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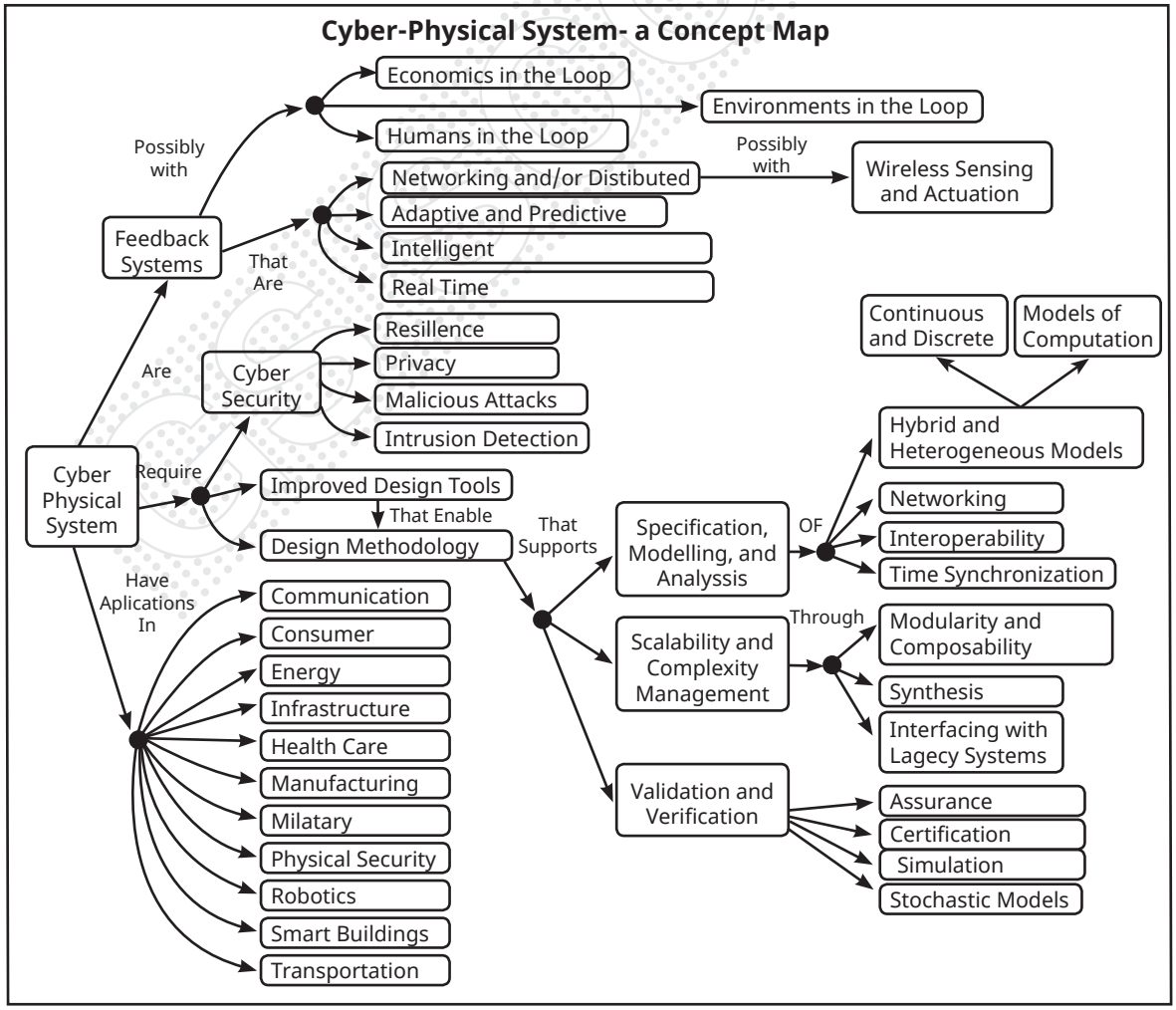
Information Technology & Computers

1 Cyber-Physical System

CONTEXT: National Mission On Interdisciplinary Cyber –Physical System (NMICPS) launched by Department of S&T.

- Cyber-Physical Systems (CPS) are i**ntegrations of computation, networking, and physical processes.** Embedded computers and networks monitor and control the physical processes, with feedback loops where physical processes affect computations and vice versa.
- **CPS integrates the dynamics of the physical processes with those of the software and networking**, providing abstractions and modeling, design, and analysis techniques for the integrated whole.



Merits: Increase in adaptability, autonomy, efficiency, functionality, reliability, safety, and usability of cyber-physical systems.

Potential Applications:

- Intervention (e.g., collision avoidance);
- Precision (e.g**., robotic surgery and nano-level manufacturing**);
- Operation in dangerous or inaccessible environments (e.g., search and rescue, fire fighting, and deep-sea exploration);
- Coordination (e.g., **air traffic control, war fighting**); efficiency (e.g., zero-net energy buildings);
- Augmentation of human capabilities (e.g. in **healthcare monitoring** and delivery)
- **India's bottlenecks:** Lack of skilled manpower, Capital
- **Positives**: Digital India and E-governance, Make in India

2 BullSequana Supercomputer

CONTEXT: France-based European Information Technology Corporation Atos and C-DAC (Centre For Development And Advanced Computing) of India have entered into agreement for designing, building and installing BullSequana Supercomputer in India.

- BullSequana Supercomputer will create a network of 70 high-performance supercomputing facilities for various academic and research institutions across India.
- Spanning over a period of seven years.

Application:

- Strengthening academic and research institutions in India
- Recreating the Big Bang
- Understanding earthquakes, cosmos and subatomic particle
- Intelligence Agencies Mapping the blood stream
- Modelling swine flu, other deadly diseases
- Testing nuclear weapons
- Data Mining
- Predicting climate change/ Weather Forecasting/ hurricanes
- Building artificial human brains

A supercomputer is a computer that performs at or near the currently highest operational rate for computers. Traditionally, supercomputers have been used for scientific and engineering applications that must handle very large databases or do a great amount of computation (or both).

Top 5 supercomputers in world:

Name	Country	Speed (High Performance Linpack)
Summit first	US (Oak Ridge National Laboratory's (ORNL))	143.5 petaFLOPS.
Sierra	US (Lawrence Livermore National Laboratory's (LLNL))	94.6 petaFLOPS
Sunway TaihuLight	China (National Supercomputing Center in Wuxi)	93.01 petaFLOPS
Tianhe-2	China (National University of Defense Technology (NUDT))	61.4 petaFLOPS,
Piz Daint	Switzerland (Swiss National Supercomputer Centre's)	21.2 petaFLOPS

Supercomputers of India developed indigenous:

- Aaditya, Anupam, PARAM Yuva II, SAGA, EKA, VIRGO, Vikram-100, PARAM Yuva, SahasraT

3 National Supercomputing Mission

CONTEXT: French IT services firm Atos has won a three-year contract to build the first phase of supercomputers under India's Rs 4,500-crore National Supercomputing Mission (NSM).

Background:

- World-wide supercomputing facilities have enabled countries in their S&T capabilities in areas such as designing vehicles, aeroplanes, massive structures like high rise buildings and bridges, infrastructure, discovery of new life saving drugs, discovery and extraction of new energy sources including oil, natural gas etc.
- Over the years, supercomputers have benefitted mankind in several ways. Weather prediction has reached accuracy of forecast as well as real time tracking of natural phenomenon. Timely warning of cyclones in the recent past have saved many lives and property. The Mission aims to further such capabilities beyond current levels.

National Supercomputing Mission (NSM):

- The Mission envisages empowering national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of more than **70 high-performance computing facilities.**
- These supercomputers will also be networked on the **National Supercomputing grid** over the National Knowledge Network (NKN).
- The NKN is another programme of the government which connects academic institutions and R&D labs over a high speed network.
- The Mission includes development of highly professional **High Performance Computing (HPC**) aware human resource for meeting challenges of development of these applications.
- India looks forward to create a cluster of machines for weather forecasting, drug discovery and data mining.

Agencies Involved:

- The Mission would be implemented and steered jointly by the **Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY**) over a period of seven years.
- The tender to build these high performance computers (HPC) had been floated by the **Centre for Development of Advanced Computing (C-DAC).**
- Atos would be deploying its energy efficient **Direct Liquid Cooled Bull Sequana supercomputers** in India.

4 Pratyush Computer

CONTEXT: Ministry of Earth Sciences has augmented the High-Performance Computing (HPC) System.

Key Facts:

- The systems are installed at two sites Indian **Institute of Tropical Meteorology (IITM), Pune (4 peta flops)** and **National Center for Medium Range Weather Forecast (NCMRWF**), Noida (**2.8 peta flops**).
- After the current augmentation, the total HPC capacity of the ministry has gone up to **8.0 Peta Flops**. India is now placed at the **4th position** after **Japan, UK and USA** for dedicated HPC resources for weather/climate community. It is India's **fastest super computer**.

Applications: The HPC system is being used for:

- The **advanced dynamical prediction systems** which are now being used for **Seasonal prediction**
- for generating probabilistic forecasts for extreme weather with extended range prediction (for next 20 days) and Short range prediction (up to 8 days)

5 SpiNNaker – World's Largest Brain – Like Supercomputer

CONTEXT: Spiking Neural Network Architecture (SpiNNaker) machine, the world's largest supercomputer designed to work in the same way as the human brain has been switched on for the first time.

