VISIONIAS
INSPIRING INNOVATION

SCIENCE & TECHNOLOGY

Classroom Study Material

(May 2020 to January 2021)

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SCIENCE AND TECHNOLOGY

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Note:

PT 365 documents comprehensively cover the important current affairs of last 1 year (365days) in a consolidated manner to aid Prelims preparation.

In our endeavour to further enhance the document in the interest of the aspirants, following additions have been incorporated:

1. Different colours have been used in the document for easy classification and recollection of a variety of information.
2. QR based Smart quiz has been added to test the aspirant's learnings and understanding.
3. Infographics have been added to ease understanding, provide for smoother learning experience and ensure enhanced retention of the content.

QUIZ **SMART QUIZ**	You can scan this QR code to practice the smart quiz at our open test online platform for testing your understanding and recalling of the concepts.	

1. BIOTECHNOLOGY

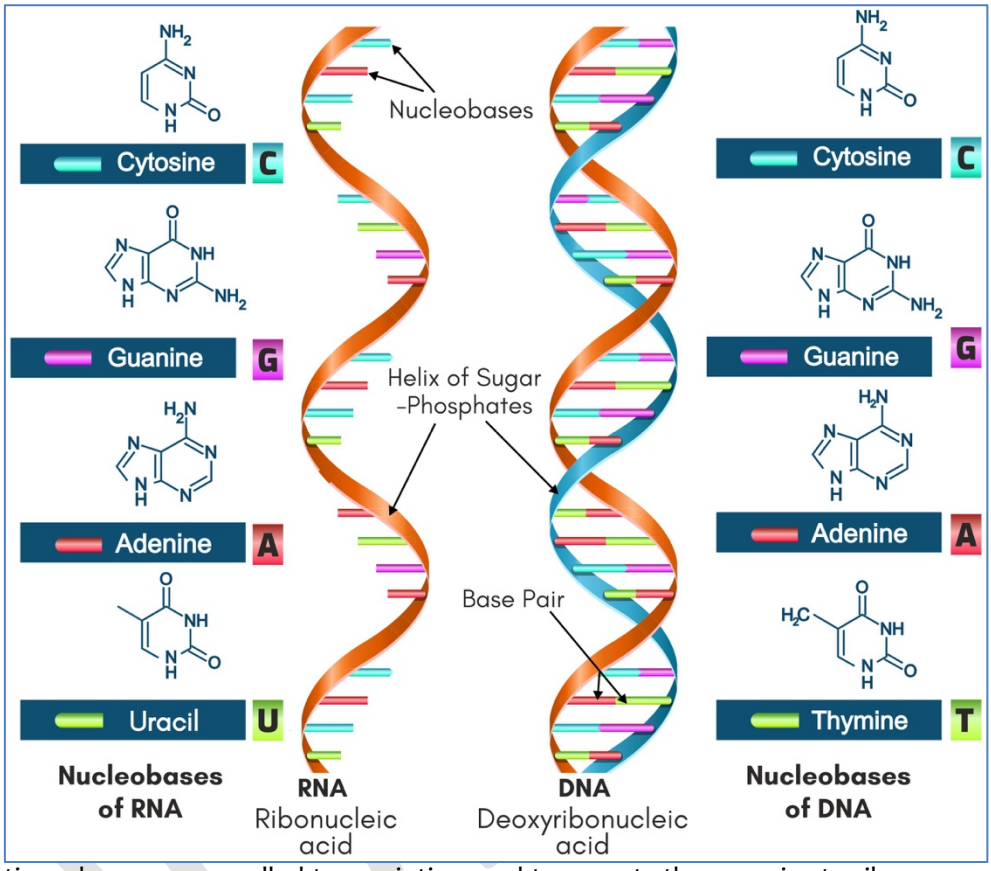
1.1. DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL, 2019

Why in News?

Parliamentary Standing Committee on Science and Technology has expressed concerns over some of the provisions of The **DNA Technology (Use and Application) Regulation Bill, 2019.**

About Deoxyribonucleic Acid (DNA) & Ribonucleic Acid (RNA)

They are two main **types of nucleic acids** responsible for the storage and reading of genetic information.



- **Three types of RNA**
  - **Messenger RNA (mRNA)** copies portions of genetic code, a process called transcription, and transports these copies to ribosomes, which are the cellular factories that facilitate the production of proteins from this code.
  - **Transfer RNA (tRNA)** is responsible for bringing amino acids, basic protein building blocks, to these protein factories, in response to the coded instructions introduced by the mRNA. This protein-building process is called translation.
  - **Ribosomal RNA (rRNA)** is a component of the ribosome factory itself without which protein production would not occur.

Ribonucleic Acid (RNA)	Deoxyribonucleic Acid (DNA)
• RNA **converts the genetic information contained within DNA** to a format used to build proteins, and then moves it to ribosomal protein factories.	• DNA **replicates and stores genetic information.** It is a blueprint for all genetic information contained within an organism. • It is a hereditary material in human and almost all other organisms.
• **RNA only has one strand,** but like DNA, is made up of nucleotides.	• **DNA consists of two strands,** arranged in a double helix.
• **RNA contains ribose sugar molecules,** without the hydroxyl modifications of deoxyribose.	• **The sugar in DNA is deoxyribose,** which contains one less hydroxyl group than RNA's ribose.
• RNA shares Adenine ('A'), Guanine ('G') and Cytosine ('C') with DNA, but contains Uracil ('U') rather than Thymine.	• The bases in DNA are Adenine ('A'), Thymine ('T'), Guanine ('G') and Cytosine ('C').
• **RNA forms in the nucleolus,** and then moves to specialised regions of the cytoplasm depending on the type of RNA formed.	• **DNA is found in the nucleus,** with a small amount of DNA also present in mitochondria.
• **RNA is more resistant** to damage from UV light than DNA.	• DNA is vulnerable to damage by ultraviolet light.

Key provisions of the Bill

- **Regulation of use of DNA technology** for establishing the identity of certain persons including offenders, victims, suspects and undertrials.

- **DNA testing is allowed only in respect of matters listed in the Schedule to the Bill** like offences under Indian Penal Code 1860, civil matters such as paternity suits, for establishment of individual identity etc.
- **Consent for collection of DNA** will be required as per provisions of the bill.
- **Establishment of a National DNA Data Bank,** Regional DNA Data Banks and also a DNA regulatory board.

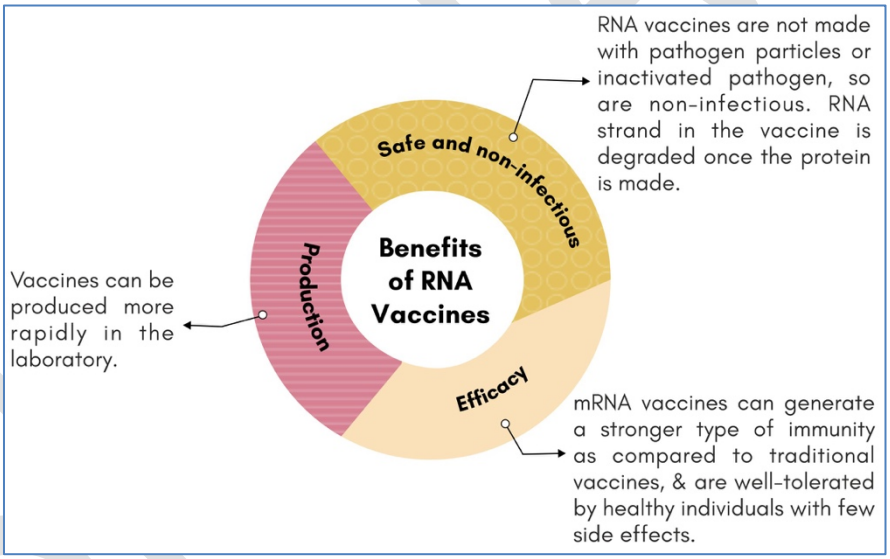
POTENTIAL BENEFITS OF DNA TECHNOLOGY

JUSTICE DELIVERY	HEALTH	AGRICULTURE	INDUSTRIES	OTHERS
• **Apprehend repeat offenders for heinous crimes** such as rape and murder. • **Expedite delivery of justice** by reducing wrongful convictions and enhancing accuracy of investigating authorities.	• **To help diagnose genetic diseases** such as sickle-cell disease, **new vaccine development.** • **To identify pathogens, identify biological remains** in archaeological digs, **trace disease outbreaks.**	• **To develop genetically transformed plants** which can provide resistance to diseases, insects and pests, herbicides, drought etc.	• **For production of chemical compounds of commercial importance,** production of proteins from wastes etc.	• **Identifying missing persons, unidentified deceased persons,** identifying migration patterns etc.

1.2. MRNA VACCINE

Why in news?

Recently, India's first indigenous mRNA vaccine got Drugs Controller General of India (DCGI) nod for human trial



About mRNA vaccine

- Unlike a normal vaccine, RNA vaccines **work by introducing an mRNA sequence which is coded for a disease specific antigen.** Once produced within the body, the antigen is recognised by the immune system, preparing it to fight the real thing.
- **mRNA vaccines teach our cells how to make a protein** that triggers an immune response inside our bodies. That immune response, which produces antibodies, is what protects us from getting infected if the real virus enters our bodies.
- **mRNA vaccines can be delivered using a number of methods,** via needle-syringe injections or needle-free into the skin, injection into the blood, muscle, lymph node or directly into organs; or via a nasal spray.
- There are **different types of mRNA vaccine** like Non-replicating mRNA, In vivo self-replicating mRNA, In vitro dendritic cell non-replicating mRNA vaccine etc.

Conventional Vaccines	Gene based Vaccines
• Includes **live attenuated vaccines, inactivated pathogens** (also known as "killed vaccines"), viral-vectored vaccines, and other types known as subunit, toxoid and conjugate vaccines. • It **exposes the body to proteins made by a virus or bacteria**, are often made by using weakened or inactive versions of that virus or bacteria. • Traditional vaccines **require refrigeration.**	• They contain two types of Vaccine: **DNA and RNA vaccines.** • Instead of injecting a weakened form of a virus or bacteria into the body, DNA and RNA vaccines **use part of the virus' own genes to stimulate an immune response**. In other words, they carry the genetic instructions for the host's cells to make antigens • Both DNA and RNA vaccines **deliver the message to the cell to create the desired protein** so the immune system creates a response against this protein. • They **can be stored at room temperature** and are more stable than conventional vaccines in warm climates "if kept dry and/or sterile at pH8'.

1.3. GM CROPS

Why in News?

Recently, Pune based Agharkar Research Institute, an autonomous institute of Department of Science and Technology, mapped two genes Rht14 and Rht18 in wheat.

About Rht14 and Rht18

- These are **two alternative dwarfing genes in wheat**, associated with **better seedling vigour and longer coleoptiles** (sheath protecting young shoot tip).
- Wheat lines with these genes **can reduce crop residue burning and can allow deeper sowing of wheat seeds** to avail advantage of residual moisture in soil under dry environments.

Related News

Mandatory 'No- genetically-modified (GM)' certificate for food imports

- As per an order of Food Safety and Standards Authority of India (FSSAI), from January 1, 2021 **importers of 24 identified food products will have tomandatorily declare that products are not GM** and that they also have a non-GM origin
  - **24 food crops include** apple, eggplant, maize, wheat, melon, pineapple, papaya, plum, potato, rice, soyabean, sugarbeet, sugarcane, tomato, sweet pepper, squash, flax seed, bean plum, and chicory.
- **GM food imports require approvals under two laws:** Environment Protection Act, 1986 (covers environmental impacts) and Food Safety and Standards Act,2006 (assesses impact on human health).
- After GEAC approval, **FSSAI does the risk assessment** before clearing it for consumption.
- Recently GEAC — giving its greenlight for biosafety research-level-II (BRL-II) **field trials for Event 142,** a new variety of Btbrinjal.

About GM crops

- A GM crop has a **gene artificially inserted into it from another species to give it some desired properties** like – pest resistance, herbicide-tolerance, drought resistance etc.
- **Currently, only GM crop permitted for cultivation in India is Bt Cotton**. But cultivation of illegal GM crops (Brinjal, Soyabean etc) has been reported from across states.
- There is a well **established regulatory framework** for approval of GM Crops as per "Rules for the Manufacture/Use/Import/Export and Storage of Hazardous Microorganisms, Genetically Engineered Organisms or Cells, 1989" under the **Environment (Protection) Act, 1986.**
  - **There are certain concerns regarding GM crops for Human health** (like allergic reaction, gene transfer etc.), **Environment** (like introduction of engineered genes into wild populations, loss of biodiversity etc).
- **GEAC** is the apex body that allows for commercial release of GM crops.

About Genetic Engineering Appraisal Committee (GEAC)

- GEAC established under Ministry of Environment, Forest and Climate Change is the apex body for **approval of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production** from the environmental angle**.**
- The GEAC is also responsible for **approval of proposals relating to release of genetically engineered organisms** and products into the environment including experimental field trials.

1.4. GENOME SEQUENCING

Why in News?

Results of IndiGen programme, the Council of Scientific and Industrial Research's (CSIR) resource, were recently published.

About IndiGen programme

- It aims to **undertake whole genome sequencing of a thousand Indian individuals** representing diverse ethnic groups from India.
- It is **funded by the CSIR India** (autonomous body).
  - CSIR is the largest research and development (R&D) organization in India under Ministry of Science and Technology.
- Its objective is to **create a pilot dataset to enable genetic epidemiology of carrier genetic diseases** towards enabling affordable carrier screening approaches in India.

Related News

- PAN-India 1000 Genome sequencing of SARS-CoV-2 completed successfully
- **Department of Biotechnology** had launched this project in May 2020.
- Sequence data will be released in **Global Initiative on Sharing All Influenza Data (GISAID)** for use by researchers across the Globe.
- This will improve understanding on **how virus is spreading, helping to interrupt transmission chains, prevent new cases** of infection, and provide impetus to research on intervention measures.

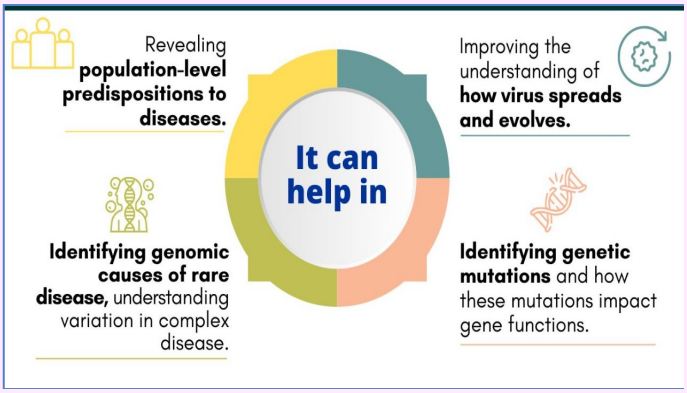
- It is also seen as a **precursor to a much larger exercise to map** a larger swathe of the population in the country.
- Now, CSIR has announced the **conclusion of 'Whole Genome Sequencing"** of 1,008 Indians from different populations across the country. It was found that:
  - **32% of genetic variations in Indian genome sequences are unique** as compared to global genomes.
  - The computational analysis led to the identification of 55,898,122 single nucleotide variants in the India genome dataset.

Significance of the 'Indigen Project'

- **Understanding the Indian genome variation:** This could help in:
  - **Understanding the epidemiology of genetic diseases** to enable cost effective genetic tests.
  - **Carrier screening** (determining chances of having a child with genetic disorders) applications for expectant couples.
  - **Pharmacogenetic** (study of how genes affect a person's response to drugs) tests to prevent adverse drug reactions.
  - **Understanding the genetic diversity** on a population scale.
  - Making **genetic variant frequencies** available for clinical applications.
- **Understanding genomes:** Study of the entire genome sequence will help scientists understand how the genome as a whole works.

About Genome sequencing

- A genome is an **organism's complete set of DNA.** It includes all chromosomes, which houses the DNA, and genes.
- Each genome contains all of the information needed to build and maintain that organism.
- The genome can be understood through the process described as sequencing.
- **Genome sequencing** means deciphering the exact order of base pairs in an individual.



Related information

Human Genome Project (HGP)

- It was the international research effort to **determine the DNA sequence of the entire human genome.**
- It began in 1990 and completed in 2003.
- The HGP gave us the **ability, for the first time, to read nature's complete genetic blueprint** for building a human being.
- It was coordinated by the **National Institutes of Health, USA and the Department of Energy, USA.**

Genome India Project

- It is **India's gene-mapping project** that is being described as the "first scratching of the surface of the vast genetic diversity of India".
  - **A genome sequence** spells out the order of each base/nucleotide of the DNA, while **genome mapping** simply identifies a series of landmarks in the DNA.
- It hopes to form a grid after collecting 10,000 samples in the first phase from across India, to arrive at a representative Indian genome
- It was cleared by the **Department of Biotechnology, Ministry of Science and Technology** in Jan, 2020.
- It involves **20 leading institutions** including the Indian Institute of Science in Bengaluru and a few IITs.

1.5. OTHER IMPORTANT NEWS

1.5.1. BIOPESTICIDES

Why in News?

Recently, Institute of Pesticide Formulation Technology, under Ministry of Chemicals and Fertilizers has developed **Bio-Pesticide Formulation for insect control in seed spice crops.**

More on News

- The formulation has **good shelf life, safe to user & environment** and it may be effectively used for controlling different agricultural insects.
  - For controlling losses from the insects, large amounts of synthetic chemical pesticides are used in seeds crops, resulting in higher levels of pesticide residues in seed spices which leads to risks for human health and environment.
- It is based on **entomo-pathogenic fungus Verticillium lecanii**.

About Biopesticides

- Biopesticides are the **formulated form of active ingredients based on microorganisms** such as bacteria, viruses, fungi, nematodes or naturally-occurring substances, including plant extracts and semiochemicals (e.g. insect pheromones).
- **Advantages of using Biopesticides:** less toxic than conventional pesticides, affect only the target pest and closely related organisms (not overall ecosystem), effective in very small quantities and often decompose quickly etc.

TYPES OF BIOPESTICIDES

MICROBES	SUBSTANCES FOUND IN NATURE	PLANT-INCORPORATED PROTECTANTS
Organisms like bacteria and fungi. For example: Bacillus thuringiensis. More targeted in their activity than conventional chemicals.	Include: Plant materials like corn gluten, garlic oil, and black pepper. Insect hormones that regulate mating, molting, and food-finding behaviours. Tend to control pests without killing them.	Genes and proteins, which are introduced into plants by genetic engineering. Allow genetically modified plant to protect itself from pests.

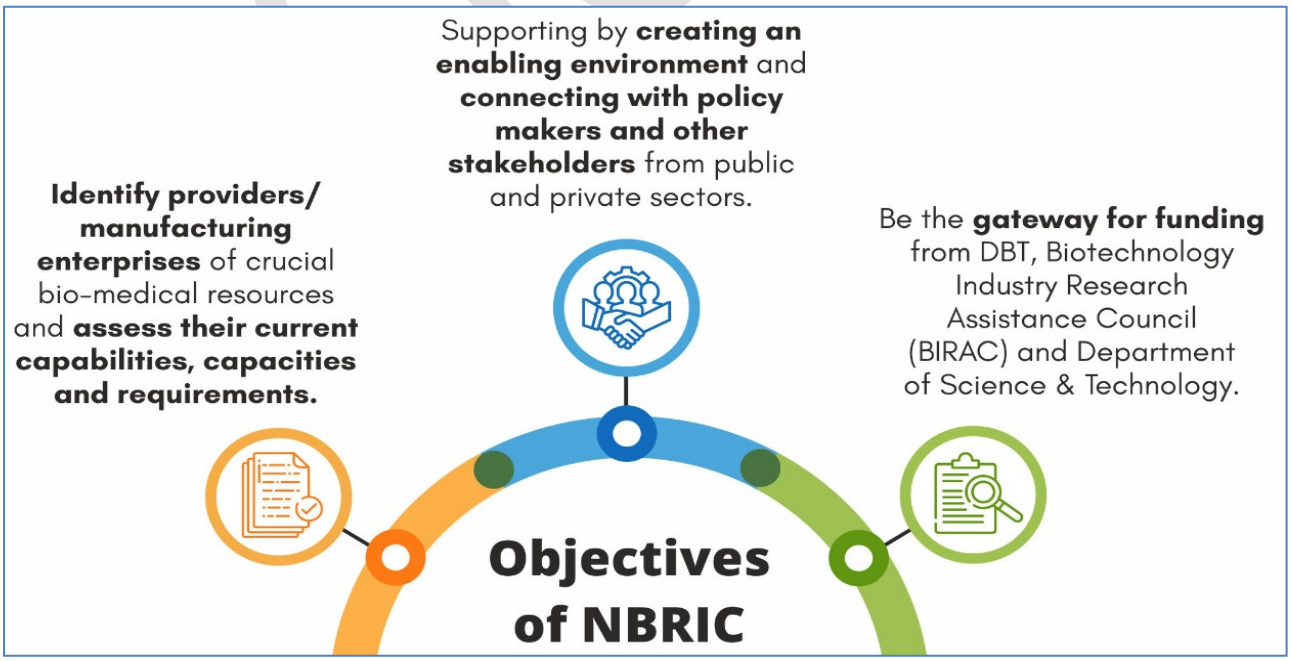
1.5.2. NATIONAL BIOMEDICAL RESOURCE INDIGENIZATION CONSORTIUM (NBRIC)

Why in News?

Recently, NBRIC was **constituted by Department of Biotechnology (DBT),** Ministry of Science and Technology**.**

About NBRIC

- It is hosted and **led by Centre for Cellular and Molecular Platforms.**
- NBRIC aims to be a nation-wide Public Private Partnership for **convergence of research, product resources and services towards developing reagents, diagnostics, vaccines, and therapeutics for COVID-19** across India.
- NBRIC is a **'Make in India' initiative** for Biomedical research and innovative products, to **promote import substitution and exports.**



1.5.3. MISCELLANEOUS

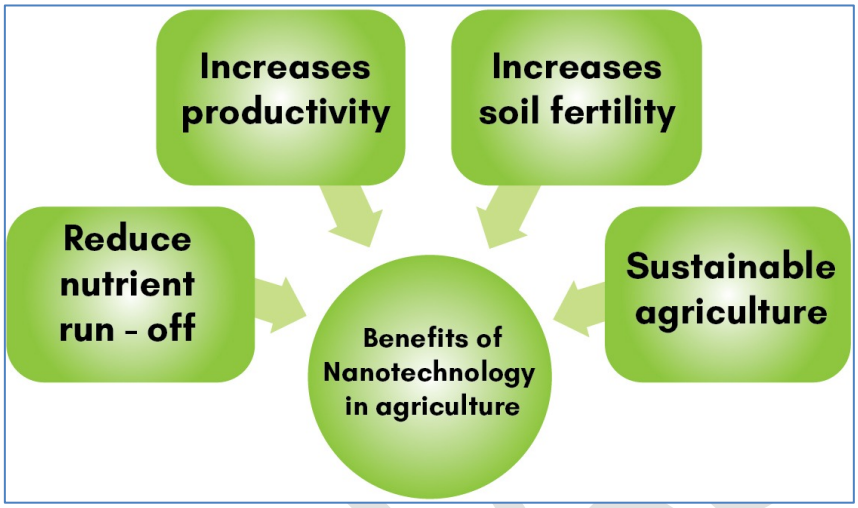
BBX11	• It is a **newly identified gene that facilitates in greening of plants** by regulating levels of protochlorophyllide — an intermediate in the biosynthesis of chlorophyll. • **Synthesis of chlorophyll in plants** is a lengthy, multi-step process. It **is required for growth of plants.** • In order to facilitate the quick synthesis of chlorophyll, **plants make a precursor of chlorophyll called 'protochlorophyllide' in the dark,** which glows red when blue light is shone on the plant. o As soon as the plant comes out into the light from under the soil, **light-dependent enzymes convert protochlorophyllide to chlorophyll.**
Centre for Biopharma Analysis (CBA)at Pune	• It was launched by Department of Biotechnology (DBT) to **provide high-quality analytical services** for biopharmaceutical developers and manufacturers. • It is designed to cater to all academics, medicine developers across India to **fast track the development of vaccines, drugs, diagnostic** and other bio-pharma products • It is **funded by DBT under the National Biopharma Mission** (NBM). o NBM aims to **make India a hub for design and development** of novel, affordable and effective **biopharmaceutical products.** o It is **jointly funded** by the **Government of India and the World Bank** in equal measure. o **BIRAC** under DBT is the **implementation partner.**

2. NANO TECHNOLOGY

2.1. NANO TECHNOLOGY IN AGRICULTURE

Why in News?

Recently centre has released **'Guidelines for Evaluation of Nano-based Agri-input and food products'** in India.



Nanotechnology in Agriculture

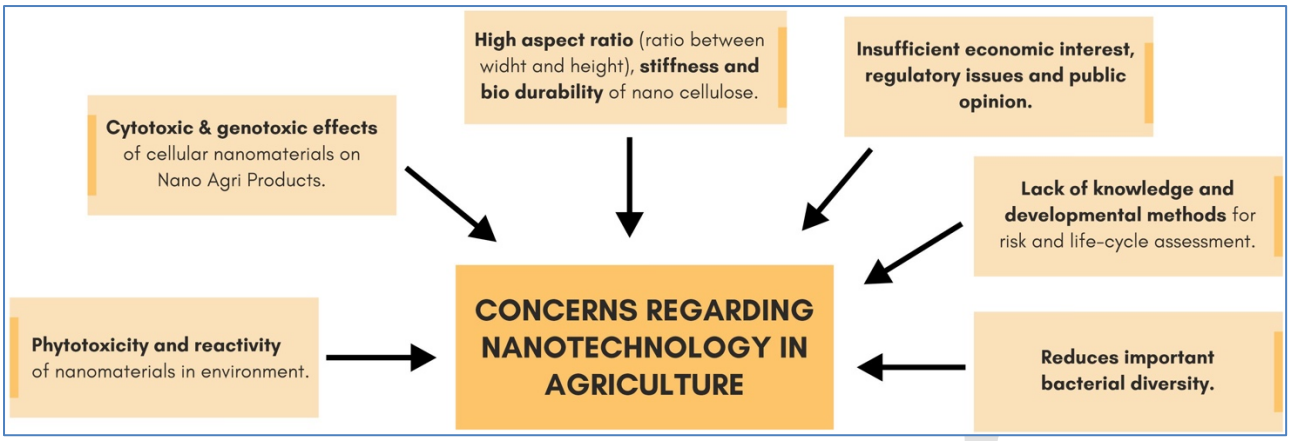
- Nanotechnology refers to a **field of applied science and technology** whose unifying theme is the control of matter on the molecular level in **scales smaller than 1 micrometre, normally 1 to 100 nanometres,** and the fabrication of devices within that size range.
- Government launched a **National Nano Mission in 2007.**
  - The mission looks at the **uses of nanotechnology for safe drinking water, materials development, sensors development,** drug delivery, etc.
  - **Department of Science and Technology (DST)** is the nodal agency for implementing the nano mission.

Definitions given in Guidelines

- **Nanomaterial (NM):** These are material that ranges in size from 1 to 100 nm at least in one dimension or any materials that possess improved properties or phenomena because of the effect of dimension(s), even if these dimension(s) fall outside the nanoscale range, up to 1000 nm.
- **Nano-Agri-Input Products (NAIPs):** They are agricultural input preparation containing NMs in any of the three dimensions i.e. zero, one or two on the nanoscale or with an internal or surface structure, intended for applications on crop for the purpose of farming through soil, seed, foliar and drip and other means.
- **Nano-Agri Products (NAPs):** They are agricultural preparation containing NMs in any of the three dimensions i.e. zero, one or two on the nanoscale or with an internal or surface structure, intended for consumption or application in food/feed and their supplements as well as nutraceutical delivery.

Highlights of the guidelines

- Guidelines **apply to Nano-Agri-Input Products (NAIPs), Nano-Agri Products (NAPs) and nano composites,** sensors made from Nanomaterials that require direct contact with crops, food and feed for data acquisitions.
  - They**do not apply to the conventional products or formulations** with incidental presence of natural nanomaterials.
- **Objectives**
  - To help researchers in **development of products** for agriculture and human consumption.
  - To help regulators to **assess quality and safety** of nano based agriculture and food products.
  - To **encourage Indian innovators and industries** to develop new nano-based formulations and products in these sectors.
- Guideline provides for **regulation of NAIPs and NAPs.**
  - **Safety, efficacy, functionality, toxicity and other quality data** for proposed NAIPs and NAPs should be conducted under:
    - ✓ Fertiliser (Control) Order, 1985, the Essential Commodities Act, 1955, Insecticides Act 1968,
    - ✓ Food and Drug Administration guidelines, Food Safety and Standards Act, 2006,
    - ✓ Cattle Feed (Regulation of Manufacture and Sale) Order, 2009
    - ✓ Food Safety and Standards Authority of India (FSSAI).
  - **Implementation of standards** should be conducted as per Bureau of Indian Standards (BIS).
    - ✓ **BIS** is a national standards body working under the aegis of **Ministry of Consumer Affairs, Food & Public Distribution.**



2.2. GOLD NANOPARTICLES (GNPS)

Why in News?

National Centre for Polar and Ocean Research and the Goa University has successfully **synthesized GNPs using psychrotolerant Antarctic bacteria.**

About GNP

- GNP's are **biocompatible, have high surface area, more stability, and are non-toxic.** GNPs are melted at much lower temperatures (300 °C) than bulk gold (1064 °C).

Advantages of GNPs	Application
Greater solar radiation absorbing ability	• A better candidate for use in the photovoltaic cell manufacturing industry.
Unique optical properties	• Can be used in therapeutic imaging for detection and diagnosis of diseases, bio-labelling, and targeted drug delivery.
Useful in the electronics industry	• Scientists have constructed a transistor known as NOMFET (Nanoparticle Organic Memory Field-Effect Transistor) using GNPs. ○ NOMFETs can mimic the feature of the human synapse known as plasticity, or the variation of the speed and strength of the signal going from neuron to neuron.

2.3. OTHER IMPORTANT NEWS

Nanomicelles	• Recently, Researchers have found that **Nanomicelles can be used for Cancer treatment.** • Nanomicelles are **globe-like structures with a hydrophilic outer shell and a hydrophobic interior**. This dual property makes them a perfect carrier for delivering drug molecules. • **Advantage:** Low toxicity, ability to minimize drug degradation, ability to permeate tissues easily for drug delivery, and lower adverse drug side effects.

3. IPR

3.1. INTELLECTUAL PROPERTY RIGHTS

Why in News?

Central government recently published the **Patent (Amendment) Rules, 2020**.

About Patent (Amendment) Rules, 2020

- Amendment provides **new format for patentees and licensees** to disclose the extent to which they have commercially worked or made the patented inventions available to the public in the country.
- By way of the Amended Rules, **certain amendments have been made to Form 27 ("New Form 27").**
  - Form 27 is the **form prescribed for patentees and licensees** to furnish statements regarding working of their patent in India. It is **mandatory under the (Indian) Patents Act, 1970** for every patentee and every licensee to file a statement as to the extent of commercial working of a granted patent in the Indian territory.
  - Form 27 must now be **furnished in respect of every financial year within six months** from the expiry of every financial year. (Earlier, it was within three months)
  - There will be one form for multiple patents.

IPR at multilateral level

- IPRs at a multilateral level have their genesis in
  - **Paris Convention for the Protection of Industrial Property** in 1883 which protected industrial property.
  - **Berne Convention for the Protection of Literary and Artistic Works** in 1886 for copyrights and related rights.
- **World Intellectual Property Organization (WIPO)** is the international agency under the United Nations that administers the work of these conventions.
- Substantive **trade related disciplines on IPRs under these international conventions have been adopted by reference into the WTO through the TRIPS Agreement.**
  - IPRs covered by the TRIPS Agreement are: **Copyright and related rights; Trademarks**, including service marks; **Geographical indications; Industrial designs; Patents; Layout-designs** (topographies) of integrated circuits; **Undisclosed information, including trade secrets and test data.**
- **India is a member of WIPO as well as committed to TRIPS** agreement.

What are IPRs (Intellectual Property Rights)?

- IPRs are the **rights given to persons over the creations of their minds.** They usually give the creator an exclusive right over the use of his/her creation for a certain period of time.
- It can include creations such as a **new drug composition, business module, product, software** and so on.

Types of Intellectual Property	Definition	Works Covered	Validity in India
Copyright	• Copyright is a legal term used to describe the **rights that creators have over their literary and artistic works.**	• Range from **books, music, paintings, sculpture and films, to computer programs, databases, advertisements, maps and technical drawings.**	• The **general rule is that copyright lasts for 60 years.** In the case of original literary, dramatic, musical and artistic works the 60-year period is counted from the year following the death of the author.
Patents	• A patent is an **exclusive right granted for an invention.** • It provides the patent owner with the right to decide how - or whether - the invention can be used by others. • Patents should be obtained in each country	• The **product or process should provide in general, a new technical solution** to a problem of any field. • An **invention relating either to a product or process** that is new, involving an inventive step and capable of industrial application **can be patented.**	• The **term of every patent in India is twenty years** from the date of filing the patent application.

	where the applicant requires protection of his invention.		
Utility Model	• A Utility Model just **like a Patent also protects inventions/innovations but for a shorter period.** • The main difference between a Patent and Utility Model is that the requirements for granting a Utility Model are less stringent than for Patents.	• A product or process which is Novel and Industrial applicable passes for Utility Model, **inventive step is not a requirement.**	• The **term of protection for utility models is shorter than for patents,** (usually between 6 and 15 years).
Trademarks	• A trademark is a sign capable of **distinguishing the goods or services of one enterprise from those of other enterprises.**	• A trademark can be **any distinctive word, symbol, slogan, logo, brand label, name, signature, letter, numeral or any combination of them.**	• **The trademark is initially registered for a period of 10 years,** which is calculated from the date of filing of the application.
Industrial Design	• An industrial design **constitutes the ornamental or aesthetic aspect of an article.**	• A design **may consist of three-dimensional features,** such as the shape or surface of an article, **or of two-dimensional features,** such as patterns, lines or color.	• In India the **maximum validity of a registration under the (Indian) Designs Act, 2000 can be 15 years.**
Geographical Indications	• **Signs used on goods that have a specific geographical origin** and possess qualities, a reputation or characteristics that are essentially attributable to that place of origin.	• Most commonly, a geographical indication **includes the name of the place of origin of the goods.**	• **It is registered for a period of 10 years** and the registration may be renewed from time to time for a period of 10 years at a time.
Trade secrets	• Trade secrets are **IP rights on confidential information which may be sold or licensed.**	• Examples include **formulae, recipes, pattern, technique, compilation, method, program, process, device or product mechanism.**	• Trade secret remains **valid as long as one does not discover it independently.**

Some terms associated with IPRs

- **Ever-greening of patent:** Section 3(d) Indian Patent Act doesn't allow the renewal of patent over a product by introducing minor changes to it. It has been an issue of concern for pharmaceutical companies (Ex: Novartis issue on the issue of patent of cancer drug Glivec).
- **Compulsory Licensing:** It enables a competent government authority to license the use of a patented invention to a third party or government agency without the consent of the patent holder.

3.2. PATENT POOLS

Why in news?

International science collaborations on COVID-19 started a discussion on patent pooling.

More on news

- Recently, **Costa Rica suggested pooling of rights to deal with the pandemic** through free or minimal, affordable licensing to ensure that the outcomes of efforts can be used by countries with limited economic resources to deal with the problem.

Patent Pooling

- According to World Intellectual Property Organisation (WIPO), **patent pools are defined as an agreement made between two or more patent holders** for licensing their patents to one another or any third party for the purpose of sharing their intellectual property rights.

- Generally, patents pools are **made for complex technologies which necessitate complementary patents** for providing productive technical solutions such as vaccines in the present COVID-19 crisis.
- **'Sewing Machine Combination" of 1856** is considered as the first modern patent pool in the United States.
- Patent pooling structures were discussed and considered in response to the SARS outbreak of 2002-03, the H5N1 influenza outbreak of 2005, and the H1N1 influenza pandemic of 2009.
- **Patent pooling ensures:**
  - **Innovation** between companies while minimizing potential legal issues.
  - **Lower transaction costs and better process efficiencies** as businesses that hold complementary patents can effectively agree not to sue each other for infringement.

India and Patent Pooling:

- The concept of 'patent pooling' is new in India and has been primarily focused to have solutions for the affordable health care.
- **Indian Patents Act (IPA), 1970does not render for any provisions related to formation of patent pools** or any guidelines for the same but at the same time it neither restrain for creation or formation of patent pools.
  - Under IPA, Central Government can set up patent pool by acquiring inventions and patents which are required in the public interest.
- However, in India, patent pooling is viewed as **restrictive practice by Competition Act, 2002,** which are anticompetitive in nature.

