

The Hindu Important News Articles & Editorial For UPSC CSE

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- ➔ In mid-2024, a 30-year-old man with the extremely rare Bombay blood group underwent a kidney transplant at a hospital in Chennai.
- ➔ This was the first-ever cross-blood transplant performed on a patient with the Bombay blood group.

Cross-blood transplant performed on a patient with Bombay blood

His mother donated her kidney, though she did not have the Bombay blood group. And doctors in Chennai, who had performed cross-blood transplants for close to two decades, were willing to cross the Rubicon and pulled off what not long ago might have looked like a sheer miracle

Ramya Kannan

It was in his blood that the 30-year-old male should create history. Literally.

In mid-2024, the patient underwent a kidney transplant. Though he was relatively young for a transplant, that's not where he stands unique. He had the extremely rare Bombay blood group, which prevented him from receiving organs or even blood transfusions from anyone who didn't have the same blood group running through their veins.

But then that's exactly what he did: his mother donated her kidney, though she did not have the Bombay blood group. Doctors at MIOT International in Chennai, who had performed cross-blood transplants for close to two decades, were willing to cross the Rubicon into a sector with no precedence whatsoever: no one had attempted a cross-blood match on a Bombay group patient ever before.

A sheer miracle

In a recent paper published in the peer-reviewed journal *Kidney International Reports*, the team that worked on the transplant – Rajan Ravichandran, Yashwanth Raj T, and Kanakaraj Arumugam – chronicled for posterity how a team of doctors in Chennai pulled off what not long ago might have been put down as a sheer miracle. "It was impossible for Bombay blood group patients to receive blood or organs from another blood group, until it was not," senior nephrologist Dr. Ravichandran explained.

The story he believes begins nearly two decades ago, when he was trained in Japan to perform cross-blood transplants, referring to the transplantation performed when donors and recipients have different blood types. In 2010, he and his team at MIOT Hospitals used a kidney from a donor with B blood group on a recipient with O blood group, successfully. Using a special procedure called double filtration plasmapheresis (DFPP) developed by the Japanese, the team had the patient discharged in a week and back at his software job in three months' time.

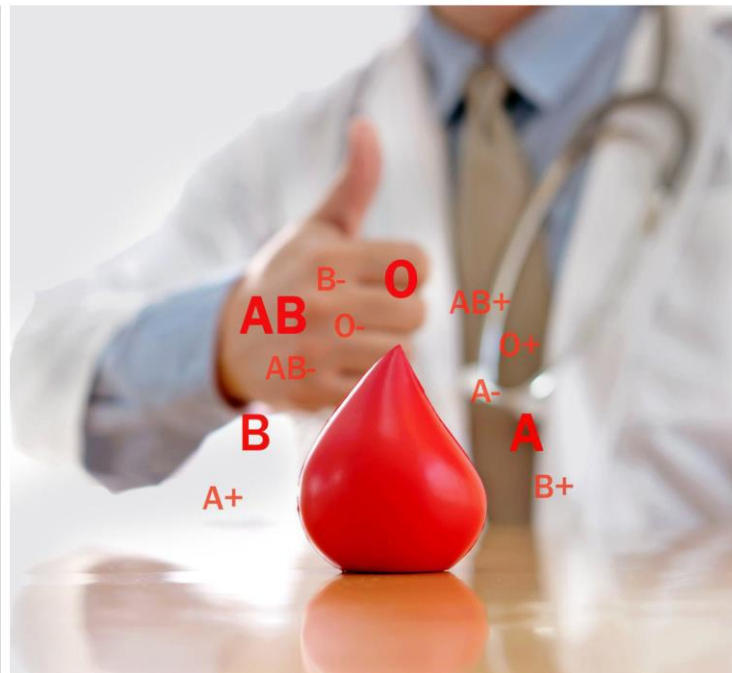
"The most essential requirement in transplantation is a blood group match – ideally, the patient's own blood group, or in the event it is not available, any group for which his blood does not carry antibodies," Dr. Ravichandran explained.

Antibodies are used by the body to detect and neutralise foreign bodies, while antigens are proteins or carbohydrates found on the surface of red blood cells, white blood cells, and platelets, and they determine blood type.

The Bombay blood group

The Bombay, a.k.a. HH, blood group is a rare blood group first discovered in Mumbai in 1952 by Y.M. Bhende. The key differences between the Bombay blood group and the common ABO blood groups lie in the presence (or absence) of the H antigen, which is the fundamental building block for the ABO blood group system.

In normal individuals, the H antigen serves as the base structure for building A and B antigens. In Bombay blood group individuals, the gene responsible for producing the H antigen is mutated or absent, so neither A nor B antigens can be formed.



The Bombay, a.k.a. HH, blood group is a rare blood group first discovered in Mumbai in 1952 by Y.M. Bhende. Representative image. GETTY IMAGES/STOCKPHOTO

Therefore, these people cannot receive blood transfusions from any ABO group, including type O, which has the H antigen. They can only receive blood from another Bombay blood group donor. Its prevalence is about 0.0004% (one in 4 million) of the total human population. While it drops to one in a million in the European population and one in 10,000 in Mumbai, the act of finding a donor is still daunting.