Key Facts:

- (SpiNNaker) machine is capable of completing more than **200 million actions per second**, with **each of its chips having 100 million transistors**.
- Designed and built in the **United Kingdom**, it can model more biological neurons in real time than any other machine.
- **SpiNNaker** is unique because, unlike traditional computers, it does not communicate by sending large amounts of information from point A to B via a standard network. Instead it mimics the massively **parallel communication architecture** of the brain, sending billions of small amounts of information simultaneously to thousands of different destinations.
- **Biological neurons** are basic brain cells present in nervous system that communicate by emitting '**spikes' of pure electro-chemical energy**.

Significance

- SpiNNaker will help neuroscientists better understand **how our own brain work**s.
- It has also simulated a region of the brain called the **Basal Ganglia** – an area affected in **Parkinson's disease**, thus, it has massive potential for neurological breakthroughs in science such as pharmaceutical testing.
- It can be used to **control robot** which can interpret real-time visual information and navigate towards certain objects while ignoring others.

6 Shakti – India's first indigenous Microprocessor

CONTEXT: Indian Institute of Technology Madras (IIT Madras) researchers have designed India's first indigenous microprocessor called 'Shakti'.

Significance

- 'Shakti' will **reduce dependency on imported microchips** and the risk of cyber attacks.
- 'Shakti' will be ideal for communication and defence sectors.
- The team is now ready with 'Parashakti', an advanced microprocessor for super computers.

Key Facts:

- **Fabricated** in the Semi-Conductor Laboratory of **Indian Space Research Organization** (ISRO) at Chandigarh.
- **Developed** under project partly funded by **Ministry of Electronics and Information Technology (MeitY).**
- **Bluespec**, an open-source high level synthesis language went into making the chip.

7 India's First Locally Developed 4G/LTE Telecom System

CONTEXT: India's first locally developed 4G/LTE telecom system was launched at the telecom industry's international buyers-sellers meet.

About 4G and LTE

- 4G is the fourth generation of mobile telecommunications technology, commonly abbreviated as 4G, which are given by the **Radio Communication Standardization Sector** of the **International Telecommunication Union (ITU)**, whose task is to regulate most of the radio spectrum.
- Referring to **4G speeds**, it is specified that the speed **in motion** must be at least **100Mb/s** (approximately **12MB/s),** while the speed when one is **at a fixed point** should be reach **1Gb/s (128MB/s**).
- The acronym LTE stands for **Long Term Evolution** and is generally published as **4G LTE**.
- Although generally the relationship of the LTE and the 4G works almost as synonyms. However, the **LTE is not 4G**.
- The LTE is known as **pre-4G**, since it offers **more benefits than the characteristics of 3G, but does not fully meet the specification of 4G**.
- The **LTE Advanced**, is version 10 of the LTE and complies with the speed characteristic proposed for the 4G, reaching **1Gb/s of descent speed**.

- The system has been **designed and developed by** India's leading telecom equipment manufacturer, **VNL Ltd**.
- The system can be deployed for a variety of applications including **emergency communication, communication needs for offshore oil fields, mines and other institutional requirements**.
- The latest range of technologically robust **4G/LTE telecom** products is the outcome of strong in-house research and development capabilities and signifies India's inherent strengths in the area of telecom equipment manufacturing.

8 5G

CONTEXT: In June 2018, The 5G committee of the Telecom Ministry recommended that 6,000 MHz of spectrum can be made available without delay for the next generation 5G mobile service.

About 5G

- 5G is the **fifth generation mobile network**.
- It's a unified platform which is much more capable than previous mobile services with **more capacity, lower latency, faster data delivery rate and better utilisation of spectrum.**
- The standards for the usage of 5G are defined and driven by 3rd Generation Partnership Project (3GPP).

Timeline: Evolution from 1G to 5G

- **1G: Launched in the 1980s**. Analog radio signals and supported only voice calls.
- **2G: Launched in the 1990s**. Uses digital radio signals and supported both voice and data transmission with a BandWidth(BW) of 64 Kbps.
- **3G: Launched in the 2000s.** With a speed of 1 Mbps to 2 Mbps it has the ability to transmit telephone signal including digitised voice, video calls and conferencing.
- **4G:** With a peak speed of 100 Mbps-1 Gbps it also enables 3D virtual reality.
- **5G**: with a speed of more than 1Gbps,it is capable of connecting entire world without limits.

Salient features

- **Capability:** 5G will provide much faster mobile broadband service as compared to the previous versions and will provide support to previous services like mission critical communication and the massive Internet Of things(IoT).
- **Speed:** With peak delivering rate of up to 20 Gbps and an average of 100Mbps, it will be much faster as compared to its predecessors.
- **Capacity**: There will be up to 100 x increase in traffic capacity and network efficiency.
- Spectrum usage: Will provide better usage for every bit of spectrum, from low bands below 1 GHz to high bands.
- **Latency**: It's expected to have lower latency with better instantaneous, real-time access of the data.
- The 5G, like 4G LTE, also uses **Orthogonal Frequency Division Multiplexing(OFDM**) but the new 5G NR(New Radio)air interface will enhance OFDM and provide better flexibility in data delivery.

Applications Of 5G technology

- **High-Speed mobile network:** 5G will revolutionize the mobile experience with supercharged wireless network. Compared to conventional mobile transmission technologies, voice and high-speed data can be simultaneously transferred efficiently in 5G
- **Entertainment and multimedia** : 5G can provide **120 frames per second**, high resolution and higher dynamic range video streaming without interruption. Audiovisual experience will be rewritten after the implementation of the latest technologies powered by 5G wireless. Augmented Reality and virtual Reality services will be better experienced over 5G.
- **Internet of Things** : IoT applications collects huge amount of data from millions of devices and sensors and thus requires an efficient network for data collection, processing, transmission, control and real-time analytics which 5G network is a better candidate.
- **Smart cities** : Smart city application like traffic management, Instant weather update, local area broadcasting, energy management, smart power grid, smart lighting of street, water resource management, crowd management, emergency response etc can use a reliable 5G wireless network for its functioning.
- **Smart farming**: 5G technology will be used for agriculture and smart farming in the future. Using smart RFID sensors and GPS technology, farmers can track the location of livestock and manage them easily. Smart sensors can be used for irrigation control, access control and energy management.
- **Mission critical applications**: Like telemedicine services, remote control of critical infrastructure and vehicles. It has the potential to transform industries with highly reliable, low latency link.

High-Level 5G India 2020 forum

- Government has constituted High-Level 5G India 2020 Forum with three Secretaries of key Ministries/Departments Telecom, Meity and DST, and also comprising renowned experts. The primary aims of the forum are:
- Early deployment of 5G in India.
- A globally competitive product development and manufacturing ecosystem targeting 50% of India market and 10% of global market over next 5 to 7 years.

9 IIT – Delhi launches first 5G Radio Lab

CONTEXT: In an effort to establish India as a key global player in the standardisation, research and development and manufacturing of 5G equipment, a Massive MIMO radio laboratory has been set up at IIT Delhi. This will be the first such lab in India.

About MIMO:

- **Multiple-input multiple-output**, or MIMO, is a radio communications technology or **RF technology** that is being mentioned and used in many new technologies these days.
- Wi-Fi, LTE; Long Term Evolution, and many other radio, wireless and RF technologies are using the new MIMO wireless technology to provide **increased link capacity** and **spectral efficiency** combined with improved link reliability using what were previously seen as interference paths.

How it works:

- MIMO technology uses a **natural radio-wave phenomenon** called **multipath**. With multipath, **transmitted information bounces off walls, ceilings, and other objects, reaching the receiving antenna multiple times at different angles and slightly different times.**
- In the past, multipath caused interference and slowed down wireless signals.
- With multipath, MIMO technology uses multiple, smart transmitters and receivers with an added spatial dimension, increasing performance and range.

Significance:

- In Massive MIMO technology, several antennas are deployed at the base station as compared to only a few antennas in 3G/4G.
- This large antenna array at the base station **allows the network to communicate reliably with a very large number of mobile terminals simultaneousl**y at the same time and on the same frequency channel.
- It will **help curb the emittance of radiation harmful to our health** and also will allow less radio interference for better communication.

10 Open Transit Data Platform

CONTEXT: To increase transparency and build transport solutions, the transport department of the Delhi government has launched the Open Transit Data platform which provides real-time datasets free of cost.

Key Facts:

- Delhi's Open Transit Data platform provides **free of cost static and real time datasets** of **Delhi's buses** for **app developers and researchers** in machine-readable format.
- This includes **geo-coordinates of all bus stops, route maps, timetables** as well as the real time GPS **feeds of bus locations** which will be updated **every 10 seconds**.
- The portal was designed and developed by **IIIT Delhi** on behalf of the Delhi government.

Significance

- It is a major step to promote collaboration and co-creation **of innovative and inclusive transport solutions for the people of Delhi**.
- This initiative will provide a lot of **useful information at the fingertips of citizens** and encourage more and more people to switch to public transport, thereby impacting pollution.