International steps towards patent pooling:

- **C-TAP:** The **COVID-19 Technology Access Pool (C-TAP) (hosted by WHO)** compiles pledges of commitment made under the Solidarity Call to Action to voluntarily share COVID-19 health technology related knowledge, intellectual property and data.
- **Global Initiative to Sharing of All Influenza Data (GISAID):** It promotes rapid sharing of data from all influenza viruses and the coronavirus causing COVID-19.
  - This includes genetic sequence and related clinical and epidemiological data associated with human viruses, and geographical as well as species-specific data.
- **Medicines Patent Pool (MPP):** It has facilitated the development of generic drugs for HIV, tuberculosis, and hepatitis C, allowing them to be sold at an affordable price.
  - MPP is a United Nations-backed public health organisation working to increase access and facilitate development of life-saving medicines for low- and middle-income countries.
- **Trade Related Intellectual Property Regime (TRIPS):** It allows countries to grant compulsory licences to companies to produce a patented product at times of emergencies.
- **Nagoya Protocol under Convention on Biodiversity (CBD):** Article 2 (e) of the protocol can be interpreted as **including the genetic sequence information** that forms the basis for all ongoing research and development on Covid treatment and prevention.
  - Protocol provides for access and benefit sharing when genetic resources are used for commercial purposes, which indirectly provides a scope for patent pooling.

About GISAID

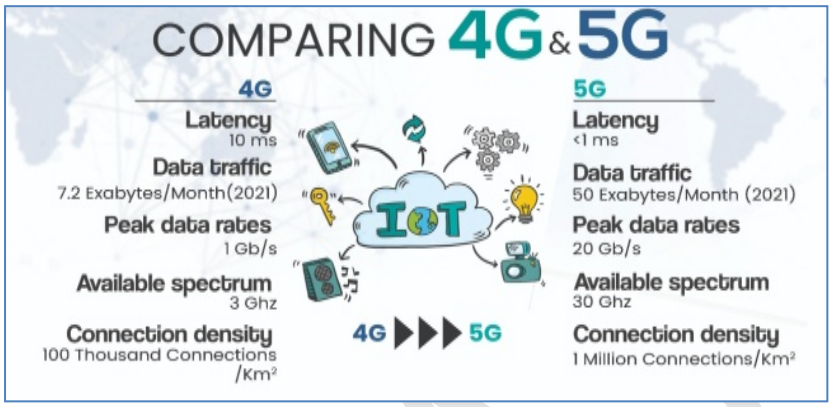
- GISAID is a collaboration involving **representatives of Member States, scientists** of the Global Influenza Surveillance and Response System (GISRS) and **Global Influenza Programme (GIP) of the WHO,** and experts in licensing intellectual property.
- The **data is provided free-of-charge to all individuals** that agreed to identify themselves and agreed to uphold the GISAID sharing mechanism

4. IT & COMPUTER

4.1. 5G

Why in News?

Recently, Reliance industry announced that it has designed **and developed a complete 5G solution from scratch.** This is the **first time an Indian company is venturing into mobile technology.**



What is 5G?

- 5G is a wireless communication technology using radio waves or radio frequency (RF) energy to transmit and receive data.

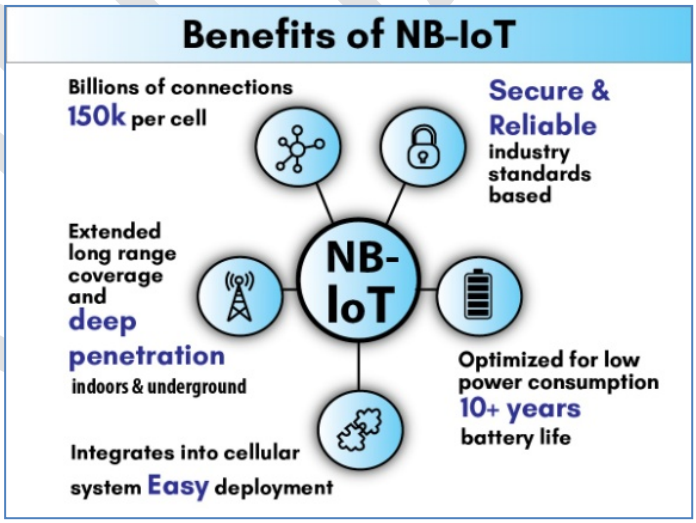
Related News

- **D10 Club**
  - UK government has approached the US with the prospect of **creating a 5G club of 10 democracies.**
  - **"D10" club of democratic partners,** including G7 countries – UK, US, Italy, Germany, France, Japan and Canada – plus Australia, South Korea and India **will aim to create alternative suppliers of 5G equipment and other technologies to avoid relying on China.**

4.2. NARROW BAND-INTERNET OF THINGS

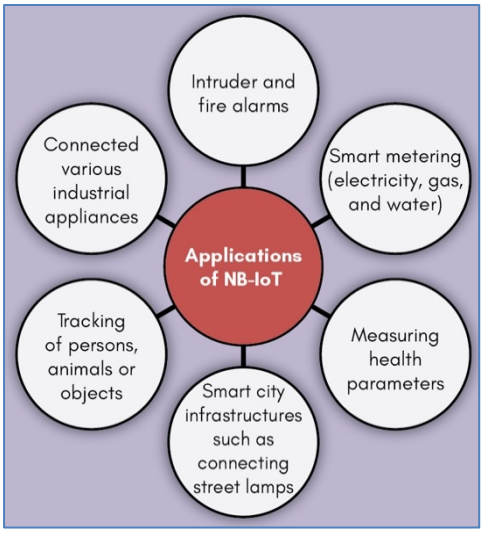
Why in news?

BSNL, in partnership with Skylotech India, announced worlds' first satellite-based narrowband-IoT (NB-IoT) network in India.



More about news

- It will **provide affordable, innovative telecom services and products across customers segments.**
- With this solution, **India will now have access to a ubiquitous fabric of connectivity for millions** of yet unconnected machines, sensors and industrial IoT devices.
- This new 'Made in India' solution will **connect with BSNLs satellite- ground infrastructure and provide PAN-India coverage.**
- NB-IoT supports the Department of Telecom and NITI Aayog's plan of **bringing indigenous IoT connectivity to India's core sectors** and already been tested successfully in Indian Railways, fishing vessels and enabling connected vehicles across India.



About Narrow Band-Internet of Things (NB-IoT)

- NB-IoT is a **wireless communication standard for the Internet of Things (IoT)** belonging to the category of low-power wide-area networks (LPWAN).
  - **IoT refers to the billions of physical devices around the world that are now connected to the internet,** all collecting and sharing data. Ex: A light bulb that can be switched on using a smartphone app is an IoT device.

- However, it doesn't necessarily have to be connected to the internet, it can also be a network of things.

- It **enables to connect devices that need small amounts of data,** low bandwidth, and long battery life.
- NB-IoT can **co-exist with 2G, 3G, and 4G mobile networks.**
- It **doesn't operate in the licensed LTE construct**, Instead, it **works in one of three ways:**
  - Independently
  - In unused 200-kHz bands that have previously been used for GSM (Global System for Mobile Communications).
  - On LTE base stations allocating a resource block to NB-IoT operations or in their guard bands.

4.3. PRIME MINISTER WI-FI ACCESS NETWORK INTERFACE (PM-WANI)

Why in News?

Union Cabinet recently approved a framework for the proliferation of public Wi-Fi networks through PM WANI scheme.

About PM-WANI

- It **aims to elevate wireless internet connectivity** in the country.
- **PM-WANI eco-system will be operated by different players** such as Public Data Office (PDO); Public Data Office Aggregator (PDOA); App Provider; Central Registry.
  - **The public network will be set up by the PDOAs** to provide Wi-Fi service through the PDOs spread throughout the country.
    - A PDOA buys bulk bandwidth from licenced telcos/ISPs, and re-sells it to multiple PDOs to ensure the latter can offer Wi-Fi connectivity to customers.
    - This **nationwide network of public Wi-Fi hotspots is termed PDOs** after the public call office (PCO) concept rolled out by government to set up a nationwide network of landline public pay-phones.
  - The government will **develop an app to register users and discover the WANI-compliant Wi-Fi hotspots** in the nearby area and display them for accessing internet service.
    - The App provider works closely with the PDOA.
  - **Central Registry** will maintain the details of App Providers, PDOAs, and PDOs. To begin with, the Central Registry will be maintained by Centre for Development of Telematics (C-DOT).
  - **PDOA shall make necessary provisions for storage of user data for one year** to ensure compliance with legal provisions, as required.
  - **The user data privacy will be ensured by App Providers and PDOAs**. Complete user data and usage logs will be stored within India.
- There shall be **no license fee for providing Broadband Internet through these public Wi-Fi networks.** A customer wanting to access the network from a PDO's premise can do so only after an eKYC authentication.

What is Wi-Fi?

- Wi-Fi is a **wireless networking technology** that allows devices such as computers (laptops and desktops), mobile devices (smart phones and wearables), and other equipment (printers and video cameras) to interface with the Internet.
  - It is commonly called a **wireless LAN (local area network).**
- It allows **these devices--and many more--to exchange information with one another, creating a network.**
- The wireless network is operating three essential elements that are **radio signals, antenna, and router**. The radio waves are keys that make Wi-Fi networking possible.
- **Mobile data works essentially the same way as Wi-Fi.** The biggest difference is that the signal comes through your mobile service provider rather than ISP (Internet service provider).
- Also, both **Bluetooth and Wi-Fi are used for providing wireless communication** through radio signals.

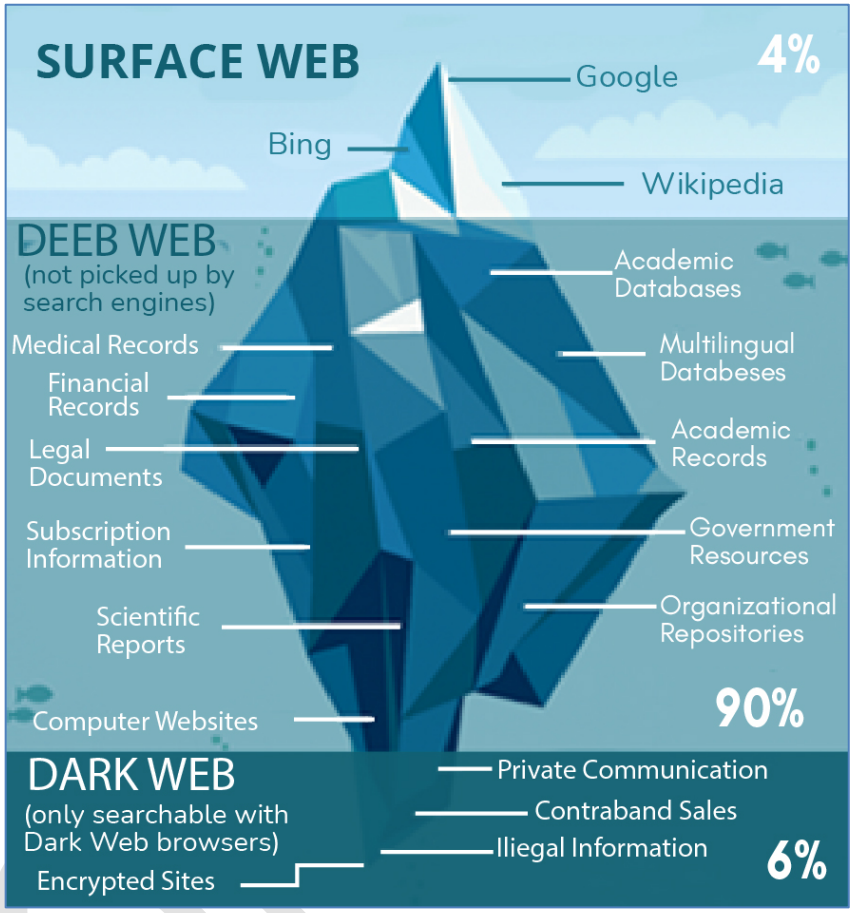
		
Suitability	Accustomed to connect short-range devices.	For providing high-speed web access or internet
Range	About 10 metres	About 100 metres
Devices that can be connected	Limits the number of devices that can connect at any given time.	Open to more devices and more users.
Usability	Simpler to use and requires less power.	Compared to Bluetooth requires more power.

4.4. DARK NET

Why in News?

Recently, records of 20 million Bigbasket users were made available on the dark net.

What is Dark Net?



- Also known as Dark Web, it is that **part of the Internet which is neither accessible through traditional search engines** like Google nor is it accessible by normal browsers like Chrome or Safari.
- It **generally uses non-standard communication protocols** which make it inaccessible to internet service providers (ISPs) or government authorities.
- **The content on Dark Net is encrypted and requires specific browser such as TOR** (The Onion Ring) browser to access those pages.
- **Dark Net itself is only a part of the Deep Web** that is a broader concept, which includes sites that are protected by passwords. **For e.g.**- A person's bank statements which are available online but will not be pulled up in generalised Internet searches. Only difference is that while the **Deep Web is accessible, the Dark Net is deliberately hidden.**
    - The **part of internet that is readily available to general public** and searchable on standard search engines **is called as Surface Web.**
- **It is used by journalists and citizens working in oppressive regimes** (to communicate without any government censorship), **researchers and students** to do research on sensitive topics, law enforcement agencies etc.
- However, it is surrounded by **concerns over Anonymity, Haven for illicit activity, Privacy and ethical concerns, use of crypto currencies, drug dealing, arms trafficking,** communication by terrorists etc.

TOR (The Onion Ring)

- **TOR browser was developed in the mid-1990s** by the United States Naval Research laboratory employees to protect US intelligence communications online.
- It is termed so as the traffic from the **browser creates several layers like those of an Onion before reaching the destination site.** In other words, unlike normal surfing, the computer does not connect directly to the server where the website is located. Instead, a whole series of servers are involved in the connection in order to create the greatest possible anonymity.

4.5. SUPERCOMPUTER

Why in News?

Centre for Development of Advanced Computing (C-DAC) to commission PARAM Siddhi – India's Fastest AI Super Computer.

More on News

- PARAM Siddhi will be Ind**ia's largest High-Performance Computing and Artificial Intelligence (HPC-AI) supercomputer**.
    - The supercomputer will have **speed of210 AI Petaflops**

- It will be **established under National Supercomputing Mission (NSM)** at C-DAC with support from NITI Aayog, Ministry of Electronics and IT (MeitY), Department of Science and Technology (DST).

About National Supercomputing Mission

- NSM was launched in 2015 to empower national academic and R&D institutions by installing a vast supercomputing grid comprising of more than 70 high-performance computing facilities.
- NSM is **jointly implemented by MeitY and DST along with C-DAC** and IISc as executing agencies.
- NSM envisages:
  - **Installing network of supercomputers** with cumulative capacity of 45 PF, ranging from few Tera Flops (TF) to Hundreds of TF and three systems with greater than or equal to 3 Peta Flops (PF) in academic and research institutions of National importance by 2022.
  - **Connecting these supercomputers on National Supercomputing grid over National Knowledge Network** – which connects academic institutions and R&D labs over a high-speed network.
  - **Development of highly professional High Performance** Computing aware human resource.
- Under NSM, **ParamShivay** – first supercomputer was assembled indigenously and is installed in IIT (BHU). **Param Shakti and Param Brahma** were installed at IIT-Kharagpur and IISER, Pune.

About Supercomputers

- A supercomputer is a computer with a **high level of performance as compared to a general-purpose computer.** The performance of a supercomputer is commonly measured in floating-point operations per second (FLOPS).
- Memory of a supercomputer is averaged around 250000 times of the usual computer.
- **Application areas:** Climate Modelling, Computational Biology, Atomic Energy Simulations, National Security/ Defence Applications, Disaster Simulations and Management, Computational Material Science and Nanomaterials, Cyber Physical Systems, Big Data Analytics etc.
- **Other Indian Super Computers**
  - **Param Shiva-** India's first supercomputer.
  - **Pratyush** located in Indian Institute of Meteorology.
  - **Mihir**located in National Centre for Medium Range Weather Forecasting.
- **World Fastest Super Computer is Fugaku of Japan** with speed of 415 petaFlops.

FLOPS (**FL**oating-point **OP**erations per **S**econd)

- It is a **common benchmark measurement for rating the speed of microprocessors.**
  - **A MegaFLOPS**is equal to one million FLOPS and a **GigaFLOPS**is equal to one billion FLOPS.
  - **A TeraFLOPS** is equal to one trillion FLOPS.
  - **A PetaFLOPS** can be measured as one thousand teraflops.

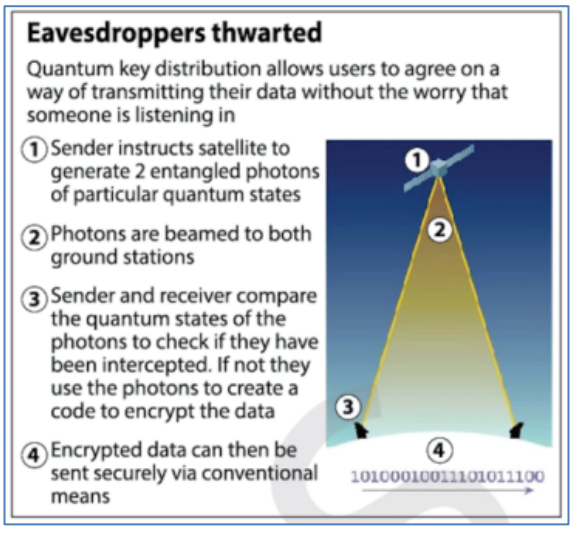
4.6. QUANTUM KEY DISTRIBUTION

Why in News?

Recently, a **satellite-based communication between two ground stations** was activated by entangled-based quantum key distribution (QKD).

More on news

- This was achieved by **Micius** (also known as the Quantum Experiments at Space Scale), **World's first quantum-enabled satellite.** Micius was launched by China in 2016**.**



About Quantum Key Distribution

- QKD is a technique that **allows for secure distribution of keys to be used** for encrypting and decrypting messages.
- In **traditional cryptography,** the security is usually based on the fact that an adversary is unable to solve a certain mathematical problem.
- In QKD, security is achieved through the **laws of quantum physics.**

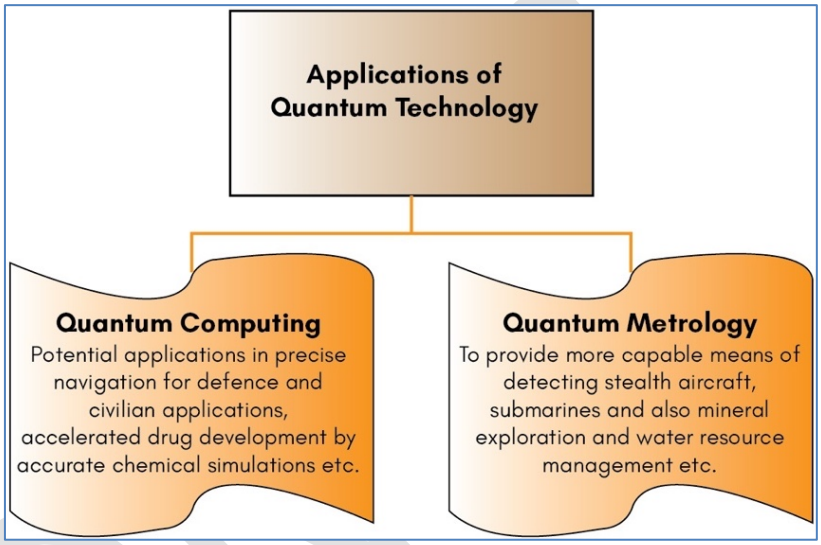
Related term: Quantum Supremacy

- It's the point at which a quantum computer can **complete a mathematical calculation that is beyond the reach of even the most powerful supercomputer.**
- Recently, **Sycamore (Google's quantum computer)** took 200 seconds to perform a calculation that the world's fastest supercomputer, **Summit**, would have taken 10,000 years to accomplish.

- Two such most important laws are **Superposition and Entanglement.**
  - **Superposition** means that each **quantum bit** (basic unit of information in a quantum computer) **can represent both a 1 and a 0 at the same time.**
  - **In quantum entanglement,** subatomic particles become "entangled" (linked) in such a way that any change in one disturbs the other even if both are at opposite ends of the universe.
- Quantum Satellite serves **as source of pairs of entangled photons, twinned light particles** whose properties remain intertwined no matter how far apart they are.

Related News

- Ministry of Electronics and Information Technology (MeitY), Amazon Web Services (AWS) to **establish Quantum Computing Applications Lab.**
- **Lab will**
  - Provide quantum computing as a **service to government ministries and departments, scientists etc.**
  - Enable **advances in areas such as manufacturing, healthcare, agriculture,** and aerospace engineering.
  - Help **identify problems and opportunities rapidly,** and test real-world challenges in a low risk environment.



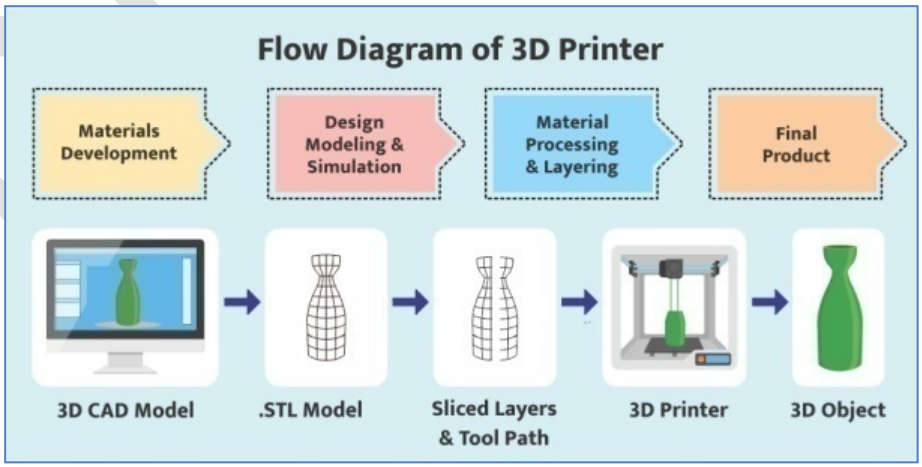
About Quantum Technology

- Quantum technology seeks to **harness laws of quantum physics,** which describe the behaviour of matter and energy at the atomic and subatomic level.
- **This is unlike classical physics,** in which an object can exist in one place at one time. E.g. classical computers operate using binary physical state, meaning its operations are based on one of two positions (1 or 0).
- Quantum principles will be used for **engineering solutions to extremely complex problems** in computing, communications, sensing, chemistry, cryptography, imaging and mechanics.

4.7. 3D PRINTING POLICY

Why in News?

Ministry of Electronics and Information Technology (MeitY) is planning a 3D printing policy.



More on News

- Policy will help develop a **conducive ecosystem for design, development and deployment of 3D printing and additive manufacturing.**
- The **policy would promote 3D printing on an industrial scale** and will help domestic companies overcome technical and economic barriers.

About 3D Printing

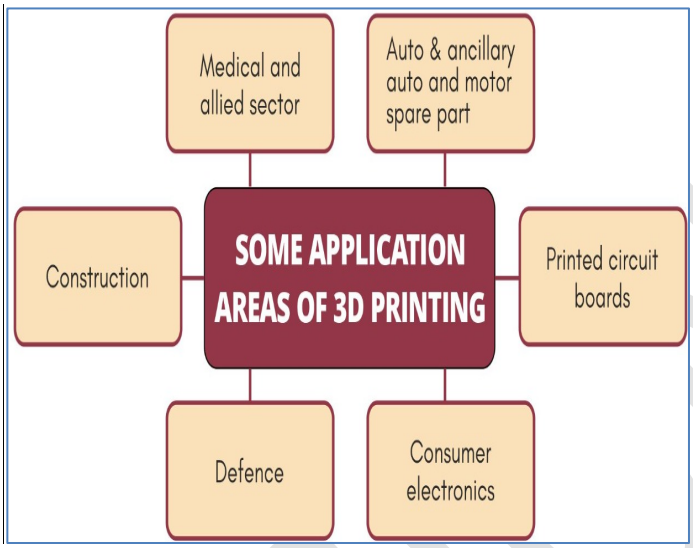
- Additive manufacturing or 3D printing is defined as the **technology that constructs a three-dimensional object from a digital 3D model or a Computer-aided design (CAD) model** by adding material layer by layer.
- The addition of material can happen in multiple ways, namely **power deposition, resin curing, filament fusing.**

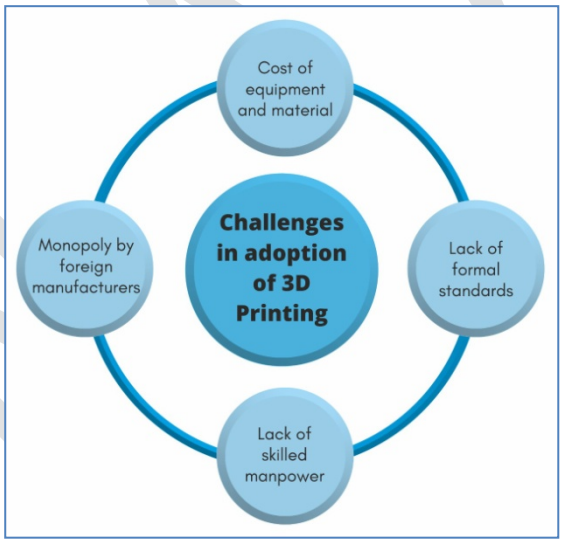
- The deposition and solidification are **controlled by computer to create a three-dimensional object.**
- These objects can be of almost any shape or geometry.

- **3D printing is the opposite of subtractive (traditional) manufacturing** which is cutting out / hollowing out a piece of metal or plastic with for instance a milling machine
- It **allows the creation of lighter, more complex designs** that are too difficult or too expensive to build using traditional dies, molds, milling and machining.

Related News

- Recently, MeitY prepared a strategy paper titled **"National Strategy on Additive manufacturing (AM).**
- Strategy aims to **promote various verticals of the AM sector,** including machines, materials, software and designs to leverage the untapped business opportunities that will unfold in the near future.
- This will further accelerate **execution of recommendations as laid out in the National Electronics Policy, 2019.**
- **Its objectives include**
  - Ensure creation of a **sustainable ecosystem for the AM industry** to compete globally.
  - Position India as a global **Innovation and Research hub for Additive Manufacturing.**
  - **Promote creation of Indian IPR.**





4.8. DATA EMPOWERMENT AND PROTECTION ARCHITECTURE

Why in news?

Recently, NITI Aayog sought suggestions and comments on the 'Data Empowerment and Protection Architecture (DEPA)' draft.

More on news

- Along with NITI Aayog, the policy involves four regulators across banking, securities, insurance, and pensions - **RBI, SEBI, IRDAI, PFRDA - and the Ministry of Finance** coming together to implement this model.
- **It has been prepared by iSPIRT,** not-for-profit think tank.

What is the current framework for Data Protection in India?

- **Information Technology (Reasonable Security Practices and Sensitive Personal Data or Information) Rules, 2011**for **general application** with regard to privacy laws.
- **Collection of Government Data** is governed by Aadhaar (Targeted Delivery of Financial and other Subsidies, Benefits and Services) Act, 2016 and **Aadhaar (Data Security) Regulations, 2016.**
- **Data related to the Banking Sector** is regulated under Credit Information Companies (Regulation) Act, 2005, Credit Information Companies Regulations, 2006, circulars of Reserve Bank of India including KYC circulars, Master Circulars on credit cards and Customer Services and Code of Bank's commitment to Customers.
- Data related to the **healthcare sector** is regulated by **Clinical Establishments (Central Government) Rules, 2012** and **Indian Medical Council (Professional Conduct, Etiquette and Ethics) Regulations, 2002.**
- As part of potential reforms with regard to the Data Protection regime, **Personal Data Protection Bill, 2019** (currently referred to the standing committee), **Non-Personal Data Governance Framework** and **National Digital Health Mission** among others have been envisaged.

4.9. NON-PERSONAL DATA

Why in news?

The draft report on **Non-Personal Data (NPD) Governance Framework** was released recently for inviting feedbacks by the committee **headed by Kris Gopalakrishnan.**

Some key stakeholders mentioned in draft report

- **Data principals:** natural persons, entities and communities to whom non-personal data (prior to anonymization or aggregation) relates.
- **Data custodians:** entities which undertake collection, storage and processing of non-personal data.
- **Data businesses:** Horizontal category of businesses involved in data collection and processing.

What is Non-Personal Data?

- The draft report defines non-personal data as any **set of data which does not contain personally identifiable information**, in essence means that no individual or living person can be identified by looking at such data.
  - It includes data sets aggregated and collected by **various mobile apps, websites and devices.**
- **Difference from personal data:**
  - Unlike personal data, which contains explicit information about a person's name, age, gender, sexual orientation, biometrics and other genetic details, **non-personal data is more likely to be in an anonymised form.**
  - Anonymous data is a data that is **initially personal data but is later made anonymous using certain data transformation techniques**, to the extent that individual specific events are no longer identifiable.
- **Classifications of non-personal data:** The draft report classifies NPD as:
  - **Public non-personal data:** All the **data collected by government and its agencies** such as census, data collected on the total tax receipts or any information collected during execution of all publicly funded works has been kept under the umbrella of public non-personal data.
    - All **Non-Personal Data collected or generated by the Government where such data is explicitly afforded confidential treatment under a law**, like data of land records, public health information, vehicle registration data **shall not constitute Public Non-Personal Data.**
  - **Community non-personal data:** Any **data identifiers about a set of people** who have either the same geographic location, religion, job, or other common social interests will form the community non-personal data.
    - E.g. the metadata (set of data that describes and gives information about other data) collected by ride-hailing apps, telecom companies, electricity distribution companies.
  - **Private non-personal data:** It can be defined as those which are produced by individuals which can be derived from application of proprietary software or knowledge. Private non-personal data is further sub-classified into 'sensitive non-personal data' & 'critical non-personal data'.

4.10. AAROGYASETU DATA ACCESS AND KNOWLEDGE SHARING PROTOCOL, 2020

Why in news?

Recently, Ministry of Electronics and IT (MeitY) had notified Aarogya Setu Data Access and Knowledge Sharing Protocol, 2020 to address **privacy and security concerns** with the Aarogya Setu app.

About Aarogya Setu Data Access and Knowledge Sharing Protocol, 2020

- **Implementation of the Protocol:** MeitY is designated as the agency responsible for the implementation of this Protocol and its developer, the National Informatics Centre (NIC) shall be responsible for collection, processing and managing response data collected by the Aarogya Setu.
- **Collection and processing of response data:** Any response data and the purpose for which it is collected by NIC shall be clearly specified in the Privacy Policy of the Aarogya Setu mobile application.
  - **NIC shall collect only such response data as is necessary** and proportionate to formulate or implement appropriate health responses.
  - Demographic **data will be retained for as long as Protocol remains in force** or if **individual requests that it be deleted, for a maximum of 30 days** from such request, whichever is earlier**.**
- **Sharing of response data:** Data can be shared with other government agencies and third parties as long as it is for critical health purposes.

- Any entity with whom response data has been shared shall use such data strictly for the purpose for which it is shared.
- In any circumstance, such **data shall not ordinarily be retained beyond 180 days** from the date on which it was accessed, after which such data shall be permanently deleted.

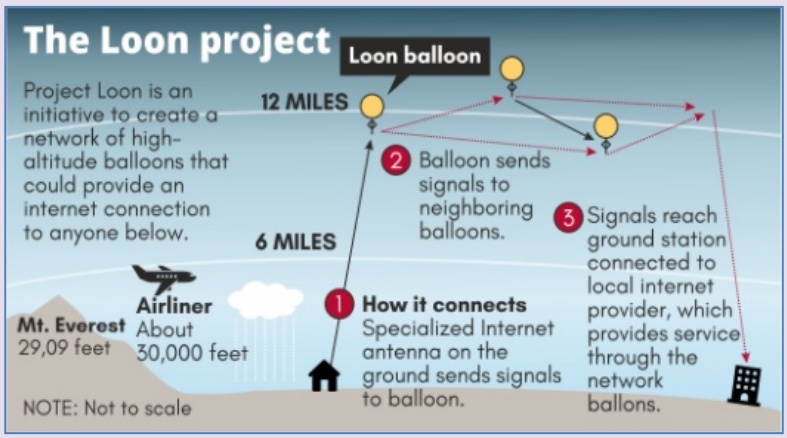
- **Response data may be made available for research purposes** to Indian universities and research institutions/ research entities registered in India by NIC.
  - Recently, Government has made the Aarogya Setu app open source, which means developers will be able to inspect the source code of the app and modify for changes. The process of supporting the open-source development will be managed by NIC.
- **Any violation of these directions may lead to penalties** as per Disaster Management Act, 2005 and other legal provisions as may be applicable.
- **The Empowered Group shall review this Protocol** after a period of 6 months from the date of this notification or may do so, at such earlier time as it deems fit.

4.11. OTHER IMPORTANT NEWS

National Startup Advisory Council (NSAC)	• Government nominated 28 non-official members to NSAC
	• NSAC is setup to **advise the Government on measures needed to build a strong ecosystem for nurturing innovation and startups in the country** to drive sustainable economic growth and generate large scale employment opportunities.
	• **Composition**
	  ○ **Chairman**: Union Minster for Commerce & Industry.
	  ○ **Ex-officio members:** Nominees of the concerned Ministries/Departments/ Organisations, not below the rank of Joint Secretary
	  ○ **Non-official members**: nominated by Central government from various categories like founders of successful start-ups for a period of two years.

EventBot Mobile Banking Trojan	• Recently, **Indian Computer Emergency Response Team (CERT-In) issued an advisory** against a Trojan called EventBot.
	• **The EventBot is a mobile Banking Trojan and information stealer** that specifically targets the financial apps on the phone and the financial data of its victim.
	• **Viruses, worms and Trojan Horses**
	  ○ A computer **virus attaches itself to a program or file so it can spread from one computer to another,** leaving infections as it travels.
	  ○ **A worm is considered to be a sub-class of a virus.** Worms spread from computer to computer, but unlike a virus, it has the capability to travel without any help from a person.
	  ○ A Trojan horse or **Trojan is atype of malware that is often disguised as legitimate software.**

BlackRock Android Malware	• It is a new **malware which can steal information like passwords and credit card information** from smartphone applications, including Amazon, Facebook, Gmail etc. • **Malware is collective name for a number of malicious software variants**, including viruses, ransomware and spyware.
Data Lake and Project Management Software	• It is a **cloud based and Artificial Intelligence** powered Big Data Analytics platform launched by National Highway Authority of India (NHAI). ○ With launch of this, NHAI becomes **first construction sector organisation to go 'Fully Digital'**

	• All project documentation, contractual decisions and approvals are now being done through portal only. • It will bring benefits like No delays, Quick decision making, No question of missing records, Work from anywhere/anytime, enhance transparency etc.
DigiBoxx	• It is **India's first digital asset management platform** launched by NITI Aayog. It provides an easy and secure way to store all the files in one centralised location. • It is a **digital file storage, sharing, and management SaaS (Software as a Service) product** that provides storage options for business as well as individual users. • It can act as a potential **alternative to Google Drive, Dropbox, and Microsoft OneDrive.** • A free account on DigiBoxx gives **up to 20 GB of storage space.**
Project Loon	• It is a **network of stratospheric balloons designed to bring Internet connectivity to rural and remote communities worldwide.** • It is a project under a **Google subsidiary.** • Huge **helium filled balloons are launched at altitudes of 20 km above the earth**, above the zone where airplanes fly. ○ The **balloons can then act as cell towers to receive and transmit signals.** • Recently, Loon set a new record for the longest stratospheric flight by staying in air for 312 days. 
Satellite internet	• Instead of connecting through copper wires and fiber optic cables, **satellite internet entails use of satellites in space to beam the internet down** to an area through satellite dishes. • It is primarily used to bring connectivity in areas **where laying cables is difficult or impossible such as hilly terrains, remote areas and islands.** • It has **bandwidth limitations, gets severely impacted by aberrations in weather,** and can be expensive too.
Super apps	• Tata Group is planning to launch an all-in-one super app by the end of this year. • Super app is a **platform developed by a company offering various services under one umbrella**. ○ E.g. China's WeChat started out as a messaging app, expanded into payments, cabs, shopping, food ordering, etc. • A **country or a region becomes super app-ready** when its large base of population has smartphone first instead of desktop and ecosystem of apps customised to local needs is not evolved.

