy Commission of India** (Known as **Father of Indian Nuclear Power**)
  - Founded and directed **Tata Institute of Fundamental Research (TIFR)** and **Atomic Energy Establishment,** Trombay, later renamed the **Bhabha Atomic Research Centre (BARC).**
  - Pioneered the use of thorium to extract uranium from it rather than relying on the meager reserves of uranium in India.
  - Established the **Cosmic Ray Research Unit** at Indian Institute of Science at Bangalore.

Vikram Sarabhai

- Founded the **Physical Research Laboratory (PRL)** in Ahmedabad in 1947.
- Established the **Indian National Committee for Space Research** in 1962, which was later, renamed ISRO.
- Played key role in setting up **Thumba Equatorial Rocket Launching Station** in Thiruvananthapuram.
- Worked on India's first satellite **'Aryabhata'.**
- **Some of the other well-known institutions established by him are:** Faster Breeder Test Reactor (FBTR), Kalpakkam; Variable Energy Cyclotron Project; Electronics Corporation of India Limited (ECIL), Hyderabad etc.

A.P.J. Abdul Kalam



- Project director of India's **first Satellite Launch Vehicle (SLV-III)** which successfully deployed the **Rohini satellite.**
- Made an effort to develop the **Polar Satellite Launch Vehicle (PSLV)** and SLV-III.
- Directed projects which sought to develop ballistic missiles.
- Worked on **Integrated Guided Missile Development Programme (IGMDP)** and played a major part in developing many missiles under the mission including Agni, Prithvi etc.

Meghnad Saha

- Formulation of **'equation of the reaction** - isobar for ionization', which later became known as Saha's **'thermo-ionization equation'** or the **Saha Equation.**
- Theory of **high-temperature ionization** of elements and its application to stellar atmospheres, as expressed by the Saha equation, is fundamental to modern astrophysics.

Subrahmanyan Chandrasekhar

- Played an important role in the study of structure and evolution of the stars including his most notable contribution of **'Chandrasekhar Limit' (1.4 of solar masses).**
  - **Chandrasekhar limit** determines if a star dies as a white dwarf, or has the mass to exceed this, launching a supernova to create a black hole or neutron star.
- Also developed theories on **star atmospheres, black holes,** the illumination of the sunlit sky, star structures and star mass.
- In 1983, Chandra was awarded the **Nobel Prize in Physics** for his work on the physical processes involved in the structure and evolution of stars.

Prasanta Chandra Mahalanobis

- Founded the **Indian Statistical Institute.**
- Established the **National Sample Survey** (1950) and set up **Central Statistical Organisation** to coordinate statistical activities.
- Shaped India's second Five-year Plan (1956-61), also called the **Mahalanobis Plan** focused on the development of public sector and rapid industrialisation.
- Propounded **Mahalanobis distance**, a statistical measure.

Tessy Thomas

- Contributed to various fields such as Guidance, Control, Inertial Navigation, Trajectory Simulation and Mission Design.
- Played a leading role on **Agni I-V series** of missile systems, Aeronautical Systems Cluster Laboratories.
- Also worked on **aeronautical systems,** including manned and unmanned aerial vehicles, lighter than air systems, aero engines, early warning airborne systems and subsonic cruise missiles.

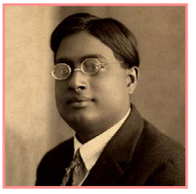
C.N.R. Rao

- Main research interests are in **solid state and materials chemistry.**
- Also, worked on **metal oxides, carbon nanotubes**, and other materials and two-dimensional systems, including graphene, boron-nitrogen-carbon hybrid materials, and molybdenum sulfide for energy applications and green hydrogen production.
- He has contributed also to studies of synthesis, properties of **transition metal oxides** and of **phase transitions.**

Gagandeep Kang

- Known for her **inter-disciplinary research** studying the transmission, development and prevention of enteric infections and their sequelae in children in India.
- Also, developed national **rotavirus** and typhoid surveillance networks.
- Investigating the **complex relationships** between infection, gut function and physical and **cognitive development.**

Satyendra Nath Bose



- He is referred as **"Father of the God Particle"**
- The **fundamental particle 'Bosons'** were named after him.
- **Bose-Einstein Condensates (BEC):** A quantum phenomenon predicted by Bose and Einstein (1925).
- **Other Contributions:**
  - **X-ray diffraction cameras:** Designed and constructed by him for rotation and powder photography.
  - Deduced **Planck's Black body radiation** law without any reference to classical electrodynamics.

