

OCTOBER 2021

YOJANA SUMMARY

AN INITIATIVE BY THE PRAYAS INDIA

THE PRAYAS IAS





Summary of Yojana

October 2021

Theme: Science and Technology

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India's Response to COVID-19

Introduction

- Mission COVID Suraksha – The Indian Covid-19 Vaccine Development Mission' was launched under the Atmanirbhar Bharat 3.0 package.
- Five vaccine candidates are in advanced development including
 - DNA Vaccine (ZyCoV-D)
 - mRNA vaccine candidate (HGCO-19)
 - Adjuvanted-protein subunit based vaccine candidate (Corbevax) by Biological E
 - Intranasal vaccine candidate (BBV 154)
 - VLP vaccine candidate
- ZyCoV-D is the world's first Covid-10 DNA vaccine, developed by Zydus Cadila.

Strengthening Vaccine Development Ecosystem

- Efforts to strengthen the vaccine development ecosystem have been undertaken under focused Missions of the Department.
- Fifty-four clinical trial sites, across India, consisting of a network of public and private hospitals, clinics, and reputed academic institutions are facilitating vaccine clinical trials.
- Each site has access to a cohort of about 50000 to 100000 healthy volunteers, who can be tracked for prolonged periods.
- These sites are equipped with harmonized systems for GCP compliance, electronic data capture on a central platform, robust disease registry for capturing patient data on clinical presentation, treatment, and outcome.
- Facilities of animal challenge studies and immunoassay laboratories are being supported to accelerate pre-clinical development of the vaccine candidates.

Upgradation of DBTs Laboratories as Central Drug Laboratories (CDLs)



- Considering the need for enhanced batch testing of vaccines, two DBT Autonomous Institutes – National Institute of Animal Biotechnology, Hyderabad and National Centre for Cell Science, Pune have been identified for upgradation as Central Drug Laboratories for vaccine testing.

PACT (Partnerships for Accelerating Clinical Trials) Initiative

- The PACT programme, a science diplomacy initiative of the Department of Biotechnology, in close partnership with the Ministry of External Affairs is aimed at advancing vaccine development activities in neighbouring countries and conducting training programmes to strengthen clinical trial capacity in those country.

COVID Diagnostics and Testing

- DBT has identified 21 city/ regional clusters to scale up Covid testing as a part of the Hub and Spoke model.
- The first infectious disease mobile laboratory (I-Lab) was developed and deployed for Covid testing in inaccessible areas.
- More than 300 Indian manufacturers are registered under the National Biomedical Resource Indigenisation Consortium, constituted by DBT for the manufacturing of nearly 15 major molecular biology components/ reagents.

COVID Genomics

- Pan-India 1000 SARS-CoV-2 RNA genome sequencing consortium has successfully completed the initial goal of sequencing of 1000 SARS-CoV-2 genomes in a record time of few months
- Subsequently, to monitor the emergence and community circulation of viral variants and variants of concern the Indian SARS-CoV-2 Genomics Consortium (INSACOG) was established with an aim to sequence SARS-CoV-2 from Covid-19 infections occurring in India.
- INSACOG partner institutions have sequenced 70420 samples.
- To date, 46404 viral genome sequences from India have been shared in the global repository of sequences called GISAID.
- Of these 35,014 are shared with INSACOG Tag in GISAID.



Therapeutics and Biorepositories

- DBT-BIRAC supported anti-viral drug – Virafin (pegylated interferon alpha-2b) – developed by Zydus Cadila, has recently been accorded restricted emergency use approval.
- Phase II clinical trials of AQCH, the first phytopharmaceutical drug approved for clinical trial by DCGI for Covid-19, developed by DBT-ICGEB and Sun Pharma are underway.
- DBT-BIRAC supported Eystem Research Pvt. Ltd has developed human iPSC-derived lung airway and alveolar epithelial cells for disease modelling and for testing potential therapeutics against Covid-19.