11 Three Factor Authentication

CONTEXT: UPI did not that get that much of a push. Now the government has introduced a unified app for UPI called BHIM, which will let users transfer money to anyone with a UPI-enabled bank account, or even a regular bank account through IFSC code.

- The BHIM apps has **three levels of authentication**.
- For one, the app binds with a device's ID and mobile number,
- Second a user needs to sync whichever bank account (UPI or non-UPI enabled) in order to the conduct transaction.
- Third, when a user sets up the app they are asked to create a pin which is needed to log into the app. Further, the UPI pin, which a user creates with their bank account is needed to go through with the transaction.

12 Facial Authentication Working

CONTEXT: The Unique Identification Authority of India (UIDAI) has allowed face recognition as an additional means of Aadhaar authentication. The new method, called face authentication, will be used in combination with existing ways such as fingerprint or iris scan.

- The move is aimed at providing easy authentication for those individuals who face a difficulty in other biometric authentication like fingerprint and iris.

What is Aadhaar Authentication?

- Aadhaar authentication is the process by which the Aadhaar number along with the demographic information or biometric information of an Aadhaar number holder is submitted to the Central Identifies Data Repository (CIDR) for verification.
- The CIDR verifies the correctness, or the lack thereof, on the basis of the information available with it.
- Aadhaar authentication is being used as the primary identity verification mechanism by many systems such as Banks, Telecom companies, PDS, Income Tax, etc. which are mandated through various laws and also by a number of private entities.

Benefits of Face Authentication The UIDAI listed the following advantages of face authentication:

- Face authentication will provide additional choice to create inclusive authentication for residents having difficulty with their fingerprints/iris authentication.
- Since face photo is already available in UIDAI database there is no need to capture any new reference data at UIDAI CIDR.
- Camera is now pervasively available on laptops and mobiles making the face capture easily feasible for AUAs without needing any additional hardware.
- Face authentication with liveness detection can be used as an additional factor to increase security.

13 First in Asia: Facial recognition technology at Bengaluru airport

CONTEXT: Kempegowda International Airport (KIA) in Bengaluru became the first airport in Asia (and largest in the world) to introduce face recognition as the boarding procedure for passengers to board flights and move across different sections of the airport from 2019.

- The project has been implemented by Vision Box, a Portuguese software firm.
- Biometric technology will identify passengers by their face as they move across the airport, avoiding stops and the repeated presentation of boarding passes, passports or other physical identity documents.
- This new system will simplify the journey of air passengers by making it hassle free.
- This will also be one of the most prominent steps toward Digital India initiative of Government of India.

14 Digital Sky Platform

CONTEXT: Digital Sky Platform, as part of Civil Aviation Regulations (CAR), for registration of drones, pilots, and operators for online permission was recently launched.

- Nano drones in India can start flying legally from now.
- For micro and above categories, operators and pilots are required to register on the Digital Sky Portal.

Digital Sky Platform:

- The platform has begun accepting registrations of users.
- **Payments for Unmanned Aerial Operator's Permit (UAOP) and Unique Identification Numbers (UIN**) will be accepted through the Bharat Kosh (bharatkosh.gov.in) portal.
- It is envisioned that in the future Digital Sky Service Providers (DSPs) will be extending the functionality of the platform through Application Program Interfaces (APIs).

Significance for Drone users:

- Existing drone operators and potential drone owners are **required to buy No Permission-No-Takeoff (NPNT)-compliant RPAS.**
- The **import of drones is now permitted** as well.
- To get permissions to fly, RPAS operators or remote pilots will have to file a flight plan.
- **Flying in the green zones** will require only intimation of the time and location of the flights via the portal or the app.
- Permissions will be required for **flying in yellow zones** and flights will not be allowed in the red zones.
- Permission, if granted, will be available digitally on the portal.
- If an RPAS does not have permission to fly, it will not be allowed to take-off under the policy of NPNT.

Future of drones:

- Drones **offer low-cost, safe and quick aerial surveys** for data collection.
- This is **useful for industries such as power, mining, realty, oil and gas exploration, railways and highways.**
- With big data and tools such as 3D modelling, businesses can simulate and analyse varied situations.
- Drones can **inspect tall structures and offshore rigs**.
- **Relief, rescue work and policing** can become more effective by using them.
- They can be used for delivery of fertilizers in fields and to ship goods, a use e-commerce firms may be interested in.

15 M2M'Communication

CONTEXT: Department of Telecom (DoT) has exempted wireless devices that operate in low frequency range like bluetooth, wireless chargers, internet-of-things products, medical devices etc. from licensing requirement.

- The move **aimed at facilitating ease of doing business for adoption of new technologies like IoT, machine-to-machine (M2M) communications** both in industrial and consumer applications.
- Henceforth, no licence will be required by any person to establish, maintain, work, possess or deal in any wireless equipment for purpose of usage of very low power radio frequency devices or equipments.
- It will be application for inductive applications in frequency bands of 302 to 435 KHz (kilohertz), 855 to 1050 KHz and 1.89 to 2.31 MHz on non -interference, non-protection and shared (non-exclusive) basis.

16 Mobile Towers are harmlesssww: CPCB

CONTEXT: A recently-declassified study of the Central Pollution Control Board (CPCB) states that mobile towers do not have any negative effect on human health.

Background Information

- "**Thermal effect**" of radiation refers to the heat that is generated due to absorption of microwave radiation which causes cellular and physiological changes in living beings
- **"Non-thermal effects"** of radiation have been shown to be responsible for fatigue, irritability, headaches, nausea, loss of appetite, sleep disturbance, disruption and other psychological disorders, memory loss and difficulties in concentration.

About International Commission on Non Ionizing Radiation Protection (ICNIRP):

- The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an international commission specialized in **non-ionizing radiation protection**. The organization's activities include **determining exposure limits for electromagnetic fields** used by devices such as cellular phones.
- ICNIRP is an **independent non-profit scientific organization chartered in Germany**. It was founded in 1992 by the International Radiation Protection Association (IRPA) to which it maintains close relations.
- The mission of ICNIRP is to screen and evaluate scientific knowledge and recent findings toward providing protection guidance on non-ionizing radiation, i.e. radio, microwave, UV and infrared.

Highlights of the report:

- Based on safety limits prescribed by the **International Commission on Non Ionizing Radiation Protection (ICNIRP**), the review report had said that there was **no substantive or convincing evidence of cell phone radiation's biological effects that could harm a person's health**. The ICNIRP standard uses the **limit of 450 μW/cm^2.**
- However, the report does admit that the current exposure safety standards are **purely based on the thermal effect while ignoring the non-thermal effects of radiation**.
- While stating that there was no impact of radiation from towers, the CPCB has said that this concern on health hazards needed further research, both national as well as international.

- However, since 2010, India has moved forward. In 2015, the Department of Telecommunications had come up with new norms of radiation from mobile phone towers which came into force in September 2015. And the limits on power density from mobile phone towers were restricted to one-tenth of the existing limit.

17 Adoption of Blockchain Technology to Stop Bank Frauds

CONTEXT: In the light of one of the recent frauds that happened in Punjab National Bank recently experts have put forward their opinion for the adoption of blockchain by India's banks which may help in averting frauds.

- Blockchain is considered as the disaggregated and transparent nature of the technology, which updates information across all users simultaneously, ensures that various officials would have instantly been alerted.

What is Blockchain?

- Blockchain is the **digital and decentralized ledger that records transactions without the need for a financial intermediary**, which in most cases is a bank.
- A blockchain is an **anonymous online ledger** that uses data structure to simplify the way we transact. Blockchain allows users to manipulate the ledger in a secure way without the help of a third party.

Benefits of blockchain technology:

- As a public ledger system, blockchain records and validate each and every transaction made, which makes it secure and reliable.
- All the transactions made are authorized by miners, which makes the transactions immutable and prevent it from the threat of hacking.
- Blockchain technology discards the need of any third-party or central authority for peer-to-peer transactions.
- It allows decentralization of the technology.

How Blockchain could have Averted Banking Scam?

- In the above mentioned scam, junior official send out Letter of Undertaking without any authority. However in blockchain, there are **smart contracts which will not get executed until specified people have not nodded.**
- **Bank issued Letter of Undertaking without any security**: There was no security kept before lending the loan which is totally against bank's policies. Here also concept of smart contracts can fit in. **Loan will not get approved until and unless securities from the person who is taking the loan are successfully deposited**.
- None of the transactions got logged on PNB's banking system: There is a centralised database which has to be updated specifically by the bank manually. There are chances of manual error. **In blockchain, there is only one ledger which is ultimate truth. There is no scope of manual error, foul play there**.

18 India's First Blockchain District in Telangana

CONTEXT: Tech Mahindra and the Telangana government have signed an agreement to establish a Blockchain district in Hyderabad, a first-of-its-kind Centre of Excellence for Blockchain in India.

Blockchain District

- Initially it would be **a virtual cluster, connecting with the stakeholders working in the emerging technology**. It would have a physical building at a later phase.
- In short, it will be **"a cluster of buildings", which will house start-ups and other stakeholders working on the development of the platform**.
- Tech Mahindra, as a founding member of the Blockchain district, will provide platform and technology assistance to all the incubators in the district.
- On its part, the Telangana government would provide regulatory and policy support to promote the growth of Blockchain.