Miscellaneous

Nuclear Energy in India

- 1.8 % of total installed capacity
- India currently on second stage of **3-stage nuclear energy program**

Initiatives

- **Resolution** of issues related to **Civil Liability for Nuelear Damage (CLND)** Act & Creation of Indian Nuclear Insurance Pool.
- **Amendment of Atomic Energy Act**
- **PRAGATI Platform**
- **Global Centre for Nuclear Energy Partnership**
- **Partnership with private sector** to develop Bharat Small Reactors (Budget 2024)

Nuclear Fusion

- India joined **ITER project in 2005**
- India has also constructed its indigenous **tokamak ADITYA** and **semi-indigenous Steady State Superconducting Tokamak (SST-1).**

Advantages

- **No carbon emissions** as only by-products are helium.
- **Abundant fuels** such as Deuterium can be extracted from water.

- **Reliable power** as they continue to produce energy for longer periods.
- **Energy efficiency & Safety**

Battery Energy Storage System (BESS)

Initiatives undertaken for BESS in India

- **Legal status for ESS** as a Generator, Transmission or Distribution element, issued by Ministry of Power (MoP) on in 2022.
- **Bidding Guidelines for Battery Energy Storage Systems (BESS)** notified by the MoP in 2022.
- **National Framew:ork for Promoting Energy Storage Systems** unveiled by the MoP in 2023.
- **Battery Waste Management Rules, 2022** to promote circular economy in BESS sector.
- **Scheme for Viability Gap Funding (VGF)** for development of BESS, 2023

Nobel Prize in Chemistry 2023

- Quantum dots sizes are normally not more than **10 nanometers.**
- **Properties of QDs:**
  - Fluorescence
  - Tunable Emission
  - Photostability
  - Material Variety
  - Biocompatibility

Application of quantum dots

- Television screens based on QLED technology, and LED lamps.
- In cancer treatment for targeted drug delivery, Nano medicine, biochemists and doctors may use them to map biological tissue etc.
- In quantum computing, thinner solar cells, flexible electronics, tiny sensors, and encrypted quantum communication etc.

Superconductivity

- Materials exhibit **zero electrical resistance.**
- Materials like Mercury, Lead, Aluminum, Tin, Niobium
- **Room-temperature superconductor:** material capable of exhibiting superconductivity above 0 °C.

PRITHvi VIgyan (PRITHVI) Scheme

- Ministry of Earth Sciences (MoES)
- **Tenure:** 2021-26
- **Overall cost:** ₹ 4,797 crore
- It encompasses five **ongoing sub-schemes:**

- **ACROSS** (Atmosphere & Climate Research-Modelling Observing Systems & Services)
- **O-SMART** (Ocean Services, Modelling Application, Resources and Technology)
- **PACER** (Polar Science and Cryosphere Research)
- **SAGE** (Seismology and Geosciences)
- **REACHOUT** (Research, Education, Training, and Outreach)

Heartiest Congratulations
to all Successful Candidates

Aditya Srivastava

16 in **TOP 20** Selections in **CSE 2023**
from various programs of **Vision IAS**

Animesh Pradhan

Ruhani

Srishti Dabas

Anmol

Nausheen

Aishwaryam Prajapati

39 Selections in **TOP 50** in **CSE 2022**

Ishita Kishore

Garima Lohia

Uma Harathi N

SHUBHAM KUMAR

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