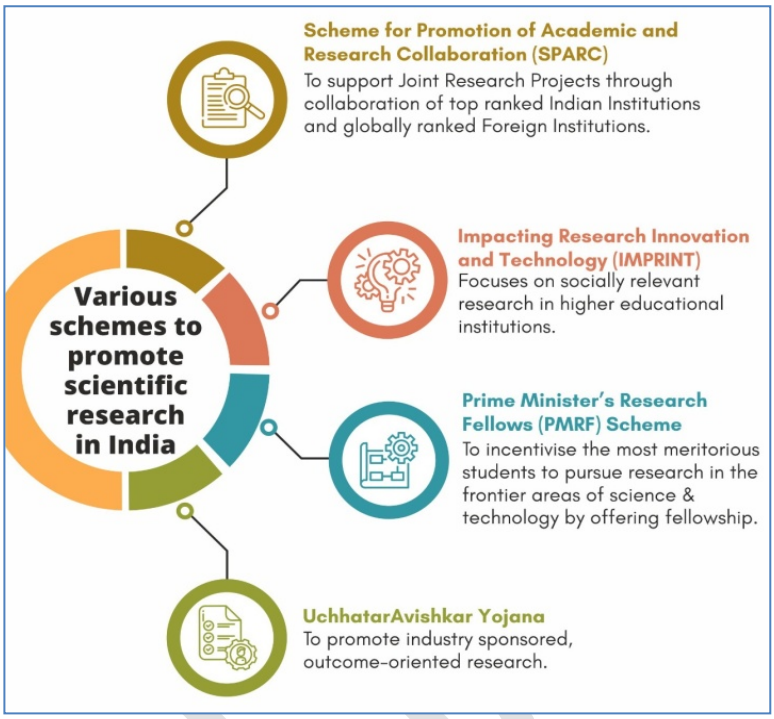
National Payment Corporation of India (NPCI) Launches Pai	• Pai is an **artificial intelligence (AI) based chatbot**, to create awareness around NPCI's products like FASTag, RuPay, UPI, AePS on a real time basis.
	  ○ It was developed by Bengaluru based startup CoRover Private Limited
	• NPCI is umbrella organisation for **operating retail payments and settlement systems** in India.
	  ○ It is an initiative of RBI and Indian Banks' Association under Payment and Settlement Systems Act, 2007.

Swadeshi Microprocessor Challenge- Innovate Solutions for Aatmanirbhar Bharat	• It seeks to invite innovators, startups and students to **use these microprocessors to develop various technology** products. • It is aimed at **meeting India's future requirements of strategic and industrial sectors** and mitigate the issues of security, licensing, technology obsolescence and cutting dependency on imports. • It was launched by **Ministry of Electronics and Information Technology**.
Bandicoot robots	• Recently, Greater Mohali Area Development Authority **introduced bandicoot robots** that will clean the sewer manholes in the city. • Bandicoot is engineered **for cleaning any type of sewer manholes.** • **It is developed by Genrobotics,** a leading private Robotics company in India.

2d-Electron Gas(2DEG)	• 2DEG is an **electron gas with ultra-high mobility, which can speed up transfer of quantum information** and signal from one part of a device to another and increase data storage and memory. • Strong spin-orbit coupling and relativistic nature of the electrons in the 2DEG **resulted in Rashba field.** ○ Rashba effect **consists of splitting of spin-bands in an electronic system,** might play a key role in spintronic devices. • **Produced by:** Institute of Nano Science and Technology, an autonomous institution of Department of Science and Technology.
Global Initiative on Data Security	• China has launched this initiative **to address global data security issues, a countermove to the US "clean network" programme** that is aimed at discouraging other countries from using Chinese technology. • Under the initiative, **China would call on all countries to handle data security in a "comprehensive, objective and evidence-based manner"** and maintain an open, secure and stable supply chain for information and communications technology and services. • It **opposes undermining key infrastructure or data theft** by using information technology and forcing firms to store data generated overseas in their home country.

5. RESEARCH AND DEVELOPMENT

5.1. ACCELERATE VIGYAN



Why in news?

Recently, Science and Engineering Research Board (SERB) launched 'Accelerate Vigyan' scheme to push scientific research.

About 'Accelerate Vigyan' scheme

- The scheme is **to boost high-end scientific research and prepare scientific manpower** that can venture into research careers by identifying research potential, mentoring, training and giving hands-on workshops on a national scale.
- **Components of AV scheme:**
  - **ABHYAAS**: To enable and groom potential PG/PhD students by developing their research skills in selected areas across different disciplines or fields.
    - It has two components: High-End Workshops (KARYASHALA) and Research Internships (VRITIKA).
  - **SAMMOHAN programme:** To encourage, aggregate and consolidate all scientific interactions in the country under one common roof.
    - It has two parts**: 'SAYONJIKA'** to catalogue capacity building activities in science and technology supported by all government funding agencies and **'SANGOSHTI'** to facilitate the scientific community to establish an interaction with other individuals and research groups to enhance knowledge exchange.
- It will seek to **garner the social responsibility of the scientific community** in the country and is expected to promote R&D in India.

Scientific and Useful Profound Research Advancement (SUPRA) Scheme

- It seeks to **explore new scientific breakthroughs**, with long-term impact on fundamental scientific understanding, and offer disruptive technologies at the cutting edge.
- **Important measures of the scheme are:** Quantum of advances, Ability of research outcomes in enhancing scientific knowledge, Global impact, outstanding publications etc.
- It is designed by **Science and Engineering Research Board** (SERB).
  - SERB is a **statutory body under the Department of Science and Technology**.
- The submissions under SERB-SUPRA can only be made against call for proposals, with public announcement through SERB online portal and social media.
- The **funding will be provided normally for a period of three years**, which could be **extended to 2 years** (5 years total).

5.2. DRAFT NATIONAL SCIENCE TECHNOLOGY AND INNOVATION POLICY

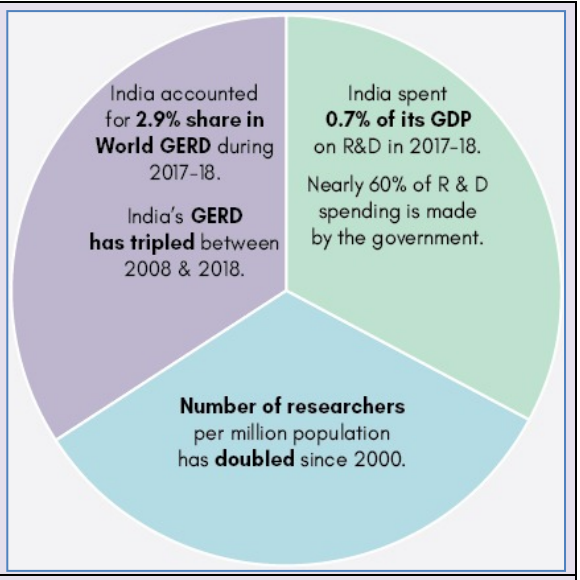
Why in News?

Recently, the draft of **5th National Science Technology and Innovation Policy (STIP)** was released by the **Department of Science and Technology (DST)**.

About STIP

Objective	• To **identify and address strengths and weaknesses** of the Indian Science, Technology, and Innovation (STI) ecosystem. • To **catalyse socio-economic development** of the country. • Make the Indian STI ecosystem **globally competitive.**

Vision	• **To achieve technological self-reliance** and position India among the top three scientific superpowers in the decade to come. • **To focus on critical human capital** through a 'people centric' STI ecosystem. • **Build individual and institutional excellence in STI.** • **To double the number of Full-Time Equivalent researchers,** Gross Domestic Expenditure on R&D (GERD) and private sector contribution to the GERD every 5 years; Recently, **R&D Statistics and Indicators 2019-20 was released by National Science and Technology Management Information** under DST. • **Key Findings**
Features	• **National STI Observatory will be established** as a central repository for all kinds of data from the STI ecosystem. • **Indian Science and Technology Archive of Research (INDSTA)** to provide access to the outputs of all publicly-funded research. • **Higher Education Research Centres (HERC) and Collaborative Research Centres (CRC)** to provide research inputs to policymakers and bring together stakeholders. • **Research in innovation practices will be made a mandatory component** of university/college teachers' professional development programmes. • **Advanced Missions in Innovative Research Ecosystem (ADMIRE)** initiative for creating hybrid funding models. • **Research and Innovation Excellence Frameworks (RIEF) will be developed** to enhance the quality of research. • **An institutional architecture to integrate Traditional Knowledge Systems (TKS)** and grassroots innovation into the overall education, research and innovation system. • **An India-centric Equity & Inclusion (E&I) charter will be developed** for tackling all forms of discrimination. Lesbian, Gay, Bisexual, Transgender, Queer (LGBTQ+) community will be included in gender equity conversations.



About STIP 2013

- It aimed at promoting a science and technology-led innovation ecosystem in the country and broadly **linking science, technology and innovation to socio-economic priorities.**
- This policy also **resulted in India's increased participation in global mega-science initiatives** such as the Laser Interferometer Gravitational-Wave Observatory (LIGO), the Large Hadron Collider (LHC — CERN), the International Thermonuclear Experimental Reactor (ITER) among others.

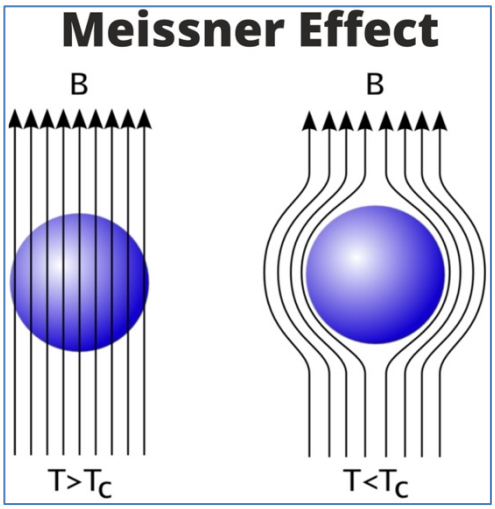
5.3. SUPERCONDUCTIVITY AT ROOM TEMPERATURE

Why in news?

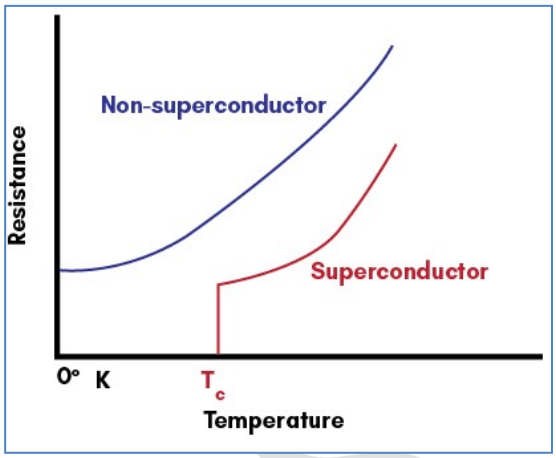
For the First Time, Physicists Have Achieved Superconductivity at Room Temperature.

More on news

- For the first time, physicists have **achieved the resistance-free flow of an electrical current in a material at room temperature** - 15 degrees Celsius (59 degrees Fahrenheit).
  - The material used is a combination of carbon, sulphur and hydrogen.
- Although, the **sample sizes used were microscopic and the pressure at which superconductivity emerged are still rather impractical.** This achievement will pave the way forward for generation of superconductivity in atmospheric conditions.



- Till now, scientists have been able to make materials superconduct only at temperatures much below zero degree C and hence making practical utility very difficult, as maintaining such low temperatures are energy intensive and, thus, expensive.



About Superconductivity

Superconductivity consists of two key elements:

- **Zero electrical resistance**: Usually, the flow of electrical current encounters some degree of resistance - a bit like how air resistance pushes back on a moving object, for example. The higher the conductivity of a material, the less electrical resistance it has, and the current can flow more freely.
- **Meissner effect**: It is the expulsion of a magnetic field from interior of a material during its transition to the superconducting state when it is cooled below the critical temperature.

POTENTIAL BENEFITS OF SUPERCONDUCTIVITY AT ROOM TEMPERATURE

Medical and biopharma applications	Superconducting materials are used in Nuclear Magnetic Resonance (NMR) and medical Magnetic Resonance Imaging (MRI).
Superconductivity and Big Science	In high-energy physics accelerators and in thermonuclear fusion reactors. The Large Hadron Collider (LHC) at CERN uses superconducting materials.
Power generation and distribution	Powerful new superconducting generators, high-capacity cables etc. will enhance the efficiency and reliability of electricity generation, transport and distribution.
Sustainable mobility	For ex: magnetically levitated high-speed train in Japan.
Sustainable mobility	Semiconductors, which have zero loss of energy, can be used to store power.

6. SPACE TECHNOLOGY

6.1. ISRO

6.1.1. JOINT LUNAR POLAR EXPLORATION MISSION

Why in News?

Recently, details of Joint Lunar Polar Exploration (LPE) mission were released by Japan Aerospace Exploration Agency (JAXA).

Details of the mission	
Launch Year	After 2023
Launch Vehicle	H3 Rocket
Launch Mass	6 tonne+
Payload Mass	350kg+ (including rover)
Operating Period	More than 3 months
Landing Point	South pole region of the Moon
Major Missions	Water Detector
	Science instrument
	Environment Measuring Instrument

Details of the Mission

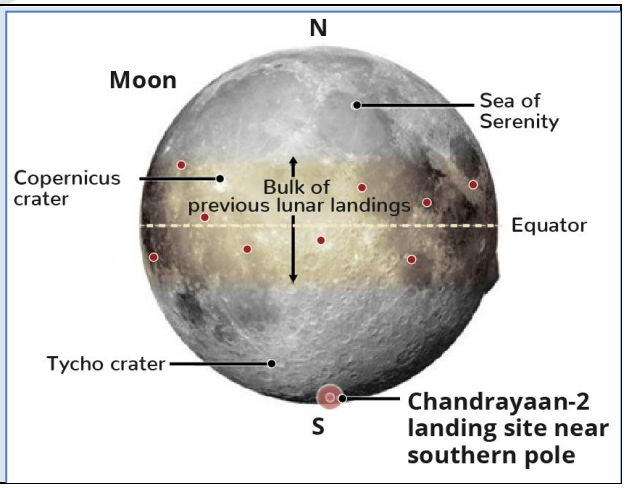
- It was conceptualized as joint mission between JAXA and Indian Space Research Organisation (ISRO) in 2017 which aims **to put a lander and a rover on the Moon's surface.**
- As per details shared by JAXA (see infographic), it will be launched after 2023.
- The mission would last for about six months and **will target a constantly sunlit region near the Moon's South Pole.**
- JAXA would be building the overall **landing module and rover** and **ISRO would develop lander system.**
- Rover will conduct an observation of the areas where **water may be presently distributed**. If it detects hydrogen, the rover will then mine the surface to collect samples.
- **Objectives of LPE mission**
  - **Obtain actual data regarding quantity of water** of areas where water is anticipated to exist.
  - Understand **distribution, conditions, form and other parameters of lunar water** resources at the moon's South Pole.
  - Improve technology needed to **explore surface of low-gravity celestial bodies** in order to support future lunar activities.
  - Determine **feasibility of utilizing such resources** for sustainable space exploration activities in future.

Related News

- Finding, by **NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA), indicates that water** may be distributed across the lunar surface, and **not limited to cold, shadowed places.**
  - SOFIA, an airborne observatory, is a joint project of NASA and German Aerospace Center.
- SOFIA has detected **water molecules (H_2O) in Clavius Crater** located in the Moon's southern hemisphere.

Why Moon's South Pole is special?

- Its craters have been untouched by sunlight for billions of years — **offering an undisturbed record of the solar system's origins.**
- Its permanently shadowed craters are **estimated to hold nearly 100 million tons of water**.
- Its elemental and positional advantages make it a **suitable pit stop for future space exploration.**
- It has traces of hydrogen, ammonia, methane, sodium, mercury, and silver — making it an **untapped source of essential resources.**



6.1.2. MARS ORBITER MISSION

Why in news?

Indian Space Research Organisation's (ISRO) Mars Orbiter Mission completed six years of orbiting Mars.

About Mars Orbiter Mission (MOM)

- MOM (also known as Mangalyan) was the **first interplanetary mission** of ISRO, **launched in 2013 by PSLV-C25** and put into Martian orbit in 2014 in its first attempt.

- **Its objectives include**
  - **Scientific:** exploration of Mars surface features, morphology, mineralogy and Martian atmosphere by indigenous scientific instruments.
  - **Technological:** deep space communication, navigation, mission planning and management.
- **Mars Orbiter Mission carried five payloads** to accomplish its scientific objectives (refer infographic).

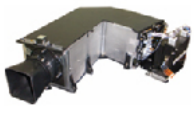
Other Mars mission in news

- **ExoMars 2022: joint programme of European Space Agency (ESA) and the Russian space agency.** It comprises two missions: First, Trace Gas Orbiter – launched in 2016 and, second, comprising a rover and surface platform, is planned for 2022.
- **Mars 2020 Rover:** Under this, NASA's **Perseverance rover** will seek signs of ancient life and collect rock and soil samples for possible return to Earth. It was launched in 2020.
- **Hope (Amal) Mission**: Launched by UAE in 2020, it is **Arab world's first mission to Mars.**
- **Tianwen-1: It is China's first Mars exploration mission,** launched in 2020.

How MOM has helped so far?

- **Helped prepare a Martian Atlas** based on the images provided by the orbiter.
- It made a finding that **dust storms on the Mars** can rise up to hundreds of kilometres.
- **Albedo map of Mars** has been prepared using MOM will be useful to study the surface properties of Mars.
  - Albedo is the fraction of solar energy reflected from planetary surface back into space.
- Recently, Mars Colour Camera (MCC) has captured the image of **Phobos, the closest and biggest moon of Mars.**
  - Mars has two moons, the other being **Deimos.**
  - Images highlighted craters on Phobos named- **Stickney, Shklovsky, Roche&Grildrig.**

MARS ORBITER MISSION PAYLOADS

				
Methane Sensor for Mars (MSM) ○ MSM is designed to **measure Methane (CH_4) in the Martian atmosphere** with Parts Per Billion (PPB) accuracy and map its sources. ○ Data is acquired **only over illuminated scene** as the sensor measures reflected solar radiation.	**Mars Color Camera (MCC)** ○ To give images & **information about the surface features and composition.** ○ MCC will help to monitor the dynamic events and weather of Mars. ○ MCC will also be used for **probing the two satellites of Mars – Phobos & Deimos.**	**Lyman Alpha Photometer (LAP)** ○ It measures the **relative abundance of deuterium and hydrogen** from Lyman-alpha emission in the Martian upper atmosphere. ○ It will allow **understanding the loss process of water** from the planet.	**Thermal Infrared Imaging Spectrometer (TIS)** ○ TIS **measure the thermal emission** and can be operated during both day and night. ○ **Temperature and emissivity** are the two basic physical parameters estimated from thermal emission measurement.	**Mars Exospheric Neutral Composition Analyser (MENCA)** ○ MENCA is a quadrupole mass spectrometer based scientific payload, capable of measuring relative abundances of neutral constituents.

6.1.3. CHANDRAYAAN 2

Why in News?

Recently, Chandrayaan 2 mission completed 1 year.

About Mission

- Chandrayaan-2, a completely indigenous mission, is India's **second lunar exploration mission with following basic components:**
  - **Orbiter**- will observe the lunar surface and relay communication between Earth and Chandrayaan 2's Lander.
  - **Lander (called Vikram)**- Designed to execute India's first soft landing on the lunar surface.
  - **Rover (called Pragyan)**- A 6-wheeled, AIpowered vehicle, which will move on the lunar surface and perform on-site chemical analysis.

- **Launcher-** It was launched by Geosynchronous Satellite Launch Vehicle GSLV MkIII-M1. It is India's most powerful launcher to date, and has been completely designed and fabricated from within the country.
- **Some notable features of Chandrayaan 2 Mission:**
  - Would have been the 1st space mission to conduct a soft landing on the Moon's South Polar Region.
  - 1st Indian expedition to attempt a soft landing on the lunar surface with homegrown technology.
  - 1st Indian mission to explore the lunar terrain with home-grown technology.
  - Would have been the 4th country ever to soft land on the lunar surface after the United States, the U.S.S.R. and China.
- **Primary Objective:** To demonstrate the ability to soft-land on the lunar surface and operate a robotic rover on the surface. It seeks to
  - stimulate the advancement of technology,
  - promote global alliances.
- **Scientific Objectives**
  - Moon provides the best linkage to Earth's early history.
  - Evidence for water molecules discovered by Chandrayaan-1 requires further studies.
  - It will also study new rock types with unique chemical composition

Mission Payloads

Orbiter payloads

- Terrain Mapping Camera-2 (TMC-2),
- Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS),
- Solar X-ray monitor (XSM),
- Orbiter High Resolution camera (OHRC)
- Dual Frequency L and S band Synthetic Aperture Radar (DFSAR),
- Imaging IR Spectrometer (IIRS),
- Chandrayaan-2 Atmospheric Compositional Explorer 2 (ChACE-2),
- Dual Frequency Radio Science (DFRS) experiment.

Vikram payloads

- Radio Anatomy of Moon Bound Hypersensitive Ionosphere and Atmosphere (RAMBHA),
- Chandra's Surface Thermo-physical Experiment (ChaSTE),
- Instrument for Lunar Seismic Activity (ILSA)

Pragyan payloads

- Alpha Particle Induced X-ray Spectroscope (APXS),
- Laser induced Breakdown Spectroscope (LIBS)
- Passive Experiment- Laser Retroreflector array (LRA)

Related News

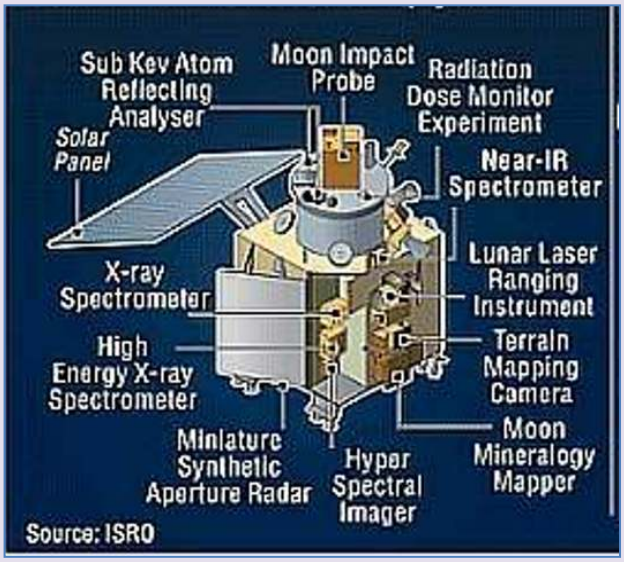
- Recently, First set of **data from Chandrayaan-2 mission was released for wider public use** through the PRADAN portal hosted by Indian Space Science Data Centre (ISSDC).
  - ISSDC is the nodal centre of planetary data archive for planetary missions of ISRO.

Related News

- Recently, Images sent by Chandrayaan-1 indicate possible impact of Earth's atmosphere on Moon.

More on News

- Images show that **Moon may be rusting at poles.** Also, Chandrayaan-1 data indicates that Moon's poles are home to water.
  - Since surface of Moon is known to have iron-rich rocks, and not water and oxygen, **NASA believes that atmosphere might be partly responsible for the same.**



About Chandrayaan-1

- Launched in 2008. It **carried 11 scientific instruments** built in India, USA, UK, Germany, Sweden and Bulgaria.
  - **Payloads from India:** Terrain Mapping Camera, Hyper Spectral Imager, Lunar Laser Ranging Instrument, High Energy X - ray Spectrometer, Moon Impact Probe.
  - **Payloads from abroad:** Chandrayaan-I X-ray Spectrometer, Near Infrared Spectrometer, Sub keV Atom Reflecting Analyzer, Miniature Synthetic Aperature Radar, Moon Mineralogy Mapper, Radiation Dose Monitor.
- It aimed at conducting **chemical and mineralogical mapping of the entire lunar surface** for distribution of mineral and chemical elements
- **Key findings:** Detected water in vapour form in trace amounts, confirmed Ocean Magma Hypothesis, detected x-ray signals during weak solar flares thus indicating presence of magnesium, aluminum, silicon and calcium on lunar surface, New spinel-rich rocks.

6.1.4. INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM

Why in News?

India's IRNSS is now part of World Wide Radio Navigation System (WWRNS)

More on News

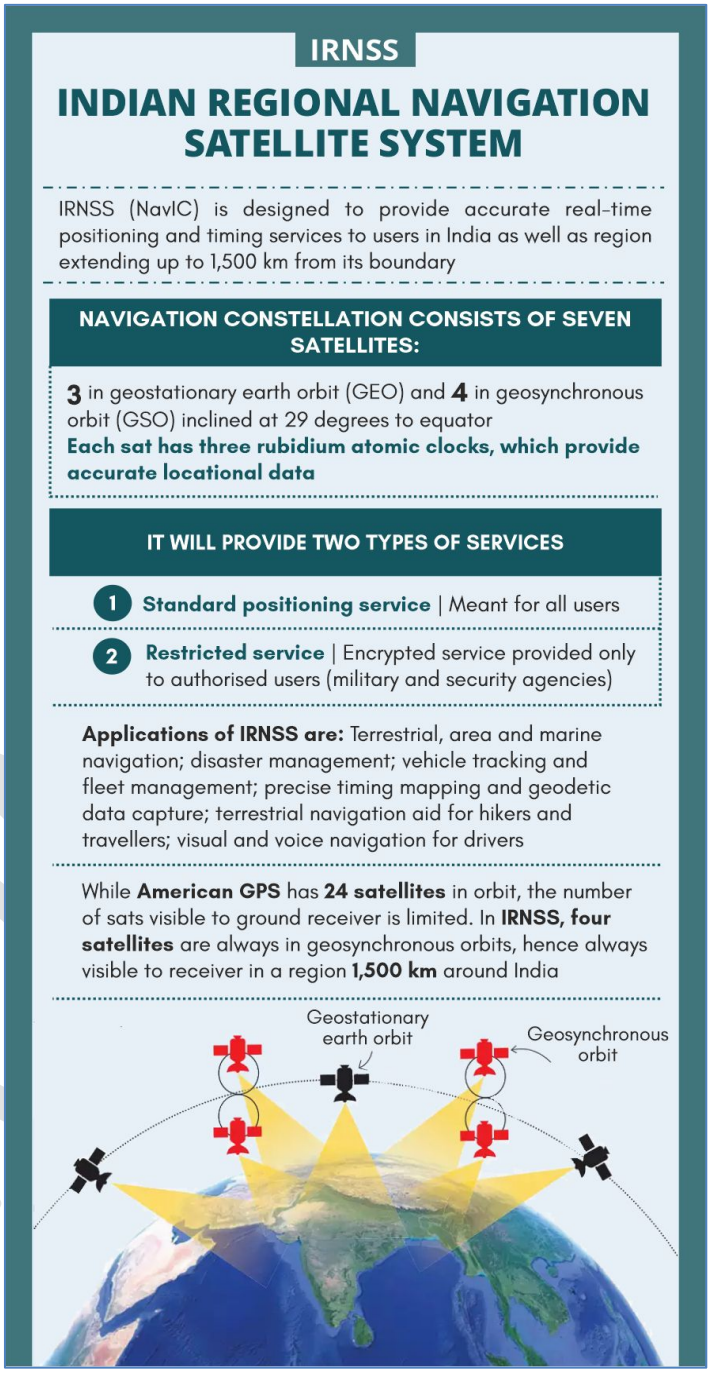
- **India became the fourth country in the world to have its independent regional navigation satellite system recognised by International Maritime Organisation (IMO)** as a part of WWRNS.
  - Other three are **US's GPS, Russia's GLONASS and China's BeiDou.**
  - IMO is a United Nations agency responsible for safety and security of shipping.
  - WWRNS is an IMO process whereby navigation system providers submit their systems for recognition.

About IRNSS

- IRNSS is designed to provide geospatial positioning information in the region **extending up to 1500 km from Indian boundary.**
  - A constellation of **seven satellites - three in geostationary orbit and four in geosynchronous orbits.**
  - It was developed by ISRO to **cut down India's dependency on foreign navigation satellite systems.**

Benefit of being part of WWRNS

- **Merchant vessels can use IRNSS for obtaining position information** to assist in navigation of ships in ocean waters within the defined area.
- **Lessen overdependence** on any single GPS system.



6.1.5. EARTH OBSERVATION SATELLITE (EOS-01)

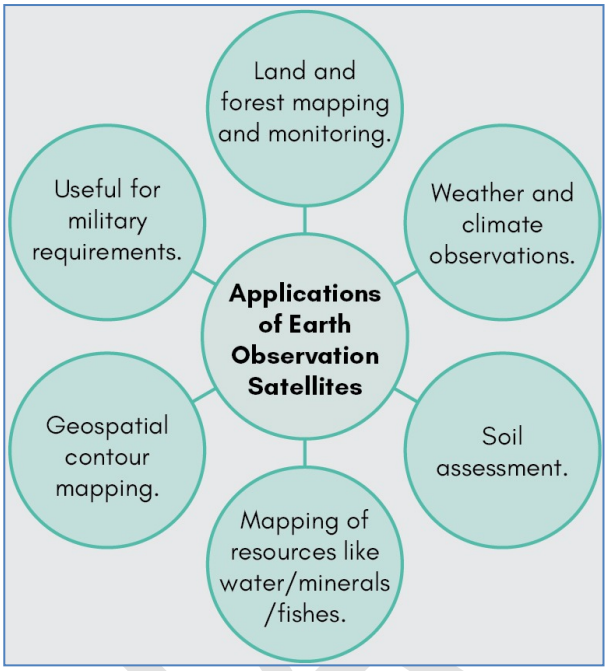
Why in News?

- Recently, Polar Satellite Launch Vehicle, in its fifty first flight (PSLV-C49), **successfully launched EOS-01 along with nine international customer satellites** from Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota.
  - The nine customer satellites are from Lithuania (1), Luxembourg (4) and USA (4).

About EOS-01

- It is another **Radar Imaging Satellite (RISAT)** that will work together with RISAT-2B and RISAT-2BR1 launched last year.
- **It will operate in Low-earth orbit.** A low Earth orbit (LEO) is relatively close to Earth's surface. It is normally at an altitude of less than 1000 km but could be as low as 160 km above Earth.

- With EOS-01, **ISRO is moving to a new nomenclature for its earth observation satellites** according to the purpose they are meant for. They were named thematically till now.
  - **Cartosat** series of satellites were meant to **provide data for land topography and mapping**
  - **Oceansat** satellites were meant **for observations over sea.**
  - Some **INSAT-series, Resourcesat series, GISAT, Scatsat** are all earth observation satellites, named differently for the specific jobs or the different instruments that they use.
- EOS01 uses **synthetic aperture radars** to **produce high-resolution images of the land.**
  - Advantage of radar imaging over optical instruments is that it is **unaffected by weather, cloud or fog, or the lack of sunlight.** It can produce high-quality images in all conditions and at all times.
  - **EOS-01, and its sister RISATs, uses X-band radars** that operate at low wavelengths and are considered best for monitoring of urban landscape, and imaging of agricultural or forest land.



New PSLV designed for EOS-01

- ISRO used a new variant of its PSLV rocket that has been **flown only once before.**
- This variant of PSLV **does not become waste after depositing its satellite** in the orbit.
- Instead, the last stage of the rocket **which remains after the satellite is separated can acquire its own orbit** and be used as **an orbital platform** for **other on-board instruments to perform experiments.**

6.2. OTHER DEVELOPMENTS RELATED TO INDIA

6.2.1. SPACE BASED REMOTE SENSING

Why in news?

Recently, Department of Space has published a draft 'Space based Remote Sensing Policy' of India (SpaceRS Policy 2020).

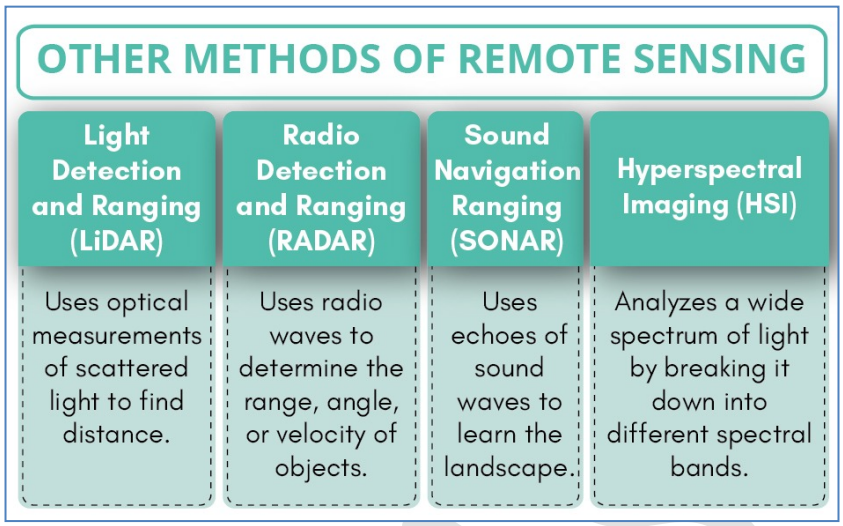
About Space Remote Sensing Policy - 2020' (SpaceRS Policy - 2020)

- Policy aims at **encouraging various stakeholders in the country to actively participate in space based remote sensing activities** to enhance commercialization of space technology.
- Policy states that Government of India shall:
  - **Promote Indian Industries** to carry out space based remote sensing activities within and outside India.
  - **Enable easy access to space based remote sensing data.**
  - **Concentrate on realisation of space based remote sensing systems** to cater to the country's needs.
  - **Provide a timely and responsive regulatory environment** for the commercial Indian industry.
- Earlier **Remote sensing data policy (RSDP) 2011 is said to be more restrictive and provides less opportunities** to service providers.

About Remote Sensing

- Remote sensing is the **process of detecting and monitoring the physical characteristics of an area/object** by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft).
- **Some examples are:**
  - **Cameras on satellites and airplanes** take images of large areas on the Earth's surface.
  - **Sonar systems on ships** can be used to create images of the ocean floor without needing to travel to the bottom of the ocean.
- Remote Sensing data have **ability to detect changes, observations at different resolutions** due to characteristics like synoptic view, repetitive coverage with calibrated sensors etc.
- **Space based remote sensing** is the process of detecting and monitoring the physical characteristics of an area from satellite, aircraft and Unmanned Arial Vehicle (UAV).

- **Spectral, spatial, temporal and polarization signatures are major characteristics** of the remote sensing, which facilitate target recognition and classification.
- **Application of the space based remote sensing includes** identifying and mapping natural resources, Disaster management, Agriculture, Rural and urban development, Weather and climate, Governance etc.



6.2.2. INDIAN NATIONAL SPACE PROMOTION AND AUTHORIZATION CENTRE (IN-SPACE)

Why in news?

Government has created **Indian National Space Promotion and Authorization Centre (IN-SPACe)** to boost private sector participation in entire range of space activities.

About New Space India Limited

- It was founded in 2019, by **Department of Space (DOS) to bridge gap between ISRO and private sector** and facilitates transfer of ISRO technologies to industry.
- It is a **wholly-owned Government of India company,** under the administrative control of DOS.
- **It will not replace ANTRIX**, a private limited company owned by Government of India in 1992 as a Marketing arm of ISRO.

About IN-SPACe

- It is the **new entity of the Department of Space** which will have its own chairperson and board.
  - It will **regulate and promote building of routine satellites**, rockets and commercial launch services through Indian industry and startups.
  - It will **have its own directorates for technical, legal, safety and security,** monitoring and activities promotion.
- It will **act as an interface between ISRO and private parties**, and assess how best to utilise India's space resources and increase space-based activities.
  - It will function autonomously and parallel to ISRO.
  - **ISRO will remain the basic body** that decides what missions are to be undertaken but IN-SPACe will help fill the gaps.
- It is the **second space organisation** created by the government in the last two years. The first one was **New Space India Limited (NSIL).**

6.2.3. INDIA'S FIRST IN-ORBIT SPACE DEBRIS MONITORING AND TRACKING SYSTEM

Why in News?

Recently, **Digantara,** India's first air and space surveillance company, **has developed India's first in-orbit Space debris monitoring and tracking system.**

About Space Debris

- Space debris **encompasses both natural (meteoroid) and artificial (man-made) particles.** Meteoroids are in orbit about the sun, while most artificial debris is in orbit about the Earth.
  - Hence, the latter is more commonly referred to as orbital debris.
- There are **more than 20,000 pieces of debris orbiting the Earth** traveling at speeds up to 17,500 mph, fast enough to damage a satellite or a spacecraft.
- There are **no international space laws to clean up debris** in LEO.

About the Debris monitoring and tracking system

- System will **provide global real-time earth coverage** by deploying a constellation of cost-efficient nano satellites in LEO (Low Earth Orbit) and **a space-based air surveillance payload for accurate tracking** of both aircraft and space objects.

How will it work?