Clinical challenges

It was daunting for this index patient as well. The issue was not to find a donor for a kidney; his mother was eager to donate hers; the nub was that his body would reject it outright because they had differing blood groups. "We decided that it was time to use the principles of cross-blood matching that we use for the ABO type here as well. We assumed it was a similar situation and decided to use the Japanese technique of DFPP," Dr. Ravichandran said.

"Once you identify the Bombay blood group, you know he has anti-H antibodies. Firstly, we measure anti-A and anti-B antibodies in the blood as we do in the case of ABO cross-blood matches. Here, additionally, you have to measure the levels for anti-H antibodies too, and titrate the levels. The next step is to give a monoclonal antibody injection to the patient to deplete B cells that produce antibodies," he said.

As the authors detailed in the paper,

In normal individuals, the H antigen serves as the base structure for building A and B antigens. In Bombay blood group individuals, the gene responsible for producing the H antigen is mutated or absent, so neither A nor B antigens can be formed. Therefore they cannot receive transfusions from any ABO group

the clinical challenges in such a scenario, even among those with rich cross-blood transplant experience in ABO, include determining a safe anti-H antibody titre cut-off, sufficient enough to stop the body from rejecting the organ from the donor.

Notably, there is no precedence for this, so one had to, again, assume a safe level of antibody concentration. There is a high risk of hyper-acute rejection as anti-H antibodies are more potent than anti-A or anti-B antibodies.

"After determining the titre (levels) of antibodies, we started plasmapheresis, which again removes the antibodies in the blood, lowering the chances of rejection. This was combined with immunosuppressive IVIG [intravenous immunoglobulin] to further suppress antibodies, thereby preventing hyperacute rejection of the organ."

Every alternate day, the team measured the level of antibodies in the patient. "Normally for anti-A and anti-B,

we consider a 1-in-16 concentration of antibody to be an ideal safe point to start transplant. It starts at 1-in-256, we then bring it down, lower the antibodies present. In anti-H there just is no cut off, so we made a few assumptions," he said.

A new hope

At what was assumed to be a safe, no-rejection antibody titre, the transplant surgery was performed. The team scoured the State for units of Bombay blood group units, just in case the patient might need it during transplant surgery, since cross-blood transfusion is not possible. However, he did not need it. The surgery was a breeze, and there were no complications during or after surgery, the team said.

While there is no published literature regarding accommodation of anti-H antibodies by the graft, as it had not been tested before, in this patient the doctors seemed to have achieved a no-rejection antibody titre status, and there was no rejection. The first two weeks, which are also crucial to decide if the organ will be rejected, also passed without incident, the doctors said.

Six months later, the patient is well and able to resume his pre-transplant activities, grateful at how the impossible became possible for him – and hopefully, for others in the Bombay blood group as well, if they are ever to require a transplant.

(ramya.kannan@thehindu.co.in)

Understanding the Bombay Blood Group

- The Bombay blood group (HH blood group) was first discovered in Mumbai in 1952.
- Unlike common ABO blood groups, Bombay blood group individuals lack the H antigen, which is required to form A or B antigens.
- People with this blood type cannot receive blood or organs from any ABO group, including type O.
- This rare blood group is found in one in 4 million people globally, with a higher prevalence in Mumbai (1 in 10,000)

Challenges in Transplant Procedure for Bombay Blood Group

- **Rarity of Donors:** Bombay blood group individuals can only receive organs or blood from another person with the same rare blood type.
- **High Risk of Rejection:** The absence of the H antigen leads to the production of anti-H antibodies, which strongly attack any incompatible donor organ.
- **Lack of Precedents:** No prior cross-blood transplants had been performed on a Bombay blood group patient, making it difficult to determine a safe antibody level.
- **Complex Antibody Removal:** Standard plasmapheresis methods used for ABO-incompatible transplants had to be adapted to remove anti-H antibodies effectively.
- **Emergency Blood Supply Issues:** Finding Bombay blood group blood units for transfusion in case of surgical complications is extremely difficult.

Page 07 : Prelims Fact

January 2025 was 0.09°C warmer than January 2024, making it the hottest January ever recorded.

January 2025 Breaks Heat Record

- ▶ This year's January was 1.75°C warmer than pre-industrial times.
- ▶ This marked the 18th month out of the last 19 when global temperatures reached or exceeded 1.5°C above pre-industrial levels.

Main Cause of Rising Temperatures

- ▶ The main reason for the record heat is the buildup of greenhouse gases from burning coal, oil, and natural gas.
- ▶ Natural factors like El Niño and La Niña also influence global temperatures.

Unexpected Temperature Trends

- ▶ El Niño, which ended in June 2024, contributed to the record heat last year.
- ▶ La Niña, which started in January 2025, usually cools the planet but has not significantly slowed warming.
- ▶ Some experts predict 2025 could be even hotter than 2024, despite earlier forecasts of lower temperatures.