Redefining Science Communication

Introduction

- For the scientists it has become important to keep the society timely aware of the developments they make in their fields of research. This is called Scientific Social Responsibility. (SSR)
- This is critical for any society and country to move further.
- Its citizens need to be duly aware of the scientific and technological developments and possess the much-needed scientific temperament.
- Adhering to the constitutional mandate of nurturing and inculcating a scientific temperament and promoting rational outlook, Vigyan Prasar, with SCoPE (Science Communication, Popularisation, and Extension) as its mandate, has been active on every possible communications platform from print to electronic to digital social media.

Foray into Electronic Media

- Vigyan Prasar, since its inception, has been utilizing visual rhetoric, the most effective mode, to make scientific awareness and rational knowledge accessible to all.
- Leveraging on the far-reaching effect of social media, Vigyan Prasar's programmes can be accessed through multiple platforms.



Popularising Science in Indian languages

- Vigyan Bhasha is VP's systematic approach to expanding science communication through Indian languages.
- The programme includes monthly newsletters, popular science books, translations, social media initiatives, films, state-level meets of science communicators, and training workshops and exhibitions in various languages.
- VP brings out publications in English and Hindi as well as in other Indian languages.

Facilitating the News World

- The news services, Indian Science News and Feature Service and India Science Wire highlight the success and progress in science and technology in India through its daily news distribution to about 500 media outlets.
- Vigyan Prasar has been continuously organizing training workshops for scientists, and masterclasses for short film making at all possible levels so that print-electronic and social media can use it easily and help spread the word of science and technology in the country.

Science Film Festivals

- VP's flagship events – International Science Film Festival of India and National Science Film Festival of India – attract talented young filmmakers and science enthusiasts.

SCoPE through Radio, Network Clubs and Research

- Ever since 2018, Vigyan Prasar has produced programmes in 19 languages and broadcast from more than 117 stations of All India Radio (AIR).
- One of VP's niche activities is inculcating science communication/ popularization through a network of science clubs (VIPNET) in schools.
 - It provides skill upgradation training, awareness camps, and hands on science workshops throughout the country.



- The project Augmenting Writing Skills for Articulating Research (AWSAR), encourages PhD and post doctoral scholars in science and technology streams to write popular science articles during their scholarship/ fellowship programme, which are later published as a book.
- Vigyan Prasar is a partner in India's most extensive talent search examination, VVM (Vidyarthi Vigyan Manthan) for the New India initiative using only digital devices.
- Engage with Science is an interactive platform aimed at school teachers and students to make science teaching and learning a lot of fun by deploying gamification tools and an incentive-driven competitive process.
- VP has been organizing various programmes through EDUSAT for maths popularization, workshops, Ramanujan Yatra 2020, and Pi Day every year.

Geomagnetism : Applications

- The magnetic field, since it originates inside the earth and travels through its different constituents and materials turns into a handy tool to peer inside and examine it.
- The antiquity of the Indian Institute of Geomagnetism (IIG) goes back to almost two centuries and it is a force to reckon within the field of geomagnetism and allied research areas.
- Geomagnetism is a global phenomena and hence it cannot be understood in isolation or locally.
- The solar magnetism impacts celestial entities which include earth as well.
- The energetic particles emanating from the sun influence earth's magnetosphere, ionosphere, mesosphere, and thermosphere.
- Solar flares, coronal mass ejections, high-speed solar wind, and solar energetic particles are the manifestation of dynamic flux.
- The earth is also magnetic and the genesis of this field is theorized, modeled and simulated to be at the core-mantle boundary.
- The field line traverse through different earth layers to protectively blanket our planet. This is the shield that stops and deflects harmful radiation. Life and electrical communication are thus maintained and sustained.



