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INDIA TO ESTABLISH BHARATIYA ANTARIKSH STATION BY 2028

SYLLABUS MAPPING:

GS-3– ***Sci and Tech-India to establish Bharatiya Antariksh Station by 2028***

FOR PRELIMS:

What is the Bharatiya Antariksh Station (BAS)?Which technology will be crucial for the assembly and maintenance of the BAS?

FOR MAINS:

Discuss the significance of the Bharatiya Antariksh Station in advancing India's space exploration capabilities.

RECENT CONTEXT:

India is on the brink of a new era in space exploration with its ambitious plan to establish the Bharatiya Antariksh Station (BAS) by 2028. This project signifies a leap forward for the Indian Space Research Organisation (ISRO) and the nation's broader aspirations in the realm of space. The proposed space station will not only enhance India's capabilities in scientific research and technology but also position the country as a significant player in the international space community.

BACKGROUND:

India has made remarkable strides in space technology over the past few decades. With missions like Mangalyaan (Mars Orbiter Mission) and Chandrayaan (Moon missions), ISRO has garnered international acclaim for its cost-effective and innovative approaches to space exploration. The successful launch of the Gaganyaan mission, India's first manned space mission, has set the stage for more ambitious projects, including the BAS.

The establishment of a space station aligns with India's growing ambitions in space and mirrors similar initiatives by countries like the United States, Russia, and China. The global space race has evolved beyond just exploration; it now encompasses commercial, military, and scientific interests, prompting nations to invest heavily in space infrastructure.

OBJECTIVES OF THE BHARATIYA ANTARIKSH STATION:

1. **Scientific Research:** The space station will provide a platform for conducting experiments in microgravity, which can lead to breakthroughs in various fields, including medicine, materials science, and astrophysics.
2. **Technological Development:** Developing technologies for life support, habitat construction, and sustainable living in space will have far-reaching implications for future missions, including potential manned missions to Mars.
3. **International Collaboration:** The station will foster collaborations with other countries and space agencies, promoting shared scientific knowledge and resources.
4. **Educational Outreach:** By establishing a presence in low Earth orbit, India hopes to inspire the next generation of scientists and engineers, fostering interest in STEM fields among students.
5. **Strategic Presence:** With the increasing importance of space in national security, having a space station will enhance India's strategic capabilities.

TIMELINE AND PHASES OF DEVELOPMENT:

1. **Phase 1: Planning and Design (2023-2025)** This initial phase will involve extensive planning, design, and feasibility studies. ISRO will collaborate with various stakeholders, including academic institutions and industry partners, to develop the necessary technologies and infrastructure. This phase will also focus on determining the optimal orbit for the station, which will likely be in low Earth orbit (LEO).
2. **Phase 2: Development of Components (2025-2027)** In this phase, ISRO will begin the development of key components for the space station. This includes life support systems, habitat modules, and docking mechanisms. Tests and simulations will be conducted on Earth to ensure that all systems function effectively in the harsh conditions of space.
3. **Phase 3: Launch and Assembly (2028)** The final phase will involve the actual launch of the station's modules into space, followed by assembly in orbit. ISRO plans to use its existing launch vehicles, such as the GSLV Mk III, to send modules into space. The assembly process will require careful coordination and precision to ensure that all components fit together seamlessly.

TECHNOLOGICAL INNOVATIONS:

1. **Life Support Systems** Creating a sustainable environment for astronauts is paramount. Innovations in air and water recycling, food production, and waste management will be essential. ISRO plans to incorporate advanced life support systems that ensure long-term habitation in space.
2. **Propulsion Technologies** Efficient propulsion systems will be critical for transportation to and from the station. ISRO is exploring advanced propulsion technologies that will reduce travel time and costs, making regular missions feasible.
3. **Robotics and Automation** Robotic systems will play a significant role in the assembly and maintenance of the space station. These technologies will allow for remote operations and reduce the need for human presence during complex tasks.

INTERNATIONAL COLLABORATIONS AND PARTNERSHIP:

The establishment of the BAS presents an opportunity for India to strengthen its ties with other countries in the field of space exploration. Collaborations with space agencies such as NASA, ESA (European Space Agency), and Roscosmos can lead to shared resources and knowledge, enhancing the scientific output of the station.

India has already initiated discussions with various countries regarding potential partnerships. Joint missions, shared experiments, and collaborative research projects are on the horizon, which will further solidify India's position in the global space community.