The Palisades Fire burns through a beach front property, in California on January 8, 2025. AP

Is global warming accelerating?

Associated Press

The world warmed to yet another monthly heat record in January, despite an abnormally chilly US, a cooling La Niña, and predictions of a slightly less hot 2025, according to the European climate service Copernicus.

The surprising January heat record coincides with a new study by a climate science heavyweight, former top NASA scientist James Hansen, and others arguing that global warming is accelerating. It's a claim that's dividing the research community.

January 2025 globally was 0.09 degrees C warmer than January 2024, the previous hottest January, and was 1.75 C warmer than it was before industrial times, Copernicus calculated. It was the 18th month of the last 19 that the world hit or passed 1.5 C above pre-industrial times. Scientists won't regard the limit as breached until global temperatures stay above it for 20 years.

By far the biggest driver of record heat is greenhouse gas buildup from the burning of coal, oil, and natural gas, but the natural contributions to temperature change have not been acting as expected, said Samantha Burgess, strategic lead for climate for the European weather agency.

The big natural factor in global temperatures is usually the natural cycle of changes in the equatorial Pacific Ocean waters. When the central Pacific is especially warm, it's an El Niño and global temperatures tend to spike. Last year was a substantial El Niño, though it ended last June, and the year was the hottest on record.

El Niño's cooler flip side, a La Niña, tends to dampen the effects of global warming, making record temperatures less likely. A La Niña started in January after brewing for months. Just last month,

It was the 18th month of the last 19 that the world hit 1.5 C above pre-industrial times. Scientists won't regard the limit as breached until temperatures stay above it for 20 years

climate scientists were predicting that 2025 wouldn't be as hot as 2024 or 2023, with the La Niña a major reason.

But Hansen, the former NASA scientist now at Columbia University, said 2025 could break 2024's records. In a study in the journal *Environment: Science and Policy for Sustainable Development*, Hansen and colleagues said the last 15 years have warmed at about twice the rate of the previous 40 years.

"I'm confident that this higher rate will continue for at least several years," Hansen said in an interview.

There's been a noticeable temperature rise even when taking out El Niño variations and expected climate change since 2020, Hansen said. He noted recent shipping regulations that have resulted in reduced sulphur pollution, which reflects some sunlight away from the earth and effectively reduces warming. And that will continue, he said.

University of Michigan environment dean Jonathan Overpeck, who wasn't part of the Hansen study, "There seems little doubt that global warming and the impacts of climate change are accelerating."

But Princeton's Gabe Vecchi and University of Pennsylvania's Michael Mann said they disagree. Vecchi said there's not enough data to show that this isn't random chance. Mann said that temperature increases are still within what climate models forecast.

Page 07 : Prelims Fact

Earth holds a vast diversity of minerals, far beyond what is commonly imagined or studied in the field of geology.

THE SCIENCE QUIZ

Please send in your answers to science@thehindu.co.in

There are more minerals on earth than are dreamt of in our geology

Vasudevan Mukunth

QUESTION 1

Tanzanite is a strikingly blue variety of calcium aluminium hydroxyl sorosilicate crystals. Its colour is the result of small amounts of X present in the crystal — in the same way that some tunicates display a vivid blue colour thanks to metalloproteins called vanabins. Name X.

QUESTION 2

Zirconium and Y are very rarely found in the same natural compounds because the processes that create and accumulate them are very different. This is what makes the mineral painite very hard to find. Most of the currently known deposits of the mineral occur in Myanmar.

Name Y.

QUESTION 3

In pure form, this mineral has the chemical formula $\text{NaAlSi}_3\text{O}_8$. It's tough, dense, and doesn't weather easily. Its green form is highly valued in China. It's formed only in the subduction zones of continents, where rock is transformed to contain new minerals under very high pressure. Name the mineral.

QUESTION 4

When angular, hard-edged rock fragments become cemented together by powdery rock, you have breccia. Name the mineral found in the Dhofar 280 meteorite that crashed in Oman in 2000 later identified as lunar breccia.

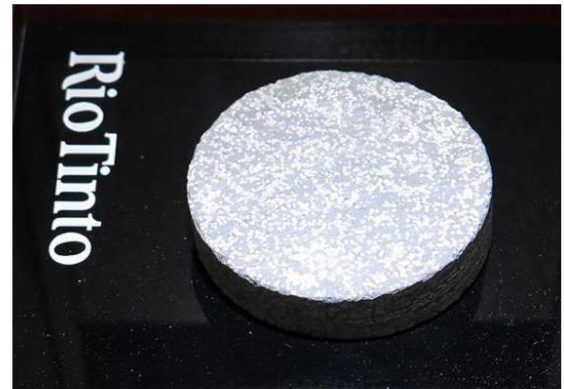
QUESTION 5

Ekanite is one of the very few minerals

on the earth that are naturally radioactive. It occurs mostly in Sri Lanka. It's hard to find because, in a process called Z, the radioactivity slowly but progressively degrades the crystal structure. Name Z.