- Team developed an **Orbit space debris Monitor using LiDAR (light detection and ranging) technology** which detects and maps any space debris less than 5 cm in size.
- LiDAR is a **remote sensing technology** that uses light in the form of a pulsed laser to measure ranges (distances) to a target.
    - A LiDAR instrument principally consists of a **laser, a scanner, and a specialized GPS receiver.**

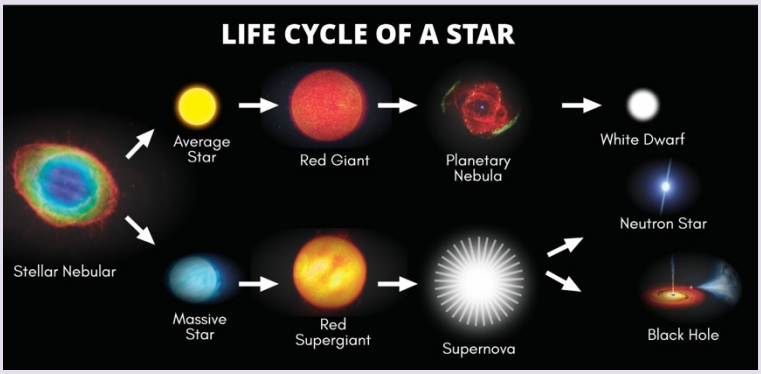
6.2.4. MISCELLANEOUS

CMS- 01	• Recently, ISRO launched the country's **42nd communication satellite CMS-01.** • CMS-01 is envisaged to provide services in the Extended-C Band of the frequency spectrum whose **coverage will include the Indian mainland, Andaman-Nicobar and Lakshadweep Islands.** • Satellite will be the first in a **new series of communication satellites by India after the GSAT and INSAT series.**

ASTROSAT	• Recently, Scientists **discovered one of the earliest galaxies using India's ASTROSAT.**
	• Also, AstroSat's Ultraviolet Imaging Telescope **spotted rare ultraviolet-bright stars in a massive intriguing cosmic dinosaur** (globular cluster NGC 2808) in the Milky Way.
	• ASTROSAT is India's **first dedicated multi wavelength space observatory.**
	  ○ It **observes universe in optical, Ultraviolet, low and high energy X-ray regions** of the electromagnetic spectrum.
	  ▪ **Light waves with shorter wavelengths (and higher frequencies) have more energy** so types of light like gamma rays, X-rays, and ultraviolet light are more energetic than visible light
	  ○ It was launched in a 650-km, near-equatorial orbit.

Himalayan Chandra Telescope (HCT)	• Recently, HCT completed 20 years of its operation.
	• It is an **optical-infrared telescope** that aims to **study solar system bodies and star formation in external galaxies**.
	  ○ The telescope has been used in many coordinated international campaigns.
	• It is installed at **Indian Astronomical Observatory (IAO), Ladakh.**
	• It is **remotely operated** from the Centre for Research & Education in Science &Technology, Indian Institute of Astrophysics.
	• It is **named after India-born Nobel laureate Subrahmanyam Chandrasekhar**.
	  ○ He was one of the first scientists to couple the study of physics with the study of astronomy.
	  ○ He proved that there was an upper limit to the mass of a white dwarf. This limit, known as the **Chandra limit, showed that stars more massive than the Sun would explode or form black holes as they died.**
	  ○ In 1983 he was **awarded the Nobel Prize in Physics** for his work on the physical processes involved in the structure and evolution of stars.

India's Second Rocket Launch Pad	• It is being setup in **Thoothukudi** (formerly known as Tuticorin) district in **Tamil Nadu**.
	• The project will house one launch pad exclusively for **small satellite launch vehicles (SSLV)**.
	• **India presently has one rocket port at Sriharikota** in **AndhraPradesh** with two launch pads.
	• **Why was Thoothukudi chosen?**
	  ○ **Geostrategic Location:** In polar missions, the PSLV from Sriharikota must perform a dogleg manoeuvre (deviation of rocket from straight flight path) to avoid flying over Sri Lanka, to protect it from rocket debris.
	  ▪ **Rockets launched from Thoothukudi don't require this manoeuvre** as there is no landmass along the flight path in the southward direction. It will also improve the payload capability.
	  ○ **Proximity to critical infrastructure:** Thoothukudi is around 70-100 kms away from ISRO's Liquid Propulsion Systems Centre (LPSC) in Tirunelveli.
	  ○ **Proximity to Earth's equator:** India prefers its spaceports as close to the equator as possible and located on the east coast for two reasons:
	  ▪ Earth's rotation provides a speed boost to rockets launched and strength of the boost is higher closer to the equator.
	  ▪ In the event of a failure, debris from an explosion would fall into the Bay of Bengal instead of land.

Lithium in Stars	• Stars, as per known mechanisms of evolution, **destroy lithium as they evolve into red giants.** Planets were known to have more lithium than their stars — as is the case with the Earth-Sun pair. • However, **some stars were found that were lithium-rich** leading to a contradiction in the earlier understanding. • According to research by Indian scientists, when stars grow beyond their Red Giant stage into the Red Clump stage, **they produce lithium in what is known as a Helium Flash** and this is what enriches them with lithium. 
Sonic boom	• It is a **thunder-like noise** heard on ground when an aircraft or other type of aerospace vehicle flies overhead **faster than the speed of sound, or "supersonic."** ○ **As long as the source of the sound keeps moving slower than the speed of sound itself**, this source– say a truck or a plane – **remains nested within the sound waves that are travelling in all directions**. ○ When an aircraft travels at supersonic speed, **field of sound waves moves to the rear of the craft.** • Recently, it was heard in Bengaluru, emanating from an Indian Air Force test flight.
Space bricks	• Researchers from ISRO and the Indian Institute of Science, Bengaluru has developed a **sustainable process to make space bricks on the lunar surface.** ○ It **uses urea sourced from human urine**, which could be mixed with lunar soil to build structures on the moon.

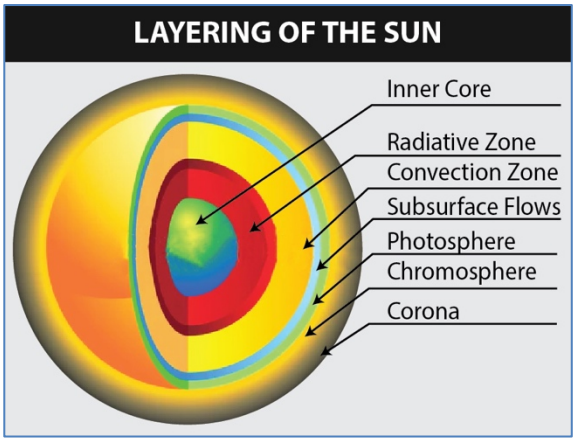
6.3. NASA

6.3.1. NASA'S HELIOPHYSICS MISSIONS

Why in News?

Recently, NASA approved two Heliophysics Missions to **Explore** Sun, Earth's Aurora.

About missions



- Missions will **explore the Sun and the system that drives space weather near Earth.** This will help scientists understand the Sun and Earth as an interconnected system.
- **Extreme Ultraviolet High-Throughput Spectroscopic Telescope (EUVST) mission**
  - EUVST is a solar telescope that will study **how the sun's atmosphere releases solar wind and drives eruptions of solar material.** Mission, also known as Solar-C, is led by Japan Aerospace Exploration Agency.
    - Solar wind is **created by the outward expansion of plasma** (a collection of charged particles) from the Sun's corona (outermost atmosphere).
    - Solar winds **can disrupt communications, navigation systems, and satellites.**
- **Electrojet Zeeman Imaging Explorer (EZIE) Mission**
  - EZIE mission **will study electric currents in Earth's atmosphere** linking aurora to the Earth's magnetosphere.

About Auroras

- Auroras are **caused by the interaction of energetic particles (electrons and protons) of the solar** wind with atoms of the upper atmosphere. Aurora occurs primarily in high latitudes of both hemispheres.
- Auroras in the Northern Hemisphere are called **aurora borealis, aurora polaris, or northern lights,** and in the Southern Hemisphere **aurora australis, or southern lights**.

- Magnetosphere is the region of space surrounding Earth where the **dominant magnetic field is the magnetic field of Earth, rather than of interplanetary space.**
- Magnetosphere is formed by the interaction of solar wind with Earth's magnetic field.

- **Some other solar missions:** European Space Agency's Solar Orbiter, Nasa's Parker Solar Probe, India's Aditya-L1 mission.

6.3.2. FIFTH STATE OF MATTER

Why in news?

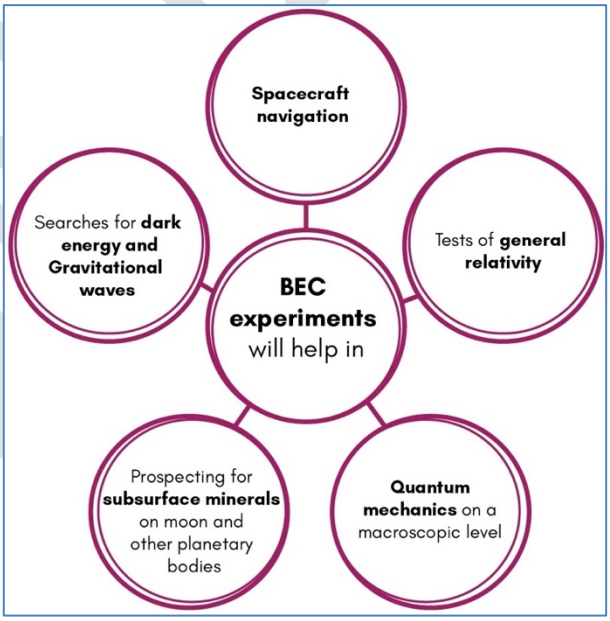
NASA Scientists recently **observed the fifth state of matter in space for the first time** as part of Bose Einstein Condensates (BEC) Experiments aboard the International Space Station (ISS).

Fifth state of matter

- The existence of **BEC,** also known as the fifth state of matter was predicted by Albert Einstein and Indian mathematician Satyendra Nath Bose in early 1920s.
  - **Solids, liquids, gases and plasma** are the other **four states of matter.**
- BEC is a **super cooled gas that no longer behaves as individual atoms and particles**, but rather an entity in a single quantum state**.**
- BECs are formed when atoms of certain elements are **cooled to near absolute zero (0 Kelvin, minus 273.15 Celsius).**
- **When they reach that temperature**, the atoms become a **single entity with quantum properties,** wherein each particle **also functions as a wave of matter**.
- **BECs are extremely fragile** and the slightest interaction with the external world is enough to warm them past their condensation threshold.
- This makes it nearly **impossible for scientists to study them on Earth**, where **gravity interferes** with the magnetic fields required to hold them in place for observation.

About Plasma – Fourth state of matter

- Plasma is like a **gas, but comprised of positive ions and free electrons** with little or no overall electric charge.
- Because of presence of charged ions, plasma is **highly electrically conductive** and **responds strongly to magnetic and electric fields** (unlike gas).
- Plasmas have **no fixed shape or volume**, and are less dense than solids or liquids.
- Plasma is the **most common state of matter** in the **Universe** comprising more than **99% of our visible universe**.
- Plasma **occurs naturally** in **sun,** the **core of stars, quasars, X-ray beam emitting pulsars and supernovas.**
- **On Earth**, plasma naturally occurs in **flames, lightening and the auroras**.
- Plasmas can be formed by **heating a gas to high temperatures**, as, when heated, the atoms in the gas either gain or lose electrons (ionization).



6.4. ANNULAR SOLAR ECLIPSE

Why in news?

Recently, the annular solar eclipse and summer solstice occurred on the same day for the first time in 19 years.

About Solar eclipse

A solar eclipse **occurs at New Moon**, when the moon moves between the Sun and the Earth. Solar eclipses happen once every 18 months. Unlike lunar eclipses, solar eclipses only last for a few minutes.

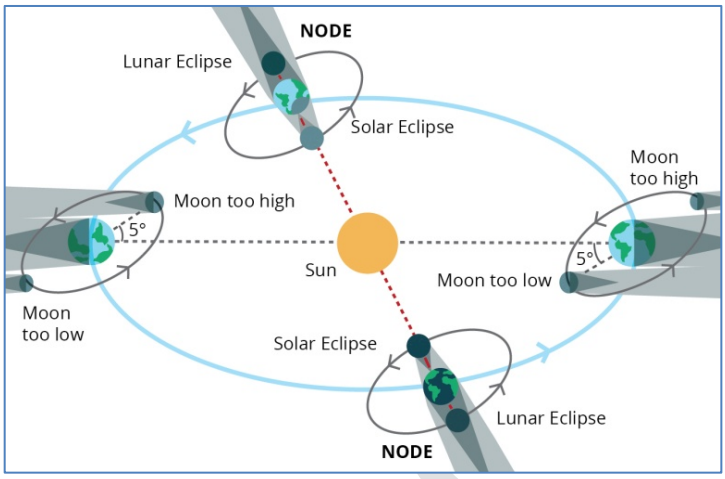
There are four types of eclipses:

- **Total solar eclipse**: Total solar eclipses are rare at any particular location because totality exists only along a narrow path on the Earth's surface traced by the Moon's **full shadow or umbra**.

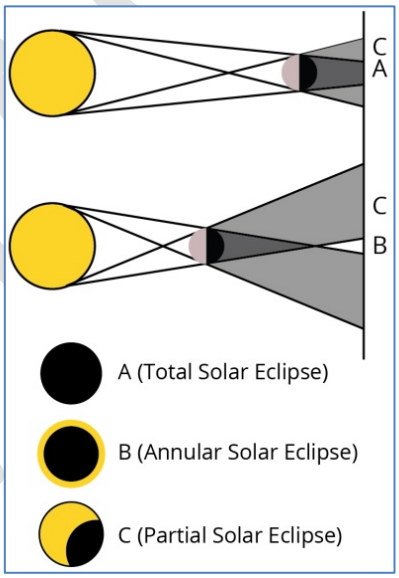
Lunar nodes

- The Moon's orbit around the Earth is tilted with relation to the Earth's orbital plane by **5 degrees** with two intersecting points – **'Ascending Node'** and **'Descending Node.'**
- Thus, despite the Moon being between the Earth and Sun on every new Moon, the three do not always come on a straight line or cause an eclipse.
- These nodes also rotate around the Earth once in **18 years.**
- In this way, if a new Moon takes place when a node is also between the Earth and Sun, the three come in a straight line and an eclipse takes place.

- **It happens when:**
  - it is New Moon.
  - the Moon is near perigee (the closest point of the Moon from Earth).
  - the Moon is at (or very near) a lunar node, so the Earth, the Moon, and the Sun are aligned in a straight (or nearly straight) line.
- It is visible only from a small area on Earth.
- People who are able to view the total solar eclipse are in the centre of the moon's shadow as and when it hits the Earth.



- **Partial solar eclipse:** This happens when the sun, moon and Earth are not exactly lined up. The sun appears to have a dark shadow on only a small part of its surface.
- **Annular solar eclipse (ASE):**
  - It occurs when the angular diameter of the Moon falls short of that of the Sun so that it cannot cover up the latter completely.
  - Since the moon does not block the sun completely, it looks like a "dark disk on top of a larger sun-colored disk" forming a **"ring of fire"** (or **annulus**).
  - **For an ASE to take place, three things need to happen-**
    - there should be **a** New Moon
    - the Moon should be at or very near a lunar node so that the Sun, Moon and the Earth all are in a straight line
    - the Moon should be near the apogee (the farthest point of the Moon from Earth) so that the outer edge of the Sun is visible.
  - During one of the phases of the ASE a phenomena called **Bailey's Beads'** are visible. This is a thin fragmented ring caused by passage of sunlight through the rough edge of the Moon.
  - This is the only time when one can find **two shadows** for everything in all the sides under the sunlight because the light source during Annularity is a giant illuminating ring.
  - During partial and annular solar eclipses, it is dangerous to view sun without proper equipment and techniques. Not using proper methods and equipment for viewing can cause permanent eye damage or severe visual loss.



- **Hybrid Eclipse:** This is a very rare eclipse where the eclipse will only be annular for the first few seconds. For the rest it will be a total eclipse.

6.5. MAGNETIC FIELD OF SUN'S CORONA

Why in News?

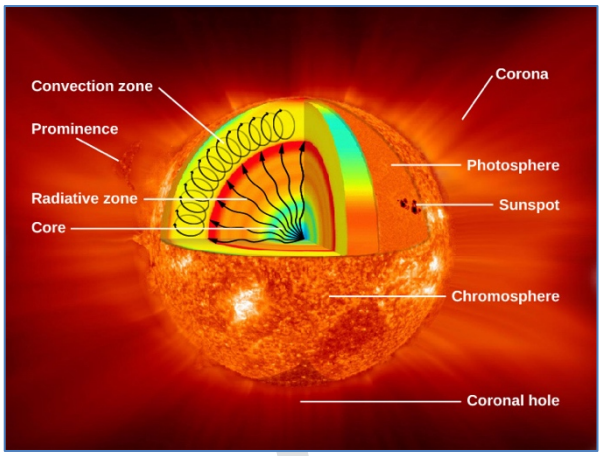
Global magnetic field of Sun's corona was measured for the first time.

More on News

- **Corona is the outermost layer of the Sun's atmosphere**, consisting of hot, diffuse, and highly ionized plasma.
- **Sun's magnetic field governs many aspects of the Sun's behavior** such as 11-year solar cycle, solar eruptions etc.
- Till now, **solar magnetic fields were measured only at Sun's surface** (photosphere).
  - Magnetic field information of whole atmosphere of sun is required to understand the interplay between solar plasma and magnetic field.
- Researchers used a technique known as **coronal seismology or magneto seismology** to measure the coronal magnetic field.

- This **method uses magnetic waves, known as Alfvénwaves**, that are observed to travel along with the magnetic fields.
- This study is first time that a **global map of the coronal magnetic field** has been obtained

- **Study will help in understanding**
  - **Reasons which causes corona to heat up**, though the photosphere is cooler than the interior.
    - Core of the Sun is at about 15 million degrees, photosphere is a mere 5700 degrees hot and corona is at one million degrees or more.
  - **Mechanisms of eruptions of the Sun,** such as solar flares and coronal mass ejections.



Related News

- **Solar Cycle 25 started in December 2019.**
  - **Sun is a huge ball of electrically-charged hot gas**. This charged gas moves, generating a powerful magnetic field.
  - **Sun's magnetic field goes through a cycle, called solar cycle**.
    - Every 11 years or so, Sun's magnetic field completely flips**.** This means that the Sun's north and south poles switch places.
  - **Scientists track a solar cycle by using sunspots,** an area on the Sun that appears dark on the surface as they are relatively cooler than surrounding parts.
    - **Beginning of a solar cycle is a solar minimum**, or when the Sun has the least sunspots. Over time, solar activity, and the number of sunspots, increases
  - During a solar cycle, giant eruptions on the Sun can have a major effect on **radio communications, Global Positioning Systems (GPS) connectivity, power grids, and satellites**

6.6. DISCOVERY OF PULSARS

Why in News?

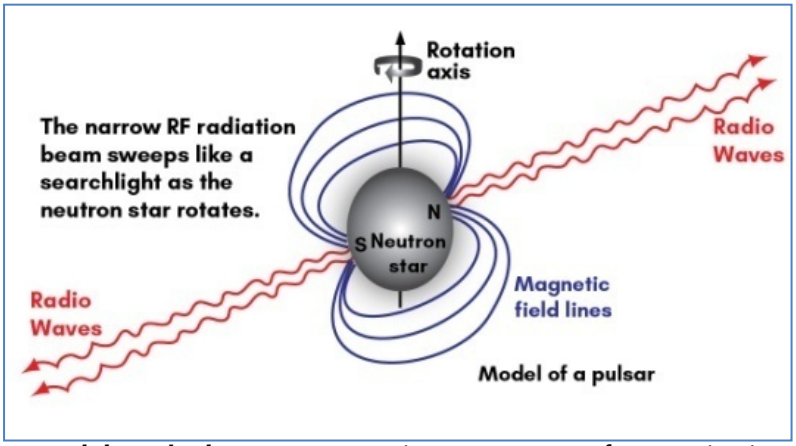
- Recently, The Royal Society unveiled a new portrait of **astrophysicist Dame Jocelyn Bell Burnell, who is credited with discovering pulsars in 1967.**
  - Discovery was **recognised by a Nobel Prize in physics in 1974** that was shared by two professors, Antony Hewish (Burnell's supervisor) and Martin Ryle.

Neutron stars, Pulsars and Magnetars

- Neutron stars are formed **when a massive star runs out of fuel and collapses.**
  - Core of the star collapses, crushing together every proton and electron into a neutron.
- **If the core of the collapsing star is between about 1 and 3 solar masses,** these newly-created neutrons can stop the collapse, leaving behind a neutron star.
  - **Stars with higher masses** will continue to **collapse into stellar-mass black holes.**
- **Magnetar is another type of neutron star**.
  - In a typical neutron star, the magnetic field is trillions of times that of the Earth's magnetic field;
  - However, **in a magnetar, the magnetic field is another 1000 times stronger.**

What are Pulsars?

- Pulsars are **rapidly rotating neutron stars that emit radio-frequency pulses.**
- **Pulsars are highly magnetic.** Pulsars have magnetic fields that range from 100 million times to 1 quadrillion (a million billion) times stronger than Earth's.
- **Pulsars can radiate light in multiple wavelengths,** from radio waves all the way up to gamma-rays, the most energetic form of light in the universe.
  - Also, the beam of radio waves emitted by a **pulsar may not pass through the field of view of an Earth-based telescope**, preventing astronomers from seeing it.



- Scientists use pulsars **to study extreme states of matter, gravitational waves, search for planets beyond Earth's solar system and measure cosmic distances.**

6.7. FIRST POTENTIAL RADIO SIGNAL FROM EXOPLANET

Why in News?

- Recently, a **potential radio signal was collected for the first time from an exoplanet system about 51 light-years away from our solar system.**

More on News

- The **emission bursts were uncovered from the Tau Bootes star-system** which contains a binary star system and an exoplanet.
- **Observing an exoplanet's magnetic field helps astronomers decipher a planet's interior and atmospheric properties,** as well as the physics of star-planet interactions.
  - The magnetic field of Earth-like exoplanets may contribute to their possible habitability by shielding their own atmospheres from solar wind and cosmic rays, and protecting the planet from atmospheric loss.
  - Earth's magnetic field protects it from solar wind dangers, keeping the planet habitable.

About Exoplanets

- Exoplanets are the **planets that orbit around stars other than the Sun.** They are very hard to see directly with telescopes as they are hidden by the bright glare of the stars they orbit.
- **Some of the exoplanets discovered so far:**
  - **Super earth:** It is an exoplanet that is similar to size of Earth but with more mass than Earth and less than a larger planet like Uranus or Neptune.
  - **Kepler-1649c:** It is Earth-size exoplanet300 light-years away which was recently discovered from data of NASA's Kepler space telescope (retired in 2018).
  - **K2-18b:** It is more than eight times the mass of Earth and orbits a red dwarf star 124 light-years away from Earth in the Leo constellation.
  - **WASP-76b:** It is 640 light-years from earth.
- **Fomalhaut B**, one of the first exoplanets ever discovered, **was recently confirmed a cloud of dust and not an exoplanet.**

6.8. DARK MATTER NOT 'SUPER HEAVY' OR 'SUPER LIGHT'

Why in News?

- Scientists have **narrowed down the range of masses within which particles that could make up dark matter may lie** using Quantum gravity.
  - **Quantum gravity** is a combination of Einstein's concepts of quantum physics and general relativity and it **attempts to explain how gravity works on the universe's smallest particles.**

More on News

- Research shows that the dark matter particles can neither be super light nor super heavy **unless there is a 'force acting on it that is yet unknown'.**
- **Dark matter and dark energy constitute 95% of the Universe.**
  - **Roughly 27% is dark matter** which is considered to be responsible for holding the galaxies together.
  - **Another 68% of the Universe is believed to be made up of dark energy** which is responsible for the accelerated expansion of the Universe**.**
- Dark matter is **completely invisible to light and other forms of electromagnetic radiation**, making it impossible to detect with current instruments.
- However, its **gravitational effects are necessary to explain the motions** of clusters of galaxies and the structure of the entire Universe at the largest scale.

6.9. SATURN'S TILT CAUSED BY ITS MOONS

Why in News?

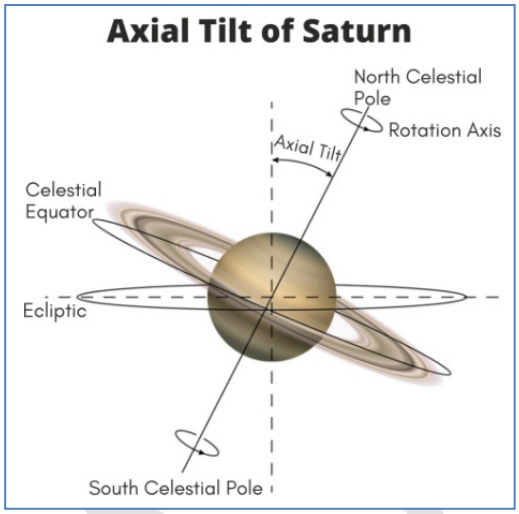
- A team of researcher reported that Saturn's axial tilt is **caused by the gravitational pull of Saturn's moons as they migrate away from their host planet.**

Missions to Saturn:

- **Pioneer 11, launched by NASA,** was the first spacecraft to study Saturn up close. The mission ended in 1995.
- **Voyager 1 and 2, launched by NASA,** to conduct close-up studies of Jupiter and Saturn, Saturn's rings, and the larger moons of the two planets.
- **Cassini probe** to explore Saturn's atmosphere, rings, magnetosphere, and moons**.**
  - It has successfully found geysers on Saturn's moon Eneladus, evidence that its moon Titan is Earth-like, and Saturn's rings are active and dynamic.

- They also predict that the planet will keep tilting in the future for a few billion years.

About Saturn



- Saturn is the sixth planet from the Sun and the **second largest planet in our solar system** and is made mostly of hydrogen and helium.
  - **Saturn's rings are thought to be pieces of comets,** asteroids or shattered moons that broke up before they reached the planet, torn apart by Saturn's powerful gravity.
  - Saturn is the **planet with most moons. Titan is the largest moon of Saturn** and the second-largest natural satellite in the Solar System.
    - ✓ Jupiter's moon Ganymede is largest.

About Saturn's Tilt

- Its **axis is tilted by 26.73 degrees with respect to its orbit around the Sun, which is similar to Earth's 23.5-degree tilt.** This means that, like Earth, Saturn experiences seasons.
  - Astronomers propose that earth's tilt is **due to energetic collisions between the 'planetessimals' which eventually coalesced to form the planets.**
    - ✓ Planetesimal, one of a class of bodies that are theorized to have coalesced to form Earth and the other planets after condensing from concentrations of diffuse matter early in the history of the solar system.

6.10. RECENT SPACE RELATED PHENOMENON AND FINDINGS

Asteroid 16 Psyche	• Asteroid 16 Psyche, which **orbits between Mars and Jupiter,** is one of the most massive objects in the asteroid belt in our solar system. ○ Asteroids, sometimes called minor planets, **are rocky, airless remnants left over from the early formation of solar system.** • A recent study has found that **asteroid 16 Psyche could be made entirely of metal and is worth an estimated $10,000 quadrillion**, more than the entire economy of Earth.

Asteroid 2020 ND	• Recently, **Asteroid 2020 ND** made a **fly-past the Earth**.
	• NASA classified it as the **Potentially Hazardous Asteroids (PHAs) and also as a Near Earth Object (NEO).**
	  ○ NEOs are **comets and asteroids** moved by the gravitational attraction of nearby planets into orbits which allow them to enter the Earth's neighborhood. These objects are **composed mostly of water ice** with **embedded dust particles**.
	  ○ Asteroids with **a minimum orbit intersection distance (MOID**) of **about 0.05 AU, and bigger than150 meters in diameter are considered PHAs**.
	  ▪ MOID is the distance between the closest points of the overlapping orbits of two bodies.
	  ▪ AU is the distance between Earth and Sun and is roughly 150 million km.
	• NASA's **Center for Near-Earth Object Study (CNEOS)** determines **the times and distances** of these objects as and when their approach to the Earth is close.
	• Scientists have suggested **different ways to ward off such threats**, such as blowing up the asteroid before it reaches Earth, or deflecting it off its Earth-bound course by hitting it with a spacecraft.
	  ○ One such project is, **Asteroid Impact and Deflection Assessment (AIDA)**, which includes NASA's Double Asteroid Redirection Test (DART) mission and the European Space Agency's (ESA) Hera.

Geminid Meteor Shower	• **Geminid Meteor showers occur every year** around the second week of December.
	  ○ A meteor is a meteoroid that enters Earth's atmosphere.
	  ○ Meteoroids are objects in space that range in size from dust grains to small asteroids.
	• Geminid meteors **are created by tiny bits of rocky debris** shed from a small asteroid named 3200 Phaethon, which was discovered in 1983.
	  ○ **Phaethon loops around the Sun every 1.4 years** in an orbit that approaches the Sun closer than any other known asteroid.

Comet NEOWISE (C/2020 F3)	• It was **spotted for the first time by NASA in March 2020** with the help of its Near-Earth Object Wide-field Infrared Survey Explorer (NEOWISE) telescope. • Comets are **dusty snowballs which orbit the Sun.** They are made of ices, such as water, carbon dioxide, ammonia and methane, mixed with dust. o These materials came from the time when the Solar System was formed.
Milky Way look alike Galaxy found	• An **extremely distant look-alike galaxy** (named SPT0418-47)of Milky Way was found, which is 12 billion light-years away from Earth. • A galaxy is a **large group of stars, gas, and dust** bound together by gravity. o Sun (a star) and all the planets around it are part of a galaxy known as the Milky Way Galaxy. • **Andromeda Galaxy,** also known as Messier 31, M31, or NGC 224 is the **nearest major galaxy to the Milky Way.** o It is **spiral in shape, visible with naked eye from earth and is having same magnitude of virial mass** as Milky way.
Proxima Centauri	• Astronomers looking for alien life have recently picked up an **intriguing radio wave emission from the direction of Proxima Centauri.** • Proxima Centauri is **nearest star to the Sun.** It is 4.2 light-years away from the Sun. • Its **mass is about an eighth of the Sun's,** and it is too dim to be seen with the naked eye from Earth.
Extreme Helium Star (EHe)	• Recently, presence of singly ionised fluorine was detected in the atmosphere, that makes a strong case that the **main formation of EHe involves a merger of a carbon-oxygen and a Helium (He) white dwarf.** • EHe is **low-mass super giant star** that is almost devoid of hydrogen, and has abundance of surface helium. o This is in **contrast to majority of Stars** (including Sun) which contain some 70% hydrogen (by mass) throughout their lives. • EHe stars are **much larger and hotter than Sun** despite being less massive.
Dwarf Planet Ceres given status of an "ocean world"	• This status was given as scientists have determined that Ceres has a **brine (solution of salt in water) reservoir,** making it "water rich". • Ceres is a dwarf planet which lies in the **asteroid belt between Mars and Jupiter**. o **There are officially five dwarf planets in our Solar System.** The other four, in order of size, are Eris, Makemake, Haumea and Ceres. • **Criteria for dwarf planet are** o Body orbits around the Sun. o Not a satellite of any planet. o Has not cleared the neighbourhood around its orbit. o Has enough mass for its gravity to pull it into a roughly spherical shape.
Venusian Atmosphere Rotates Faster than the Planet Itself	• Venus takes 243 Earth days to rotate once around its axis. Despite this very slow rotation, **Venus's atmosphere rotates westward 60 times faster** than its planetary rotation. This phenomenon, called **super rotation**, was first discovered in the 1960s. • Venus atmosphere is thick and full of **clouds of sulfuric acid.** Its atmosphere heats so much making it **hottest planet in solar system**. • Sun heats planet's dayside, creating **atmospheric tidal waves** due to temperature difference with night side. These thermal tides push atmosphere around planet, making it rotate quickly.
Opposition event	• Opposition is the event **when sun, Earth and an outer planet (Mars in this case) are lined up,** with the Earth in the middle. • The time of opposition is the point when the **outer planet is typically also at its closest distance to the Earth for a given year.** And because it is close, the **planet appears brighter in the sky.** • Due to opposition event, **Mars will outshine Jupiter, becoming the third brightest object** (moon and Venus are first and second, respectively) in the night sky **during the month of October.**

6.11. OTHER SPACE MISSIONS

NASA	
Mars 2020	• Under this, **NASA's Perseverance rover will seek signs of ancient life and collect rock and soil samples** for possible return to Earth. • The rover is equipped with specialized **equipment to collect data, analyse weather conditions** that can help plan for future human missions, and produce oxygen from the carbon-dioxide rich atmosphere. • The mission also includes the **Ingenuity Mars Helicopter**. Ingenuity will be the **first aircraft to attempt controlled flight** on another planet.
Artemis Accords" for Responsible Space Exploration	• Artemis Accord are a **series of bilateral agreements between NASA and its international partners** that want to cooperate on **Artemis program** o Artemis is NASA's moon mission under which it will land the first woman and the next man on Moon by 2024. • It has been established to **create common set of principles** to govern the civil exploration and use of outer space at times when numerous countries and private sector players conducting missions and operations in **cislunar space** (space between earth and moon). • The **agreement includes various norms** such as transparency, peaceful exploration, Interoperability of systems, Registration of Space Objects, Orbital Debris & Spacecraft Disposal etc. • Accord is **based on the Outer Space Treaty of 1967** that was created to ensure fairness and peaceful relationships at a time when humans were first exploring the final frontier. • France, Japan, Australia and Canada have already shown their support. **India has not clarified its stand yet.**
OSIRIS-Rex (Origins Spectral Interpretation Resource Identification Security - Regolith Explorer)	• It is a **NASA spacecraft**, that will **travel to near-Earth asteroid, called Bennu** and bring sample back to Earth for study. • It was **launched in 2016,** and **first sample collection attempt** was scheduled for October 2020, during which spacecraft descended to Bennu's surface and collect material. • It is scheduled to **depart Bennu in 2021** and will return sample to Earth in 2023. • It will help scientists **investigate how planets formed** and how life began, and improve understanding of asteroids.
Astrophysics Stratospheric Telescope for High Spectral Resolution Observations at Submillimeter-wavelengths (ASTHROS)	• It is **NASA's new mission to send a telescope**, on a football stadium-sized balloon, high into the stratosphere to observe wavelengths of light invisible from the Earth. • The mission will try to find answers about **formation of giant stars in the galaxy.** • It is to be **launched in December 2023 from Antarctica**.
Antarctic Impulsive Transient Antenna (ANITA)	• ANITA instrument is a radio telescope **to detect ultra-high energy cosmic-ray neutrinos from a scientific balloon flying over the continent of Antarctica.** o A neutrino is a subatomic particle that is very similar to an electron, but has no electrical charge and a very small mass. o They are one of the most abundant particles in the universe. • ANITA is the **first NASA observatory for neutrinos** of any kind.
SpaceX Demo-2 Mission	• It is **part of NASA's Commercial Crew Program (CCP)** to certify if SpaceX's crew transportation system can be used **to ferry crew to and from International Space Station(ISS)** regularly. o **CCP has worked** with several American aerospace industry companies with **aim of developing reliable and cost-effective access to and from ISS.**
CHINA	
Chang'e 5	• China's Chang'e 5 mission recently **returned to Earth, loaded with moon rocks** – the first since the Soviet Union's Luna 24 mission in 1976. o China is the **third country to have retrieved lunar samples after U.S and Russia**. • The Chang'e-5 mission collected material in an area **north of the Mons Rumker** known as **Oceanus Procellarum or "Ocean of Storms"** which is a vast, unexplored lava plain.
BeiDou	• It is **China's navigation satellite system** to provide global services which became operational recently.