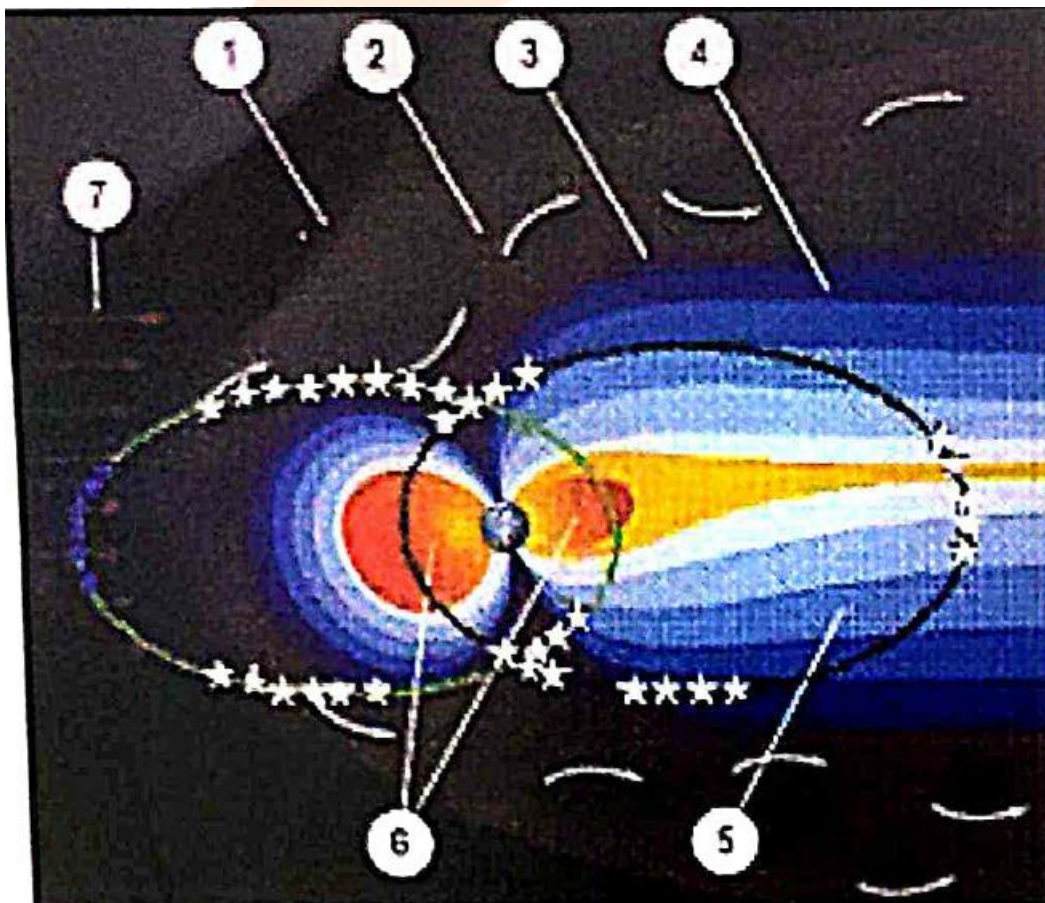
- The interaction of these charged particles with the atmospheric constituents creates aurorae at the polar regions.
 - These ‘curtains of light’ are especially more active and prominent when a magnetic storm hits the earth.



- Solar wind emanates and flows continuously throughout the space in all directions.
- The complex interplay of heat and energy at the surface of the sun and its atmosphere creates a temperature dichotomy.
- The waves and particles that originate at the solar domain travel outwards at incredible speeds. To tackle this diaphanous domain, an eclectic approach is pursued to unravel complex forces that include gravity waves, infrared rays, ultraviolet radiation and other perturbations, along with high altitude winds that blow ions (charged atoms) across the earth’s magnetic field by creating a dynamo.
- All these forces cause collisions between neutral and charged particles, enabling them to exchange charge, to transfer energy and momentum amongst them.



- It is now dawning on the experts that solar energy fluctuations can have an impact on the temperature dynamics of the earth.
- The atmospheric tides are global scale variations in wind, temperature, and pressure, tied to solar input.
- They occur throughout the atmosphere on a regular basis and are seen once or twice daily with smaller tides at more frequent intervals.
- The tides move westward with the sun, driven by solar radiation, its absorption, and re-emission at various heights.
- These processes are active even when the sun is 'inactive' or quiet. But there is a crescendo of events when there is a solar 'storm'.
- The cataclysmic burst of charged particles and radiation completely rearranges global thermospheric circulation in a matter of hours.