Answers to January 30 quiz:

1. First computer virus that 'escaped' to other networks – **Ans: Elk Cloner**
 2. First virus for the IBM Personal Computer – **Ans: Brain**
 3. Code that mutates its algorithm when it runs – **Ans: Polymorphic code**
 4. Code that rewrites itself to perform new functions – **Ans: Metamorphic code**
 5. Worm believed to have disrupted Iran's nuclear programme – **Ans: Stuxnet**
- Visual: **John von Neumann**
First contact: ViswanadhaRao Batchu | K.N. Viswanathan | Dalbeer Singh | Ashish Nair | Joe V.R.



Visual: Name this mineral, thus far found only in Serbia. Its chemical formula is very similar to that of kryptonite as described in the 2006 film *Superman Returns*. DUNGODUNG (CC BY-SA 4.0)

- A blue variety of calcium aluminium hydroxyl sorosilicate, found only in Tanzania.
- Its blue colour comes from traces of vanadium (X) in the crystal structure.
- Used in jewelry and is highly valued due to its rarity and pleochroism (showing different colors under different lighting).

Painite

- A rare borate mineral first discovered in Myanmar, containing zirconium and boron (Y).
- It was once considered the rarest mineral on Earth due to its scarcity.
- Has a dark brown to reddish colour and is highly sought after.
- A blue variety of calcium aluminium hydroxyl sorosilicate, found only in Tanzania.
- Its blue colour comes from traces of vanadium (X) in the crystal structure.
- Used in jewelry and is highly valued due to its rarity and pleochroism (showing different colors under different lighting).

Jadeite

- ▶ A pyroxene mineral with the chemical formula $\text{NaAlSi}_2\text{O}_6$.
- ▶ Known for its green varieties, which are highly valued in Chinese culture as imperial jade.
- ▶ Forms in subduction zones under high pressure and temperature, making it geologically rare.

Lunar Breccia (Dhofar 280 Meteorite)

- ▶ A type of rock formed from fragmented lunar material fused together.
- ▶ The Dhofar 280 meteorite found in Oman (2000) contains lunar breccia, indicating moon origin.
- ▶ Studied to understand the Moon's geology and impact history.

Ekaniite

- ▶ A radioactive mineral found mainly in Sri Lanka.
- ▶ Its crystal structure is slowly destroyed by self-radiation damage, a process known as metamictization (Z).
- ▶ Contains uranium and thorium, making it a rare radioactive silicate mineral.

The Union Budget 2025-26 allocates significant funds to science and technology, focusing on private-sector R&D, biotechnology, nuclear energy, and AI.

What has the Budget offered scientists?

The Union Budget for 2025-26 provided an overall and possibly unprecedented thrust on research and innovation, especially in the private sector. The Budget's support for private sector research is expected to accelerate advancements in areas such as gene-editing, personalised medicine, and sustainable agriculture

FULL CONTEXT

T.V. Padma

What does India's 2025-26 Union Budget spell for India's research ecosystem? The author asked seven scientists and science administrators. Their replies are presented below, edited for clarity. [Read the full version online here: bit.ly/scientistsbudget](#)

Abhay Karandikar, Secretary, Department of Science & Technology: The Budget provides an overall and possibly unprecedented thrust on research and innovation by setting aside ₹20,000 crore for the Department of Science & Technology (DST), and towards research in the private sector, including corporates and startups. There is a focused attempt to bring together academia, the private sector, and startups to work on national missions.

The dedicated fund of ₹20,000 crore is part of the ₹1 lakh crore corpus fund announced in the Budget of July 2024 to boost private sector R&D, especially in the deep-tech and sunrise sectors. The DST will be the nodal ministry driving this fund. This will be a major step towards creating strategic autonomy in some key technology sectors. The National Geospatial Mission has been allocated ₹100 crore for FY 2025-2026 to develop foundational geospatial infrastructure and data. The mission will help implement the National Geospatial Policy 2022, with the goal of expanding the access and use of geospatial data and making India a world leader in the geospatial sector.

The Finance Minister has announced several initiatives to boost science, and innovation in the country including the Nuclear Energy Mission, clean tech initiatives, Atal Tinkering Labs etc.

Rajesh Gokhale, Secretary, Department of Biotechnology (DBT): The Union Budget demonstrates a commitment to advancing India's biotechnology sector, which aligns closely with the DBT's objectives. The ₹3,446.64 crore allocation reflects a significant increase of 51.45% from the previous year's allocation.

Recently, the government also approved the 'Bio RIDE' scheme to foster innovation, promote bio-entrepreneurship, and strengthen India's position as a global leader in biomanufacturing and biotechnology.

The Budget's support for private sector research is expected to accelerate advancements in areas such as gene-editing, personalised medicine, and sustainable agriculture. The proposal for a light-touch regulatory framework based on principles and trust is a progressive step. Aligned with the government's 'BioE Policy' for fostering high-performance biomanufacturing, the National Manufacturing Mission (NMM) announced in the Budget aims to accelerate technology development and commercialisation.