19 NASSCOM unveils centre for Data, AI

CONTEXT: The National Association of Software and Services Companies (Nasscom), India's premier software lobby, has opened a Center of Excellence (CoE) for Data Science and Artificial Intelligence in Bangalore.

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans. The term was **coined in 1956 by John McCarthy** at the Dartmouth conference, Massachusetts Institute of Technology.

- It is a simulation of human intelligence processes such as learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions), and self-correction by machines, especially computer systems.

Some Applications:

- **Finance**: Banks use intelligent software application to screen & analyse financial data. Software that can predicts trends in stock market have been created which have been known to beat humans in predictive power.
- **Computer Science**: Researchers in quest of AI have created spin offs like dynamic programming, object oriented programming, symbolic programming, intelligent storage management system etc.
- **Aviation:** Air lines use expert system in planes to monitor atmospheric condition & system status.
- **Weather Forecast:** Neural Network is used for predicting weather condition. Previous data are fed to a neural network which learns the pattern & uses that knowledge to predict weather pattern.
- **Healthcare Sector**: Machine learning is being used for faster, cheaper and more accurate diagnosis and thus improving patient outcomes and reducing costs. For Example, IBM Watson and chatbots are some of such tools.

Centre of Excellence:

- The **CoE initiative is a nationwide programme on innovation, focusing on solutions** in smart manufacturing, automotive, healthcare, agriculture, energy, IoT, banking and financial services, retail, telecom, and host of emerging technologies.

NASSCOM

- The National Association of Software and Services Companies (NASSCOM) is a **non-profit global trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) industry** which was established in 1988 with over 1500 members, of which over 250 are companies from the US, UK, EU, Japan and China.

- It is **headquartered in New Delhi**, India with regional offices in the cities of Mumbai, Chennai, Hyderabad, Bangalore, Pune and Kolkata.
- It facilitates **business and trade in software and services** and encourages the advancement of research in software technology. It is registered under the Indian Societies Act, 1860.

20 Mumbai to have India's First Artificial Intelligence Centre

CONTEXT: In a first in the country, the State government will be setting up an institute for artificial intelligence (AI) in Mumbai.

- AI institute will **give a fresh impetus to the 'fourth industrial revolution'**, and **promote Mumbai as an investment destination in innovation and data analysis**.
- The State is already experimenting with AI in the health sector, and has plans to involve a Mumbai¬based tech startup to use AI-powered X-ray, MRI, and CT scan machines. The AI involves application of deep-learning algorithm to highlight deviations in medical imaging.

For effective use of AI in the public sector, the government must first have structured data, and give its cloud access to the public. Once this architecture is in place, AI at the most basic level could be applied to power saving and defence equipment. The policy making could also be streamlined once data is structured for an AI use.

21 Model International Center for Transformative AI (ICTAI)

CONTEXT: NITI Aayog, Intel and TIFR collaborate to set up a Model International Center for Transformative AI (ICTAI)

Key Facts:

- The initiative is part of NITI Aayog's '**National Strategy for Artificial Intelligence'** Discussion Paper that focuses on establishing ICTAI in the country through **private sector collaboration**.
- Based in **Bengaluru**, the Model ICTAI aims to conduct advanced research to incubate AI-led solutions in **three important areas – healthcare, agriculture and smart mobility**.
- The model ICTAI is chartered to develop AI foundational frameworks, tools and assets, including curated datasets and unique AI algorithms.
- The model Centre also plans to develop AI foundational technologies to promote applied research that can scale for national impact and will lead to the creation of a vibrant and self-sustaining ecosystem.

22 Saposhi

- It is a new Malware detected by cybersecurity agencies.
- The **Malware can take over electronic devices and use them for Distributed Denial of Service (DDoS) attacks.**
- Saposhi Malware **is capable of taking over electronic devices and turning them into bots** (device taken over by malware) which can then be used for any purpose, including DDoS attacks which, with enough firepower, can cripple entire industries.

Types of Malwares

- **Virus:** Viruses attach themselves to clean files and infect other clean files. They can spread uncontrollably, damaging a system's core functionality and deleting or corrupting files.

- **Trojans:** This kind of malware disguises itself as legitimate software, or is included in legitimate software that has been tampered with. It tends to act discretely and create backdoors in security to let other malware in.
- **Spyware:** It hides in the background and takes notes on what you do online activities including passwords, credit card numbers, surfing habits and more.
- **Worms:** Worms infect entire networks of devices, either local or across the internet, by using network interfaces. It uses each consecutive infected machine to infect more.
- **Ransomware:** Also called scareware, this kind of malware can lock down computer and threaten to erase everything — unless a ransom is paid to its owner.
- **Adware:** Though not always malicious in nature, particularly aggressive advertising software can undermine security just to serve ads — which can give a lot of other malware a way in.
- **Botnets**: Botnets are networks of infected computers that are made to work together under the control of an attacker. Government of India has launched **Cyber Swachhta Kendra** – Botnet Cleaning and Malware Analysis Centre for analysis of malware and botnets that affect networks and systems.

23 GravityRat Malware

CONTEXT: GravityRAT, a malware allegedly designed by Pakistani hackers, has recently been updated further and equipped with anti-malware evasion capabilites, Maharashtra cybercrime

About GravityRAT

- GravityRAT infiltrates a system in the form of an **innocuous-looking email attachment**, which can be in any format, including MS Word, MS Excel, MS PowerPoint, Adobe Acrobat or even audio and video files.
- The 'RAT' in its name stands for **Remote Access Trojan**, which is a **program capable of being controlled remotely** and thus difficult to trace.
- The hackers first identify the interests of their targets and then send emails with suitable attachments.
- The RAT was **first detected** by **Indian Computer Emergency Response Team (CERT-In)**, on various computers in **2017**.

Features of RAT

- It is designed **to infiltrate computers and steal the data of users** and **relay the stolen data** to Command and Control centers in other countries.
- The latest update to the program by its developers is part of GravityRAT's function as an **Advanced Persistent Threat (APT**), which, **once it infiltrates a system**, **silently evolves and does long-term damage.**
- It **lies hidden in the system** that it takes over and keeps **penetrating deeper**
- According to latest inputs, GravityRAT has now **become self-aware** and is capable of evading several commonly used malware detection techniques.

About CERT-In

CERT-In has been designated to serve as the national agency to perform the following functionsin the area of cyber security:

- **Collection, analysis and dissemination of information on cyber incidents**.
- **Forecast and alerts of cyber security incidents**
- Emergency measures for handling cyber security incidents

- Coordination of cyber incident response activities.
- Issue guidelines ,advisories, vulnerability notes and whitepapers relating to information security practices, procedures, prevention, response and reporting of cyber incidents.
- It is a functional organization of Ministry of Electronics and Information Technology

24 ToneTag

CONTEXT: ToneTag, a Bengaluru-based financial technology company, is set to introduce sound-based data transfer technology named Tonetag.

ToneTag Technology - ToneTag is a technology which is a **communication protocol** that will enable data transfer using sound waves. It is **not hardware dependent** and works with the devices that **do not have a microphone or speaker**. Also, they are not dependent on internet connectivity.

Working of Tone Tag technology

- A merchant can **programme any device** - a mobile phone or a PoS device - or use **a ToneTag device** and transmit a bill amount and transaction details via a **sound signal**.
- Customers can authenticate payments using their phones.
- The technology allows for transactions to be completed when **two devices are in close proximity** of each other.
- It can be also be integrated with **digital wallets, and payment apps**. The technology can also work on **any operating system** – iOS, Android, Windows, and Linux - and **does not necessarily need a smartphone** to function.

Analysis

- ToneTag sound-wave communication platform enables highly secure proximity payments, customer engagement services and on-the-go mobility solutions. The approach in this technology makes the entire process device agnostic and completely frictionless, making the user experience intuitive and highly adaptable.

25 World Congress on Information Technology

- Prime Minister inaugurated the 22nd edition of World Congress on Information Technology (WCIT) 2018 in Hyderabad through video conferencing from New Delhi.
- The key themes of the event are: Bracing for Impact, Digitise the Core, Firm of the Future (FoF), Emerging Imperatives, Collaborate to Disrupt.

World Congress on Information Technology:

- It was first held in 1978 by WITSA (World Information Technology & Services Alliance), the World Congress on Information Technology (WCIT) has become the premier international ICT forum.