ECONOMIC IMPACT:

The establishment of the Bharatiya Antariksh Station is expected to have a significant economic impact. The space sector has proven to be a catalyst for technological advancements and job creation. By investing in space infrastructure, India can stimulate growth in various industries, including aerospace, telecommunications, and materials science.

Furthermore, the potential for commercial activities in space, such as satellite servicing and space tourism, opens up new avenues for economic development. As the global space economy continues to grow, India's investments in the BAS will position the country to take advantage of emerging opportunities.

CHALLENGES AHEAD:

1. **Funding and Budget Constraints** Establishing a space station is a costly endeavor. Securing adequate funding from the government and potential private investors will be critical. ISRO will need to demonstrate the value and return on investment for the project to attract the necessary financial support.
2. **Technological Hurdles** Developing the required technologies for life support, propulsion, and habitat construction poses significant challenges. Continuous research and development will be essential to overcome these hurdles and ensure the safety and well-being of astronauts.
3. **International Regulations and Policies** Navigating the complex landscape of international space regulations will be necessary for the successful establishment of the BAS. Collaborating with other nations will require adherence to various treaties and agreements governing space activities.

PUBLIC ENGAGEMENT AND OUTREACH:

As India embarks on this monumental journey, public engagement and outreach will play a vital role. ISRO aims to involve citizens in the space program through educational initiatives, public lectures, and outreach programs in schools and universities. This engagement will foster a sense of ownership and pride in the nation's space achievements.

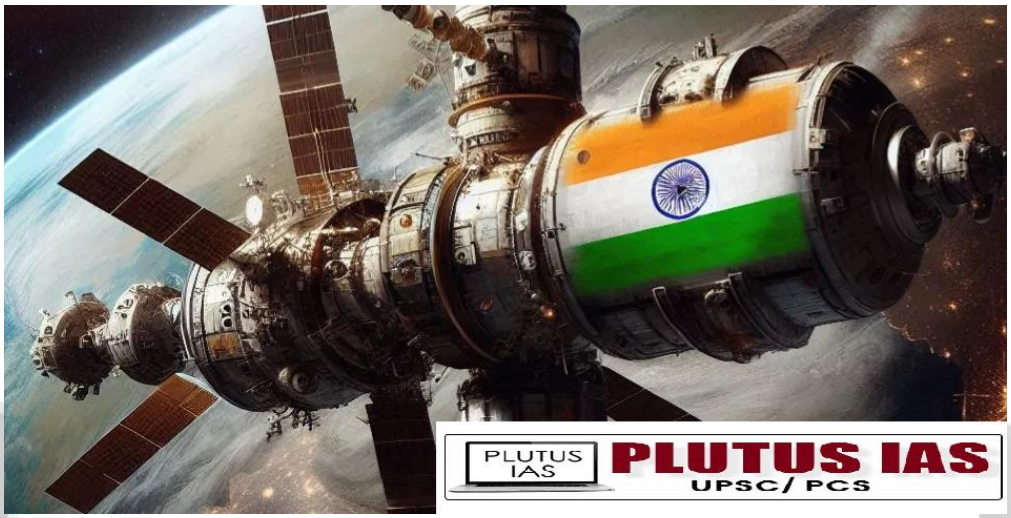
1. **Inspirational Stories** Sharing success stories from space missions and highlighting the contributions of Indian scientists and engineers will inspire future generations to pursue careers in space science and technology. By showcasing the real-world impact of space exploration, ISRO hopes to ignite interest and enthusiasm among young people.

CONCLUSION:

The establishment of the Bharatiya Antariksh Station by 2028 marks a transformative step for India in the realm of space exploration. This ambitious project has the potential to enhance scientific research, technological innovation, and international collaboration, positioning India as a formidable player in the global space community.

As the country prepares to embark on this exciting journey, the successful execution of the BAS will not only elevate India's standing in the field of space exploration but also inspire future generations to reach for the

stars. With the right investments, collaboration, and public support, India is poised to make significant contributions to humanity's understanding of space and its possibilities.



PRELIM QUESTION:

Q. What is one of the primary objectives of the BAS?
A. Conducting military operations
B. Space tourism
C. Scientific research in microgravity
D).Mining asteroids
Answer:C

MAINS QUESTION:

Q. Reflect on the historical context of India's space program and its evolution towards the establishment of a space station.(150wors)

Ritik singh

India's High-Tech Revolution: Driving Global Leadership in Advanced Technology & Manufacturing

This article covers "Daily Current Affairs" and topic details of India's Advancement in technologies and recent advancements.