The National Mission on High Yielding Seeds will focus on strengthening the research ecosystem and developing high-yielding, pest resistant, and climate-resilient seeds. Similarly, some of DBT's initiatives contribute to self-reliance programmes, such as the mission on minor oil seeds. Another is a mission programme on "Characterisation of Genetic Resources", to sequence/re-sequence and characterise available germplasm resources of pulses.



ISTOCKPHOTO

N. Kalaisevi, Director-General, Council of Scientific and Industrial Research (CSIR):

The Budget reinforces science, technology, and innovation (STI) as key enablers of national progress, aligning with CSIR's vision of advancing self-reliance and global competitiveness. The Budget's focus on public-private partnerships, industry collaboration, and technology-driven entrepreneurship will accelerate innovation in manufacturing, healthcare, and sustainability.

For agriculture and rural prosperity, CSIR's Aroma and Floriculture Missions align with the Agri-Hubs initiative, promoting value-added farming and boosting farmer incomes. Similarly, CSIR's Millets Mission supports self-reliance in the farming of pulses and oilseeds, ensuring nutritional security and climate-resilient farming. The CSIR Cotton Mission aligns with the National Cotton Mission, strengthening India's position in global textile markets.

The Indigenous Manufacturing and Smart Packaging Missions find synergy with the NMM, driving innovation-led industrial growth. The Green Hydrogen Mission, spearheaded by CSIR, supports the clean energy transition.

For youth-skilling, CSIR's Jigyasa Programme complements Atal Tinkering Labs, fostering STEM education and research exposure. The Seaweed Mission and Learn & Earn Program empowers women entrepreneurs, supporting economic inclusion. Additionally, CSIR's Footwear for Healthcare and India Footwear Sizing Program align with the leather sector's initiatives. This Budget cements CSIR's pivotal role in nation-building and reinforces STI as the foundation for a self-reliant, inclusive, and globally competitive India.

K.S. Parthasarathy, former Secretary, Atomic Energy Regulatory Board: The Central government's ambitious

programme to enhance the share of nuclear power to 100 GW by 2047 and to invest heavily to support associated R&D is challenging to all stakeholders.

Accepting private sector participation in the nuclear sector adds a new dimension to the programme. Success in the project to develop and install Small Modular Reactors (SMRs) is essential in India's energy transition. As per the International Atomic Energy Agency (IAEA), SMRs are nuclear reactors with a power generating capacity of 300 MWe equivalent or less.

The Atomic Energy Regulatory Board (AERB) has implemented measures to regulate the safety of VVER Russian reactors, pressurised heavy water reactors of 700 MWe etc, all of which include first of its kind technologies.

AERB's reports to the IAEA Convention of Nuclear Safety reveal how openly and transparently it has been fulfilling its mandate. AERB staff updates its knowledge and expertise in safety-related disciplines associated with new technologies. It has linkages with the U.S. Nuclear Regulatory Commission and the French regulatory agency among others, and exchanges its experience regularly.

C.P. Rajendran, National Institute of Advanced Studies, Bengaluru:

The Budget infuses significant funding for science and technology and for the DBT, whereas the allocation for the Department of Scientific and Industrial Research is nominal.

The importance of curiosity-driven science doesn't seem to be a major priority. Much of the funding appears directed towards mission-mode programmes such as nuclear energy, AI, private sector initiatives, etc. The government also plans to amend the Nuclear Liability and Damage Act 2010 that makes operators liable for nuclear damage. This will have serious ramifications. Many experts have raised concerns about SMRs.

The Finance Minister also announced

the expansion of the Small Industries Development Bank of India Fund for Startups with an additional ₹10,000 crore corpus to enhance the "deep-tech ecosystem" in startups focused on AI, biotech, and space technology. India had over 3,600 deep-tech startups in 2023. In that year, they raised \$850 million, reflecting a 77% decrease from 2022 due to investors' lack of confidence regarding investment returns.

Curiosity-driven research is propelled by scientists' curiosity regarding specific research questions. What I observe is a growing corporatisation of science driven solely by immediate utility. Another critical issue is the rigid bureaucracy surrounding funding, which has created significant problems over the years.

Tapasa Srivastava, University of Delhi, South Campus:

The Budget meets the increasing needs of health research and biomedical devices, given that the Economic Survey recognised the physical and mental harms of ultra-processed food leading to non-communicable diseases.

The percentage increase from the Revised Estimate of 2024-2025 to Budget Estimate of 2025-2026 for Central universities (4.3%) is about half of that given to IITs (8.4%), which is disappointing given the number of students and the overhauling with respect to the National Education Policy (NEP) that universities are going through. These changes require unprecedented support from the government, which is not evident looking at these numbers.

It would have been more meaningful if the Prime Minister's Research Fellowship became an interim research fellowship of a reasonable amount that replaces the abysmally low ₹8,000 non-NET UGC. The PMRF is competitive and, therefore, ends up mostly in labs with sufficient funding.