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Space Technology & Events

1 ISRO's Mission/Programme:

Mission/ Programme	Objective	Specifications
1.India's heaviest satellite GSAT-11	⊙ The **Bharat Net Project** aims to enhance the public welfare schemes like e-banking, e-health, e-governance among others.	⊙ The 5854-kg GSAT-11 will **provide high data rate connectivity to users of Indian mainland and islands** through 32 user beams in Ku-band and 8 hub beams in Ka-band. ⊙ GSAT-11 will **boost the broadband connectivity to rural and inaccessible Gram Panchayats in the country** coming under the Bharat Net Project, which is part of Digital India Programme
GSAT-7A	⊙ The Satellite is built **to provide communication capability** to the users in Ku-band over the Indian region.	⊙ GSAT-7A is an **advanced military communications satellite** meant primarily for the **Indian Air Force with Indian Army using 30% of capacity**. GSAT-7A is similar to **Indian navy's GSAT-7 and the Indian Air Force will be the sole operator of the satellite**. ⊙ **GSAT-7A is the 35th Indian Communication satellite** built by ISRO. GSAT-7A Spacecraft is configured on ISRO's standard I-2000 Kg (I-2K) Bus.
ExseedSAT 1, India's 1st private satellite	⊙ The satellite would provide a **big boost to private radio operators and help in coordinating messages among them** and help the country in time of disaster.	⊙ The mini communication satellite weighing just a kg with double the size of a Rubik's cube (10 cm x 10 cm x 10 cm) is made up of aluminium alloy. ⊙ The satellite with a lifespan of five years will allow people to receive signals on 145.9 Mhz frequency with the help of a TV tuner.
GSLV-Mk III D2	⊙ GSAT-29 carries Ka/Ku-band high throughput communication transponders which will bridge the digital divide of users including those in Jammu & Kashmir and North Eastern regions of India.	⊙ GSLV MkIII-D2, the second developmental flight of **GSLV MkIII successfully launched GSAT-29**, a high throughput communication satellite on November 14, 2018 from the Second Launch Pad(SLP) at Satish Dhawan Space Centre SHAR, Sriharikota. ⊙ GSLV-Mk III which is **three-stage vehicle with two solid motor strap-ons, a liquid propellant core stage and a cryogenic stage, is capable of launching 4 ton class of satellite to Geosynchronous Transfer orbit (GTO).** ⊙ GSAT-29 satellite with a lift-off mass of 3423 kg, is a multi-beam, multiband communication satellite of India, configured around the ISRO's enhanced I-3K bus. This is the heaviest satellite launched from India.

ISRO's AstroSat	• To understand high energy processes in binary star systems containing neutron stars and black holes • Estimate magnetic fields of neutron stars • Study star birth regions and high energy processes in star systems lying beyond our galaxy • Detect new briefly bright X-ray sources in the sky • Perform a limited deep field survey of the Universe in the Ultraviolet region	• ASTROSAT **observes universe in the optical, Ultraviolet, low and high energy X-ray regions of the electromagnetic spectrum,** whereas most other scientific satellites are capable of observing a narrow range of wavelength band. • ASTROSAT is **India's first dedicated multi wavelength space observatory**. This scientific satellite mission endeavours for a more detailed understanding of our universe. • One of the unique features of ASTROSAT mission is that enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite.
Gaganyaan 2022	• Manned mission to space, making the country **fourth in line to have sent a human to space.**	• It consists of a service module and a crew module, collectively known as the **Orbital Module** • Isro's GSLV Mk III, the three-stage heavy-lift launch vehicle, will be used to launch Gaganyaan.
ISRO conducts pad abort test	• The test, which was unmanned, is designed to validate the launch escape system that would carry the spacecraft and its crew to safety in the event of a major malfunction during the early stages of a future manned launch.	• A **Pad Abort Test is a trial run for the spacecraft's launch abort system** (sometimes called a launch escape system). • This system is **designed to quickly get the crew and spacecraft away from the rocket in the event of a potential failure**. • The technology developed is expected to be applied to the first Indian crewed spacecraft called Gaganyaan, scheduled to be launched in 2022.
Polarimetry Doppler Weather Radar	• Provides **advance information, enhancing the lead-time so essential for saving lives and property**, in the event of **natural disaster associated with severe weather**.	• The DWR, being the first S-band (operating at 2.7 - 2.9 GHz) dual polarimetric Doppler Weather Radar can detect Weather phenomenon upto 500 km.
ISRO launches two U.K. satellites	• **PSLV-C42** is carrying two earth observation satellites of Britain's Surrey Satellite Technology Limited (SSTL) **NovaSAR and S1-4**, weighing 450 kg each.	• NovaSAR is a S-Band Synthetic Aperture Radar satellite intended for forest mapping, land use & ice cover monitoring, flood & disaster monitoring. • S1-4 is a high resolution Optical Earth Observation Satellite, used for surveying resources, environment monitoring, urban management and for the disaster monitoring
ISRO's IRNSS-1I Satellite	• Eighth navigation satellite to join the IRNSS space segment.	• The navigation payload of **IRNSS-1I transmits signals for the determination of position, velocity and time**. • This payload is operating in L5-band and S-band. Rubidium atomic clocks are part of the navigation payload of the satellite. • The ranging payload of **IRNSS-1I consists of a C-band transponder**, which facilitates accurate determination of the range of the satellite. It also carries Corner Cube Retro Reflectors for LASER Ranging.

Sounding Rocket: RH-300 MKII	• The study will enrich available atmospheric data and refine models used for tropical weather prediction.	• The rocket was launched by **VSSC under *Sounding Rocket Experiment (SOUREX) programme*** for atmospheric studies. • TMA experiment is **being conducted now with indigenously made payload and rocket**.
India's First Robotic Telescope	• To observe dynamic or transient events in the universe.	• Country's first robotic telescope. • The telescope is located at the **Indian Astronomical Observatory (IAO)** at Hanle in Ladakh. • The 70 cm robotic telescope joins other larger facilities at IAO in Hanle .
Laser Interferometer Gravitational Wave Observatory (LIGO) project	• LIGO is a large-scale physics experiment and observatory to detect gravitational waves.	• A new **gravitational wave detector to measure ripples in the fabric of space** and time is set to be built in **India by 2025** • World's **third LIGO detector**. • It will be built in collaboration with universities from across the globe • It will significantly **improve the ability of scientists to pinpoint the sources of gravitational waves** and analyse the signals • Other 2 LIGOs are in USA.
GRACE-FO mission-NASA & GFZ	• GRACE-FO, which launched May 22, 2018, will **continue the work of tracking Earth's water movement to monitor changes in underground water storage,** the amount of water in large lakes and rivers, soil moisture, ice sheets and glaciers, and sea level caused by the addition of water to the ocean. • These discoveries provide a **unique view of Earth's climate and have far-reaching benefits to society and the world's population.**	• The Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) mission is a partnership between NASA and the German Research Centre for Geosciences (GFZ). GRACE-FO is a successor to the original GRACE mission, which orbited Earth from 2002-2017. • GRACE-FO will carry on the extremely successful work of its predecessor while testing a new technology designed to dramatically improve the already remarkable precision of its measurement system.
Communication Satellite GSAT-31	**Augment the Ku-band transponder capacity in Geostationary Orbit for at least 15 years.** Provide continuity to operational services on some of the in-orbit satellites. Help bridge the digital divide in the Indian subcontinent as part of an ambitious Indian space program, whose objectives are to develop India while pursuing scientific research and planetary exploration.	• Indian Space Research Organisation's latest communication satellite, *GSAT-31 was successfully launched by **Arianespace aboard its launch vehicle Ariane 5*** **from the spaceport in French Guiana** recently. • A telecommunications satellite **designed and manufactured by the Indian Space Research Organisation (ISRO).** • India's **40th communication satellite and derives its heritage from ISROs earlier INSAT/ GSAT satellite series**. • It will be placed in **Geostationary Orbit (36,000 km above the equator)** using its onboard propulsion system.

		⊙ It has a unique configuration of **providing flexible frequency segments and flexible coverage**. Hence, it will provide communication services to Indian mainland and islands. ⊙ It will also provide DTH Television Services, connectivity to VSATs for ATM, Stock-exchange, Digital Satellite News Gathering (DSNG) and e-governance applications. The satellite will also be used for bulk data transfer for a host of emerging telecommunication applications.
Hyperspectral Imaging Satellite	It can be **used for a range of applications from monitoring the environment, crops, looking for oil and minerals, military surveillance.**	⊙ The Indian Space Research Organisation (ISRO) is **planning to launch a full-fledged niche Earth observation (EO) satellite** — called the **Hyperspectral Imaging Satellite (HySIS)**. ⊙ The HySIS satellite has critical chip called an "optical imaging detector array'" indigenously developed by ISRO. ⊙ Its launch will **allow ISRO to enter the domain of operational hyperspectral imaging from earth orbit**. ⊙ Hyperspectral imaging or hyspex imaging (imaging spectroscopy) **combines the power of digital imaging and spectroscopy**. It collects and processes information from across the electromagnetic spectrum. Hyspex' imaging enables distinct identification of objects, materials or processes on Earth by reading the spectrum for each pixel of a scene from space. The hyspex technology is still an evolving science. In recent times, it has become trend that is being experimented globally. It has ability to add a new dimension to plain-vanilla optical imagers.

2 NASA's Mission/Programme:

Mission/Programme	Objective	Specifications
Chandra X-Ray Observatory	⊙ To detect **X-ray emission from very hot regions of the Universe** like exploded stars, clusters of galaxies, and matter around black holes.	⊙ Named after the Indian Scientist **Subrahmanyan Chandrasekhar (known for Chandrashekhar limit)** ⊙ It was positioned above the Earth's atmosphere up to an altitude of 139000 km in space. ⊙ In February 2017 detected a very strange and distinctive **X-ray signal from the Milky Way galaxy**. This observation can help the scientists in proving the existence of dark matter in the universe
ICESat-2 (**Ice, Cloud, and land Elevation Satellite 2**)	⊙ for measuring **ice sheet elevation and sea ice thickness,** as well as land topography, vegetation characteristics, and clouds	⊙ ICESat-2 will carry a single instrument, the Advanced Topographic **Laser Altimeter System**, or ATLAS. With **10,000 laser pulses per second**, this fast-shooting laser technology allows ATLAS to take measurements every 28 inches along the satellite's path.