	• BeiDou provides **positioning accuracy of up to 10cm**. Global Positioning System (GPS), owned by the US is accurate to about 30cm. • **More than 100 countries** including Pakistan and countries part of the Belt and Road Initiative (BRI) are already using the system. • **Other Navigation Satellite Systems**: GLONASS (Russia), Galileo (EU), GPS (US), QZSS (Japan) and **IRNSS (India).**
European Space Agency (ESA)	
Ariel (Atmospheric Remote-sensing Infrared Exoplanet Large-survey)Space Mission	• It is a space telescope planned for launch in 2029 under **European Space Agency's Cosmic Vision programme.** o The consortium comprises **more than 50 institutes from 17 European countries.** • It will perform a **large-scale survey of over a thousand exoplanets** over a period of four years and will study the nature, formation and evolution of exoplanets.
JAPAN	
Hayabusa 2	• Hayabusa 2 is a **Japanese mission** launched in 2014 on a six-year mission **to study asteroid Ryugu and to collect samples to bring to Earth for analysis**. o Recently, it **landed safely in Australia.** o Ryugu is a carbonaceous near-Earth asteroid. • Mission seeks to answer some fundamental **questions about the origins of the solar system and where molecules like water came from.**
UAE	
Hope Mission	• **UAE spacecraft Amal (Hope)** has been launched which is **the Arab world's first mission to Mars.** Hope is the UAE's fourth space mission and first interplanetary mission. • It will **orbit Mars to study the Martian atmosphere** and its interaction with outer space and solar winds.
Joint Collaboration	
Solar Orbiter	• It is an **international collaboration between the ESA and NASA,** to study the Sun. • It was **launched in February 2020**, and completed its first close pass of the Sun in mid-June. • It is the **nearest probe with sensors facing Sun**(77 million kms away from Sun)and the closest with cameras that can capture our closest star at extreme proximity. • Recently, **first images from Solar Orbiter** have revealed omnipresent miniature solar flares, dubbed 'campfires', near the surface of sun.
BepiColombo	• It is a joint endeavor between the **ESA and the Japan Aerospace Exploration Agency (JAXA).** • It is **first European mission to Mercury** and is the first to send two spacecraft to make complementary measurements of Mercury and its dynamic environment at same time. • It consists of two individual orbiters: **ESA's Mercury Planetary Orbiter (MPO) and JAXA's Mercury Magnetospheric Orbiter (MMO, or 'Mio').** • Recently, it successfully completed its first flyby of Venus.
Other important developments	
Starlink	• **Starlink** is a **network of satellites** being built by **SpaceX**, an aerospace company. • It will deliver **high speed broadband internet** to locations where a**ccess has been unreliable, expensive, or completely unavailable**. • The satellite network **operates at 550km above the Earth's surface in low Earth orbit (LEO)**, unlike conventional internet satellites that are positioned much higher, at over 35,000km. • At end of life, the **satellites will utilize their on-board propulsion system to deorbit** over the course of a few months.
Stardust 1.0	• Stardust 1.0 was launched from Loring Commerce Centre, US, becoming the **first commercial space launch powered by biofuel,** which is non-toxic for the environment as opposed to traditionally used rocket fuels. • The rocket is **manufactured by bluShift**, an aerospace company based in Maine. These rockets **will help to launch small satellites called cubesats into space.** • **Biofuels are obtained from biomass**, which can be converted directly into liquid fuels that can be used as transportation fuels. • The **two most common kinds of biofuels in use today are ethanol and biodiesel** and they both represent the first generation of biofuel technology.
New Shepard	• It is reusable suborbital rocket system **designed to take astronauts and research payloads** past the Karman line (the internationally recognized boundary of space). • It was launched by US based **space company Blue Origin.**

	• It is named after astronaut Alan Shepard, the **first American to go to space.**

Thirty Meter Telescope (TMT) project	• Indian astronomers collaborated with 2020 Physics Nobel Laureate Prof. Andrea Ghez on TMT project.
	• TMT is a proposed **new class of extremely large telescopes that will allow seeing deeper into space** and observing cosmic objects with unprecedented sensitivity.
	  ○ It is a **joint venture of five countries**-India (Department of Science and Technology), Canada, US, China and Japan.
	  ○ It is **being installed at Mauna Kea in Hawaii.**
	• The **level of contribution determines the amount of viewing time, or slots,** that the member-countries' scientists get on the machine.
	• TMT would be more than 200 times more sensitive than current telescopes and **would be able to resolve objects 12 times better than the Hubble Space Telescope**.

US Spacecraft to be named after Kalpana Chawla	• Next spacecraft carrying supplies to International Space Station **will be called SS Kalpana Chawla.**
	• Kalpana Chawla was **born in Karnal, Haryana on March 17, 1962**. She began her career at NASA in 1988.
	  ○ Her work concentrated on the simulation of complex air flows encountered by aircraft flying in ground-effect.
	  ○ She became the **first woman of Indian descent to go to space.**
	• **She lost her life during the STS-107 mission** (2003) when Space Shuttle Columbia disintegrated upon reentering the Earth's atmosphere.

7. HEALTH

7.1. FOOD AND HEALTH

7.1.1. TRANS FATS

Why in news?

World Health Organization (WHO) released progress report on trans-fat elimination titled "Countdown to 2023: Global Trans Fats Elimination 2020".

Background

- In May 2018, WHO called for the global elimination of industrially produced trans-fatty acids (TFA) by 2023.
- In May 2019, WHO released REPLACE action framework which is a roadmap for countries to implement the prompt, complete and sustained elimination of industrially produced TFA from the food supply.
- **Under REPLACE framework, the six areas of action include:**

About Trans fat

- Trans fat, or trans-fatty acids, are **unsaturated fatty acids** that come from either natural or industrial sources:
  - **Naturally occurring trans-fat** occurs naturally in some dairy and meat products.
  - **Industrially produced trans-fat** are formed in an industrial process that adds hydrogen to vegetable oil converting the liquid into a solid, resulting in "partially hydrogenated" oil (PHO).
- Industrially produced trans-fats are **found in hardened vegetable fats such as margarine and *ghee* (clarified butter)** and are often present in snack foods, baked goods and fried foods.
- Manufacturers often use them as they **have a longer shelf life and are cheaper than other fats.**
- **In India, vanaspati, desi ghee, butter and margarine are the main sources** of Trans fat.
- They are **more unhealthy than Saturated fats** as they increases LDL ("bad") cholesterol levels while lowering HDL ("good") cholesterol levels.
- They are supposed to be the **main cause ofType-2 Diabetes** and linked to insulin resistance.
- **WHO recommends that trans-fat intake** be limited to **less than 1% of total energy intake** i.e. **less than2.2 g/day** with a 2,000-calorie diet.

REPLACE
TRANS FAT

AN ACTION PACKAGE TO
ELIMINATE INDUSTRIALLY-PRODUCED
TRANS-FATTY ACIDS

R E P L A C E

REVIEW	PROMOTE	LEGISLATE	ASSESS	CREATE	ENFORCE
dietary sources of industrially-produced trans fats and the landscape for required policy change	the replacement of industrially-produced trans fats with healthier fats and oils	or enact regulatory actions to eliminate industrially -produced trans fats	and monitor trans fat content in the food supply and changes in trans fat consumption in the population	awareness of the negative health impact of TFA among policy-makers, producers, sup-pliers, and the public	compliance with policies and regulations

Steps taken by India against Trans fats

- India has set targets to reduce the industrially **produced trans-fat to less than 2% by the year 2022** in a phased manner, a year ahead of the WHO target.

- Currently, **FSSAI limits trans-fat content in fats and oils to 5 per cent**.
- Also, FSSAI has capped the amount of **TFA in 'oils and fats' to 3% for 2021 and 2% by 2022 from the current permissible limit of 5%**
- To achieve the target, FSSAI launched two initiatives:
  - **Eat Right Movement** aims to cut down on salt, sugar and oil consumption by 30% in three years by educating customers.
  - **Heart Attack Rewind campaign** to warn citizens about the health hazards of consuming trans fats and offer strategies to avoid them through healthier alternatives.
- **Trans Fat Free logo:** Food establishments which use trans-fat free fats/oil and do not have industrial trans-fat more than 0.2g/100g of food, can display "Trans-fat free" logo in their outlets and on their food products.

Food Safety and Standards Authority of India (FSSAI)

- It has been **established under Food Safety and Standards, 2006 which consolidates various acts & orders** that have hitherto handled food related issues in various Ministries and Departments.
  - Various central Acts like Prevention of Food Adulteration Act, 1954, Fruit Products Order, 1955, Meat Food Products Order, 1973, Vegetable Oil Products (Control) Order, 1947, Edible Oils Packaging (Regulation)Order 1988, Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967, Milk and Milk Products Order, 1992 etc. **were repealed after commencement of FSS Act, 2006**.
- FSSAI has been created for laying down science-based standards for articles of food and **to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.**
- The Act also **aims to establish a single reference point for all matters relating to food safety and standards**, by moving from multi- level, multi-departmental control to a single line of command
- **Ministry of Health & Family Welfare** is the Administrative Ministry for the implementation of FSSAI.

7.1.2. STATE FOOD SAFETY INDEX 2019-20

Why in news?

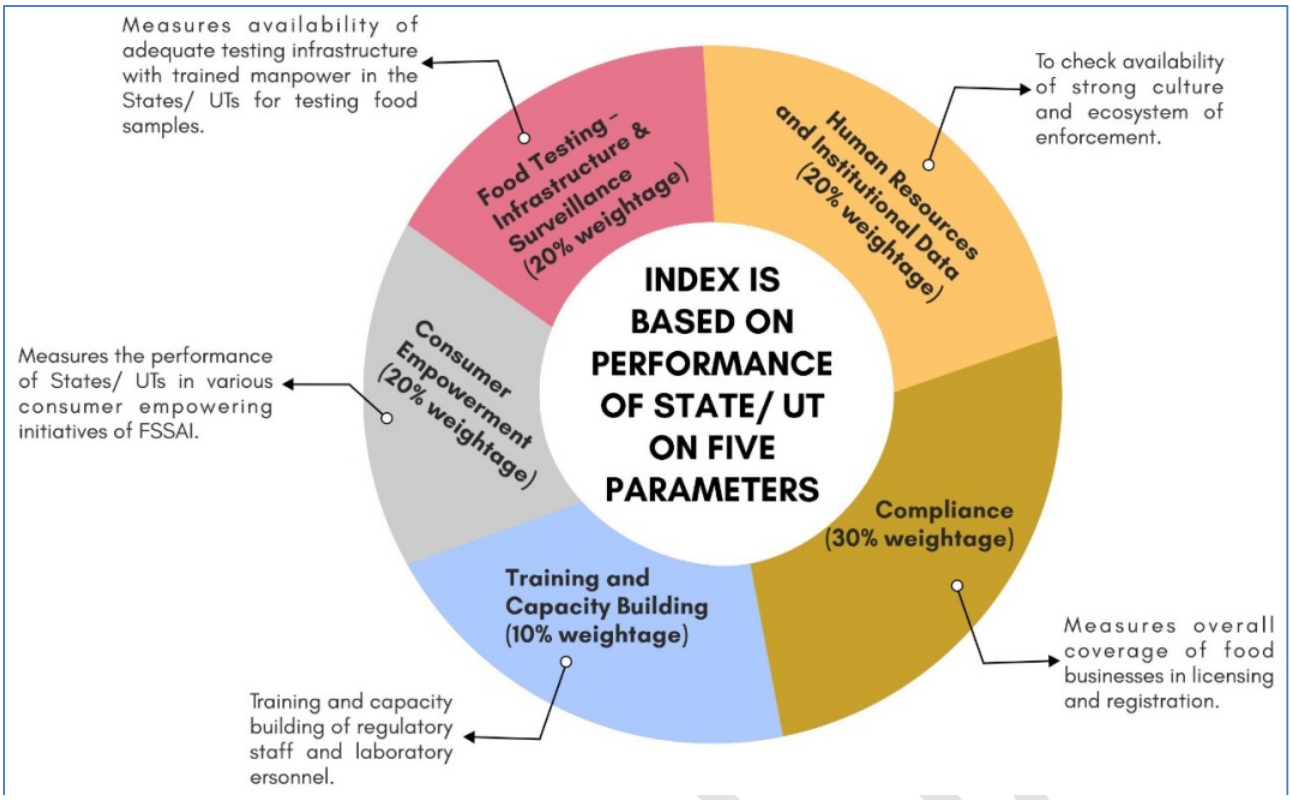
Recently Food Safety and Standards Authority of India (FSSAI) released the results of **second State Food Safety Index on World Food Safety Day (June 7).**

About Index

- The Index is a dynamic quantitative and qualitative benchmarking model that **provides an objective framework for evaluating food safety across all States/UTs**. It is an incentive to create a sense of competition among states to improve food safety.
- To ensure comparison among similar entities, index is divided in **3 categories**. State/UTs topped in 2019-20 Index
  - **Large state: Gujarat** followed by Tamil Nadu and Maharashtra.
  - **Small state: Goa** followed by Manipur and Meghalaya.
  - **UT: Chandigarh** followed by Delhi and Andaman Islands.

FSSAI Initiative

- **Eat Right Movement**: It is to improve public health in India and combat negative nutritional trends to fight lifestyle diseases
- **"Blissful Hygienic Offering to God" (BHOG):** To encourage Places of Worship (POW) to adopt and maintain food safety and hygiene as well as convey food safety messages through such places to the people to follow as responsible citizens.
- **Hygiene Rating Scheme** is an online, transparent scoring and rating process which aims to allow consumers to make informed choices about the places where they eat out & through these choices, encourage businesses to improve their hygiene standards & thus reduce the incidence of food-borne illness.
- **Heart Attack Rewind:** It is the first mass media campaign of its kind – will support FSSAI's global target of eliminating trans-fat in India by the year 2022.
- **FSSAI-CHIFSS:** FSSAI has joined hands with CHIFSS (CII-HUL Initiative on Food Safety Sciences) with the purpose of driving activities related to science-based food safety in the country, to strengthen protection of consumers and create an innovative environment for the industry.
- **Food Safety Compliance System (FoSCoS):**FoSCoS is cloud based, upgraded food safety compliance online platform that will act as one-stop point for all regulatory and compliance engagements of FSSAI with Food Business Operators.
  - It will replace existing Food Licensing and Registration System.
  - It will enable pan India integrated response system to any food fraud and ensure an advanced risk based, data driven regulatory approach.
  - To eliminate errors and grant licences quicker, licensing process for food manufactures will be based on a standardised food product list on FoSCoS.



7.1.3. FOOD ADULTERATION

Why in news?

Recently, Honey sold by several major brands in India was found adulterated with sugar syrup.

More about news

- It was found that **golden syrup, invert sugar syrup and rice syrup are used for adulteration in honey,** which are being procured from China and also manufactured in India.
  - Findings were **part of an investigation by Centre for Science and Environment (CSE),** a public interest research and advocacy organisation based in New Delhi.
- Such adulteration in honey is traced by tests like **Nuclear Magnetic Resonance Spectroscopy (NMR), Trace Marker for Rice (TMR), Specific Marker for Rice syrup test (SMR), C3-C4 and oligosaccharides sugar tests.**
- Still such sugar syrups used for adulteration of honey **pass all the adulteration tests** listed in the 2020 standards by Food Safety Standards Authority of India.

About Nuclear Magnetic Resonance (NMR) Spectroscopy

- It is an analytical chemistry technique used in quality control and research **for determining the content and purity of a sample** as well as its molecular structure.
- This technique **allows for non-destructive screening and quantification** of both known ingredients and unanticipated contaminants and adulterants.

COMMON FOOD ADULTERATION

Food Stuffs	Adulturants
Cereal	Soil, pieces of stone, infested cereal
Pulses	Khesari dal
Bengal gram Flour	Starch powder, maize flour
Ghee	Vegetable ghee, Animal fat, sweet potato
Milk	Water
Tea	Used tea leaves
Pepper	Papaya seeds
Clove	Clove after extraction
Dhaneya	Saw dust, horse dung
Red Chelli Powder	Saw dust, Powdered Red Brick
Honey	Sugar, Water
Turmeric	Yellow Soil

About food adulteration

- Food adulteration is an act of **adding or mixing of poor quality, inferior, harmful, substandard, useless** or unnecessary substances to food (added substances may be food or non-food item).
- Food items, medicines, vegetables, paste, creams, products of famous brands etc. are adulterated.

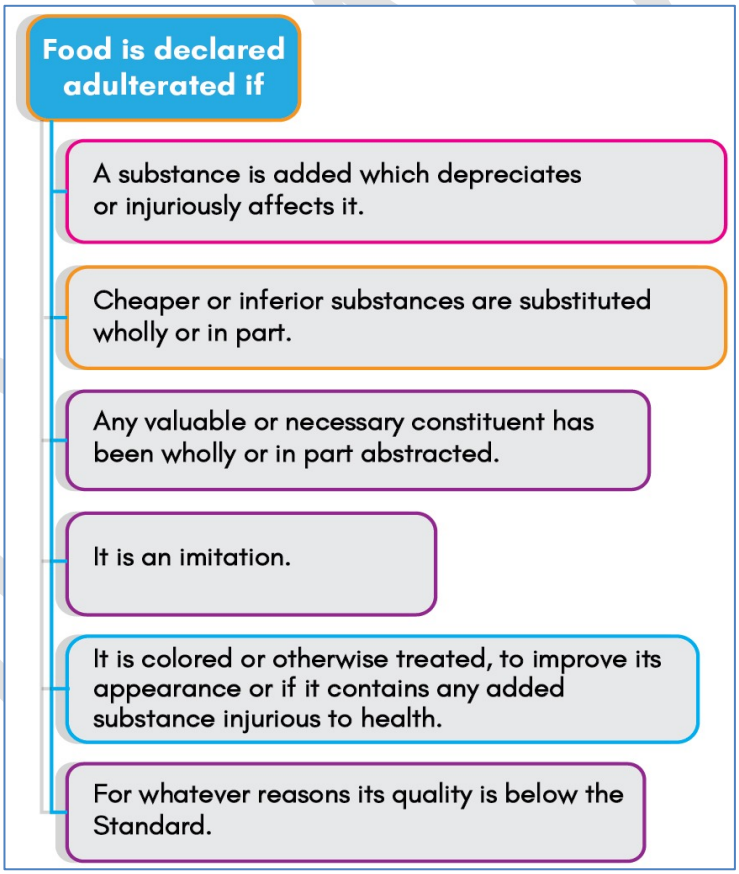
Regulations and steps taken to check food adulteration in India

- **Food Safety and Standards Authority of India (FSSAI)**
  - **It imposes a penalty under Food Safety and Standards Act, 2006.**
  - FSSAI has released a **manual 'Detect Adulteration with Rapid Test (DART)' for quick detection of adulterants** in everyday food items.
  - FSSAI released **directives on import of golden syrup, invert sugar syrup and rice syrup** used for adulteration in honey.
- **Consumer Protection Act, 2019:** It provides for a three tier quasi-judicial machinery at national, state and district level to provide simple and speedy redressal to consumer disputes.
- **Codex Alimentarius commission:** It adopts international food standards, guidelines and codes of practice which contribute to the safety, quality and fairness of this international food trade.
- **Harmonised system (HS) code:** It describes the type of good that is shipped, so certain items that are used for adulteration can be scrutinized well during custom clearance.

7.1.4. DRAFT FOOD SAFETY AND STANDARDS (AMENDMENT) BILL 2020

Why in news?

Ministry of Health & Family Welfare released the draft bill that seeks to amend Food Safety and Standards Act, 2006 **to revamp Food Safety and Standards Authority of India (FSSAI's) functioning** by giving it more powers, enhancing penalties imposed for violations and simplifying processes.



Key amendments

- Jurisdiction of FSSAI extended **to include animal feed**. So far, FSSI had powers on food industry.
  - Feed means any **substance that satisfies nutritional requirements of animals.**
- **Enhanced penalties for violations,** including manufacture and sale of unsafe food, adulteration of food causing death, carrying out business without licence and repeat offences.
- **It would specify standards for food contact material,** which would mean specifying standards for food packaging material.
- Proposal to appoint a **chief executive officer at FSSAI as member secretary to oversee functions.** So far, the role had not been defined.
- **Changes in definition of proprietary food,** which means an article of food for which standards have not been specified but is not unsafe.

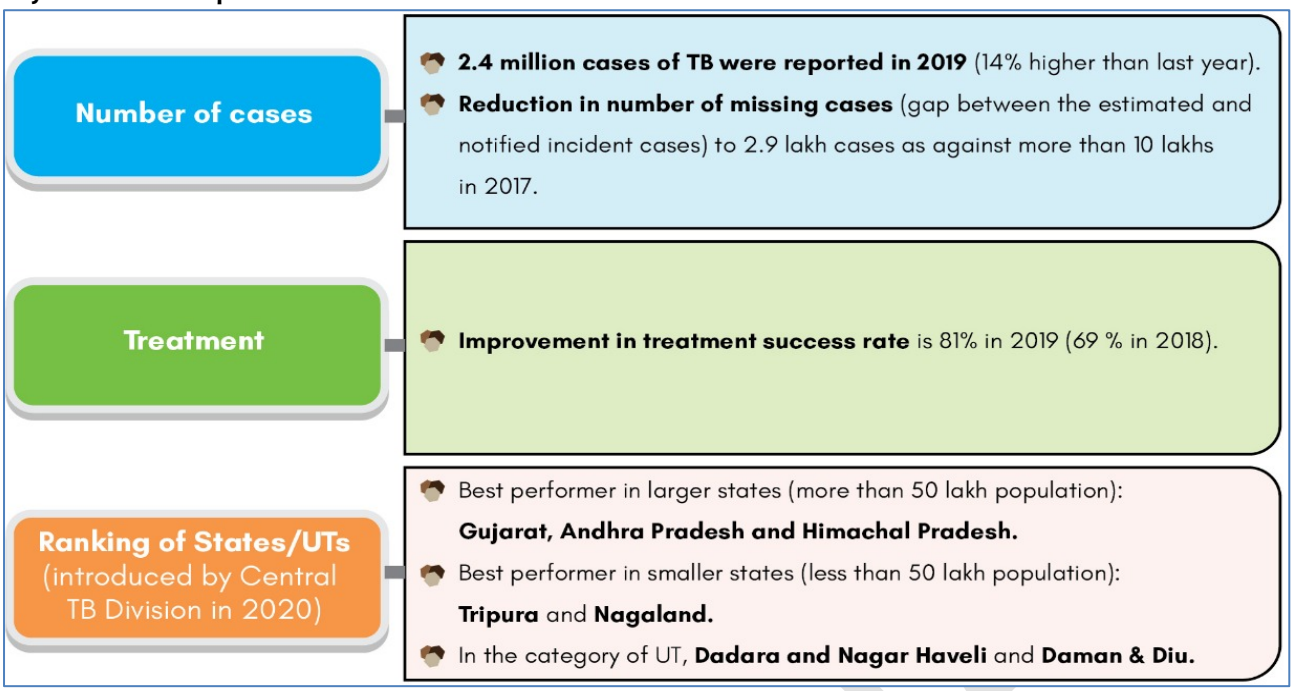
7.2. BACTERIAL DISEASES

7.2.1. INDIA TUBERCULOSIS REPORT 2020

Why in news?

Union Minister for Health and Family Welfare released the **annual India Tuberculosis Report 2020.**

Key statistics in report



Key initiatives and achievements

- **National Strategic Plan (2017-2025):** to eliminate TB by 2025, 5 years ahead of Sustainable Development Goal-3, 2030.
- **Revised National Tuberculosis Control Program (RNTCP):** It has been **renamed as "National Tuberculosis Elimination Program (NTEP)"** to accelerate momentum towards eliminating Tuberculosis in the country by 2025.
- **Early accurate diagnosis** being done.
  - **Ziehl-Neelsen acid-fast staining /Fluorescence Microscopy** are the primary tools for diagnosis of patients with Pulmonary Tuberculosis presumed to be drug sensitive.
  - Patients at risk of **Multi-Drug Resistant TB (MDR-TB)are diagnosed using WHO endorsed** rapid diagnostics (WRD) like Cartridge Based Nucleic Acid Amplification Test (CBNAAT) / Line Probe Assay (LPA)/ TrueNAT.
- On-line notification of TB patients through the **NIKSHAY portal.**
- India is one of the first countries to adopt the Communities, Rights and Gender Tools developed by the Stop TB Partnership.
  - **Stop TB Partnership** aims to ensure that every TB patient has access to effective diagnosis, treatment and cure. It was founded in 2001 and has its secretariat in Geneva, Switzerland.
- **TB Sample Transport Network** has been widened through support from Department of Post's services for specimen transportation from peripheral health facilities to TB diagnostic laboratories.

Related News

- **Global TB report 2020 released by WHO**
- **Key Findings**
  - Globally, **an estimated 10.0 million people fell ill with TB in 2019,** slowly declining in recent years.
  - **India, Indonesia, the Philippines and South Africa account of 44% of global TB cases** and these countries would bear the maximum brunt of COVID-19- induced TB problems.
  - **Drug-resistant TB continues to be a public health threat** and 3 countries that had the largest burden of these cases include **India, China and Russia.**
  - World is **not close to meeting the targets of the 2020 milestones** of the **'End TB Strategy'**. Actual reduction was 9% as against aim of 20% between 2015- 19.

Global commitments and efforts

- **WHO End TB Strategy:**
  - 80% reduction in the TB incidence rate (new and relapse cases per 100 000 population per year) by 2030, compared with 2015
    - **2020 milestone:** 20% reduction; 2025 milestone: 50% reduction
  - 90% reduction in the annual number of TB deaths by 2030, compared with 2015
    - **2020 milestone:** 35% reduction; 2025 milestone: 75% reduction
  - No households affected by TB face catastrophic costs by 2020.
- **SDG Target 3.3:** By 2030, end the epidemics of AIDS, TB, malaria and neglected tropical diseases, and combat hepatitis, water-borne diseases and other communicable diseases
- **Moscow Declaration to End TB:** It is commitment to increase multi-sectoral action and enhance accountability in the global TB response towards ending tuberculosis (TB) by 2030.

About Tuberculosis (TB)

- TB is caused by **bacteria (Mycobacterium tuberculosis)** that most often affect the lungs.
- It spreads from **person to person through cough, sneeze or spit.**
- It typically **affects the lungs (pulmonary TB)** but can also affect other organs (extrapulmonary TB).
- **Drug Resistant TB**
  - **Multidrug Resistance TB (MDR):** It is TB that does not respond to at least isoniazid and rifampicin (2 of the most powerful first line drugs).
  - **Extensively drug-resistant tuberculosis (XDR-TB):** It is resistant to at least four of the core anti-TB drugs. It involves multidrug-resistance (MDR-TB), in addition to resistance to any of the fluoroquinolones (such as levofloxacin or moxifloxacin) and to at least one of the three injectable second-line drugs (amikacin, capreomycin or kanamycin).
  - **Totally drug-resistant tuberculosis (TDR-TB):** TB which is resistant to all the first- and second-line TB drugs
- **India being the country with highest TB burden** (Global TB report 2019, World Health Organization).

7.3. VIRAL DISEASES

7.3.1. POLIO

Why in News?

- Recently, **World Health Organization (WHO) certified African region free of wild polio.**

Region	Year certified polio-free
WHO African Region	2020
WHO Region of the Americans	1994
WHO South-East Asia Region	2014
WHO European Region	2002
WHO Eastern Mediterranean Region	
WHO Western Pacific Region	2000

More on News

- For certification, **all countries in WHO Region need to have no case of wild polio for 3 consecutive years.** No single country can be certified as polio-free.
  - **Now, five of six WHO regions**, except Eastern Mediterranean which includes Afghanistan and Pakistan, **are certified free of wild poliovirus.**
  - India is in South-East Asia Region of WHO and **received polio-free certification in 2014.**

Related News
WHO Emergency Use Listing (EUL)

- WHO has added **novel oral polio vaccine type 2 (nOPV2),** useful in treatment of Vaccine derived polio virus (VDPV) strain to its EUL.
- EUL is a **risk based procedure to assess and list unlicensed vaccines** during public health emergencies, such as polio and COVID.
  - Its objective is **to make these medicines, vaccines and diagnostics available faster.**
  - It was introduced during the West Africa Ebola outbreak of 2014-2016.

About Polio

- Poliomyelitis (polio) is a highly **infectious viral disease that invades nervous system.** There are **3 types of wild polio virus** – type 1, type 2, and type 3. **Only type 1 wild poliovirus remains in circulation.**
- There is **no cure for polio, it can only be prevented** through immunization.
- **Two types of vaccinations** against poliovirus:
  - **Inactivated polio vaccine** is made up of inactivated (killed) polio virus and will provide immunity from all strains of polio.
  - **Oral polio vaccine** contains a live, attenuated (weakened) vaccine-virus. When a child is vaccinated, the weakened vaccine-virus replicates, triggering a protective immune response.
- However, in some cases, **vaccine-virus is genetically altered during replication. This is called a vaccine-derived poliovirus (VDPV).**
- VDPVs are **extremely rare and found in children with immune-deficiency** and among populations with low immunity levels.
  - Recently, WHO report flagged spike in cases of VDPV.
- **Diseases eradicated from India:** Yaws, Polio, Guinea worm, smallpox, Maternal and neonatal tetanus.

7.3.2. AVIAN INFLUENZA (BIRD FLU)

Why in News?

- Central teams were deployed to visit the affected states of Kerala, Haryana and Himachal Pradesh for monitoring and for epidemiological investigation.

About Bird Flu

- Bird flu, also called avian influenza, is **a viral disease which is contagious** and can spread from one bird to other birds and animals.
  - **Migratory birds have been assumed to be largely responsible** for long-distance transmission of the virus into India.
  - It also spreads through **local movement of residential birds and poultry.**
- It is **caused by Influenza Type A viruses which generally affect poultry birds** such as chickens and turkeys. Aquatic birds are primary natural reservoir for most subtypes of influenza A viruses.
  - Depending on the origin host, **influenza A viruses can be classified as avian influenza** (H5N1, H9N2 etc.), **swine influenza** (H1N1 and H3N2), or other types of animal influenza viruses.
- Influenza type A viruses are classified into subtypes according to the **combinations of different virus surface proteins, hemagglutinin (HA) and neuraminidase (NA).**
  - For example, a virus that has an HA 7 protein and NA 9 protein is designated as subtype H7N9.
- Human infections are primarily acquired **through direct contact with infected animals or contaminated environments.**

Related News
G4 Virus

- It is **recently emerged strain of H1N1 influenza virus** that is **infecting Chinese pigs** and that has the potential of triggering a pandemic.
- **G4 is swine flu strain** having genes similar to those in the virus that caused the 2009 flu pandemic.
- G4 strain **has the capability of binding to human-type receptors** (like, the SARS-CoV-2 virus binds to ACE2 receptors in humans).

About Influenza viruses

- Influenza viruses belong to the family Orthomyxoviridae and **have a single-stranded segmented RNA genome.**
- Influenza virus is **transmitted primarily by droplets or respiratory secretions of infected persons.**
- **There are four types of influenza viruses: types A, B, C and D:**
  - **Influenza A viruses infect humans and many different animals**. The emergence of a new and very different influenza A virus with the ability infect people and have sustained human to human transmission, can cause an influenza pandemic.
  - **Influenza B viruses circulates among humans** and cause seasonal epidemics. Recent data showed seals also can be infected.
  - **Influenza C viruses can infect both humans and pigs** but infections are generally mild and are rarely reported.
  - **Influenza D viruses primarily affect cattle** and are not known to infect or cause illness in people.

7.3.3. AIDS

Why in News?

According to Indian Council of Medical Research (ICMR) Study, India is likely to Miss Target of Eradicating AIDS by 2030.

Background

- In 2016, at the **UNs' High-Level Meeting on AIDS,** India committed towards the goal of 'ending the AIDS epidemic as a public health threat by 2030'.
  - **SDG 3.3** aims to End AIDS as a public health threat by 2030.
- **Acquired immunodeficiency syndrome** (AIDS) is a **chronic, life-threatening condition** caused by the human immunodeficiency virus (HIV).HIV interferes with body's ability to fight infection and disease, by damaging immune system.

Related News
Union Minister for Health and Family Welfare addresses Global Prevention Coalition (GPC) for HIV Prevention

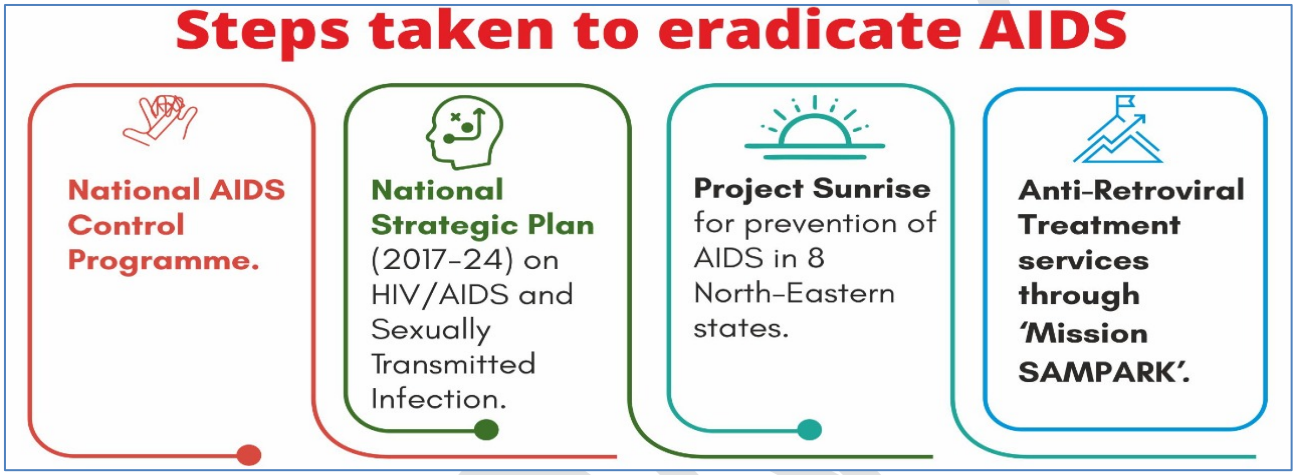
- GPC, formed in 2017, is a **coalition of United Nations Member States, donors, civil society organizations** and implementers to support global efforts to accelerate HIV prevention.
- It seeks **to ensure accountability for delivering prevention services** at scale in order to achieve the targets of the 2016 Political Declaration on Ending AIDS, including a 75% reduction in HIV infections by 2020, and to ending the AIDS epidemic by 2030.

KEY HIGHLIGHTS OF THE STUDY

• **Decline in annual new HIV infections was only 27% from 2010 to 2017** against a national target of a 75% decline by 2020.	• **People Living With HIV/AIDS** (PHLIV) 2.1 million in 2017.	• **States with highest number of PHLIV in 2017:** Maharashtra, Andhra Pradesh and Karnataka. • **Rising new HIV infections in the low-burden states** of Arunachal Pradesh, Assam, Mizoram etc.

7.3.4. OTHER IMPORTANT NEWS

Yellow Fever	• According to recent study, burden and geography of yellow fever is projected to shift to Central and East Africa from West Africa by 2050.
	  ○ **Climate change-related factors,** including temperature and rainfall, would lead to this.
	• Yellow fever is an **acute viral haemorrhagic disease** transmitted by mosquitoes, belonging to the Aedes and Haemogogus species.
	  ○ The "yellow" in the name refers to the **jaundice that affects some patients.**
	• Symptoms of yellow fever include **fever, headache, jaundice, muscle pain, nausea, vomiting and fatigue.**
	• Virus is endemic in **tropical areas of Africa and Central and South America.**
	• Vaccine for this disease is available and a **single dose of yellow fever vaccine is sufficient to grant sustained immunity and life-long protection.**
	• **WHO launched Eliminate Yellow Fever Epidemics strategy in 2017.**

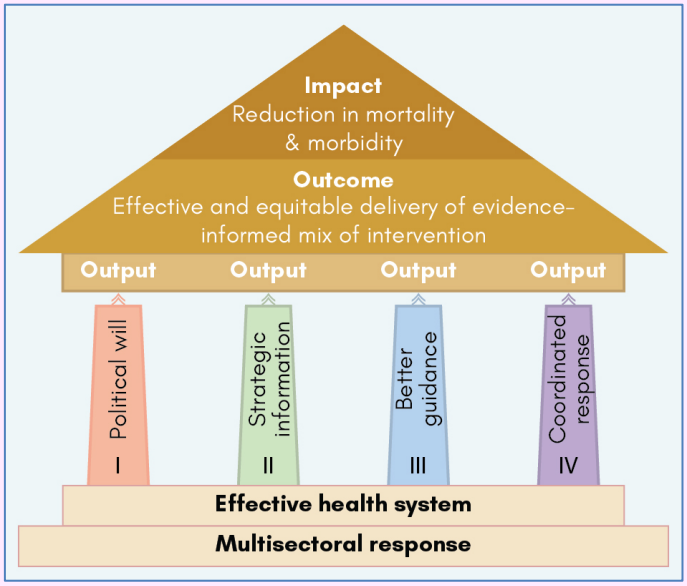


7.4. OTHER DISEASES

7.4.1. WORLD MALARIA REPORT 2020 RELEASED BY WORLD HEALTH ORGANISATION (WHO)

- Report **tracks investments in malaria programmes and research,** as well as progress across all intervention areas: prevention, diagnosis, treatment and surveillance.
  - Malaria is **caused by parasites** that are **transmitted to people through infected female Anopheles mosquitoes.**
  - Out of 5 malaria causing parasite species, **Plasmodium falciparum and Plasmodium vivax** pose greatest threat.
- **Key findings**
  - **Malaria case incidence** (cases per 1000 population at risk) **reduced** from 80 in 2000 to 57 in 2019 globally.
  - **WHO African Region** accounted for about 94% of cases.
  - India is the only high endemic country which has **reported a decline of 17.6% in 2019 as compared to 2018.**
- **Steps to eradicate Malaria:**
  - **WHO had initiated the High Burden to High Impact (HBHI) initiative** in 11 high malaria burden countries, including India.