The AI bandwagon is something that all governments seem to want to rush into. The allocation has come into the Centre of Excellence in AI education and one hopes the Centre sets benchmarks for adoption in a way that truly benefits Indian society, beyond buzzwords.

With a significant number of youth struggling with mental health issues, overall health decline, reduced attention span and consumerism, the unprecedented advantage of a steady government to implement value-based learning and life skills in school education to bring about generational change appears to have been lost.

Soumitro Banerjee, IISER, Kolkata:

The scientific community of India is dismayed to see the low financial allocation to sectors crucial for scientific development. The NEP 2020, adopted by the same government, recommended the expenditure on education be 6% of the GDP, which requires at least 10% of the Union Budget to be spent on education.

But since 2020, there has been no attempt to meet this target. This year the allocation is only 2.54%. This implies that through NEP-2020, the government is trying to change the structure and content of education without improving its quality. The direction of change is clear from the five-fold increased outlay for "Indian Knowledge Systems".

Basic science research has taken a backseat as the funding for IISc and the IISERs has been reduced. The UGC, which funds all universities, saw a drastic reduction in its budget last year (from ₹5,360 crore to ₹2,500 crore). Despite some increase this year (33% BE to BE), it is far below the pre-2024 figure. *T.V. Padma is a science journalist.*

THE GIST

▼ The dedicated fund of ₹20,000 crore is part of the ₹1 lakh crore corpus fund announced in the Budget of July 2024 to boost private sector R&D, especially in the deep-tech and sunrise sectors.

▼ The importance of curiosity-driven science doesn't seem to be a major priority. Much of the funding appears directed towards mission-mode programmes such as nuclear energy, AI, private sector initiatives, etc.

▼ Basic science research has taken a backseat as the funding for IISc and the IISERs has been reduced.

➤ However, concerns remain about reduced funding for basic research, rigid bureaucracy, and corporatisation of science.

Boost for Research and Innovation

- ▶ The Budget allocates ₹20,000 crore to the Department of Science & Technology (DST) and private sector research, including startups.
- ▶ The DST will oversee the fund, which is part of a ₹1 lakh crore corpus aimed at strengthening R&D, particularly in deep tech and sunrise sectors.
- ▶ The National Geospatial Mission receives ₹100 crore for geospatial infrastructure development, supporting the National Geospatial Policy 2022.
- ▶ Other initiatives include the Nuclear Energy Mission, clean tech programs, and Atal Tinkering Labs.

Biotechnology Advancements

- ▶ The Department of Biotechnology (DBT) receives ₹3,446.64 crore, a 51.45% increase from the previous year.
- ▶ The recently approved 'Bio-RIDE' scheme aims to promote bio-entrepreneurship and biomanufacturing.
- ▶ The Budget's support for private sector research will accelerate progress in gene-editing, personalized medicine, and sustainable agriculture.
- ▶ The National Mission on High Yielding Seeds will focus on developing pest-resistant and climate-resilient seeds.

Support for Scientific and Industrial Research

- ▶ The Budget prioritizes science, technology, and innovation (STI) for national progress.
- ▶ Public-private partnerships and industry collaborations will drive innovation in manufacturing, healthcare, and sustainability.
- ▶ Initiatives such as the Aroma and Floriculture Missions will boost agriculture, while the Millets Mission supports self-reliance in pulses and oilseeds.
- ▶ The Green Hydrogen Mission aligns with India's clean energy goals.
- ▶ Programs for youth skilling, entrepreneurship, and sustainable farming receive emphasis.

Nuclear Power and Private Sector Participation

- ▶ The Budget supports India's goal of increasing nuclear power capacity to 100 GWe by 2047.
- ▶ Private sector participation in nuclear energy introduces new challenges and opportunities.
- ▶ The success of Small Modular Reactors (SMRs) is vital for India's energy transition.
- ▶ The Atomic Energy Regulatory Board (AERB) ensures nuclear safety through global collaborations.

Concerns Over Reduced Funding for Basic Science

- ▶ While science and technology funding increases, basic research receives limited attention.
- ▶ The Budget mainly supports mission-mode projects such as nuclear energy and AI.
- ▶ Amendments to the Nuclear Liability and Damage Act 2010 raise concerns.
- ▶ The deep tech startup ecosystem benefits from a ₹10,000 crore fund, but investment confidence remains low.
- ▶ Bureaucratic hurdles continue to affect research funding.

Education and Health Research

- ▶ Health research receives increased support, particularly in biomedical devices and nutrition.

- ▶ Central universities receive only a 4.3% budget increase, compared to an 8.4% rise for IITs, despite serving more students.
- ▶ A revision of research fellowships is needed to support young researchers adequately.
- ▶ AI research receives funding, but concerns remain about its real benefits for Indian society.
- ▶ The Budget lacks significant steps to address mental health and value-based learning in schools.