Syllabus mapping:

GS-3: Science and Technology: Recent advancement in the field of communication and biotechnology and other science domains.

For Prelims:

What are the schemes and related facts? National Quantum Mission, National Semicorn Mission, Green Hydrogen Mission, India AI program, PM—DRIVE Scheme, etc.

For Mains:

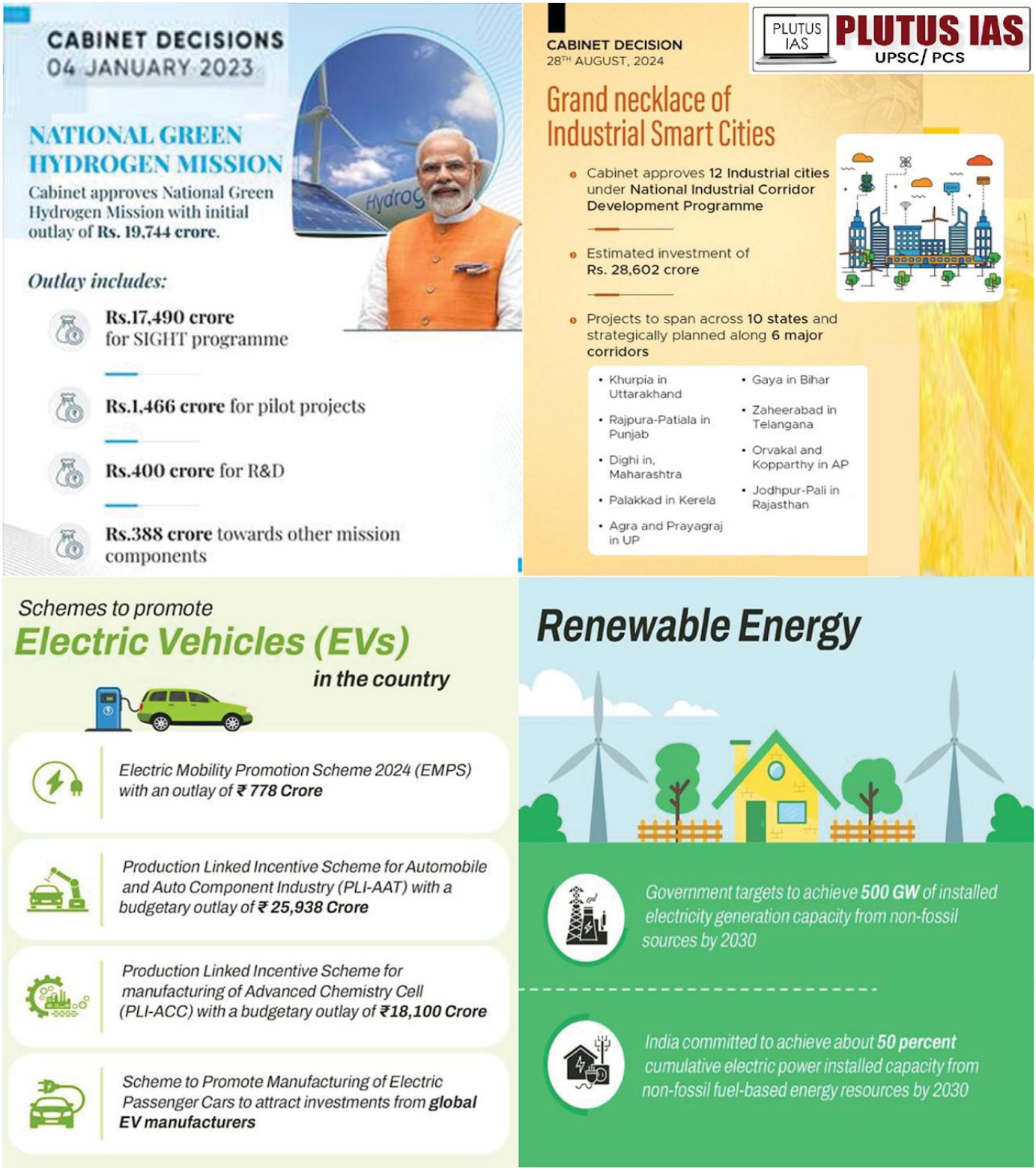
What are the major forces behind the recent advancements in science and technology in India, What are the challenges to making India's science and technology on par with the other developed countries and way forward?

Why in the News?