		⊙ The launch of ICESat-2 took place on 15 September 2018 from Vandenberg Air Force Base Space Launch Complex 2 aboard a Delta II 7420-10C.
Advanced Supersonic Parachute Inflation Research Experiment (ASPIRE)	⊙ to test supersonic parachute that will help NASA space exploration missions to land on Mars	⊙ The parachute was launched aboard of sounding rocket from NASA's Wallops Flight Facility in US. It was **tested in sky, mimicking conditions of entering red planet**. ⊙ NASA's ambitious **Mars rover mission is set to launch in 2020** to deploy six-wheeled vehicle on martian surface to study rocks on site and cache samples for eventual return to Earth. ⊙ It will rely on **special parachute to slow spacecraft down when it is entering Martian atmosphere** at over speed of 12,000 mph (5.4 kilometers per second). The six-wheeled rover body is based heavily on NASA's earlier Curiosity Mars rover.
Radar in a CubeSat (RainCube)	⊙ **Technology demonstration mission to enable Ka-band precipitation radar technologies** on a low-cost, quick-turnaround platform.	⊙ This mission will validate a new architecture for Ka-band radars and an **ultra-compact lightweight deployable Ka-band antenna** in a space environment to raise the technology readiness level (TRL) of the radar and antenna from 4 to 7 within the three year life of the program.
New Horizons	⊙ An **interplanetary space probe** that was launched as a part of **NASA's New Frontiers program**.	⊙ The spacecraft was launched in 2006 with the primary mission to perform **a flyby study of the Pluto system in 2015**, and a **secondary mission to fly by and study one or more other Kuiper belt objects (KBOs)** in the decade to follow, which as of 2019 includes 2014 MU69. ⊙ It is the fifth space probe to achieve the escape velocity needed to leave the Solar System. ⊙ NASA's **New Horizons spacecraft has completed its epic flyby of the most distant object ever explored**, the recently-unveiled fossil from the beginning of the solar system.
MU69, nicknamed Ultima Thule	⊙ To study Objects from outer solaer system	⊙ NASA's **New Horizons spacecraft**, the same craft that made **humanity's first-ever visit to Pluto in 2015**, is approaching its next target, a **Kuiper Belt object a billion miles beyond Pluto, nicknamed Ultima Thule**. It will be another first for New Horizons, the farthest planetary flyby in human history. ⊙ Ultima Thule is located in the **Kuiper belt in the outermost regions of the Solar System,** beyond the orbit of Neptune.

		⊙ It measures approximately **30 km in diameter, and is irregularly shaped**. ⊙ Ultima Thule has **a reddish color, probably caused by exposure of hydrocarbons to sunlight over billions of years**. ⊙ Ultima Thule belongs to a class of Kuiper belt objects called the "cold classicals", which have nearly circular orbits with low inclinations to the solar plane.
OSIRIS-Rex	⊙ The mission's main goal is to obtain a sample of at least 60 grams (2.1 oz) from 101955 Bennu, **a carbonaceous near-Earth asteroid, and return the sample to Earth for a detailed analysis.**	⊙ OSIRIS-REx reached to the proximity of Bennu on December 2018,where it **began analyzing its surface for a target sample area over the next several months**. ⊙ It is expected to return with its sample to Earth on 24 September 2023. ⊙ The material returned is expected **to enable scientists to learn more about the formation and evolution of the Solar System**, its initial stages of planet formation, and the source of organic compounds that led to the formation of life on Earth
Transiting Exoplanet Survey Satellite (TESS)	⊙ Designed to search for exoplanets using the transit method in an area 400 times larger than that covered by the Kepler mission.	⊙ It is a space telescope for **NASA's Explorers program**, ⊙ The Transiting Exoplanet Survey Satellite (TESS) is the next step in the search **for planets outside of our solar system**, including those that could support life. ⊙ The mission will find exoplanets that periodically block part of the light from their host stars, events called transits. ⊙ It was launched on April 18, 2018 atop a **Falcon 9 rocket**. ⊙ Falcon 9 is a **two-stage rocket** designed and manufactured by **SpaceX** for the reliable and safe transport of satellites and the Dragon spacecraft into orbit. Falcon 9 is the **first orbital class rocket capable of reflight**. SpaceX believes rocket reusability is the key breakthrough needed to reduce the cost of access to space and enable people to live on other planets. ⊙ During its 2-year primary mission, it is expected to find more than 20,000 exoplanets, compared to about 3,800 exoplanets known when it launched.
NASA's Voyager 2 spacecraft	⊙ Space probe to study the outer planets.	⊙ The **Voyager 1 and 2 spacecraft** launched from Earth in 1977. Their mission was **to explore Jupiter and Saturn**—and beyond to the outer planets of our solar system. ⊙ Voyager 2 was launched 16 days before its twin, Voyager 1, on a trajectory that **took longer to reach Jupiter and Saturn but enabled further encounters with Uranus and Neptune**.It is the only spacecraft to have visited either of these two ice giant planets.

		⊙ Voyager 2 is now in **its extended mission to study the outer reaches of the Solar System** and has been operating for 40 years. It remains **in contact through the NASA Deep Space Network.** ⊙ Voyager 2 is the fourth of five spacecraft to achieve the escape velocity that will allow them to leave the Solar System. ⊙ The probe **left the heliosphere for interstellar space on November 2018**, becoming the second artificial object to do so, and has begun to provide the first direct measurements of the density and temperature of the interstellar plasma.
Apollo 8		⊙ NASA's 1st flight to moon, Apollo 8, marks 50th anniversary. ⊙ On Dec. 21st, 1968, three men flew to the moon for the first time in human history. The three-astronaut crew—Frank Borman, James Lovell, and William Anders—were the first humans to witness and photograph an Earthrise and to escape the gravity of a celestial body. ⊙ The mission is considered NASA's boldest and perhaps most dangerous undertaking ever.
NASA's Orion spacecraft	⊙ NASA's Orion spacecraft is built to take humans farther than they've ever gone before. ⊙ Orion will serve as **the exploration vehicle that will carry the crew to space, provide emergency abort capability, sustain the crew during the space travel, and provide safe re-entry from deep space return velocities.**	⊙ Europe's Airbus has delivered **the "powerhouse" for NASA's new Orion Spaceship** that will take astronauts to the Moon and beyond in coming years, hitting a key milestone that should lead to hundreds of millions of euros in future orders. ⊙ Airbus's European Service Module will provide propulsion, power, thermal control and consumables to the Orion crew module, **marking the first time that NASA will use a European-built system as a critical element to power an American spacecraft**.
NASA's Ralph and Lucy	⊙ To study the properties of the asteroids.	⊙ **NASA's Ralph and Lucy are all set to explore Jupiter's Trojan asteroids**, which are remnants from the earliest days of our solar system. ⊙ Ralph is a space instrument that has **travelled as far as Pluto, while Lucy is a mission payload, or the spacecraft which would be carrying various scientific instruments including Ralph to study the properties of the asteroids.**

		⊙ The mission scheduled for launch in October 2021 would be the very first space mission to study the Trojans.
In Sight spacecraft	⊙ designed to burrow beneath the surface of Mars	⊙ It has landed on the red after a six-month, 482 million-km journey. ⊙ It was NASA's ninth attempt to land at Mars since the 1976 Viking probes. All but one of the previous U.S. touchdowns was successful. NASA last landed on Mars in 2012 with the Curiosity rover. ⊙ It will be the first mission to peer **deep beneath the Martian surface, studying the planet's interior by measuring its heat output and listening for marsquakes, which are seismic events similar to earthquakes on Earth**. ⊙ It will use the seismic waves generated by marsquakes to develop a map of the planet's deep interior.
The Seismic Experiment for Interior Structure (SEIS)	⊙ SEIS is expected to provide seismic measurements of Mars, enabling researchers to develop 3D structure maps of the deep interior.	⊙ It is a **seismometer and the primary scientific instrument on board the InSight Mars lander** ⊙ It will lead to Better understanding of the **Martian interior as well as the Earth, Moon, and rocky planetary bodies in general**.
Dawn Mission	⊙ The mission of studying two of the three known protoplanets of the asteroid belt, Vesta and Ceres.	⊙ Dawn is the first spacecraft **to orbit two extraterrestrial bodies,** the first spacecraft to visit either Vesta or Ceres, and the first to visit a dwarf planet, arriving at Ceres in March 2015.
NASA balloon mission	⊙ To study polar mesospheric clouds (PMCs) at a height of 50 miles above the surface.	⊙ A recent NASA **long-duration balloon mission observed the clouds over the course of five days in the mesosphere.** ⊙ The resulting photos, which scientists have just begun to analyze, will **help us better understand turbulence in the atmosphere, as well as in oceans, lakes and other planetary atmospheres**, and may even improve weather forecasting.
Cassini-Hugens spacecraft	⊙ To study the planet Saturn and its system, including its rings and natural satellites.	⊙ NASA's Cassini spacecraft **shared the wonders of Saturn and its family of icy moons**—taking us to astounding worlds where **methane rivers run to a methane sea and where jets of ice and gas are blasting material into space from a liquid water ocean** that might harbor the ingredients for life. Cassini revealed in great detail the true wonders of Saturn, a giant world ruled by raging storms and delicate harmonies of gravity.