- The ionosphere and magnetosphere are a closely coupled system that channels energy and momentum from the solar wind to the upper atmosphere.



- A number of coupled current systems flow in these regions of highly conducting plasmas. These currents are responsible for most of the temporal changes in the geomagnetic field that occur on timescales of seconds to days, including magnetic pulsations.
- Plasma encountered in the earth's as well as other planetary magnetospheres, are generally far from their thermodynamic equilibrium states, and hence contain some amount of free energy.
- These free energy sources can generate several kinds of plasma modes in the magnetospheric boundary layers such as magnetopause boundary layer, polar cap boundary layer etc.
- Magnetic mineral also tell us about continental migration. Before the era of GPS, paleomagnetism was the only reliable and accurate technique to understand the direction and quantum of plate movement.
- The concept of polar wandering and magnetic reversal baffled the geoscientists. The realisation of the presence of magnetic banding in the oceans ultimately led to the formulation of the concept of plate tectonics and seafloor spreading.
- It revolutionized the way scientists thought about investigating natural resources.
- The plate boundaries and faulting zones were found to be the ideal candidates for mineralization.
- Palaeomagnetism tied all the diverse and distant plates with the grand continent, Pangaea and its later subsidiaries like Gondwanaland and Laurasia.
- The dynamo that generates the magnetic field of the earth and how it operates is now fairly known and clear. The reversals that are generated are recorded in the rocks and sediment containing magnetic minerals.
- These polarity reversals and the 'normal' polarity of the earth are used as a relative timescale to magnetically date the rocks and sediments.
- The other geophysical techniques like gravity, electricity, seismicity and GPS have shed light on many unknown aspects of the crust and mantle.