Recently, the PM of India highlighted the advancement in the science and technology field at the Semicorn India Summit 2024.

Government of India's initiatives in recent times for the advancement of science and technology:

WISE-KIRAN: The Women in Science and Engineering-KIRAN (WISE-KIRAN) initiative aims to promote gender equity in science and technology by providing diverse opportunities for women from various backgrounds.
INSPIRE program: The Innovation in Science Pursuit for Inspired Research (INSPIRE) program seeks to attract talented youth to study basic and natural sciences and pursue research careers, thereby expanding India's research and development base.
VAIBHAV Research Programme: This aims to connect the Indian STEMM diaspora with local institutions to foster research collaborations and innovation.
National Programme on Nano Science and Technology (NPNST): the National Programme on Nano Science and Technology (NPNST) focuses on building capacity in nanoscience research, promoting high-impact innovation, fostering **interdisciplinary collaboration, and enhancing India's global competitiveness in the field of nanotechnology.**



Reasons for the Recent boost in the science and technology Advancement:

1. **The proactive policies of the governments:** The initiatives like National Quantum Mission, and the National Semiconductor mission are examples of the proactive role of the Governments.
2. **Skilled workforce:** Due to the government's positive approach many enthusiastic budding scientists join the hands of the Government.

3. **Role of private players:** Private players are working hand in hand with the government for the advancement of scientific development. For example India's space sector. Recently private startup in Hyderabad launched its small satellite.
4. **The increased allocation of funding to R&D:** In the last decade, The Gross Expenditure on Research and Development (GERD) increased from ₹601,968 million in 2010-11 to ₹1,273,810 million in 2020-21.
5. **Robost of the startup culture:** India has become the third largest startup economy in the world and most startups are in the domain of science and technology.
6. **Global Collaborations**: Partnerships with international research institutions and organizations have facilitated knowledge exchange and access to cutting-edge technologies. India is actively engaging with the International Renewable Energy Agency, and Space institutions to boost the advancement in the science field.
7. **Focus on STEM Education**: The NEP 2020, emphasizes science, technology, engineering, and mathematics (STEM) education has created a skilled workforce equipped to tackle complex challenges.
8. **Digital Transformation**: The rapid adoption of digital technologies has accelerated research processes and enhanced data analysis capabilities. Digital India mission and digital Agriculture mission are boosting g the demand for new technologies.
9. **Emerging Technologies**: Advancements in fields such as artificial intelligence, biotechnology, and nanotechnology have opened new avenues for research and application.
10. **Sustainability Initiatives**: Growing awareness and initiatives focused on sustainability and climate change have spurred research in green technologies and renewable energy.

Amongst the 12 Central Government major scientific agencies, DRDO accounted for the maximum share of 30.7% of R&D expenditure followed by DOS (18.4%), ICAR (12.4%), DAE (11.4%), CSIR (8.2%) and DST (6.8%), DBT (4.4%) and ICMR (3.1%), MeitY (2.2%), MoES (1.5%), MoEFCC (0.8%), and MNRE (0.1%) during 2020–21.

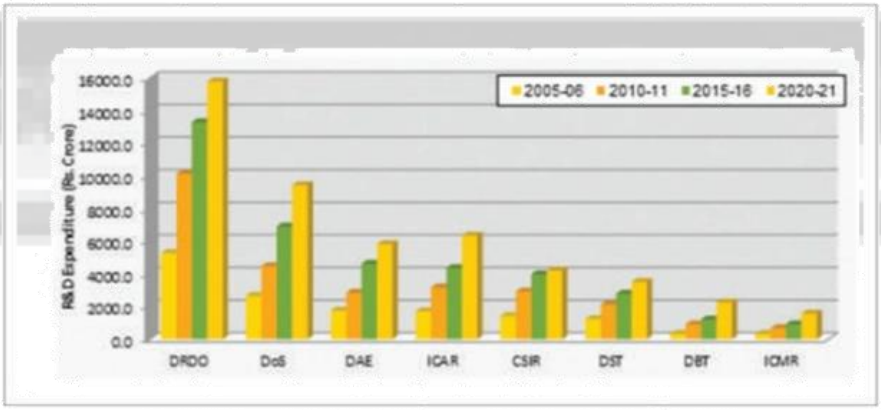


Fig. R&D Expenditure by Select Scientific Agencies

Despite the recent boost, the challenges persist:

1. **Less GERD:** The spending on gross expenditure on research and development is just approx, 1 % of India's GDP compared to China(2%) and the US (3.5 %).
2. **Lack of Formalization of Innovation:** In India, most of the innovations are not patented as compared to China and the US. This limits the impact of innovation on the ground level and social benefits for society as a whole.