High burden to high impact (HBHI) country-led approach includes the four key response elements:



- **Global technical strategy for malaria 2016-2030** which aimed for a reduction in malaria case incidence and mortality rate of at least 40% by 2020, 75% by 2025 and 90% by 2030 from a 2015 baseline.
- In India, **National Framework for Malaria Elimination in 2016 & National Strategic Plan for Malaria Elimination in 2017.**

Some programs to control NCDs

- National Programme for Control of Blindness & Visual Impairment (NPCBVI)
- National Mental Health Programme (NMHP)
- National Programme for healthcare of Elderly (NPHCE)
- National Programme for the Prevention & Control of Deafness (NPPCD)
- National Tobacco Control Programme (NTCP)
- National Oral Health Programme (NOHP)
- National Iodine Deficiency Disorders Control Programme

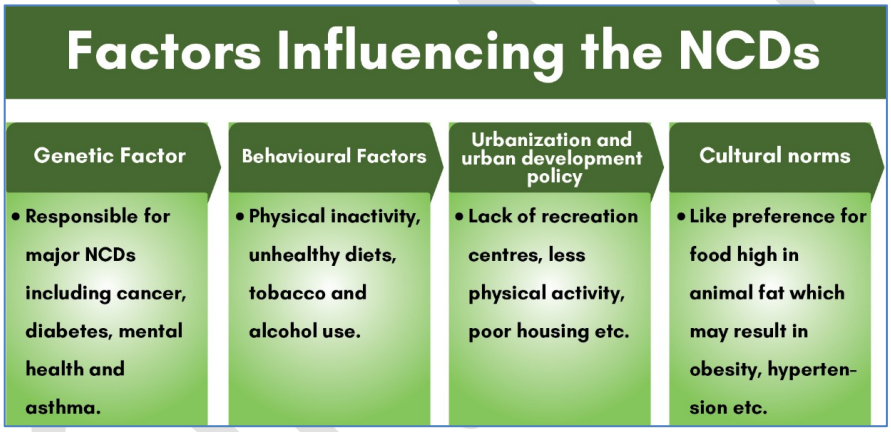
7.4.2. NON-COMMUNICABLE DISEASES

Why in News?

Global Health Estimates (GHE) released by World Health Organization (WHO) estimates that all non-communicable diseases (NCDs) together accounted for 74% of deaths globally in 2019.

Key findings of GHE 2019 report

- NCDs make up **7 of the world's top 10 causes of death,** an increase from 4 of the 10 leading causes in 2000.
  - The new data cover the period from 2000 to 2019.
- Heart disease now represents 16% of total deaths from all causes.
- **Lifespan has increased over the years,** with a global average of more than 73 years (in 2019) compared to nearly 67 (in 2000).



Non-Communicable Diseases

- NCDs are **medical conditions or diseases that are not caused by infectious agents.** These are chronic diseases of long duration, and generally slow progression.
- **Main types of NCDs are** cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma), Chronic neurologic disorders (Alzheimer's, dementias), diabetes etc.

Global Measures to control NCDs

- NCDs are **recognized as a major global challenge in the United Nation's 2030 Agenda for sustainable development.**
  - It aims to reduce by one-third premature mortality from NCDs through prevention and treatment (SDG target 3.4).
- WHO has developed a **Global action plan for the prevention and control of NCDs 2013-2020**, which includes nine global targets. It **recognizes role of governments** in responding to challenges of NCDs.
  - **India is the first country to develop specific national targets** and indicators aimed at reducing the number of global premature deaths from NCDs by 25% by 2025.

Measures taken by India to control NCDs

- **National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)** was launched in 2010.
  - It focuses on **strengthening infrastructure, human resource development, health promotion,** early diagnosis, management and referral.
- **Ayushman Bharat which would help to deal with NCDs** and injuries along with communicable diseases.
- **Food Safety and Standards Authority of India** (FSSAI) proposed a tax and advertisement ban on unhealthy foods.
  - **FSSAI has launched 'Eat Right India' movement** and a **mass media campaign 'Heart Attack Rewind'** for the elimination of industrially produced trans-fat in the food supply.
- **Pradhan Mantri Ujjwala Yojana scheme** helps to reduce indoor air pollution.

7.4.3. OTHER IMPORTANT NEWS

Glucose-6-Phosphate Dehydrogenase (G6PD) Deficiency	• It is a **genetic abnormality (more prevalent in males)** that results in an **inadequate amount of G6PD in the blood.**
	  ○ This is a very important enzyme (or protein) that regulates various biochemical reactions in the body.
	  ○ G6PD is also responsible for **keeping red blood cells healthy.**
	• Recently, Surat Municipal Corporation raised a specific COVID-19 alert for **Vataliya Prajapati community whose 25% population suffers from G6PD deficiency.**

Lead Poisoning in Children	• According to a new report launched by UNICEF and Pure Earth (Non-Profit Organization), around **one third i.e.800 million children globally, are affected by lead poisoning.** • **Lead is a cumulative toxicant** (increasing in quantity in the body over many years) that affects multiple body systems. • **Bureau of Indian Standard (BIS)** Drinking Water Specifications prescribed lead content in water **not to exceed 50 parts per billion (ppb).** ○ **World Health Organisation** (WHO) limit for lead in drinking water is **5 ppb.**
Kala-azar or Visceral Leishmaniasis (VL)	• It is a **tropical disease characterised by irregular fever, weight loss, anaemia** and swelling of the spleen and liver. • It is **caused by a protozoan Leishmania parasite** and is transmitted to humans by the bite of infected female sandflies. • According to WHO, globally, about 7 to 10 lakh new cases occur annually. ○ India accounts for about **two-thirds of the total global cases**, and the disease is endemic to **Bihar, Jharkhand, Uttar Pradesh and West Bengal.** • An initiative was launched by WHO to eliminate VL as a public health problem from the South East Asia region by 2020. The **deadline has now been extended to 2023.**
Neglected tropical diseases (NTDs)	• Recently, **UP and West Bengal have achieved their elimination target of the deadly Kalaazar a NTDs w**hile only four blocks in Bihar and 12 in Jharkhand have reported more than one case per 10,000 population. • NTDs such as dengue, rabies, leprosy, lymphatic filariasis, trachoma, and leishmaniasis, are called "neglected," because they **generally afflict the world's poor and historically have not received as much attention as other diseases.**

7.5. PHARMACEUTICALS

7.5.1. COVID-19 THERAPIES AND ANTIMICROBIAL RESISTANCE (AMR)

Why in News?

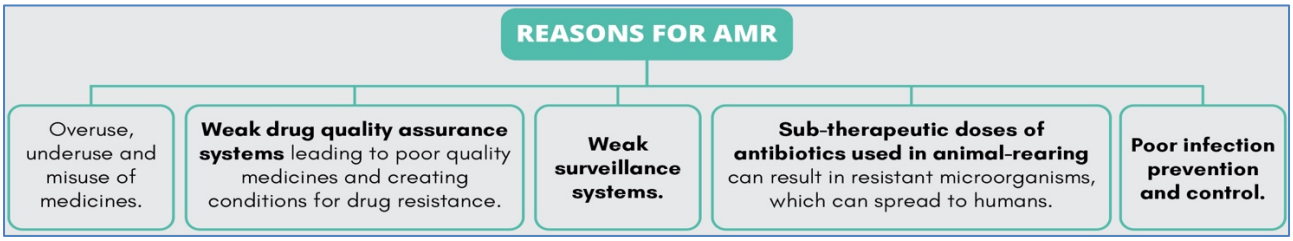
There are concerns that potentially **fatal bacterial respiratory infections** may arise during hospital stays and **because of therapies given to COVID-19 patients.**

Related News

- **One Health Global Leaders Group on Antimicrobial Resistance (AMR)**
  - This Group was recently launched by **Food and Agriculture Organization, World Organisation for Animal Health and World Health Organization.**
  - It was created in response to a **recommendation from the Interagency Coordination Group on AMR (IACG).**
  - It **will elevate the need to prioritize best practices to address AMR** at global, regional, and national levels.
  - It **will work for polices and legislation to govern the importation,** manufacture, distribution and use of quality antimicrobial drugs across all sectors.

What is AMR?

- AMR happens **when microorganisms** (such as bacteria, fungi, viruses, and parasites) **change when they are exposed to antimicrobial drugs** (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintics).
  - Microorganisms that develop AMR are sometimes referred to as superbugs.
- As a result, the **medicines become ineffective and infections persist in the body,** increasing the risk of spread to others.
  - AMR occurs naturally over time, usually through genetic changes. However, misuse and overuse of antimicrobials is accelerating this process.



Initiatives by World Health Organisation (WHO) to address AMR

- **Global Antimicrobial Resistance Surveillance System (GLASS):** supports a standardized approach to the collection, analysis and sharing of data related to antimicrobial resistance at a global level.
- **AWaRE tool:** aimed at guiding policy-makers and health workers to use antibiotics safely and more effectively. It classifies antibiotics into three groups:
  - **A**ccess — antibiotics used to treat the most common and serious infections
  - **Wa**tch — antibiotics available at all times in the healthcare system
  - **Re**serve — antibiotics to be used sparingly or preserved and used only as a last resort
- **Global Antibiotic Research and Development Partnership (GARDP):** encourages research and development through public-private partnerships.
- **Interagency Coordination Group on Antimicrobial Resistance (IACG):** established by United Nations Secretary-General to improve coordination between international organizations and to ensure effective global action.
- **Global Action Plan** aims to ensure prevention and treatment of infectious diseases with safe and effective medicines.
- **One Health approach** to promote best practices to avoid the emergence and spread of antibiotic resistance, including optimal use of antibiotics in both humans and animals.

AMR Situation in India

- A study published by the Indian Council of Medical Research (ICMR) has found **antibiotic resistant organisms in the digestive tracts of two out of every three healthy persons** that it tested.
- AMR bacteria and their genes **have been reported from different water sources.** The major sources are the pharmaceutical waste waters and hospital effluents that are released into the nearby water bodies without adequate treatment.
- Antimicrobial agents are being **used in abundance to increase the productivity in Animal husbandry.**

Steps taken

- **National Anti-Microbial Resistance Research and Surveillance Network** to strengthen the surveillance of AMR by compilation of National Data of AMR at different levels of Health Care.
- **National Action Plan to combat Antimicrobial Resistance** that aims to understand emergence, spread and factors influencing AMR.
- **Red Line Campaign' for antibiotics packaging** to curb their over-the-counter sale.
- **Drugs and Cosmetics Rule, 1945** were amended in 2013 to incorporate a new schedule H1. Such drugs will be sold on prescription only and are also marked with Red line (Red Line campaign).

7.5.2. PLASMA BANK

Why in news?

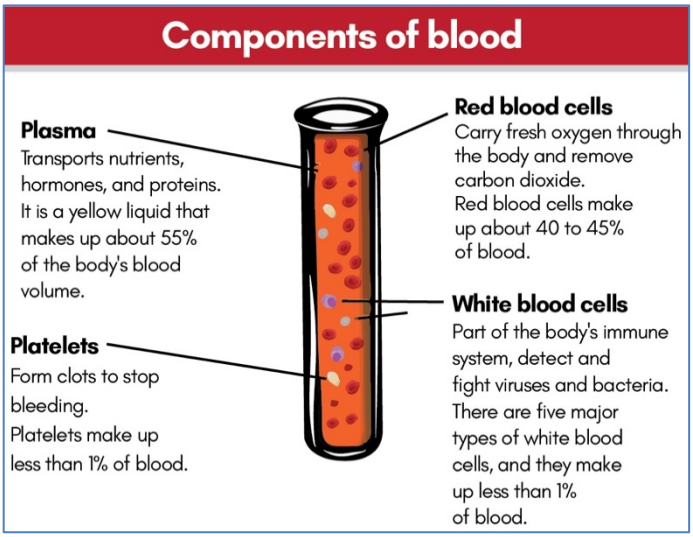
In a first in India, Delhi government has launched a plasma bank for treating covid-19 patients.

About Plasma Bank

- The facility is to be set up at the **Institute of Liver and Biliary Sciences (ILBS)**, and will be made available to government and private hospitals.
- **Plasma Bank functions like a blood bank,** and has been created specifically for those who are suffering from COVID-19, and have been advised for plasma therapy by doctors.
- Idea is to **extract and store plasma from people who have recovered from COVID-19** and give it to someone suffering from the disease.
- Delhi has been **using Convalescent Plasma Therapy**, an experimental treatment that doctors are using for people with severe coronavirus disease (COVID-19).

About Convalescent plasma therapy

- It seeks to **make use of the antibodies developed in the recovered patient** against the coronavirus.
- The whole or plasma from such people is taken, and the **plasma is then injected in critically ill patients** so that the antibodies are transferred and boost their fight against the virus.
- **Either a blood fractionation process** is used to separate the plasma from the donated blood **or a special machine called aphaeresis machine can be used** to extract the plasma directly from the donor.



7.5.3. OTHER IMPORTANT NEWS

Anti-microbial chemical Triclosan	• In a recent study it is found that **triclosan can cause neurotoxic effects** and damage the neurons. • Triclosan is used as **antimicrobial chemicals to increase the shelf life of consumer products.** • It is added to **personal care products, such as hand soaps and cosmetics,** and materials ranging from athletic clothing to food packaging. • US Food and Drug Administration have imposed a partial ban on its use. However, **India lacks any such regulation so far on the use of triclosan-based products.**

7.6. COVID-19 RELATED INVENTIONS/ DEVELOPMENTS

Antisera	• Biological E, in collaboration with the Indian Council of Medical Research, has developed highly purified antisera that **can be used in prevention and treatment of COVID-19**. • Antisera are **blood sera that contain antibodies against a specific viral toxin or antigen**. Therapy works **similar to plasma therapy**, but **here plasma is obtained from horses** that have recovered from viral infection.
AarogyaPath	• It is **CSIR National Healthcare Supply Chain Portal** that aims to provide real-time availability of critical healthcare supplies. • It would serve manufacturers, suppliers and customers. • AarogyaPath is **expected to become the national healthcare information platform**, thereby filling a critical gap in last-mile delivery of patient care within India through improved availability and affordability of healthcare supplies.

CovidKavach Elisa	• It is **India's first indigenous antibody detection test** for COVID-19, developed by National Institute of Virology, Pune.
	  ○ Test will detect the Immunoglobulin G (IgG) antibodies in blood samples and has advantage of testing 90 samples together in two-and-a-half hours.
	• Enzyme-linked immunosorbent assay (ELISA) is routinely used for detecting HIV infection.
	  ○ ELISA measures antibodies in blood.

COVIRAP	• It is a **COVID-19 diagnostic machine developed by IIT Kharagpur.** • Unlike real-time reverse transcription polymerase chain reaction (RT -PCR) machine, which could cost up to ₹25 lakh, and needed to be operated by a molecular biologist, the **COVIRAP machine cost less than ₹5,000 to make and the test kits would each cost about ₹500.** • COVIRAP method requires very little equipment, and is **ideal for use in rural areas with limited facilities.**
eCovSens	• It is a biosensor developed by National Institute of Animal Biotechnology, Hyderabad that can **detect the novel coronavirus** in saliva samples. ○ Biosensor is a device which **uses a living organism or biological molecules**, especially enzymes or antibodies, to detect presence of chemicals.
Project CARD (Consortium for Affordable & Rapid Diagnostics)	• It was launched by **NITI Aayog** and **Department of Biotechnology** to **scale up India's capacity to make coronavirus testing kits.** • Under this, private companies working on antibody test kits in India will get **initial support in terms of procurement and availability of testing facilities** to manufacture kits.
COBAS 6800 Testing Machine	• It is a **fully automated, high end machine** for performing RT-PCR testing for COVID-19. • Machine **minimizes chance of contamination** as well as **risk of infection** since it can be **operated remotely** with limited human intervention. • COBAS 6800 can **also detect other pathogens** like Viral Hepatitis B & C, HIV etc.

Compendium of Indian Technologies for Combating COVID-19 (Tracing, Testing and Treating)	• It carries **information about 200 COVID-19-related Indian technologies**, research activities and efforts by Government, categorised under 3Ts of **Tracking, Testing and Treating.**
	• It has been prepared by **National Research Development Corporation** (NRDC).
	  ○ **NRDC** was established in 1953, with **objective** to **promote, develop and commercialise the technologies,** inventions, patents etc. emanating from various national R&D institutions.
	  ○ It is working under **Department of Scientific & Industrial Research.**

Defence Research Ultraviolet Sanitiser (DRUVS)	• It is an automated, contactless UV cabinet system to sanitise electronic gadgets, papers and currency notes. • Developed by: Hyderabad based DRDO's lab, Research Centre Imarat.
Microwave sterilizer ('ATULYA')	• It is developed by Defence Institute of Advanced Technology, Pune, a deemed university supported by Defence Research and Development Organisation **to disintegrate COVID-19 virus.** • Virus gets disintegrated by **differential heating** in the range of **56° to 60° Celsius** temperatures. • It can be **used for non-metallic objects only**.
Next Generation Sequencing (NGS) machines	• Council of Scientific and Industrial Research (CSIR) is working on developing **"mega labs" where NGS machines will be used** for detecting SARS-CoV-2 novel coronavirus. • **NGS** is a DNA sequencing technology which can sequence entire human genome in a single day. • **NGS machines can:** ○ **Detect the possible presence of the virus** even in several instances where the traditional RT-PCR misses out on them. ○ **Trace the evolutionary history of the virus** and track mutations more reliably.
Portable UV Light Device to Kill Corona Virus	• A recent research has reported the feasibility of making an **Ultraviolet (UV) light emitting, hand held and portable device that can kill Corona virus.** • UV radiation in the **200-300 nanometer range** is known to **destroy the virus**, making it **incapable of reproducing and infecting.** ○ UV radiation covers the **wavelength range of 100–400 nm**, which is a **higher frequency and lower wavelength than visible light**. • **However, currently such devices** require expensive mercury-containing gas discharge lamp, which requires high power, has a relatively short lifetime, and is bulky. • The **recently discovered device use a material called strontium niobate,** that can help develop UV light-emitting diodes (LEDs), which would be portable and energy-efficient. • However, it **can be used to disinfect public spaces only**, not human skin as UV exposure can cause skin cancers, cataracts and immune system damage.
RT-LAMP (Reverse Transcriptase loop-mediated isothermal amplification) technology	• LAMP technology has been recently validated by the Indian Council of Medical Research with sensitivity 98.7% and specificity 100%. • It is **a new technology for detecting COVID-19 involving one-step nucleic acid amplification** method to multiply specific sequences of RNA of the coronavirus. • LAMP technology **has advantage over RT-PCR technology.** ○ RT-PCR test needs different temperatures in one cycle while **RT-LAMP technology is done at 65 degrees Celsius**, where the DNA amplification is done at a constant temperature (isothermal).
TataMD CHECK	• It is a **low-cost, paper-based test strip** for detecting COVID-19. • Developed by : Council of Scientific and Industrial Research - Institute of Genomics and Integrative Biology and Tata Group. • It is world's first viral **diagnostic kit based on FELUDA CRISPR Cas-9 platform.** ○ Feluda test **uses CRISPR gene-editing technology** to identify and target the genetic material of SARS-CoV2, the virus that causes Covid-19.
COVID-19 Biorepositories	• **Department of Biotechnology established five dedicated COVID-19 Biorepositories.** • These are at Translational Health Science and Technology Institute Faridabad, Institute of Life Science Bhubaneshwar, Institute of Liver and Biliary Sciences New Delhi, National Centre for Cell Science Pune and Institute for Stem Cell Science and Regenerative Medicine Bangalore. • **Main purpose of biorepositories** are **archival of inactivated virus and clinical samples**, including naso-oropharyngeal swabs, stool, urine, saliva, serum, plasma, PBMC and Serum.
COVID Vaccine Intelligence Network or Co-WIN app	• It has been developed by Ministry of Health **to monitor inoculation drive and track the listed beneficiaries for COVID-19 vaccination** on a real-time basis. • Co-WIN will also facilitate **real time information of vaccine stocks, storage temperature etc.** • **There are five modules in Co-WIN app** - administrator, registration, vaccination, beneficiary acknowledgment and report.
India COVID-19 Emergency Response and Health System	• It is project financed by World Bank (WB) and Asian Infrastructure Investment Bank (AIIB) to help India's healthcare system tackle the Covid-19 pandemic. • **Both WB and AIIB will give about $1.5 billion in the next 4 years** to finance a range of activities.

Strengthening Project (ESMF)	• **Key implementing entities** for the project: Ministry of Health & Family Welfare, National Centre for Disease Control, Indian Council of Medical Research (ICMR) and Ministry of Railways.
Integrated Government Online training (iGOT) platform	• It is a **training module for management of COVID-19** on Ministry of Education's DIKSHA platform **for the capacity building of frontline workers** to handle the pandemic efficiently. • Platform provides the **training module on flexitime and on-site basis**.
Latent viral Infection (LVI)	• It is an infection that is **inactive or dormant**. Latent infections **last the life of the host** and occur when the primary infection is not cleared by the adaptive immune response. • These are **opposed to active infections**, where a virus is actively replicating and potentially causing symptoms. • **Examples of LVI:** Herpes simplex viruses type 1 and 2, HIV, cytomegalovirus etc.
Sero-survey	• A sero-survey involves **testing of blood serum of a group of individuals.** • It will help in monitoring Covid-19 trends and **also check for community transmission.** • It was conducted **by Indian Council of Medical Research** and **National Centre for Disease Control** in collaboration with key stakeholders and state health departments. • Agencies used a **combination of RT-PCR and Elisa antibody kits** for these surveys. • **Some other tests for testing COVID-19:** Rapid Antigen Test (RAT), CB-NAAT or Cartridge Based Nucleic Acid Amplification Test (also known as Genexpert test), TrueNAT.
WHO Solidarity trial	• FOUR COVID-19 treatment centres, in **Jodhpur, Ahmedabad, Chennai and Bhopal**, have received regulatory approvals for taking part in "Solidarity trial" of World Health Organisation's (WHO). • **Solidarity trial** is a **multi-country clinical study for potential treatments for COVID-19**, launched by **WHO** on March 20, 2020. • By **enrolling patients in multiple countries**, it aims to rapidly discover whether any of the drugs slow disease progression or improve survival. • Solidarity trial will test four different drugs or combinations: Remdesivir, Lopinavir and Ritonavir, Chloroquine and Hydroxychloroquine, Same combination plus interferon-beta.
GAVI Alliance (Global Alliance for Vaccines and Immunisation)	• Recently, Union Health Minister of India has been nominated to the Board of GAVI. • GAVI is an **international public–private global health partnership** with the shared goal of creating equal access to new and underused vaccines for children living in the world's poorest countries. • It helps **vaccinate half the world's children against deadly and debilitating diseases**. • GAVI Alliance partners include UNICEF, WHO, World Bank, and Bill & Melinda Gates Foundation. • **India has pledged $ 15-millionto GAVI** at the 2020 Global Vaccine Summit.
Operation Warp Speed	• It is a public-private partnership, launched by U.S., **to facilitate and accelerate development of COVID-19 vaccines, therapeutics, and diagnostics.**
Team Halo Initiative	• **United Nations (UN)** in collaboration with The Vaccine Confidence Project at the University of London has **launched Team Halo initiative.** • It aims **to use social media to counter the misinformation around COVID-19 vaccines** and build confidence by busting myths and sharing information on the safety and effectiveness of vaccines. • **In India over 22 scientists have joined** the initiative.
United Nations Children's Fund (UNICEF) to lead global procurement, supply of COVID vaccines	• UNICEF **will lead this effort on behalf of COVAX Facility** for 92 low- and lower middle-income countries. It will also serve as **procurement coordinator to support 80 higher-income economies.** ○ COVAX is a global initiative **to ensure COVID-19 vaccines are available worldwide** to both higher-income and lower-income countries.

7.7. ALTERNATIVE MEDICINES

Why in news?

Recently, **Parliament passed three Bills related to alternative medicine** viz. The National Commission for Indian System of Medicine (NCISM) Act, 2020, The National Commission for Homoeopathy (NCH) Act, 2020 and The Institute of Teaching and Research in Ayurveda (ITRA) Act, 2020.

Alternative Medicine System in India

- Alternative medicine is **any practice that aims to achieve the healing effects of medicine, but which lacks biological plausibility and is untested, untestable or proven ineffective.**
- It is also known by different names such as Traditional Medicine, Complementary medicine (CM), integrated medicine or integrative medicine (IM). **In India, it is known by the name Indian System of Medicine (ISM).**

Other Steps taken by the Government to promote Indian system of medicine

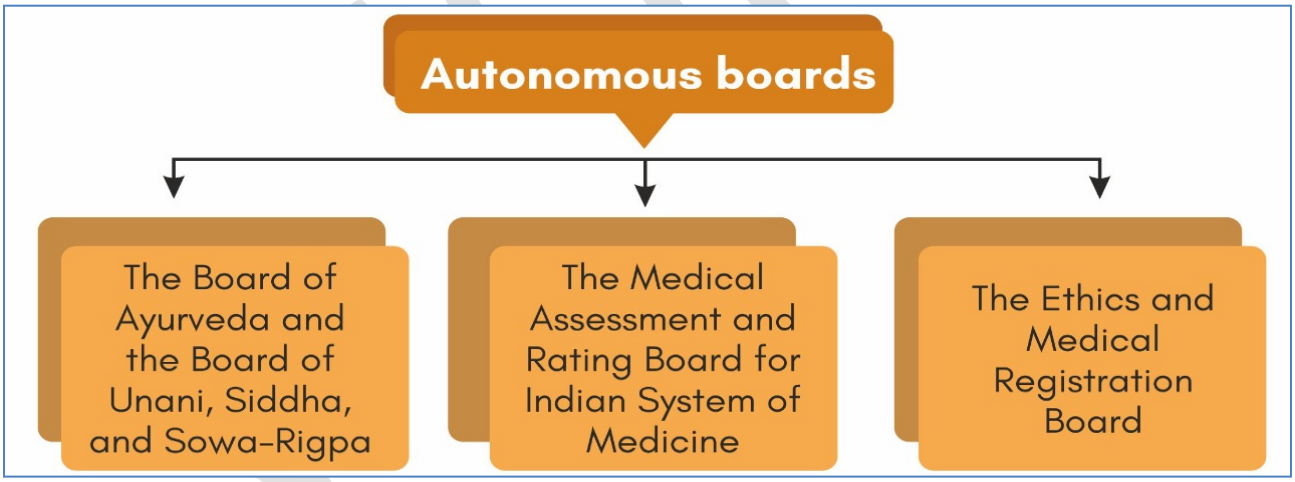
- **Centrally Sponsored Scheme of National AYUSH Mission** and the strategy of **mainstreaming of AYUSH under National Health Mission and National Health Policy-2017** are implemented for promoting and strengthening AYUSH sector.
- **Ministry of AYUSH has signed Country to Country** MoUs for cooperation in field of Traditional Medicine and Homeopathy, Collaborative Research/ Academic collaboration and for setting up AYUSH Academic Chairs in foreign Universities.
- **Under Ayushman Bharat,**10% of the Sub- centres are to be upgraded as Health and Wellness Centres (HWCs) which will be developed by the Ministry of AYUSH to provide comprehensive Health care to the needy community.

- ISM **mainly comprises the AYUSH streams** (Ayurveda, Unani, Yoga, Naturopathy, Siddha, and Homeopathy).
- The **Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH)** was formed in November 2014 **to ensure the optimal development and propagation of AYUSH** systems of healthcare.

7.7.1 THE NATIONAL COMMISSION FOR INDIAN SYSTEM OF MEDICINE ACT (NCISM), 2020

Key provisions of the act

- The Act **seeks to repeal the Indian Medicine Central Council Act, 1970** and to provide for a medical education system which ensures:
  - availability of adequate and high-quality medical professionals of Indian System of Medicine
  - adoption of the latest medical research by medical professionals
  - periodic assessment of medical institutions and an effective grievance redressal mechanism.
- **Constitution of National Commission for Indian System of Medicine (NCISM)** and **State Medical Councils.**
- **Autonomous boards:** Under the supervision of the NCISM. These boards are:



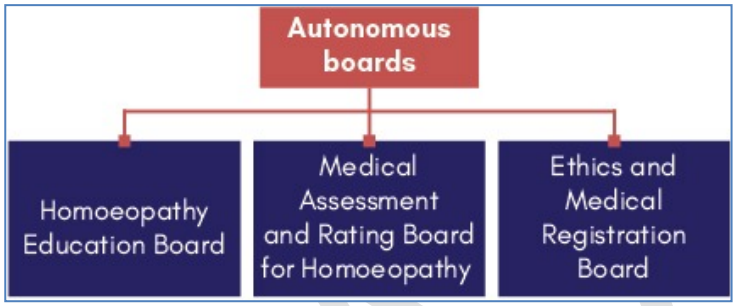
- **Advisory Council for Indian System of Medicine:** will be constituted by the central government and will be the **primary platform through which the states/union territories can put forth their views and concerns** before the NCISM.
  - Further, the Council **will advise the NCISM** on measures to determine and maintain the minimum standards of medical education.
- **Entrance examinations**: **uniform National Eligibility-cum-Entrance Test** for admission to under-graduate education in each of the disciplines of the Indian System of Medicine in all medical institutions regulated by the Act.
  - A **common final year National Exit Test** for the students graduating from medical institutions to obtain the license for practice.
  - Further, there will be a **uniform post-graduate National Entrance Test** for admission into post-graduate courses in each of the disciplines of the Indian System of Medicine in all medical institutions.

- **National Teachers' Eligibility Test** for postgraduates of each discipline of Indian System of Medicine who wish to take up teaching that particular discipline as a profession.

7.7.2. THE NATIONAL COMMISSION FOR HOMOEOPATHY (NCH) ACT, 2020

Key Provisions

- The Act **seeks to repeal the Homoeopathy Central Council Act, 1973** and provide for a medical education system which ensures availability of adequate and high quality homoeopathic medical professionals, etc.
- **Constitution of the National Commission for Homoeopathy(NCH) and State Medical Councils for Homoeopathy**
- **Functions of** (NCH): same as of NCISM but with regards to homeopathy
- **Autonomous boards:** The Act sets up certain autonomous boards under the supervision of the NCH. These are:
  - **Advisory Council for Homoeopathy**
  - **Entrance examinations for UG, PG and license for practice.**
  - **National Teachers' Eligibility Test**



- **Appeal on matters related to professional and ethical misconduct:** The State Medical Councils and the Board of Ethics and Medical Registration for Homoeopathy have the power to take disciplinary action against the medical practitioner including imposing a monetary penalty. If the medical practitioner is aggrieved of the decision of the Board, he can approach the NCH to appeal against the decision. Appeal of the decision of the NCH lies with the central government.

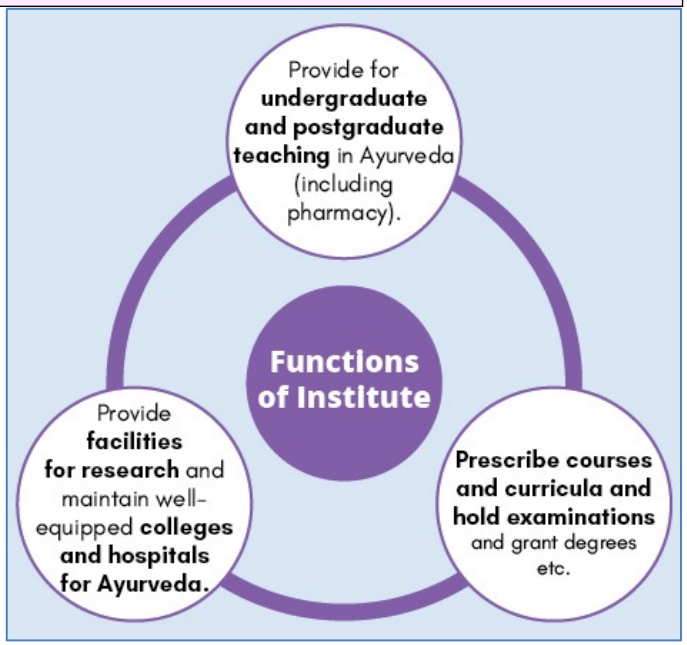
7.7.3. THE INSTITUTE OF TEACHING AND RESEARCH IN AYURVEDA (ITRA) ACT, 2020

Key Provisions

- It **seeks to merge three Ayurveda institutes into one institution** by the name of Institute of Teaching and Research in Ayurveda (ITRA). The proposed Institute will be situated in the campus of Gujarat Ayurveda University, Jamnagar and **will be an institution of National Importance.**
  - The existing institutes which will be merged into the Institute are: (i) the Institute of Post Graduate Teaching and Research in Ayurveda, Jamnagar, (ii) Shree Gulabkunverba Ayurveda Mahavidyalaya, Jamnagar, and, (iii) the Indian Institute of Ayurvedic Pharmaceutical Sciences, Jamnagar.
- **Composition of Institute:** Institute will consist of 15 members including the Minister of AYUSH, Director-General, Central Council for Research in Ayurveda, three experts in Ayurveda with expertise in education, industry and research, and three Members of Parliament.

Institute of National Importance (INI)

- As per Ministry of Education, INI is a **status that may be conferred on a premier public higher education institution** in India which serves as a pivotal player in developing highly skilled personnel within the specified region of the country/state'.
- The status is **granted by an act of Parliament.**
- As of 2020, **there are 159 institutes, declared as Institutes of National Importance** under a distinct Act of Parliament that includes IITs, AIIMSs, IIMs, NITs, IIITs, Indian Institutes of Science Education and Research (IISER), Schools of Planning and Architecture (SPA), National Institutes of Design (NID) etc.
- **ITRA will be the first institution with INI status in the AYUSH Sector**, and will enable the institution to be independent and innovative in the matter deciding course content and pedagogy.



7.8. OTHER NEWS

7.8.1. ASSISTED REPRODUCTIVE TECHNOLOGY

Why in news?

Recently, Assisted Reproductive Technology (ART) (Regulation) Bill, 2020, was introduced in the LokSabha.

More on news

- Objective of the bill is **to standardise protocols of the growing fertility industry** and **to provide for the regulation of ART services** in the country.
- This is the **third proposed legislation to protect the reproductive rights of women** after the Surrogacy Regulation Bill, 2019, and the Medical Termination of Pregnancy Amendment Bill, 2020.

Key provisions of the bill

- **Assisted Reproductive Technology (ART):** Will include all techniques that seek to obtain a pregnancy by handling the sperm or the oocyte (immature egg cell) outside the human body and transferring the gamete or the embryo into the reproductive system of a woman.
  - Examples of ART services include gamete (sperm or oocyte) donation, in-vitro-fertilisation (fertilising an egg in the lab), and gestational surrogacy (the child is not biologically related to surrogate mother). ART services will be provided through:
    - **ART clinics**, which offer ART related treatments and procedures, and
    - **ART banks**, which store and supply gametes.

Types of ARTs

In Vitro Fertilization (IVF)	Gamete intrafallopian transfer	Intrauterine insemination	Gestational Surrogacy
Woman's eggs are combined with man's sperm in a laboratory. The fertilised egg is then placed inside the woman's uterus in a procedure called embryo transfer.	The man's sperm and a woman's egg are made to combine in a lab. Then the eggs are implanted into the fallopian tubes and the fertilization occurs inside a woman's body.	Also known as artificial insemination, it involves insertion of the male partner's (or a donor's) sperm into a woman's uterus at or just before the time of ovulation by long narrow tube.	In this, embryo is created via IVF, using the eggs and sperm of the intended parents or donors, and is then transferred to the surrogate.The child is thus not biologically related to the surrogate mother.

- **Regulation of ART clinics and banks:** Every ART clinic and bank must be registered under the National Registry of Banks and Clinics of India.
- **Conditions for gamete donation and supply, offering ART services** have also been prescribed.
- **Rights of a child born through ART:** A child born through ART will be deemed to be a biological child of the commissioning couple and will be entitled to the rights and privileges available to a natural child of the commissioning couple. A donor will not have any parental rights over the child.
- **National and State Boards:** To regulate ART services. The State Boards will coordinate enforcement of the policies and guidelines for ART as per the recommendations, policies, and regulations of the National Board.
- **Offences and penalties:** for (i) abandoning, or exploiting children born through ART, (ii) selling, purchasing, trading, or importing human embryos or gametes, (iii) using intermediates to obtain donors, (iv) exploiting commissioning couple, woman, or the gamete donor in any form, and (v) transferring the human embryo into a male or an animal.

7.8.2. HUMAN MONOCLONAL ANTIBODIES (HMABS)

Why in News?