Challenges in Education and Scientific Development

- ▶ The National Education Policy (NEP-2020) recommended spending 6% of GDP on education, but the Budget allocates only 2.54%.
- ▶ Funding for institutions such as IISc and IISERs has been reduced.
- ▶ The University Grants Commission (UGC) faced a major budget cut in the previous year, and although there is an increase this year, it remains below pre-2024 levels.
- ▶ There is a ve-fold increase in funding for 'Indian Knowledge Systems,' indicating a shift in educational priorities.

Conclusion

- ▶ Overall, the Budget places a strong focus on applied research and industrial collaboration but raises concerns about the lack of support for basic research and education.

UPSC Mains PYQ : 2014

Ques : Scientific research in Indian universities is declining, because a career in science is not as attractive as our business operations, engineering or administration, and the universities are becoming consumer oriented. Critically comment. (200 words/12.5m)

In News : PM-VIKAS SCHEME

The Pradhan Mantri Virasat Ka Samvardhan (PM VIKAS) is a key initiative of the Ministry of Minority Affairs that integrates ve previously existing schemes.

Launch of Integrated Scheme

By Combining Five (5) existing schemes of MoMA viz. Seekho aur Kamao, USTTAD, Hamari Dharohar, Nai Roshni and Nai Manzil

Guidelines for PM VIKAS

(Pradhan Mantri Virasat Ka Samvardhan)



अल्पसंख्यक कार्य मंत्रालय
MINISTRY OF
MINORITY AFFAIRS

- **Objective:** Aims to uplift artisans and craftsmen from minority communities by providing skill development, market linkages, and nancial support.
- **Ministry:** Implemented by the Ministry of Minority Affairs.
- **Target Beneciaries:** Focuses on minority communities, including Muslims, Christians, Sikhs, Buddhists, Jains, and Parsis.
- **Skill Development:** Provides upskilling and entrepreneurship training in traditional arts, crafts, and modern skills.
- **Financial Assistance:** Facilitates credit support through subsidized loans under various government schemes.
- **Market Linkages:** Enhances access to national and international markets through exhibitions and digital platforms.
- **Integration with Other Schemes:** It converges other government schemes such as PM Vishwakarma Yojana, 'Seekho Aur Kamao', 'Nai Manzil', 'Nai Roshni', 'Hamari Dharohar' and 'USTTAD's scheme.
- **Digital Empowerment:** Encourages e-commerce adoption and digital marketing skills.
- **Employment Generation:** Aims to create sustainable livelihoods and preserve India's rich heritage.

India as a bridge between the Global North and South

In his address in January 2025, in Bhubaneswar, Odisha, while addressing the 18th Pravasi Bharatiya Divas convention, the Prime Minister, Narendra Modi, said, 'Today's India not only firmly asserts its own point but also strongly amplifies the voice of the Global South'. Similarly, when India held the 3rd Voice of Global South Summit 2024, last August, Mr. Modi said that India aspires to lead the required reforms to take developing countries into a new, more inclusive structure of global governance.

What has influenced India's renewed enthusiasm to champion the cause of the developing world? And, how can the country influence change to become an effective global development partner?

Unlike the Non-Alignment Movement (NAM), India's motivation does not appear to be based on decolonisation or strong criticism of the West. Rather, as India attempts to increase its presence in the Global South, it is simultaneously deepening its relationships with traditional partners such as the United States and Europe. The high-level visit of Jake Sullivan, the former U.S. National Security Adviser, in January, reflects this. Mr. Modi's visit to Poland, in August 2024, also shows India's attempt to create new alliances.

The China factor argument

The cynical answer often circles back to India trying to counter China's growing global dominance. Trends of foreign direct investments in Africa indicate that India appears to be in a race with China, mainly focusing on countries which already have a significant Chinese presence. Further, industrialised countries are thought to be strategically partnering with India to contain China's rising international footprint. The Quad partnership, an on-going dialogue between Japan, India, Australia and the U.S., for a free and fair Indo-Pacific, is seen as one such attempt. However, the India-China competition does not give the full picture.

India is trying to create an individual identity as an emerging power in its own right to forward



Pooja Ramamurthi

is an Associate Fellow at the Centre for Social and Economic Progress (CSEP), New Delhi

its own strategic trade, defence, and geopolitical interests. Global South countries are disillusioned with present economic paradigms, burdened with debt and conditionalities. They are not looking for another China or a new western institution. India can fill this gap while being a bridge between the Global North and Global South. To be successful, India needs to back up its rhetoric with the right strategies.

Steps that India must take

The first is for India to double-down on its call for an alternate paradigm of development cooperation that is not solely top-down, dictated by the Global North. India often lays emphasis on equal partnerships with other developing countries, trying to set itself apart from traditional powers. In practice, it signals otherwise by putting forward strategies with an India-first approach.

The newly announced 'Global Development Compact' aimed at facilitating growth in the Global South, was described as rooted in Indian experiences and strategies. India's development story as an emerging power and being the world's largest democracy makes it unique. However, it does not hold all the policy answers. It would merit India to not only assert itself as a provider of knowledge but also be open to learning from other Global South countries to address its domestic challenges. Countries are bound to be more receptive toward a country that views them as partners. Otherwise, India may also be perceived as a big brother imposing traditional donor and recipient relationships.