		◎ Cassini carried a passenger to the Saturn system, the **European Huygens probe—the first human-made object to land on a world in the distant outer solar system.** ◎ Findings of Hugens have revealed the existence of **earth-like geographic features, great lakes of liquid nitrogen gas on Titan's surface.** ◎ Cassini also found evidence for the **existence of Underground Ocean on the moon Enceladus and some sort of life underneath**. ◎ Cassini was the fourth space probe to visit Saturn and the first to enter its orbit.
MAVEN spacecraft	◎ Determine the role that **loss of volatiles to space from the Martian atmosphere** has played through time. ◎ Determine **the current state of the upper atmosphere, ionosphere, and interactions with the solar wind**. ◎ Determine the **current rates of escape of neutral gases and ions to space and the processes controlling them**. ◎ Determine the ratios of stable isotopes in the Martian atmosphere.	◎ Mission was launched on November 2013, and went into orbit around Mars on September 2014. ◎ Spacecraft has beamed **back a selfie to mark its four years orbiting Mars and studying the upper atmosphere of the red planet.** The image was obtained with the Imaging Ultraviolet Spectrograph (IUVS) instrument that normally looks at **ultraviolet emissions from the Martian upper atmosphere**.
The Hubble Space Telescope (HST)	◎ To look deep into space with cameras that can see across **the entire optical spectrum from infrared to ultraviolet.**	◎ **Hubble Space Telescope has captured the** first image of a surviving companion to a supernova, compelling evidence that some supernovas originate in Binary-star systems. ◎ It is a space telescope that was launched into **low Earth orbit in 1990** and remains in operation. Although not the first space telescope, Hubble is one of the largest and most versatile and is well known as both a vital research tool and a public relations boon for astronomy. ◎ The HST is named after the astronomer **Edwin Hubble** and is one of NASA's Great Observatories, along with **the Compton Gamma Ray Observatory, the Chandra X-ray Observatory and the Spitzer Space Telescope**.

		⊙ With a 2.4-meter (7.9 ft) mirror, Hubble's four main instruments observe in the **ultraviolet, visible, and near infrared regions** of the **electromagnetic spectrum.**
NASA Mars Helicopter	⊙ The rover will conduct **geological assessments of its landing site on Mars, determine the habitability of the environment**, search for **signs of ancient Martian life**, and **assess natural resources and hazards for future human explorers**.	⊙ The Mars Helicopter, a small, autonomous rotorcraft, will travel with the agency's Mars 2020 rover mission, currently scheduled to launch in July 2020, to **demonstrate the viability and potential of heavier-than-air vehicles on the Red Planet.** ⊙ Once the rover is on the planet's surface, a suitable location will be found to deploy the helicopter down from the vehicle and place it onto the ground. ⊙ The rover then will be driven away from the helicopter to a safe distance from which it will relay commands. ⊙ Scientists will use the instruments aboard the rover to identify and collect samples of rock and soil, encase them in sealed tubes, and leave them on the planet's surface for potential return to Earth on a future Mars mission.
New Shepard rocket and space capsule	⊙ designed to take **astronauts and research payloads past the Kármán line** – the internationally recognized boundary of space.	⊙ New Shepard is a **vertical-takeoff, vertical-landing (VTVL),** suborbital crewed rocket that is being **developed by Blue Origin** as a commercial system for suborbital space tourism ⊙ On November 2015, after reaching 100.5 km altitude (outer space), the New Shepard booster successfully performed a **powered vertical soft landing,** the first time a booster rocket had returned from space to make a successful vertical landing. ⊙ The test program continued in 2016 and 2017 with four additional test flights made with the same vehicle (NS2) in 2016and the first test flight of the new NS3 vehicle made in 2017. ⊙ Blue Origin is planning the first crewed test flight to occur in 2019
Visualizing Ion Outflow via Neutral Atom Sensing-2 (VISIONS-2) Mission	⊙ To get a closer look at the how the Earth's atmosphere is slowly leaking into space by the use of Sounding Rockets	⊙ Understanding atmospheric escape on earth has applications all over the Universe, from predicting which planets might be habitable, to piecing together how Mars became a desolate landscape. ⊙ The aurora borealis is of keen interest to the VISIONS-2 team,as it play a key role in the process of atmospheric escape, whereby **planets, including Earth, gradually leak their atmosphere into space.**

Lunar 'Gateway' space station	⊙ The lunar platform-Gateway would provide impetus to NASA's goal of fashioning another human landing on the moon. But the main of the Mission will be to determine that can the water near the surface of Moon could be used to manufacture propellant for deep-space missions.	⊙ As reflected in **NASA's Exploration Campaign**, the next step in human spaceflight is the **establishment of U.S. preeminence in cislunar space** through the operations and the **deployment of a U.S.-led Gateway**. Together with the **Space Launch System (SLS) and Orion, the Gateway is central to advancing and sustaining human space exploration goals,** and is the unifying single stepping off point in our architecture for human cislunar operations, lunar surface access and missions to Mars. ⊙ The lunar platform will be **NASA's planned 'staging' area for studies of the moon and the deep-space environment**. It will eventually also function as a gateway space station for Astronauts travelling to and from Mars.
Magnetospheric Multiscale spacecraft (MMS)	⊙ Scientists analysed the data obtained by the NASA's Magnetospheric Multiscale spacecraft (MMS) to find the new magnetic event in near-Earth environment.	⊙ The Magnetospheric Multiscale Mission (MMS) is a NASA unmanned space mission **to study the Earth's magnetosphere, using four identical spacecraft flying in a tetrahedral formation** ⊙ In a new find, NASA scientists have discovered **a new type of magnetic event in turbulent space surrounding Earth**. ⊙ **Magnetic reconnection is one of the most important processes in the space** — filled with **charged particles known as plasma** — around Earth. ⊙ This fundamental process **dissipates magnetic energy and propels charged particles,** both of which contribute to a **dynamic space weather system that scientists want to better understand**, and even someday predict, as we do terrestrial weather. ⊙ Reconnection **occurs when crossed magnetic field lines snap, explosively flinging away nearby particles at high speeds**.
Spitzer telescope	⊙ NASA's Spitzer Space Telescope was launched in 2003 to **study the universe in the infrared**. It is the last mission of the NASA Great Observatories program, which saw four specialized telescopes (including the Hubble Space Telescope) launched between 1990 and 2003.	⊙ NASA's Spitzer Space Telescope, the youngest member of the **"Great Observatory"** programme, has completed 15 years in space. ⊙ Launched into **solar orbit on August 2003**, Spitzer was initially **scheduled for a minimum 2.5-year primary mission**. But the space telescope has lasted far beyond its expected lifetime. ⊙ Spitzer's discoveries extend from **our own planetary backyard, to planets around other stars, to the far reaches of the universe**. And by working in collaboration with NASA's other Great Observatories, Spitzer has helped scientists gain a more complete picture of many cosmic phenomena.

		⊙ Spitzer has logged over 106,000 hours of observation time in the past 15 years. It has illuminated some of the oldest galaxies in the universe, revealed a new ring around Saturn, and peered through shrouds of dust to study newborn stars and black holes. ⊙ The space telescope also assisted in the discovery of planets beyond our solar system, including the **detection of seven Earth-size planets orbiting the star TRAPPIST-1**, among other accomplishments.

3 Other Agencies Missions

Mission/Programme	Objective	Specifications
Sentinel-3B- European Space Agency		⊙ Sentinel-3B was successfully launched on 25 April 2018, is a **European Space Agency Earth observation satellite dedicated to oceanography** which launched on 25 April 2018. It was built as a part of the Copernicus Programme, and is the second of four planned Sentinel-3 satellites.
A Soyuz rocket carrying Russian, American and Canadian astronauts	A **Soyuz rocket carrying Russian, American and Canadian astronauts took off from Kazakhstan and reached orbit**, in the first manned mission since a failed launch in October.	⊙ Russian space agency **Roscomos announced that the capsule was "successfully launched into orbit**". ⊙ It was the first manned launch for the Soviet-era Soyuz since October 11, when a rocket carrying Russia's Aleksey Ovchinin and U.S. astronaut Nick Hague failed just minutes after blast-off, forcing the pair to make an emergency landing. ⊙ They escaped unharmed but the failed launch — the first such incident in Russia's post-Soviet history — raised concerns about the state of the Soyuz programme. ⊙ The **Soyuz is the only means of reaching the ISS since the U.S. retired the space shuttle in 2011.**
Emirates Mars Mission - Hope Probe	Providing a complete picture of the Martian atmosphere.	⊙ It is a **space exploration probe mission to Mars built by the United Arab Emirates** and set for launch in **2020**. ⊙ The probe has been named **Hope probe or 'Al-Amal'** and it is scheduled to reach Mars in 2021, which **coincides with the 50th anniversary of the United Arab Emirates' formation**. ⊙ Upon launch, it will become the first mission to Mars by any Arab or Muslim majority country.