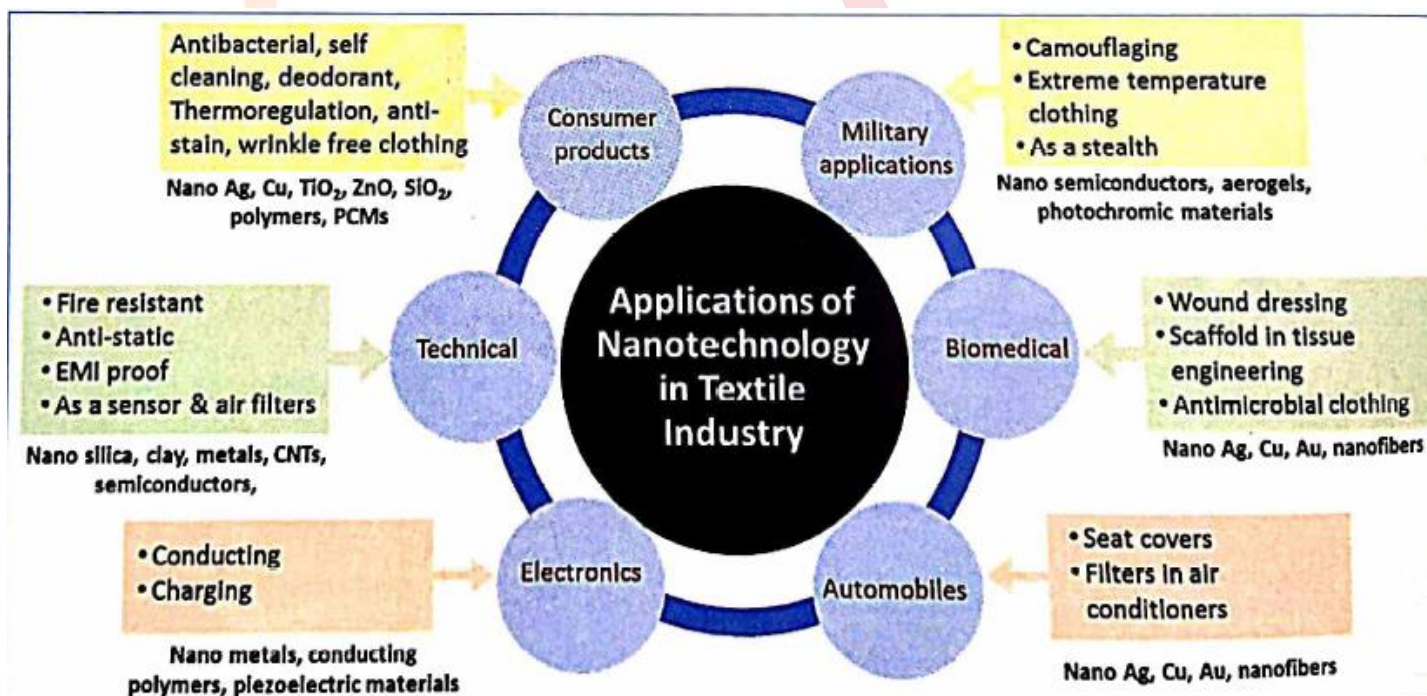
Conclusion

- Geomagnetism or earth magnetism is an ever changing entity, because of which it has to be monitored and recorded continuously.
- It is vital research in the field of scientific technology, allowing us to get more familiar with our planet and the solar system.