3. **Selective domains:** the present focus on innovation and research is majorly concentrated in space technology and communication technology. However, the health sector, education sector, and social welfare sector these sectors do not attract more science funding or support.
4. **Infrastructure Limitations**: Inadequate research facilities and infrastructure hinder the ability to conduct high-quality research and development.
5. **Talent Retention**: There is a brain drain as skilled researchers and professionals often seek opportunities abroad, leading to a loss of talent.
6. **Interdisciplinary Collaboration**: Despite the attempt from the NEP 2020 there is still a Lack of collaboration between different scientific disciplines can limit innovative solutions to complex problems.
7. **Policy Implementation**: Challenges in translating supportive policies into effective action can slow down progress and innovation. This is a clear example in the case of the rare diseases innovation and many other health issues.
8. **Cybersecurity Threats**: As reliance on digital technologies increases, so does the vulnerability to cyberattacks, affecting research data and infrastructure. The recent attack highlighted the vulnerability of the digital public infrastructure.
9. **Dependency on imports**: India's most scientific advancement depends on imported raw materials and this is not sustainable for the long term, especially in the context of the border conflict with China and, the PAGER attack in Lebanon.
10. **Equity in Access**: Ensuring that advancements in science and technology are accessible to all regions and demographics is essential but challenging.

Solutions to make scientific development for we the people of India

1. **Robust Government Support**: The Indian government has significantly increased its funding and support for research and development, with allocations exceeding ₹1,00,000 crore in recent budgets for science and technology initiatives.
2. **International Partnerships**: Collaborations with global tech giants and research institutions will facilitate technology transfer and knowledge sharing, enhancing India's capabilities in key sectors such as artificial intelligence and biotechnology.
3. **Strategic Investments**: Focused investments in emerging areas like electric vehicles and renewable energy would pave the way for sustainable growth. For instance, India aims to have 30% electric vehicle penetration by 2030, which will require substantial innovation and infrastructure development.
4. **Electronics Manufacturing**: The government's **Production-Linked Incentive (PLI)** scheme aims to boost electronics manufacturing, with an investment target of ₹75,000 crore to attract global manufacturers and promote local production. The major domain for scientific advancement will need special attention and support.
5. **Innovation-Driven Ecosystem**: innovations need to be further boosted such as India's start-up ecosystem has been thriving, with over 60,000 start-ups and a valuation exceeding $200 billion as of 2023, fostering innovation across various sectors.
6. **Reducing Import Dependency**: By enhancing domestic manufacturing capabilities, India is striving to reduce its reliance on imports, particularly in critical areas such as semiconductors, where the government has launched a ₹76,000 crore initiative to boost local production.
7. **Nurturing Home-Grown Talent**: Initiatives like the **Skill India Mission** aim to equip the workforce with the necessary skills, targeting over 400 million individuals by 2022 to meet the demands of the evolving tech landscape.
8. **Advancements in New-Age Technologies**: India is making strides in cutting-edge technologies such as 5G, IoT, and AI, with investments expected to reach $20 billion in AI alone by 2025.

9. **Long-Term Growth and Increased Exports**: With a target to reach $1 trillion in manufacturing output by 2025, India is positioning itself as a key player in global supply chains, enhancing its export capabilities.
10. **Job Creation**: The focus on expanding manufacturing and technology sectors is projected to create millions of new jobs, contributing to economic growth and stability.

Conclusion:

The recent advancement in scientific development is commendable and it helps India to achieve many milestones like internet connectivity in villages, renewable energy targets, etc. The need is to address the dependency, equity, and infrastructure challenges through a public-private partnership, equitable distribution of resources, and nurturing the scientific temper. The main objective make India a developed country by 2047 and scientific development is a major pillar in this journey the need is to harness its potential.

Prelims Question:

Q. Consider the following Constitutional provisions:

1. Fundamental Rights
2. Directive Principles of State Policies
3. Fundamental Duties
4. Preamble

How many of the above provisions explicitly mention science and related topics?

A. Only one
B. Only two
C. Only three
D. All four

ANSWER: B

Mains Question:

Discuss the recent advancement in the field of science and technology in India, and mention its challenges and how these developments would help to make India a developed country by 2047?

Munde Dhananjay Navnath