Council of Scientific & Industrial Research (CSIR) through its New Millennium Indian Technology Leadership Initiative (NMITLI) program approved a multi institutional project to develop hmAbs that can neutralize SARS-CoV-2 in patients.

About NMITLI

- It is **largest public-private-partnership effort within R&D domain** in the country.
- It seeks to build, capture and retain for India a leadership position by **synergising the best competencies of publicly funded R&D institutions, academia and private industry**.
- CSIR implements it.
- **NMITLI has so far evolved 60** largely networked **projects in diverse areas** viz. Agriculture & Plant Biotechnology, Bioinformatics, Drugs & Pharmaceuticals, Chemicals, Information and Communication Technology and Energy etc.
- **Strategy adopted for NMITLI** is to obtain an inverse risk-investment profile i.e. **low investment - high-risk technology areas** with investments increasing as developments take place.

More on News

- **Project aims to**
  - **Generate hmAbs to SARS-CoV-2 from convalescent phase of COVID-19 patients** and select high affinity and neutralizing antibodies.
  - **Anticipate future adaptation of the virus** and generate hmAbs clones that can neutralize the mutated virus.

About Monoclonal Antibodies (mAbs)

- mABs are **man-made proteins that act like human antibodies** in the immune system.
- Antibodies are proteins that are released naturally by body's immune system to fight pathogens. They are **called mAbs when produced by identical immune cells that are all clones of a unique parent cell**.
  - Unlike a vaccine, that protects a person from future infection, **antibodies helps in treating infected patients by providing passive immunization.**
- There are **4 different ways to make MAbs** and they are named based on what they are made of:
  - **Murine:** Made from mouse proteins and names of the treatments end in -omab.
  - **Chimeric:** A combination of part mouse and part human protein and names of the treatments end in -ximab.
  - **Humanized:** Made from small parts of mouse proteins attached to human proteins and the names of the treatments end in -zumab
  - **Human:** Fully human proteins and the names of the treatments end in -umab.
- **mABs have more potential,** as they are **derived from a single recovered cell** and **have a targeted response.** They can either be used alone or in combination with other therapies to neutralize virus in body.
  - In case of covid-19, mABs target specific spike proteins on virus surface, which facilitates entry into host cells.
- Apart from therapeutics, **mABs could also be useful for antigen-detection tests and serological assays targeting.**
- It is a **natural extension of convalescent plasma therapy (CPT)** and in future can replace CPT.
- Normally, scientists develop monoclonal antibodies by using mouse cells in culture and then 'humanize' them by using human-hybrid cells in the cell-culture.

Related News

- Biocon's (Bangalore based pharma company) Itolizumab drug got approval byDrugs Controller General of India (DCGI) for **restricted emergency use** in treating moderate to severe **COVID-19 patients.**
- Itolizumab, a **monoclonal antibody** was already approved for severe chronic plaque psoriasis.
- **Other approved drugs for Covid-19 treatment in India-** Antivirals such as Remdesivir, and immunosuppressant tocilizumab, steroid dexamethasone, and anti-malarial hydroxychloroquine.

7.8.3. OTHER IMPORTANT NEWS

Global Center for Traditional Medicine	• World Health Organisation announced that it **will set up a Global Centre for Traditional Medicine in India** to strengthen the evidence, research, training and awareness of traditional and complementary medicine. • This new centre will support WHO's efforts to implement the WHO traditional medicine strategy 2014-2023 which aims to support countries in developing policies and action plans to strengthen **the role of traditional medicine** as part of their journey to **universal health coverage and a healthier, fairer and safer world.**
Human Growth Hormone (hGH)	• Recently, Pardeep Singh (2018 Commonwealth Games silver medallist), has been suspended provisionally after his **blood sample tested positive for hGH.** • hGH is **produced in the body and secreted by the pituitary gland near the base of the brain.** • hGH helps in bone, organ and cartilage growth and also helps in repairing damaged muscles. • It is **banned both in-competition as well as out-of-competition** by World Anti-Doping Agency.
Pharmacopoeia Commission for Indian Medicine & Homoeopathy (PCIM&H)	• Cabinet has approved **re-establishment of PCIM&H as Subordinate Office** under **Ministry of AYUSH** (MoA) by **merging into it Pharmacopoeia Laboratory for Indian Medicine** and **Homoeopathic Pharmacopoeia Laboratory.** o PCIM&H is an autonomous body under aegis of MoA established since 2010. • Merger is aimed at **optimizing use of infrastructural facilities, technical manpower and financial resources** of three organizations for **enhancing standardization outcomes of Ayurveda, Siddha, Unani and Homoeopathy drugs** towards their effective regulation and quality control.
N-nitrosodimethylamine (NDMA) and N-nitrosodiethanolamine (NDEA)	• NDMA and NDEA **are carcinogenic or mutagenic compound** sometimes **found in food items** like cured meat, bacon, some cheese, and low-fat milk. • It was achieved by **developing a modified electrode by immobilizing carbon nanomaterials** (carbon dots) in DNA. • **Institute of Advanced Study in Science and Technology**, Guwahati, has **developed an electrochemical sensing platform** for detecting these compounds.
Nanoparticle to reduce severity of rheumatoid arthritis	• Rheumatoid arthritis **is an autoimmune disorder** that primarily affects joints in feet and hands. **Zinc levels** are reported to **get reduced** in such patients. • Scientists have formulated **nanoparticles with chitosan** and loaded these with zinc gluconate for reducing the severity of rheumatoid arthritis. o **Chitosan is a natural polysaccharide** obtained from the exoskeleton of crustaceans and is biodegradable, biocompatible, non-toxic, and mucoadhesive in nature. • **Developed by: Institute of Nano Science & Technology, Mohali**, an autonomous institute of Department of Science and Technology.
Pneumosil	• It is **India's first pneumococcal conjugate vaccine (PCV)** developed recently by Serum Institute of India in collaboration with partners like the Bill and Melinda Gates Foundation. • Pneumosil targets the **pneumococcal bacterium, which causes pneumonia and other serious life-threatening diseases such as meningitis and sepsis.** o Pneumococcal disease is a **significant contributor under-five mortality rate worldwide and** cause nearly four lakh deaths in children each year worldwide
Plant Based Vaccine (PBV)	• It is **emerging as an affordable and efficient alternative for vaccination** against diseases. • **PBV are a kind of recombinant vaccines** that introduce antigens against particular pathogens into the selected plant. o Rather than replicating a virus, it **aims to engineer a virus-like protein (VLP)** in living plants. o When administered, a **VLP mimics a virus and is recognised by the immune system**, thus eliciting a protective response.
Scientists discover new organ in the throat	• New organ is **a set of salivary glands set deep in the upper part of the throat.** o It is about 1.5 inches (3.9 centimeters) in length on average and are located over a piece of cartilage called the torus tubarius. o So far, this nasopharynx region — behind the nose — was not thought to host anything but microscopic, diffuse, salivary glands. • The discovery may be **important for cancer treatment.**

The Cancer Genome Atlas Program (TGCA)	• TCGA is a **cancer genomics program of the US-India** which began in 2006 bringing together researchers from diverse disciplines and multiple institutions. • Over the years, TCGA generated over 2.5 petabytes of genomic, epigenomic, transcriptomic, and proteomic data. These data **led to improvements in the ability to diagnose, treat, and prevent cancer**. • On similar lines, the establishment of an **'Indian Cancer Genomics Atlas (ICGA)'** has been initiated by a consortium of **key stakeholders in India led by CSIR.**

73rd World Health Assembly (WHA)	• WHA had unanimously adopted a resolution that seeks to-
	  ○ **Establish the origins** of the novel coronavirus
	  ○ **Impartial, independent and comprehensive evaluation on the response** of the World Health Organisation (WHO) to the coronavirus crisis.
	About WHA
	• It is the **decision-making body of WHO**.
	• It is **attended by delegations from all WHO Member States** and focuses on a specific health agenda prepared by the Executive Board.
	• **Main functions:** to determine policies of Organization, appoint Director-General, supervise financial policies, and review and approve the proposed programme budget.
	• It is **held annually in Geneva, Switzerland.**

Toxin in Hand sanitizer	• United States Food and Drug Administration **announced presence of 1-propanol in hand sanitisers.** • 1-propanol is toxin that can **depress the central nervous system and can be life-threatening** if ingested. • **1-propanol is a primary alcohol** and is used in the manufacture of products including pharmaceuticals, cosmetics, rubbing alcohols, and other chemicals and commercial goods.

8. DEFENCE

8.1. COASTAL RADAR NETWORK

Why in News?

India is planning at integrating more countries into coastal radar network.

More on News

- Efforts are in advanced stages to set up coastal radar stations in **Maldives, Myanmar, Thailand and Bangladesh**
  - **Mauritius, Seychelles and Sri Lanka have already been integrated** into the country's coastal radar chain network.
- **Integration is being done on mainly two platforms:**

Indian Navy's Information Management and Analysis Centre (IMAC)	• **IMAC,** located in Gurugram, was set up after the 26/11 Mumbai terror attacks and **is the nodal agency for maritime data fusion**.
	• IMAC is **jointly operated by the Navy and Coast Guard** and is the cornerstone of the National Command Control Communication and Intelligence Network **for monitoring maritime traffic in India's area of interest.**
	  ○ It **focuses on ships passing through Indian Ocean Region.**
	  ○ IMAC **tracks only non-military or commercial ships, known as white shipping**. Military ships, or grey hull ships, are tracked by the Directorate of Naval Operations.
	• Navy has been authorised to conclude white shipping agreements with 36 countries and three multilateral constructs.

Navy's Information Fusion Centre for the Indian Ocean Region (IFC-IOR)	• IFC-IOR is meant **to promote Maritime Domain Awareness.** It has been established at Gurugram. • IFC-IOR had **established itself as the hub of maritime security information in the IOR through white shipping exchange agreements with 21 countries** and 20 maritime security centres. • IFC is jointly **administered by the Indian Navy and Indian Coast Guard.**

8.2. DIGITAL OCEAN

Why in News?

Recently, web-based application Digital Ocean was launched.

About Digital Ocean

- Digital Ocean is a state of the art data platform **to provide ocean data related services at one place.**
  - It includes a set of applications developed to **organize and present heterogeneous oceanographic data** by adopting rapid advancements in geospatial technology.
- It has been **developed by the Indian National Centre for Ocean Information Services (INCOIS)** of the Ministry of Earth Science.
  - **INCOIS provides ocean information and advisory services to various stakeholders,** including Potential Fishing Zone advisories, Ocean State Forecast, high wave alerts, tsunami early warnings, etc.
  - It is a unit of the Earth System Science Organization (ESSO), an executive arm of the Ministry of Earth Science to develop and improve capability to forecast, weather, climate and hazard related phenomena.
  - **Significance of the 'Digital Ocean'**
  - It will serve as a **one stop-solution for all the data related needs** of a wide range of users.
    - Data from **various projects like Deep Ocean Mission, 'Samudrayaan' project,** research on alternative sources of energy, etc would be included.
  - It will help to **assess the evolution of oceanographic features** through 3D and 4D data visualization.

INDIA'S PROJECTS ON OCEANS

- **'Deep Ocean Mission' envisages exploration of minerals, energy and marine diversity** of the underwater world, a vast part of which still remains unexplored. It is yet to be launched.
- **'Samudrayaan' project** proposes to send a submersible vehicle with three persons to a depth of about 6000 metres to carry out deep underwater studies.

8.3. MISSILES, SUBMARINE AND SHIPS

Missiles	
Akash Missile system	• Cabinet approved **export of indigenously developed Akash missile systems** to friendly countries. • **It is a mid-range surface-to-air missile (SAM)** system built by DRDO. • It was developed under the **integrated guided-missile development programme (IGMDP).** ○ The programme also involved the development of the **Nag, Agni and Trishul missiles, as well as the Prithvi ballistic missile.** • Two versions of the missile have been built **for the Indian Air Force and the Indian Army.**
Akash-NG Missile	• Recently, **DRDO** successfully conducted the maiden test of the New Generation Akash missile (Akash-NG). • Akash-NG is a **new generation Surface to Air Missile meant for use by Indian Air Force** with an aim of intercepting high manoeuvring low RCS (Radar Cross Section) aerial threats.
NAG Missile	• The final user trial of Nag was **successfully carried at the Pokhran range** in Rajasthan. • It is India's third-generation, **anti-tank guided missile.** • **Features:** All-weather, fire-and-forget, lock-on after launch, with an operational range of 500 m to 20 km. It has a single-shot hit probability of 90%.
Anti-radiation missile- Rudram	• It is **first indigenous anti-radiation missile developed by DRDO.** • Anti-radiation missiles are designed **to detect, track and neutralise the adversary's radar, communication assets and other radio frequency sources**, which are generally part of their air defence systems. • It can be launched from a **height ranging from 500 metres to 15 km.** • With this, IAF now has the capability to **perform SEAD (Suppression of Enemy Air Defence)** operations deep into enemy territory to destroy enemy air defence setup.

Brahmos Supersonic Cruise Missile	• India successfully test-fired **land-attack version of BrahMos supersonic cruise missile.**
	  ○ Supersonic includes speeds **up to five times faster than the speed of sound.**
	  ○ **Cruise missiles are Self-propelled till the end of flights** and are used to deliver large warhead over long distance with high precision.
	• The range of the **new land-attack version has been extended to 400 km from 290 km** but speed has been maintained at 2.8 Mach.
	• BrahMos Aerospace, is an **India-Russian joint venture** to produce lethal weapons that can be launched from submarines, ships, aircraft and land platforms.
	• **Air-launched version and Naval version of the BrahMos missile** were also successfully test fired.

Medium-Range Surface-to-Air (MRSAM) Missile	• **MRSAM,** developed by the DRDO in collaboration with Israel Aerospace Industries (IAI) for Army **has been tested successfully** • The propulsion system, coupled with a thrust vector control system, **allows the missile to move at a maximum speed of Mach 2.** • The weapon has the ability to engage multiple targets simultaneously at ranges of 70km. • In May 2019, **Indian Navy, DRDO and IAI successfully tested Naval version** of MRSAM.
Dhruvastra anti-tank guided missile	• It is a **helicopter-launched Nag Missile (HELINA),** also known as 'Dhruvastra'. • It is a **third-generation fire-and-forget-class missile** and uses an imaging infrared seeker in lock-on-before-launch mode. • It is **indigenously developed byDRDO.**
Prithvi-II missile	• Recently India conducted a successful night test fire of its **indigenously developed nuclear capable surface-to-surface Prithvi-II missile.** ○ Prithvi-II is **capable of carrying 500 to 1,000 kg of warheads.**
Quick Reaction Surface-to-Air Missile (QRSAM) System	• QRSAM is **a short-range surface-to-air missile system,** indigenously designed and developed. • It provides a protective shield to moving armoured columns of the Army from enemy aerial attacks. **It has a range of 25 to 30 km.**
Shaurya Missile	• India successfully test fired its **indigenously developed nuclear capable hypersonic missile** 'Shaurya' with **a strike range of around 1,000 km.** • Shaurya is a canister-based system, which means that it is **stored and operated from specially designed compartments.**

	• Shaurya is a **land-based parallel of the submarine launched K-15 missile.** ○ The K family of missiles are primarily Submarine Launched Ballistic Missiles, which have been indigenously developed by DRDO and are named after DrKalam.

S-400	• India is set to get S-400 air defence missile system from Russia.
	  ○ It is **Russia's fourth generation of long-range surface-to-air missile system** capable of firing three types of missiles to create a layered defence.
	  ○ The system can **engage all types of aerial target**s including aircraft, unmanned aerial vehicles (UAV),ballistic and cruise missiles within the **range of 400km, at an altitude of up to 30km.**

Stand-off Anti-tank (SANT) Missile	• India **has successfully test-fired air-to-surface SANT missile** from a roof-top launcher at the Integrated Test Range (ITR). • SANT missile is an **upgraded version of the Helicopter Launched Nag (HeliNa) missile,** equipped with an advanced node-mounted seeker. • It is **developed by DRDO** for the Indian Air Force (IAF). • It will have both Lock-on After Launch and Lock-on Before Launch capability.
Submarines	
P-75 I	• **Indian Navy is set to acquire 24 new submarines under the Mega Project** which has been named P-75 I. • Presently the Indian Navy is **operating two different types of submarines** — Russian Kilo-class and German Type 209 conventional submarines. • And one **'Scorpene' class submarine is the new one inducted** in the Indian Navy.
Scorpene Class Submarine Vagir	• It is the **fifth among the six Kalvari-class submarines** being constructed by Mazagon Dock Ltd. • **Other vessels in the class are** INS Kalvari, INS Khanderi, INS Karanj, INS Vela and INS Vagsheer (under construction). • Design of Kalvari class of submarines, a class of diesel-electric attack submarines, is **based on Scorpene class of submarines with technology transfer from France.**
Ships and Other Vessels	
INS Vikrant	• It is India's **first domestically built aircraft carrier**. • It is lead ship of the Indian Navy's Vikrant-class, to be designed and **built in India under Indigenous Aircraft Carrier (IAC) program.** • It **operates a ski-jump assisted Short Take-Off But Arrested Recovery (STOBAR) launch systems for launching aircraft** and is capable of accommodating MiG 29K fighter jets and helicopters. • **INS Vishal,** also known as Indigenous Aircraft Carrier 2 (IAC-2), is to be the second aircraft carrier to be built in India after INS Vikrant (IAC-1). • **INS Vikramaditya (India's only active aircraft carrier)** is Indian Navy's largest short take-off, but assisted recovery (STOBAR) aircraft carrier, converted from the Russian Navy's decommissioned vertical take-off and landing (VTOL) missile cruiser carrier.
Indian Naval Ship (INS) Viraat	• **To be scrapped** at ship breaking yard at Alang in Gujarat. ○ Alang in Gujarat is the **world's biggest ship breaking yard** • It was **decommissioned in 2017** after 30 years of service with Indian Navy and around 27 years prior to that in British Royal Navy. • **Used in Op Parakram**, post terrorist attack on Parliament (2001-02)

Fast Patrol Vessel (FPV)ICGS Kanaklata Barua	• It is the **fifth and last in a series of FPV built by Garden Reach Shipbuilders and Engineers Ltd.**
	  ○ **Other four are** ICGS Priyadarshini (named after Indira Gandhi), ICGS Annie Besant, ICGS Kamala Devi (after Kamala Devi Chattopadhyay), and ICGS AmritKaur.
	  ○ It is **named after a teenage freedom fighter** who was shot dead in Assam during the Quit India Movement.
	• These FPVs are **upgraded versions of the inshore patrol vessels.**
	• These are **suited for patrolling, maritime surveillance, anti-smuggling, anti-poaching operations** and also for fishery protection, and rescue and search missions.

Project 17A	• Under Project 17A program, **a total of seven ships (guided missile frigates) are being built with enhanced stealth features, advanced indigenous weapon and sensor fit** along with several other improvements. • Recently, **Indian Navy's 2nd Project 17A Frigate 'Himgiri'** was launched by India's shipbuilder Garden Reach Shipbuilders and Engineers Limited.
INS Kavaratti	• INS Kavaratti has been commissioned in the Indian Navy.

	• It is the **last of the 4 indigenously built Anti-Submarine Warfare (ASW) stealth corvettes** built under Project 28 (Kamorta class) by Garden Reach Shipbuilders & Engineers (GRSE), Kolkata. ○ It joins 3 other ships of the same class namely- **INS Kamorta, INS Kadmatt and INS Kiltan.** • It is **named after the capital of the Lakshadweep group of islands.** • It has **90% indigenous content** with the state-of-the-art equipment and systems to fight in **Nuclear, Biological and Chemical warfare conditions**.
Others	
Rafale fighter jets	• Rafale is a French **twin-engine multi-role fighter jet** designed and built by Dassault Aviation. ○ It can **carry out all combat aviation missions**: air superiority and air defence, close air support, in-depth strikes, reconnaissance, anti-ship strikes and nuclear deterrence. • **India France signed agreement** in 2016 for supply of 36 Rafale multi-role fighter jets.
Light Combat Aircrafts (LCA) Tejas	• Cabinet approved procurement of **83 LCA Tejas from Hindustan Aeronautics Limited (HAL) for IAF.** ○ It is the **first Buy (Indian-Indigenously Designed, Developed and Manufactured) category procurement** of combat aircrafts with an indigenous content of 50%. • Tejas is an indigenously designed, developed and manufactured **state-of-the-art modern 4+ generation fighter aircraft**. • It is equipped with operational capabilities like **Active Electronically Scanned Array Radar, Beyond Visual Range Missile,** Electronic Warfare Suite and Air to Air Refuelling.
Pinaka	• Recently the **first ever pinaka rockets fully manufactured by the private sector** have been successfully test fired by the army. • Pinaka is **indigenous multi barrel rocket launch system** developed by DRDO. • Each Pinaka rocket is capable of **carrying a 100kg payload for a range of 40km**.
ABHYAS	• Abhyas is a **High-speed Expendable Aerial Target (HEAT)** which is designed and developed by DRDO. • It is an **unmanned aerial vehicle based on** indigenously developed **micro electromechanical systems** (MEMS) navigation system.
Smart Anti-Airfield Weapon (SAAW)	• **DRDO** successfully test fired SAAW from Hawk-1 jet of Hindustan Aeronautics Limited (HAL). • SAAW is **indigenously designed stand-off weapon developed** capable of engaging ground enemy airfield assets such as radars, bunkers, taxi tracks, and runways etc. up to a **range of 100 kms**.
Supersonic Missile Assisted Release of Torpedo (SMART)	• DRDO has **successfully flight-tested SMART.** It will have a range of over 600 km. • SMART is a Torpedo System for **Anti-Submarine Warfare** (ASW) operations far beyond Torpedo range. • Torpedo is a weapon consisting of **a self-propelled, self-guided, cigar-shaped underwater projectile** that carries a conventional or nuclear warhead.
Varunastra	• Varunastra is a **ship launched, heavy weight, electrically-propelled anti-submarine torpedo** which is capable of targeting quiet submarines, both in deep and shallow waters. • The weapon has a **range of 40 kilometers, can travel at a speed of up to 70 kilometers per hour** and dive to a maximum depth of 400 meters. • It is developed by **DRDO.**

8.4. BIO-TERRORISM

Why in news?

Parliamentary panel has **highlighted the need for the government to have laws to counter bio-terrorism** in its report 'The Outbreak of Pandemic COVID-19 and its Management'.

About bio-terrorism

- **Bioterrorism is a planned and deliberate use of pathogenic strains of microorganisms** such as bacteria, viruses, or their toxins to spread life-threatening diseases on a mass scale in order to devastate the population of an area.
- **Bioterrorism agents are classified as categories A, B, and C.**
  - **Category A:** High-priority agents that pose a risk to national security because they can be easily disseminated or transmitted from person to person, result in high mortality rates. Eg. Anthrax by Bacillus anthracis, botulism by Clostridium botulinum toxin, plague by Yersinia pestis etc.

- **Category B:** The second highest priority agents include brucellosis (Brucella species), glanders (Burkholderia mallei), melioidosis (Burkholderiapseudomallei), psittacosis (Chlamydia psittaci) etc.
- **Category C:** This includes emerging pathogens that could be engineered for mass dissemination in the future. Eg. Emerging infectious diseases such as Nipah virus and Hanta virus etc.

- These agents are **delivered by Scud missiles, motor vehicles with spray, hand pump sprayers, book or letter, guns, remote control, robots** etc.

Existing measures to counter bio-terrorism in India

- **Epidemic Diseases Act of 1897.**
- **National Disaster Management Authority (NDMA):** Half of the existing force is specifically trained to deal with chemical, biological, radiological, and nuclear (CBRN) threats.
- **Integrated Disease Surveillance Project (IDSP):** It was initiated in assistance with World bank, to strengthen/maintain decentralized laboratory-based IT enabled disease surveillance system for epidemic-prone diseases.
- **International Health Regulations:** Revised International Health Regulations came into force in India in June 2007 to ensure that outbreaks and other public health emergencies of international concern are detected and investigated more rapidly.

Initiatives at international level

- **Biological Weapons Convention:** It is first multilateral disarmament treaty banning the development, production and stockpiling of Bacteriological (Biological) and Toxin Weapons.
- **INTERPOL Bioterrorism Prevention Unit:** Enable law enforcement agencies against deliberate use of bacteria, viruses or biological toxins.
- **Cartagena Protocol on Biosafety:** to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology.

9. AWARDS

9.1. NOBEL PRIZE IN CHEMISTRY

Why in News?

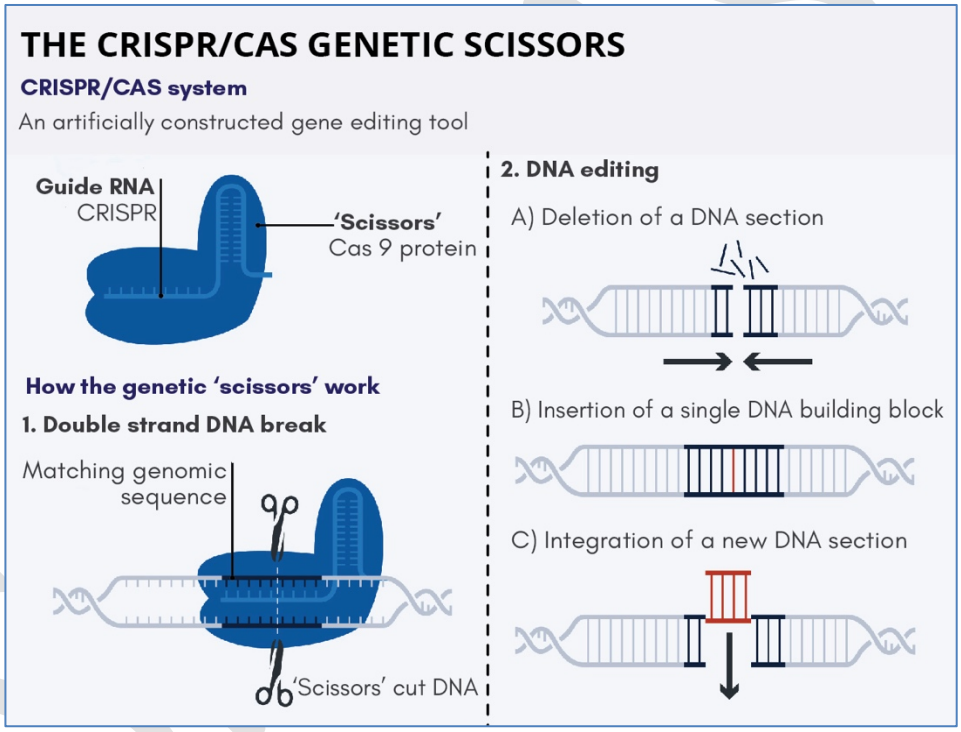
It was awarded jointly to Emmanuelle Charpentier and Jennifer A. Doudna **for discovering the CRISPR-Cas9 genetic scissors,** which allows scientists to 'cut-paste' inside a genetic sequence.

Clusters of Regularly Interspaced Short Palindromic Repeats (CRISPR)

- **CRISPR:** They are specific segments in the bacterial DNA that contain palindromic repeats inter spaced with pieces of DNA (called spacer) that bacteria snip off from attacking viruses.
  - Rodolphe Barrangou discovered that CRISPR is the natural defence mechanism of Bacteria against virus attack.
- **Cas9:** It is a CRISPR-associated (Cas) endonuclease, or enzyme, that acts as "molecular scissors" to cut DNA at a location specified by a guide RNA.
- **CRISPR-Cas9:** It is a unique genome editing technology that enables geneticists and medical researchers to edit parts of the genome by removing, adding or altering sections of the DNA sequence.

About the discovery

- **TRACRRNA:** During Emmanuelle studies of streptococcus pyogenes, one of the bacteria that cause the most harm to humanity, she discovered a previously unknown molecule, tracrRNA.
  - Further studies revealed that this tracrRNA was part of the bacteria's immune system and **it helps the bacteria destroy viral DNA.**
- **REPROGRAMMED CRISPR-CAS9:** Both succeeded in recreating the bacteria's scissors and reprogramming it and then proved that they can now use these scissors to cut any dna molecule at a required site.



Genome editing

- Genome editing is a technology that gives scientists the ability to change an organism's DNA.
- This allows genetic material to be added, removed, or altered at particular locations in the genome.
- It is a three-stage complex mechanism of **unwinding, cleaving and rewinding of DNA** to bring desirable changes in the genome of any living beings.
  - Cleaving of the DNA includes editing of genes (cut paste of the DNA).
- **Other genome editing systems** include TALENs and Zinc-Finger Nucleases.

Significance of the discovery

- CRISPER cas9 tool is **easier to adapt and genes could be edited within few weeks** with this tool.
- It has contributed to **discoveries in basic research,** and plant researchers have been able to develop crops that withstand mould, pests and drought.
- In medicine, **clinical trials of new cancer therapies are underway,** and it can help cure inherited diseases.
- These genetic scissors have **taken the life sciences into a new epoch** and, in many ways, are bringing the greatest benefit to humankind.

9.2. NOBEL PRIZE IN MEDICINE

Why in News?

It was awarded to Harvey Alter, Charles Rice, and Michael Houghton for **discovering the Hepatitis C virus (HCV).**

Hepatitis

- Hepatitis is **inflammatory disease of the liver.**
- **Hepatitis viruses** are the most common cause of hepatitis in the world but other infections, toxic substances (e.g. alcohol, certain drugs), and autoimmune diseases can also cause hepatitis.

About the discovery

- **Clue of the existence of the HCV:** In the 1970s, Dr. Harvey Alter led a team of scientists in discovering that most cases of post-transfusion hepatitis couldn't be linked to Type A or B viruses. This discovery provided a hint to the existence of a pathogen that had not yet been described.
- **Identification and Naming of the HCV:** In the 1980s, Dr. Houghton and his colleagues became the first to identify and formally name the hepatitis C virus as the infectious culprit.
  - Their work led to the development of a diagnostic test to identify the virus in blood, enabling doctors and researchers for the first time to screen patients and donors.
- **Confirmation of HCV being the sole cause for "non-A, non-B" cases of hepatitis:** Dr. Rice showed that HCV could be isolated in the lab and cause disease in an animal host, the chimpanzee.
  - These studies confirmed the HCV as the sole infectious agent responsible for the mysterious "non-A, non-B" cases of hepatitis and set up a crucial animal model for future studies.

About Hepatitis C virus (HCV)

- It is a **blood-borne virus and causes Hepatitis C disease** which affects the liver.
  - It happens through **transfusions of HCV-contaminated blood and blood products,** contaminated injections during medical procedures, and through injection drug use.
  - **Sexual transmission is also possible**, but is much less common.
  - According to WHO, there about 71 million people (6-11 million of them in India) who are suffering from chronic infection caused by HCV.
  - It is also a **major cause of liver cancer.**
  - **No vaccine is available for HCV yet.**

OTHER TYPES OF HEPATITIS	MODE OF TRANSMISSION	AVAILABILITY OF VACCINE
Hepatitis A virus (HAV)	Present in the faeces of infected persons and is most often transmitted through **consumption of contaminated water or food.** Certain **sex practices** can also spread HAV.	Yes
Hepatitis B virus(HBV) (Baruch Blumberg won the **Nobel Prize in Physiology or Medicine in 1976 for HBV discovery**)	Through exposure to **infective blood, semen, and other body fluids.** Can be transmitted from **infected mothers to infants** at the time of birth or from family member to infant in early childhood. Through **transfusions of HBV-contaminated blood and blood products,** contaminated injections during medical procedures, and through injection drug use.	Yes
Hepatitis D virus (HDV)	Infections occur only in **those who are infected with HBV.**	**Hepatitis B vaccines provide protection** from HDV infection.
Hepatitis E virus (HEV)	Through consumption of **contaminated water or food.**	Yes

9.3. NOBEL PRIZE IN PHYSICS

Why in News?

It was awarded to Roger Penrose, Reinhard Genzel and Andrea Ghez for **furthering the understanding of black holes**, the most "enigmatic" objects in the universe.

More about their discovery

- **Black hole formation is a robust prediction of the general theory of relativity:** In January 1965, Roger Penrose proved that black holes really can form and described them in detail, black holes hide a singularity in which all the known laws of nature cease.
  - Penrose used ingenious mathematical methods in his proof that black holes are a direct consequence of Albert Einstein's general theory of relativity.
- **Discovery of a supermassive black hole (Sagittarius A*) at the centre of our galaxy:** All the stars in the Milky Way orbit the centre Sagittarius A* (the Sun orbits Sagittarius A* in more than 200 million years).
  - For nearly three decades, the team led by Genzel and Ghez observed some thirty stars.
  - They found that the stars move in perfect elliptical orbits, just as if the object about which they were orbiting (Sagittarius A*) is a concentrated mass and not diffused or scattered.
  - Given its calculated mass of about four million solar masses, and its invisibility, **this could only be a supermassive black hole, they deduced.**

General Theory of Relativity

- This theory was proposed by **Albert Einstein in 1915.**
- Essentially, it's **a theory of gravity** whose basic idea is that instead of being an invisible force that attracts objects to one another, **gravity is a curving or warping of space.** The more massive an object, the more it warps the space around it.
  - **For example,** the sun is massive enough to warp space across our solar system (a bit like the way a heavy ball resting on a rubber sheet warps the sheet). As a result, Earth and the other planets move in curved paths (orbits) around it.
- **This warping also affects measurements of time**. We tend to think of time as ticking away at a steady rate. But just as **gravity** can stretch or warp space, it **can also dilate time.**
- **Confirmation:**
  - In the first major test of general relativity, **astronomers in 1919 measured the deflection of light from distant stars as the starlight passed by our sun,** proving that gravity does, in fact, distort or curve space.
  - **In 2016, the discovery of gravitational waves** (subtle ripples in the fabric of spacetime) was another confirmation of general relativity**.**
    - **Gravitational waves are produced by cataclysmic events** such as colliding black holes, supernovae (massive stars exploding at the end of their lifetimes), and colliding neutron stars.
    - **They travel at speed of light**, squeezing and stretching anything in their path.

What are black holes?

- A black hole is a place in **space where gravity pulls so much that even light cannot get out.** The gravity is so strong because matter has been squeezed into a tiny space.
  - This can happen **when a big star is dying** (our sun will never turn into a black hole as it is not big enough to make a black hole).
  - Because no light can get out **they are invisible.**
  - **In the center of a black hole is a gravitational singularity.**
- **In 2019 scientists got the first optical image of a black hole through Event Horizon Telescope.**

Basic parts of black hole:

- **Singularity:** It is the one-dimensional point in the centre of a black hole which contains a huge mass in an infinitely small space, where density and gravity become infinite and space-time curves infinitely. It is a tiny volume with very big density.
- **The event horizon:** It is the "point of no return" around the black hole. It is not a physical surface, but a sphere surrounding the black hole that marks where the escape velocity is equal to the speed of light.
- **The Schwarzschild Radius:** This is the event horizon's radius. It is the radius at which the escape velocity is equal to the speed of light.
- **The Ergosphere:** If the black hole is rotating, then as it spins, its mass causes the space time around the black hole to rotate as well. This region is called the ergosphere.
- **The Accretion Disk:** This is a disk composed of stellar material that is spiraling towards that black hole.

- It has captured the just outside region of a black hole, located 55 million light-years from Earth, at the centre of a galaxy named **Messier 87.**The image shows a photon (light quantum) can orbit the black hole without falling in. This is called the 'last photon ring'
- **Sagittarius A*** is the second black hole whose photographs have been captured by the Event Horizon Telescope project.

- **On the basis of size black holes can be divided in the 3 categories:**

- **Detection of Black Holes:**
  - They cannot be directly observed because they themselves do not emit or radiate light, or any other electromagnetic waves that can be detected by instruments built by human beings.
  - But the area just outside the boundary of the black hole (Event Horizon), which has vast amounts of gas, clouds and plasma swirling violently, emit all kinds of radiations, including even visible light.
  - Hence, the presence of black holes can be inferred by detecting their effect on other matter nearby them.
- **Importance:**
  - Their detection can provide a test for existing theories of the universe, and lead to a better understanding of black holes and the nature of the universe itself.
  - **Enhances the understanding of gravitational force**- which can be useful for the Global Positioning Satellites in order to make them accurate to more than a few metres.

9.4. OTHER IMPORTANT NEWS

Shanti SwarupBhatnagar(SSB) Prize	• It is given **each year for outstanding contributions to science and technology.** • **Disciplines covered** are Biological Sciences, Chemical Sciences, Earth, Atmosphere, Ocean and Planetary Sciences, Engineering Sciences, Mathematical Sciences, Medical Sciences and Physical Sciences. • **Eligibility:** Any citizen of India up to the age of 45 years. Overseas citizen of India and Persons of Indian Origin working in India are also eligible. • The award is **named after the founder Director of the Council of Scientific & Industrial Research .**

10. ALTERNATIVE ENERGY

10.1. INDIA'S FIRST LITHIUM REFINERY

Why in News?