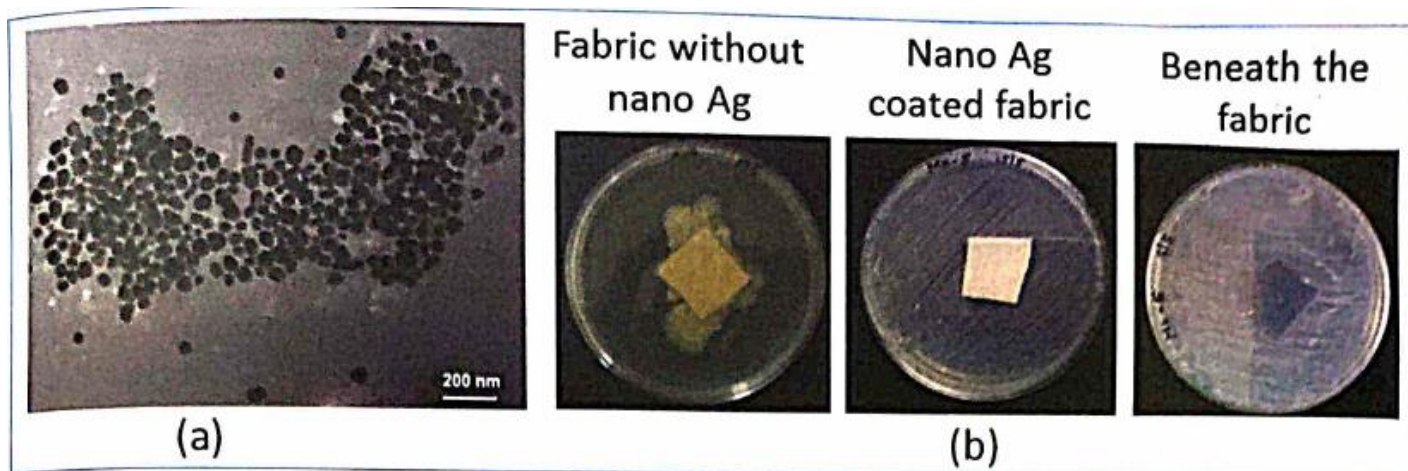


Nanotechnology in Textiles

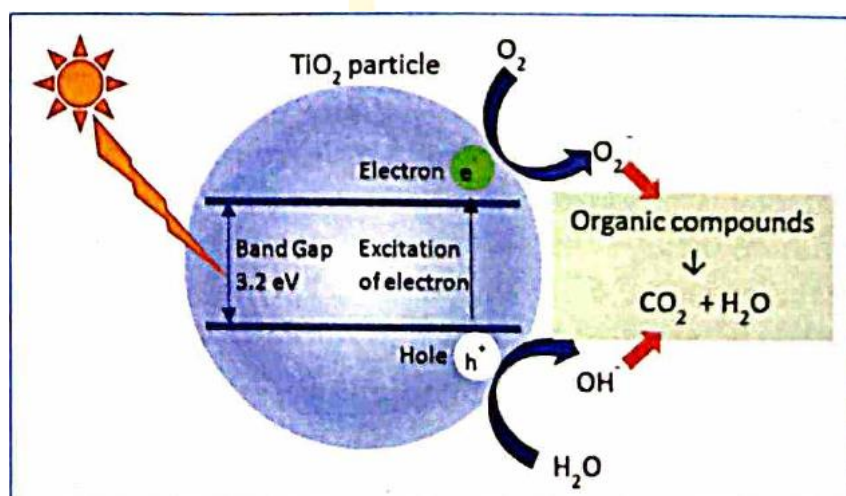
- Although the primary function of clothing is protection and aesthetics, our changing lifestyle, pollution, environmental conditions, and unexpected challenges such as the Covid-19 pandemic has led us to new requirements in the apparel industry, for instance added comfort, thermoregulation, hygiene, protection from UV light, fire, pathogens, electromagnetic field, etc.



- International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) has developed a nanosilver-based suspension that can be applied on the fabric surface to get antibacterial activity.
- Nano silver uses the same scientific principle as the one that lies in our tradition to drink water stored in copper and silver vessels, where the ions of these metals, released in water, kill micro-organisms and make it safe for drinking.
- The antimicrobial textiles are most essential in the medical sector, especially in the present deadly pandemic conditions, for eg, in curtains, bed covers, face masks, etc.
- It can also serve for the best hygiene in sportswear, baby products, sanitary napkins, wound healing dressings etc.



- Other compounds such as zinc, copper and their oxides coupled with metal nanoparticles can also be used as antibacterial agents.
- Titanium dioxide (TiO_2) is another strong antimicrobial material that conducts the phenomenon known as “Photocatalysis”.
 - In simple words, the active Titanium dioxide, a semiconductor material:
 - Absorbs ultraviolet rays in sunlight equivalent to its energy bandgap in presence of little moisture in the air
 - Creates highly reactive radicals, which degrade most of the organic pollutants, including germs, in its contact.
 - Keeps the surface and surroundings clean.
 - The highest efficiency of photocatalysis is achieved by engineering the bandgap and by surface functionalization of metal nanoparticles.
 - Thus, any surface coated with TiO_2 gets self cleaned when exposed to sunlight.





- A thin coating of nanofibres on the fabric used in air filters for air conditioners and automobiles exhaust, stops ultra fine particles thereby increasing the efficiency of the filters.
 - Electro-spinning technique has been used to produce these air filters.
- There are several other needs for everyday clothing such as thermoregulation, where fabric responds to changes in the body temperature and maintains comfort by either heating or cooling.
 - The Phase Change Material (PCM) is incorporated into fabric to fulfill this function.
 - The PCM stores and releases heat by self-undergoing a change in its phase.
- There is another class of textiles called technical textiles, which are used in special applications.
 - For eg., fireproof and flame retardant fabric is required in the suit used by firefighters. The high temperature stable materials are combined with thermally insulating and fireproof materials such as nanoporous silica aerogel for this application.
 - The silica aerogels are ultra low density nanoporous materials, best known for their thermal insulation performance in the temperature ranging from cryo to 800 degree C.
- Other examples of technical textiles include functions like electromagnetic field shielding, electrical conducting, anti-static, camouflaging, stealth, water repellency, and so on.
- The nanomaterials can be applied to the fabric at various levels, at the fiber or yarn stage, during the spinning or weaving process, or directly on the fabric.