Second, New Delhi has laid stress on a more human-centric approach to tackle developmental challenges. This has been defined at international fora towards promoting behavioural change via Mission LIFE ('Lifestyle For Environment'), which encourages low consumption lifestyles. While important, the need is to rebrand human-centric development in order to focus on building human resource and capacity, especially to tackle future sustainability challenges. Skill India or schemes that mainstream women into entrepreneurship,

will be attractive for countries in the Global South which are also seeking to grow their domestic industry. India's capacity building strategy has tended to revolve around the Indian Technical and Economic Cooperation (ITEC) programme, which implements sector-specific short-term activities. It would be more effective for longer term engagement to assist countries in creating their own institutional capacity to create a better workforce. India can leverage its experiences with micro, small and medium enterprises to foster exchanges. A focus on digital infrastructure, climate and energy solutions as well as water and food security are key areas for cooperation.

The goal ahead

Lastly, India has called for more inclusive global governance. The nation demonstrated this intent by championing the addition of the African Union into the G-20 (in 2023) during India's presidency. India should not be content with facilitating changes in established international institutions but also learn to build domestic capacity. As India aspires to become a stronger global development player, it must establish norms, standards and systems to work with partner countries. Initially, it is beneficial to use existing institutional channels of partners such as the United Nations or Germany and France that are more experienced in development cooperation. However, the long-term goal should be for India to create its own robust domestic systems for international cooperation. Trilateral partnerships and increased engagement with new partners need to be seen as a learning by doing process, where India imbibes its experiences to scale up India-led global initiatives.

India aspires to be the 'Voice' of the Global South, but it also must 'listen' to be a good leader. When India spearheaded NAM, the country showed the world that there is a new, third option for developing countries. India should not miss out on an opportunity to do the same thing now.

The views expressed are personal

GS Paper 02 : International Relations

UPSC Mains Practice Question: Discuss India's evolving role in the Global South and the key strategies it must adopt to become an effective global development partner. (250 Words /15 marks)

Context :

- The Prime Minister, Narendra Modi, on January 2025, at the 18th Pravasi Bharatiya Divas – emphasized India's commitment to amplifying the Global South's voice through inclusive governance and development cooperation.

India's Renewed Interest in the Global South

- India is actively advocating for the concerns of developing countries and aims to create a more inclusive global governance system.
- Unlike past movements focused on decolonization, India is strengthening ties with traditional partners like the United States and European nations.
- High-level diplomatic visits indicate India's attempt to build new alliances while maintaining strategic relationships.

Strategic Considerations and Global Positioning

- Some believe India's growing role in the Global South is aimed at countering another major global power's influence.
- Investment patterns suggest competition, particularly in African countries where both nations are expanding their presence.
- Industrialized nations are strategically aligning with India, partly to balance the global power dynamics.
- The country, however, is not just competing but also trying to establish itself as an independent emerging power with its own strategic and economic interests.

Addressing Global South Concerns

- Many developing nations face economic hardships, debt burdens, and conditional aid from major powers.
- These nations are looking for alternative partnerships that do not replicate existing models of dependency.
- India has the potential to act as a bridge between developed and developing nations but must implement effective strategies to strengthen its position.

Key Steps for India's Success

1. Redefining Development Cooperation

- India must promote an alternative model of development that is not dictated solely by advanced economies.
- The newly introduced 'Global Development Compact' focuses on strategies rooted in India's experiences. While India's development journey is valuable, it should also learn from other developing nations to address domestic and global challenges effectively.
- A balanced approach will help avoid perceptions of dominance over smaller nations.

2. Adopting a Human-Centric Approach

- India promotes sustainability and responsible consumption through initiatives like Mission LiFE.
- A broader focus on human resource development is needed, particularly in skills training and entrepreneurship.
- The Indian Technical and Economic Cooperation (ITEC) program has traditionally provided short-term skill-building initiatives.
- To enhance long-term impact, India should help countries build strong institutions that can develop skilled workforces.
- Cooperation in digital infrastructure, climate resilience, energy solutions, water, and food security can strengthen India's role in global development.

3. Building Inclusive Global Governance

- India has advocated for more inclusive decision-making by pushing for the inclusion of the African Union in the G-20. While influencing existing global institutions is important, India must also strengthen its own domestic capacity for international cooperation.
- Initially, collaboration with experienced development partners like the United Nations or European nations can be beneficial.
- Over time, India should build independent mechanisms for international development partnerships.
- Trilateral cooperation and long-term engagement can help India scale up its own global initiatives.

The Road Ahead

- India's ambition to be a leading voice for the Global South requires active listening and collaboration.
- The country once led a major global movement by offering an alternative path for developing nations.

- Now, it has a similar opportunity to create an inclusive and sustainable development model for the world.
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