India's first Lithium refinery which will **process Lithium ore to produce battery-grade material will be set up in Gujarat.**

About Lithium

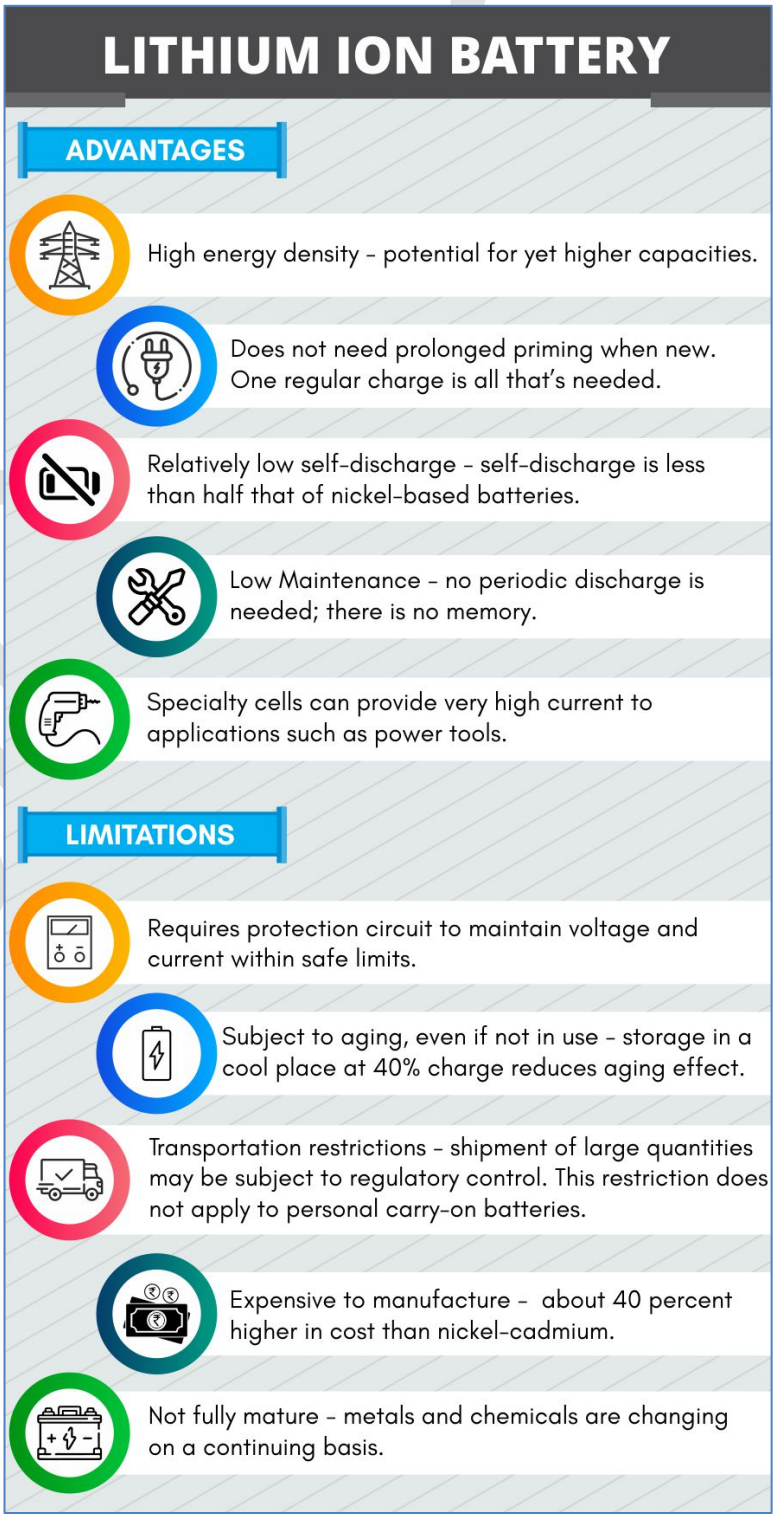
- Lithium an alkali metal is the **lightest of the solid elements**. It is soft, white, and lustrous.
- It is **found in brine deposits and as salts in mineral springs;** its concentration in seawater is 0.1 part per million.
- It constitutes **about 0.002 percent of Earth's crust.**
- It is **also found in minerals and ores like:** petalite, lepidolite amblygonite etc.
- A significant proportion of lithium reserves are **located in South America's "lithium triangle"** – an area encompassing parts of Chile, Argentina and Bolivia (largest reserves of lithium in the world).
- **Australia is largest producer** of lithium in the world.

About Lithium-ion battery

- Lithium-ion batteries are rechargeable batteries having **high voltage capacity, high energy density, long life cycle and high storage characteristics.**
  - Rechargeable lithium-ion batteries cycle 5000 times or more compared to just 400-500 cycles in lead acid.
- Lithium-ion batteries are smaller and lighter than a NiCad (Nickel Cadmium) battery. Lithium-ion also two to three times more expensive than NiCad. On the other hand, Lithium-ion has virtually no self-discharge.
- It finds wide applications in **electronic gadgets, tele-communications and Industrial applications as well as in aerospace.**
- Recent progress in Lithium-ion battery technology has made it a **favourite power source for electric and hybrid electric vehicles.**

Related News

- Preliminary surveys, by Department of Atomic Energy, have shown presence of Lithium resources in **igneous rocks of Marlagalla-Allapatna region of Mandya (Karnataka).**
  - **Other Potential Sites:** mica belts in Rajasthan, Bihar, and Andhra Pradesh; Pegmatite (igneous rocks) belts in Odisha and Chhattisgarh; Brines of Sambhar and Pachpadra in Rajasthan, and Rann of Kachchh in Gujarat.



- **Also, Graphine based super capacitors** are being produced by using discareded/waste lithium ion batteries.
- Super capacitor are now being used explicitly, in wind turbine pitch control, rail, automobile, heavy industry, telecom system and memory backup.

10.2. OTHER IMPORTANT NEWS

India's first 100 Octane petrol: XP100	• Recently, Indian Oil has launched **world-class premium grade Petrol (Octane 100) in the country. Branded as XP100**, the premium grade petrol was launched across ten cities. • Octane number is a **measure of the resistance of fuels to knock or to ignite prematurely**. • The **higher an octane number, more stable the fuel.**
World's Largest Solar Tree	• **Solar tree** is made of metal structure and have solar panels at the top instead of branches of real tree. o One solar tree **can reduce ten to twelve tonnes of carbon dioxide emissions.** • **Developed by CSIR-Central Mechanical Engineering Research Institute,** it is installed in Durgapur. • **I**ts installed capacity is above 11.5 kWp.

11. MISCELLANEOUS

11.1. INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR (ITER)

Why in news?

India has recently competed 50 per cent of the work assigned to it under the ITER project.

About ITER Project

- Launched in 1985, ITER is an **experimental fusion reactor facility** currently under construction in Cadarache, south of France.
- It aims to prove the feasibility of **nuclear fusion as a future source of energy** and build the world's largest tokamak through an international collaboration**.**
- Once complete, ITER will be the first fusion device to produce **net energy**.
- **ITER Members:** Signatories to the ITER Agreement include China, the European Union, India, Japan, Korea, Russia and the United States (35 nations).
  - **These countries share the cost of project construction, operation and decommissioning,** and will also share in the experimental results and any intellectual property generated by the project.
  - European Union being the host party contributes 45% while the rest of the parties contribute 9% each. Most of these contributions (around nine-tenths) are through 'in-kind' procurement of ITER components.
  - Each Member has created **a** Domestic Agency to fulfill its procurement responsibilities to ITER.
- **India's contribution:** India which formally joined the ITER project in 2005, is responsible for delivery of cryostat, in-wall shielding, cooling water system, cryogenic system, heating systems, Diagnostic Neutral Beam System, power supplies and some diagnostics.
  - India is contributing resources worth about $2.2 billion to this effort.
  - ITER-India is the Indian domestic agency, a specially empowered project of the Institute for Plasma Research (IPR), an aided organization under Dept. of Atomic Energy.
  - Larsen & Toubro Ltd (L&T) has worked and supplied all the parts for Cryostat.

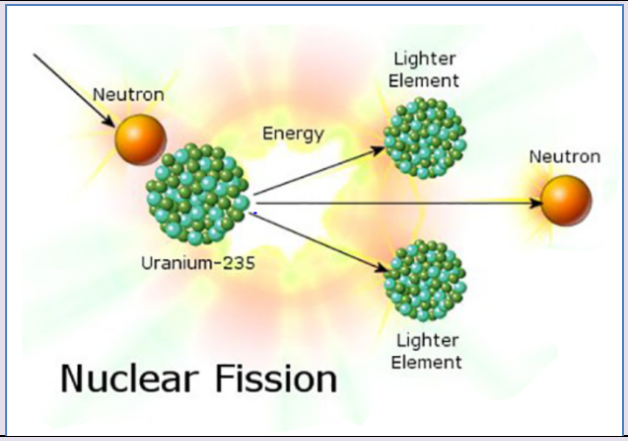
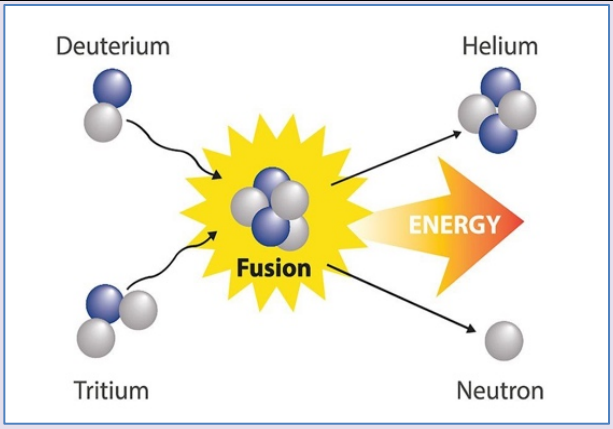
Tokamak

- The **tokamak** is an experimental **magnetic fusion device** designed to harness the energy of fusion.
- Inside a tokamak, the energy produced through the fusion is **absorbed as heat in the walls of the vessel**, which will be used by a fusion power plant to produce steam and then electricity by way of turbines and generators.
- The device uses **magnetic fields** to contain and control the hot plasma, which enables the fusion between **deuterium and tritium nuclei** to produce great amounts of energy.
- The machine has been designed specifically to:
  - **Produce 500 MW of fusion power**
  - **Demonstrate the integrated operation of technologies for a fusion power plant** such as heating, control, diagnostics, cryogenics and remote maintenance.
  - **Achieve a deuterium-tritium plasma** in which the **reaction is sustained for a long duration** through internal heating
  - **Test tritium breeding**: Since the world supply of tritium is not sufficient to cover the needs of future power plants
  - **Demonstrate the safety characteristics of a fusion device**: such as the control of the plasma and the fusion reactions with negligible consequences to the environment.

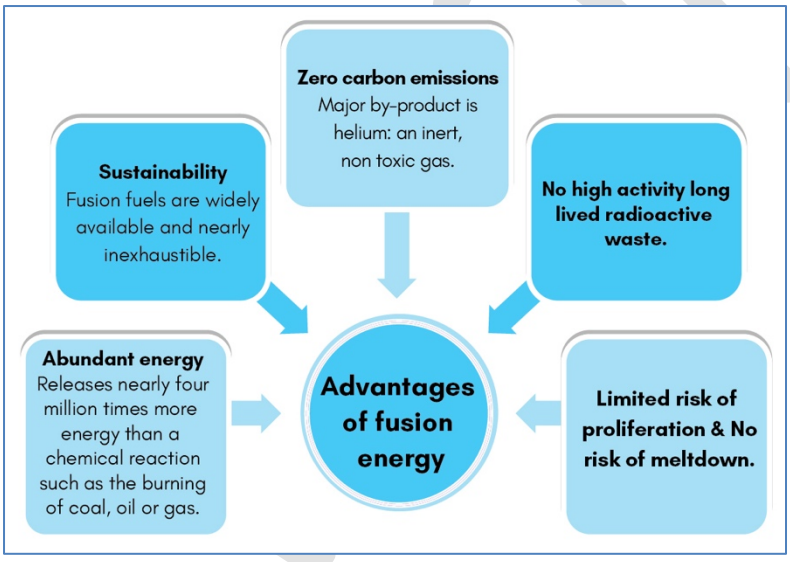
Related News

- Recently, China successfully **powered up its HL-2M Tokamak nuclear fusion reactor,** often called an artificial sun on account of enormous heat and power it produces.

Differences between Nuclear Fission and Fusion

Nuclear Fission	Nuclear Fusion
Fission is the **splitting of a heavy, unstable nucleus into two lighter nuclei,** which releases a tremendous amount of energy.	Fusion is the process where **two light nuclei combine together** releasing vast amounts of energy.
	
Uranium and plutonium are most commonly used for fission reactors.	**Atoms of Tritium and Deuterium** (isotopes of hydrogen) are used in fusion reactors.
Energy produced is **lesser** than that in nuclear fusion.	Energy released is **several times greater** than fission.
Fission reactors produce **highly radioactive fission products.**	Fusion reactors produce **no high activity/long-lived radioactive waste.** The burnt fuel in a fusion reactor is helium, an inert gas.
Additional neutrons released in the fission reaction can initiate a **chain reaction** which **sustains fission reactions for longer durations.**	Due to the tremendous amount of pressure and temperature needed to join the nuclei together, fusion reactions are **difficult to sustain for long periods** of time.

Advantages of fusion energy



Issues related to India's participation in ITER

- **Delays in in-cash contribution:** Since 2017, India has not fulfilled its in-cash contribution.
- **Low allocation of human resources at the ITER site:** Only 25 Indians are currently working there, as against 100 engineers/ scientists allowed as per the agreement. This gives opportunity to countries like China to have excess staffing.
- India deputed a rather **junior person to represent the country** in comparison to heads of states by other nations at the recent high profile global virtual event.

11.2. THIRD UNIT AT KAKRAPAR ATOMIC POWER PLANT (KAPP-3) ACHIEVES CRITICALITY

Why in News?

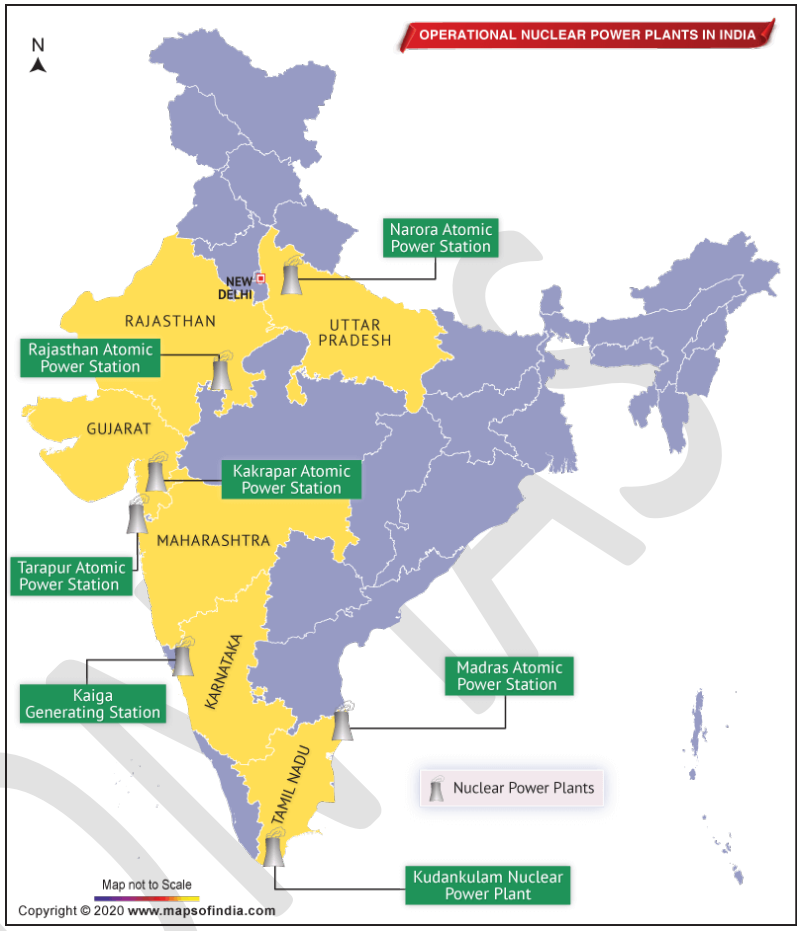
Recently, third unit at Kakrapar Atomic Power Plant (KAPP-3) achieved criticality.

More on News

- KAPP-3 isIndia's first700 MWe (megawatt electric) unit, and **biggest indigenously developed variant of Pressurised Heavy Water Reactor (PHWR).** Until now, biggest reactor size of indigenous design was 540 MWe PHWR (Tarapur).
  - First two units at Kakrapar were based on Canadian technology.

- PHWR is a nuclear power reactor commonly using **un enriched natural uranium** as its fuel, that uses **heavy water** (deuterium oxide) as its coolant and moderator.

- A reactor **achieves criticality (and is said to be critical)** when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions.
- **India has** current installed **nuclear power capacity** of 6780 **MW.**
- Indian Nuclear Power Generation **envisages a Three Stage Programme.**



INDIAN NUCLEAR POWER GENERATION ENVISAGES A THREE STAGE PROGRAMME

STAGE 1
- **Use natural uranium to fuel** pressurized heavy water reactors (PHWRs). The byproduct is Plutonium-239 (Pu-239).
- **Heavy water as moderator and coolant.**
- India achieved complete self- reliance in this technology and it is in industrial domain.

STAGE 2: FAST BREEDER REACTOR (FBR)
- FBR envisages the **use of Pu-239 obtained from the first stage** as fuel core.
- Uses fast neutron to generate more nuclear fuels than they consume.
- Known as FBR because it **doesn't use moderator while liquid sodium is used as coolant.**
- Uranium-233 is also formed.

STAGE 3 (BREEDER REACTOR)
- Thorium-based reactors that can be **refuelled using India's thorium reserves,** which are converted to Uranium-233 inside the reactor.
- **U-233, obtained from second stage** will be used as fuel.

Related Info
- **Nuclear reactors in India are placed under IAEA safeguards only if they are fuelled by uranium procured from abroad.**
- There are at present (2020) 22 operational reactors, of which 14 are under the International Atomic Energy Agency (IAEA) safeguards as these use imported fuel.
- India currently imports uranium from **Russia, Kazakhstan and Canada.**

11.3. HYPERLOOP

Why in News?

Recently, Virgin hyperloop became the first company to conduct a human test of the technology.

More on News

- Hyperloop is a **high-speed train that travels in a near-vacuum tube.** It is **considered 5th mode of transportation** (other 4 includes railways, roadways, airways, waterways).
  - **It is among 6 new proposals for the Public Transportation System,** cleared by NITI Aayog. Other five include metrino, stadler buses, pod taxis, hybrid buses and freight rail road.
- Hyperloop aims to **remove the two things that slow down regular vehicles: friction and air resistance.**
  - For Friction, the pod hovers above its track, like a magnetic levitation train and tube is used to reduce air resistance.
- The **reduced air resistance** allows the capsule inside the tube to reach **speeds of more than 1000 km/h,** thereby drastically reducing travel times.
- Hyperloop is **environment friendly** and doesn't call for much maintenance too.

- **IIT Madras Avishkar' project team has been working** on developing India's first self-propelled Hyperloop Pod.

11.4. CHEMOSYNTHESIS AIDS MICROBES SURVIVAL

Why in News?

Recently, scientists have discovered that **microbes across globe could live on air** — by feeding off the hydrogen, carbon dioxide and carbon monoxide to survive extreme conditions.

More on News

- In 2017, the **phenomenon was observed in Antarctica** but researchers have now discovered that **the phenomenon is global, and occurs in soils across the world's three poles** (Antarctic, Arctic and Tibetan Plateau in the Hindu Kush-Himalayas).
- The findings mean that microbes use **trace gases (gases in the atmosphere other than nitrogen, oxygen and argon) as energy and carbon source to grow.**
- This is possible by process called **Chemosynthesis,** which helps **microbes grow in areas of low photosynthetic capacity** (low or absence of sunlight).

About Chemosynthesis

- It is the process through which **bacteria or other living organisms derive energy** — from **reactions involving inorganic chemicals** — typically in the **absence of sunlight**.
- The process is also called **carbon fixation**, through which **inorganic carbon is converted to organic compounds** by living organisms and **stored as form of energy**.
- Chemosynthesis has profound impact on the **production and cycling of greenhouse gases** such as **carbon dioxide**, **methane** and **nitrous oxide**.

Photosynthesis vs Chemosynthesis

- **Photosynthesis – occurs in plants and some bacteria**, wherever there is enough sunlight.
- Photosynthetic organisms **use the sun's energy** to turn **carbon dioxide and water into sugar and oxygen.**
- Chemosynthesis – is the **use of the energy released by chemical reactions** (instead of the sun's energy) **to produce food.**

11.5. INDIA'S TRADITIONAL KNOWLEDGE DIGITAL LIBRARY

Why in News?

Recently, **India's Traditional Knowledge Digital Library completed 20 years of functioning.**

About Traditional Knowledge Digital Library (TKDL)

- **TKDL** is an **Indian digital knowledge repository of traditional knowledge** (TK), especially about medicinal plants and formulations used in Indian systems of medicine.
  - TK is knowledge, know-how, skills and **practices that are developed, sustained and passed on from generation to generation within a community,** often forming part of its cultural or spiritual identity.
- **TKDL was initiated in 2001, as collaboration** between the Council of Scientific and Industrial Research (CSIR), Ministry of S&T, and Department AYUSH, Ministry of Health.
  - TKDL database contains more than 3.9 lakh formulations/ practices from the **Indian systems of medicine (Ayurveda, Yoga, Siddha, Unani and Sowa Rigpa)** in digitized format **in five languages:** English, German, French, Japanese and Spanish.
- It seeks **to prevent misappropriation of the country's traditional medicinal knowledge at International Patent Offices** by preventing the granting of patents for products developed utilizing Indian TK.
- The database is **available to only patent examiners through TKDL Access** (Non-disclosure) Agreement.

11.6. INDIAN PERSONALITIES IN NEWS

11.6.1. C.V. RAMAN

Why in news?

Recently Chandrasekhara Venkata Raman was remembered on his 50th death anniversary (21st November 2020).

More about C. V Raman

- He was born at Tiruchirappalli in Tamil Nadu and worked as a **civil servant** in the Indian Finance Department in Calcutta.
- He founded the **Indian Journal of Physics in 1926, Indian Academy of Sciences in 1933** and established **Raman Institute of Research at Bangalore in 1948.**
- He was awarded with the **Nobel Prize for Physics in 1930** for the discovery of the Raman effect and **Bharat Ratna in 1954**.
- India celebrates **National Science Day on 28 February** of every year to commemorate the discovery of the Raman effect in 1928.

Contributions to physics by C. V. Raman

- **Raman effect/ Raman scattering:** In 1922 he published his work on the 'Molecular Diffraction of Light', which ultimately led to his discovery of 'Raman Effect' in 1928.
  - Light consists of particles called **photons; whose energy is directly proportional to the frequency with which they travel.**
  - **When they strike molecules in a medium at high speeds, they bounce back and scatter** in different directions depending on the angle with which they hit the molecules, is **known as Raman effect.**
  - Daylight interacts with the gases in Earth's atmosphere and scatters, instead of coming back straight to our eyes from the sun.
    - **Blue light is scattered most,** which means that it involves our eyes from all over within the sky, thus the sky appearance blue.
    - Yellow and red light are scattered least, thus we tend to typically see a yellow sun, and generally a red sun.
- **Raman spectroscopy:** It is used to better understand the composition of the structures, crystallographic orientation of the sample and the change in vibrational frequency for chemical bond in Raman effect.
  - It is used in many varied fields where non-destructive, microscopic, chemical analysis and imaging is required.
  - It can provide key information easily and quickly.
  - It can be used to rapidly characterise the chemical composition and structure of a sample, whether solid, liquid, gas, gel, slurry or powder.
  - Raman spectroscopy has been used to monitor manufacturing processes in the petrochemical and pharmaceutical industries.
  - It is additionally utilized in medication to research living cells, tissues and even in detection of cancers - while not inflicting damage.
- **Scattering by ocean:** He used a prism, miniature optical instrument and optical device to review the sky and therefore the ocean and found that the ocean was scattering light.
  - This, led to oppose the view of Lord Rayleigh, who said sea's colour is solely a mirrored image of the sky's colour.

11.6.2. DR VIKRAM SARABHAI

Why in News?

Recently, Moon Crater **Captured by Chandrayaan-2 was named After Vikram Sarabhai called "Sarabhai" Crater.**

About Dr Vikram Sarabhai

- Born in Ahmedabad in 1919, Dr. Vikram Sarabhai is considered as the **father of India's space program.**

Significant Contribution	Other institution established by him
Established the Physical Research Laboratory (PRL) in Ahmedabad.	Community Science Centre, Ahmedabad Darpan Academy for Performing Arts, Ahmedabad (along with his wife).
Founded the Ahmedabad Textile Industry's Research Association.	Space Applications Centre, Ahmedabad.
Established the Indian National Committee for Space Research in 1962, which was later, renamed the Indian Space Research Organization (ISRO).	Faster Breeder Test Reactor (FBTR), Kalpakkam Electronics Corporation of India Limited (ECIL), Hyderabad.
Setting up the Thumba Equatorial Rocket Launching Station in Thiruvananthapuram. Later renamed as the Vikram Sarabhai Space Centre.	Variable Energy Cyclotron Project, Calcutta.
Major role in the creation of the Indian Institute of Management, Ahmedabad.	Uranium Corporation of India Limited (UCIL), Jaduguda, Bihar.

- After the death of physicist HomiBhabha in 1966, **Sarabhai was appointed chairman of the Atomic Energy Commission of India.**
- Carrying forward Bhabha's work in the field of nuclear research, Sarabhai was largely responsible for the establishment and development of India's nuclear power plants. He laid the foundations for the indigenous development of nuclear technology for defense purposes
- **Awards conferred on him**
  - Shanti SwarupBhatnagar Award (1962)
  - Padma Bhushan (1966)
  - Padma Vibhushan, posthumous (after-death) (1972)
  - In 1973, a crater on the moon was named after him.
  - Lander of Chandrayaan 2, India's 2nd mission to moon is named 'Vikram' to honour late Dr.Vikram Sarabhai.

11.6.3. SRINIVASA RAMANUJAN

Why in News?

The year 2020 **marks 100th death anniversary** of Srinivasa Ramanujan.

About Ramanujan

- Srinivasa Ramanujan was born on **December 22, 1887** in the town of **Erode, Tamil Nadu.**
  - His **birth anniversary on 22 December is celebrated as National Mathematics Day** to honour the achievements of the legendary mathematician.
- He received his degree from Cambridge in 1916 and went on to **publish several brilliant papers on his subject with the help of his professor GH Hardy of Trinity College, Cambridge University.**

Ramanujan's Work

- Ramanujan made priceless contributions to several mathematical concepts like **infinite series, continued fractions, number theory and mathematical analysis**. He also made notable contributions like the **hypergeometric series, the Riemann series, the elliptic integrals, the theory of divergent series, and the functional equations of the zeta function.**
- Heintroduced a summation in **1918**, now known as the **Ramanujan sum** which is currently used in **signal processing, i.e., analysing, modifying and synthesising periodically repetitive signals such as speech, music, DNA sequences etc.**
- In hisfamous**letter to Hardy in 1919**, he introduced the **"mock theta functions"** which are **used today in 'String Theory' in theoretical physics.**
- He is also credited for his work in **'Modular functions'** which are used to **reveal properties of Black Holes by astrophysicists.**
- He 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- $1729 = 1^3 + 12^3 = 9^3 + 10^3$.

- Ramanujan was **elected to the London Mathematical Society in 1917** and was elected a Fellow of the Royal Society for his excellent work on Elliptic Functions and the theory of numbers.
- He was also **the first Indian to be elected a Fellow of the Trinity College.**
- Ramanujan**died at the young age of 32** owing to deteriorating health on April 26, 1920.
- In 1976 George E. Andrews found Ramanujan's notes written during his last few years in England. Prof. Andrews, along with Bruce C. Berndt went on to compile the contents of this lost notebook into a **five-volume book entitled Ramanujan's Lost Notebook.**
- Robert Kanigel also wrote a book about him called **'The Man Who Knew Infinity'** and a **movie of the same name** premiered in **2015**.

11.7. OTHER IMPORTANT NEWS

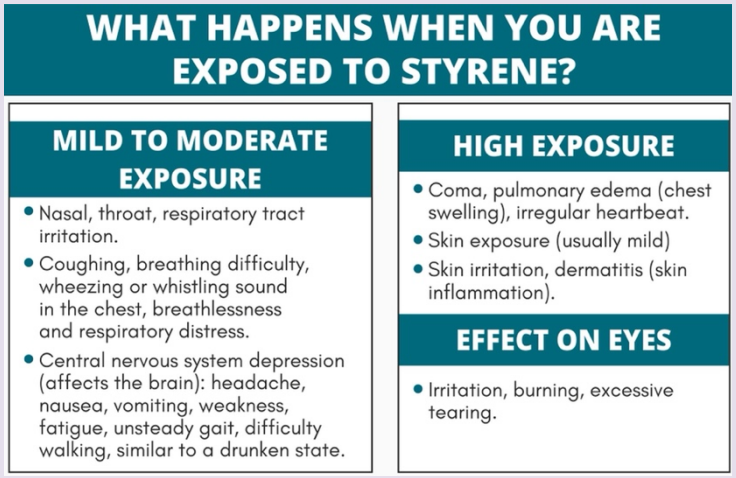
Winter Diesel	• Winter diesel is a **specialised fuel** that was introduced by Indian Oil Corporation**Limited specifically for high altitude regions** and low-temperature regions such as Ladakh, where ordinary diesel can become unusable. • **Benefits of winter diesel** ○ Contains additives to **maintain lower viscosity** can be used in temperatures as low as -30°C ○ **Higher cetane rating**-an indicator of combustion speed of diesel and compression needed for ignition. ○ **Lower sulphur content,** which would lead to lower deposits in engines and better performance. ○ **It has a low pour point** (the temperature below which the liquid loses its flow characteristics) of -33° Celsius. ○ **Unlike regular diesel, it is free from paraffin wax.**
Green crackers	• Green crackers **don't contain banned chemicals** such as lithium, arsenic, barium and lead. • They are called **Safe Water Releaser** (SWAS), **Safe Thermite Cracker** (STAR) and **Safe Minimal Aluminium** (SAFAL) crackers. • Green crackers release water vapour and **don't allow the dust particles to rise**. They are designed to have **30% less particulate matter pollution**. • While regular crackers emit about 160 decibels of sound, **green crackers' emission rate is limited to 110-125 decibels.** • They have been developed by **National Environmental and Engineering Research Institute (NEERI),** a Council of Scientific and Industrial Research lab. ○ **QR codes on green cracker packages** help consumers scan and identify counterfeits.
Vanadium	• An exploration carried out by Geological Survey of India has found **promising concentration of Vanadium metal in Arunachal Pradesh.** • Vanadium in its pure form is a soft, grey and ductile element primarily **derived from mined iron ore, carbonaceous shale or phyllites and steel slag.** • It is a ductile transition metal with a **natural resistance to corrosion and stability against alkalis, acids and salt water.** • Vanadium has an atomic number of 23. Its atomic symbol is V. • **India is a significant consumer of vanadium** but is not a primary producer of the strategic metal. China is the largest producer and consumer. • In India, the largest reserves of Vanadium are found in the state of Karnataka followed by Maharashtra and Odisha.
Emerging Technologies Initiative (ETI)	• Aim of ETI is to **assist in recommending appropriate policy choices** and help inform negotiating capacities vis-a-vis global technology governance rules, and standards, keeping in mind India's development and national security priorities. ○ Emerging technologies have the **potential to disrupt many existing industries** and significantly **impact employment, security, social equity, and global relations.** For ex: AI, Blockchain, Quantum Technology etc. • **Partners of ETI:**Office of the Principal Scientific Adviser, New Emerging & Strategic Technologies Division in the Ministry of External Affairs, Science Policy Forum.
Global Innovation & Technology Alliance (GITA)	• **GITA is a not–for–profit Section-8 Public-Private Partnership (PPP)** company promoted jointly by the Technology Development Board (TDB), Department of Science & Technology (DST) and the Confederation of Indian Industry (CII).

	• GITA has served as a catalyst **for nurturing innovation and industrial R&D** by fostering bilateral academic industry and government collaborations.
Vaishvik Bhartiya Vaigyanik (VAIBHAV) summit	• It is aimed at **developing mechanisms for involving Indian Diaspora working in top universities and R&D organisations** across the world, to further **enhance the knowledge-base of Indian Research and Academic Institutions.** • It will be organized by **Department of Science and Technology and Defence Research and Development Organisation.**
National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS)	• A **Technology Innovation Hub** at IIT Delhi under (NM-ICPS) was established. • **NM-ICPS** aims to create a strong foundation and a **seamless ecosystem for CPS technologies by coordinating and integrating nationwide efforts** encompassing knowledge generation, human resource development, research, technology and product development, innovation and commercialization. • It is **implemented by the Department of Science & Technology.**

Lab-grown meat	• Recently, the Singapore Food Agency approved the sale of a lab-grown meat product**.** This is **the first-time a cultured meat has been cleared** for sale anywhere in the world.
	• In lab-grown or cultured meat **scientists use the animal's stem cells to create meat rather than slaughtering animals**.
	  ○ **Stem cells are the building blocks of cells and tissues,** and by feeding them amino acids and carbohydrates, the muscle cells will be multiplied and grown in the lab.
	  ○ Once muscle fibers start growing, the result is an artificially created meat that resembles actual meat in terms of appearance, texture, and nutrient profile.
	• **Lab-grown meat is different from plant-based meat as** latter is made from **plant sources such as soy or pea protein,** while cultured meat is **grown directly from cells in a laboratory**.

Nerve agent Novichok	• As per German government, Russian opposition figure Alexei Navalny was poisoned with a **variant of Novichok, a Soviet-era nerve agent.**
	  ○ Novichok means newcomer in Russian**,** and applies to a **group of advanced nerve agents developed by Soviet Union** in 1970s and 1980s.
	• Nerve agents **cause their toxic effects by preventing the proper operation of an enzyme** that acts as the body's off switch for glands and muscles.
	  ○ Without an off switch**, glands and muscles are constantly being stimulated.**

Styrene Gas	• Styrene gas leak at LG Polymers' Vizag plant killed 11 people. • Styrene is a **poisonous volatile organic compound** (derivative of benzene). • It is **stored in factories as a liquid,** but evaporates easily, and has to be kept at temperatures under 20°C. • It is **used in the manufacturing** of latex, synthetic rubber, plastic packaging, disposable cups, intermediate to producecopolymers etc. • Styrene is **found in vehicle exhaust, cigarette smoke, in natural foods** like fruits and vegetables. • Styrene is classified as a "hazardous and toxic chemical under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 and Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 for regulating hazardous substances.
Trinity Test	• On July 16, 1945, **scientists tested the Gadget-world's first atomic bomb. This test was called as the Trinity Test.** Bomb was developed as part of the US-led **Manhattan Project.** • After this, within a month, an **identical nuclear bomb** called **'Fat Man'** was dropped on the Japanese city of Nagasaki. • An **atomic bomb uses either uranium or plutonium and relies on fission.**



Moushik	• It is **indigenous microprocessor,** developed by IIT Madras. • **It aims to reduce dependence on other countries** and as it is open source the design can be picked up by start-ups and customised to their needs. • It can **cater to the rapidly-growing Internet of things (IoT) devices,** an integral part of Smart Cities of a Digital India.

WAG-12	• It is **first 12,000 horse power (HP) electric locomotive** operationalised by Indian Railways.
	• It has been **manufactured** by Madhepura Electric Locomotive Pvt. Ltd. (MELPL), Bihar.
	  ○ MELPL is **a joint venture between** French rolling stock manufacturer **Alstom and Indian railways.**
	  ○ With this India became 6th country in world to produce high horse power (HP) locomotive indigenously.
	• WAG12 **will allow faster and safer movement of heavier freight trains** capable to haul around 6000 tonnes at a top speed of 120 kmph.

Battery made from nuclear waste	• A California-based company has made a **self-charging battery by trapping carbon-14 (C14) nuclear waste** in artificial diamond-case.
	  ○ Carbon-14 (C14), or radiocarbon, **is a radioactive isotope of carbon.** It also helps in provides **objective age estimates for carbon-based materials** that originated from living organisms.
	• The battery **works by generating electricity on its own from a shower of electrons as result of radioactive decay** scattered and deposited in the artificial diamond-case.
	  ○ The company claims the battery **can run for 28,000 years on a single charge.**

Heartiest Congratulations to all successful candidates

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