Conclusion

- Nanotechnology has great potential in the textile industry. Functional and smart textiles can play an important role in the economy of the nation.
- However, there are limitations in the applications due to the scientific complexity and the cost adhered to it.
- A proper study is necessary to find any toxic effects of handling or wearing the nanomaterials to eliminate any health risks due to short or long-time exposure.
- For example, nanosilver application on textiles was studied for leaching of silver in water while washing the fabric, and it achieved its concentration within safe limits.
- Before launching the technology commercially, it was confirmed that the technology is environment-friendly.



Science Education

INSPIRE Programme and MANAK Scheme

- Innovation in Science Pursuit for Inspired Research (INSPIRE) programme is one of the flagship programmes of DST and implemented by National Innovation Foundation to encourage students to pursue science as a career.
- INSPIRE aims to communicate to the youth population of the country the excitements of creative pursuit of science, attract talent to the study of science at an early age and build the required critical human resource pool for strengthening and expanding the S&T system and R&D base.
- INSPIRE Scheme has included three programmes:
 - Scheme for Early Attraction of Talents for Science (SEATS)
 - Scholarship for Higher Education (SHE)
 - Assured Opportunity for Research Careers (AORC)
- The INSPIRE Awards – MANAK (Million Minds Augmenting National Aspirations and Knowledge) Scheme, being executed by DST with NIF – India, aims to motivate students in the age group of 10-15 years and studying in classes 6-10.
 - Under this, schools can nominate the five best original ideas/innovations of students by mid-October, every year.

Vigyan Jyoti and Engage with Science

- The DST is scaling up its two initiatives – Vigyan Jyoti and Engage with Science. Both the programmes are mandated to create a level-playing field for the meritorious girls in high school to pursue Science, Technology, Engineering, and Mathematics (STEM) in their higher education.
- Vigyan Jyoti is a programme to promote STEM learning among girl students from grades 9 to 12 to pursue STEM in their higher education, especially from the top colleges in the areas where girls are hugely underrepresented.
 - The initiative focuses on solving the multidimensional problems associated with the meager representation of women in the Engineering and Technology streams in higher education, by building confidence and excitement towards these streams.



- Engage with Science has been planned to make learning relevant and foster scientific spirit amongst the country's youth.

Vidyarthi Vigyan Manthan Programme

- It is a national programme for popularizing science among school students of standard VI to XI, conceptualized to identify the bright minds with a scientific aptitude among the student community.
- With objectives to create an interest among students in science, VVM programme educates school children about India's contributions, from traditional to modern, to the world of science and technology and provides hands-on training to students through workshops and other events.

Kishore Vaigyanik Protsahan Yojana

- It is a flagship programme of the DST, implemented by the Indian Institute of Science (IISc), Bangalore to encourage students who are studying Basic Sciences to take up a research career in science.

National Children's Science Congress

- It is a nationwide Science Communication programme of the National Council for Science and Technology Communication, DST.
- It is available to children in the age group between 10-17 years. It prompts children to think of some significant societal problems, ponder over its causes and subsequently try and solve the same using the scientific process.

Science Clubs

- VIPNET an acronym for VIGyan PrasAr NETwork of Science Clubs, weaves all science clubs, societies, organisations which are already established or are going to be established and are willing to work for science communication, to strengthen the popular science movement in the country with far-reaching implications for the development of society.



JIGYASA Programme

- The CSIR has launched a student-scientist connect programme JIGYASA in collaboration with Kendriya Vidyalaya Sangathan with the primary objectives of extending the classroom education and focusing on well-planned research laboratory-based learning.
 - It is planned to inculcate the culture of inquisitiveness along with the scientific temper amongst the school students and their teachers.

Conclusion

- Along with these innovative programmes, the Govt of India has launched Atal Innovation Mission (AIM) to create and promote a culture of innovation and entrepreneurship across the country to adopt a holistic approach, encompassing schools, universities, research institutions, industry, etc.
- With many student centric programmes on S & T the launch of NEP will develop a scientific attitude in children and pave the way for the creation of New India.