Mini space elevator test-Japan	the world's **first experiment to** test **elevator movement in space**	⊙ The test involves **a miniature elevator stand-in**—a box just six centimetres (2.4 inches) long, three centimetres wide, and three centimetres high. ⊙ If all goes well, **it will provide proof of concept by moving along a 10-metre cable suspended in space between two mini satellites that will keep it taut.** ⊙ The mini-elevator **will travel along the cable from a container** in one of the satellites.
Hayabusa 2-Japan	It is expected **to provide additional knowledge on the origin and evolution of the inner planets and, in particular, the origin of water and organic compounds on Earth, all relevant to the origin of life on Earth.**	⊙ It is an **asteroid sample-return mission operated** by the Japanese space agency, **JAXA**. It follows on from Hayabusa mission which **returned asteroid samples in 2010.** Hayabusa2 was launched on 3 December 2014 and rendezvoused with near-Earth asteroid 162173 **Ryugu** on 27 June 2018. ⊙ It is in the **process of surveying the asteroid for a year and a half**, departing in December 2019, and returning to Earth in December 2020.Hayabusa2 **carries multiple science payloads for remote sensing, sampling, and four small rovers** that will investigate the asteroid surface to inform the environmental and geological context of the samples collected.
Gaia Mission- European Space Agency (ESA)	Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy.	⊙ ESA's Gaia mission has **produced the richest star catalogue to date**, including **high-precision measurements of nearly 1.7 billion stars** and revealing previously unseen details of our home Galaxy. ⊙ Preliminary analysis of this phenomenal data reveals **fine details about the make-up of the Milky Way's stellar population** and about **how stars move**, **essential information for investigating the formation and evolution of our Galaxy**. ⊙ Launched on December 19, 2013, the Gaia satellite both rotates and orbits around the Earth, while surveying the sky with its two telescopes.
MeerKAT radio telescope	MeerKAT will address some of the key science questions in modern astrophysics – **how did galaxies form, how are they evolving, how did we come to be here.**	⊙ MeerKAT is a **followup to the KAT 7** (Karoo Array Telescope), **built in the vast semi-desert Karoo region north of Cape Town** to demonstrate South Africa's ability to host the SKA. ⊙ It will be the **biggest radio telescope of its kind in the southern hemisphere.**

		⊙ Built at a cost of 4.4 billion rand, **MeerKAT will be incorporated into the complex Square Kilometre Array (SKA) instrument**, which when fully operational in the late 2020s would be the world's biggest and most powerful radio telescope.
Aeolus Satellite-ESA	It is **world's first wind-sensing satellite dedicated to map Earth's wind on global scale** in **particular tropical winds which are very poorly mapped** because of **almost complete absence of direct observations**.	⊙ European Space Agency (ESA) has successfully launched **wind-sensing satellite named Aeolus** into orbit on board of Vega rocket from French Guyana. ⊙ Aeolus satellite will provide **much-needed data to improve quality and accuracy of weather forecasting**. It will help to improve understanding of working of atmosphere dynamics and contribute to climate change research.
The Bangabandhu Satellite-1-Bangladesh		⊙ It is the **first Bangladeshi geostationary communications and Broadcasting Satellite.** It was manufactured by Thales Alenia Space and launched on 11 May 2018.
Hongyun project-China	The satellite **aims to rival Google and other companies which have similar plans for providing Internet services worldwide**.	⊙ China started the Hongyun project in September 2016. ⊙ Under this project, **China plans to give broadband internet connectivity to users all over the world by building a space-based communications network**. The project also seeks to take the Internet connectivity to the underserved regions of the world. ⊙ CASIC will be placing than **150 Hongyun satellites** on orbits about 1,000 km above the ground around 2023 and can be expanded as per the demand.
BeiDou Navigation Satellite System (BDS)-China		⊙ China's BeiDou Navigation Satellite System (BDS), **touted as a rival to the widely-used American GPS**, has started providing global services. ⊙ **Pakistan has become the first country to use the BeiDou system** ending its reliance on the Global Positioning System (GPS). ⊙ It will be the fourth global satellite navigation system after the **US GPS, Russia's GLONASS and the European Union's Galileo.**
Chang'e-4- first probe to explore the dark side of the Moon	A first probe ever to explore the dark side of the Moon.	⊙ A **Long March-3B rocket**, carrying the probe including **a lander and a rover**, blasted off from the Xichang Satellite Launch Center in **southwest China's Sichuan Province**.

		◎ The exploration will gain first-hand information about the terrain and lunar soil components and other scientific data, which will help enrich human understanding of the moon and the universe.
Queqiao Relay Satellite to explore Far Side Of Moon-China	To establish **communication link between earth and it's planned Chang'e-4 lunar probe (rover)** that will explore the dark side of moon.	◎ **Queqiao (meaning bridge of magpies)** satellite will serve as **communications relay for future Chang'e-4 rover** that will explore in **South Pole-Aitken Basin** in **moon's far side.** ◎ It will be **situated in halo orbit i.e. Earth-moon Lagrange point L2,** a gravitationally stable spot located 64,000 kilometers beyond lunar far side. It will be world's first communication satellite operating in this location. ◎ It will help **China to realise its goal of being first country to send probe to soft-land on and rove far side of the moon.**
Yutu 2-China	It will carry out a string of experiments on the unexplored far side of the moon.	◎ The rover's touchdown is **part of China Chang'e-4 lunar probe**. ◎ The rover has been **programmed to launch ground penetration radar that would help map the moon's inner structures.** ◎ It would also **analyse soil and rock samples for minerals, apart from activating a radio telescope** to search for possible signals from deep space.
China to launch Artificial Moon to light up Night Sky	Chinese scientists are planning to launch an artificial moon into orbit by 2020 to illuminate city streets after dark	◎ It is estimated that new moons could save the city of Chengdu around 1.2 billion Yuan ($173 million) in electricity costs annually, and could even assist first responders during blackouts and natural disasters such as earthquakes and floods. ◎ Scientists are hoping to hang the man-made moon above the city of Chengdu, the capital of China's south-western Sichuan province

4 Point Nemo

- It is considered the **most remote place on Earth (at about 2400 km from any spot of land in middle of the South Pacific Ocean).**
- It is **often used to crash-land defunct satellites** and thus is called the **spacecraft cemetery**.
- Between 1971 and mid-2016, space agencies all over the world have dumped between 260 and 300 spacecraft into the region.

5 Exoplanet

- **Indian researchers** have discovered their **first exoplanet orbiting a star 600 light years away from earth**. Planets that orbit around stars other than the sun are called exoplanets.

6 'Super-Earth' in Constellation Cassiopeia

- Researchers have discovered a **new exotic planet outside our solar system** in the constellation **Cassiopeia**. Located 21 light years away from us, this planet, dubbed ***HD219134 b***, has a mass almost five times that of Earth, which is considered a so-called "super-Earth".
- Unlike the Earth, however, it most likely **does not have a massive core of iron**, but is **rich in calcium and aluminium alongside magnesium and silicon**.
- A **super-Earth is an extrasolar planet** with a mass higher than Earth's, but **substantially below those of the Solar System's ice giants**, Uranus and Neptune, which are 15 and 17 times Earth's, respectively.
- The term **"super-Earth" refers only to the mass of the planet**, and so **does not imply anything about the surface conditions or habitability.**

7 Galaxy Proto-Supercluster — Hyperion

- The Hyperion proto-supercluster is the largest and earliest known proto-supercluster, 5,000 times the mass of the Milky Way and seen at 20% of the current age of the universe.
- It was discovered in 2018 by analysing the redshifts of 10,000 objects observed with the Very Large Telescope in Chile.

8 Einstein's Theory of Relativity

- The theory of relativity usually encompasses two interrelated theories by Albert Einstein: **special relativity and general relativity**.

Special relativity:

- Special relativity is a theory of the structure of spacetime. It was introduced in Einstein's 1905 paper "On the Electrodynamics of Moving Bodies" (for the contributions of many other physicists see History of special relativity). Special relativity is based on two postulates which are contradictory in classical mechanics:
  - The **laws of physics are the same for all observers in uniform motion relative to one another (**principle of relativity).
  - The **speed of light in a vacuum is the same for all observers, regardless of their relative motion or of the motion of the light source.**

General relativity:

- Explains **the law of gravitation and its relation to other forces of nature**. It applies to the cosmological and astrophysical realm, including astronomy.
- It introduced **concepts including space-time as a unified entity of space and time**, relativity of simultaneity, kinematic and gravitational time dilation, and length contraction.
- In the field of physics, **relativity improved the science of elementary particles and their fundamental interactions**, along with ushering in the nuclear age. With relativity, cosmology and astrophysics predicted extraordinary astronomical phenomena such as neutron stars, black holes, and gravitational waves.

9 Einstein's theory: Earth is a free-falling elevator in Sun's gravity

CONTEXT: Physicists at NIST (National Institute of Standards and Technology) pulled out a 14-year-long experiment to test a key principle underlying Einstein's famous theory of general relativity – that describes how gravity relates to space and time.

About the experiment:

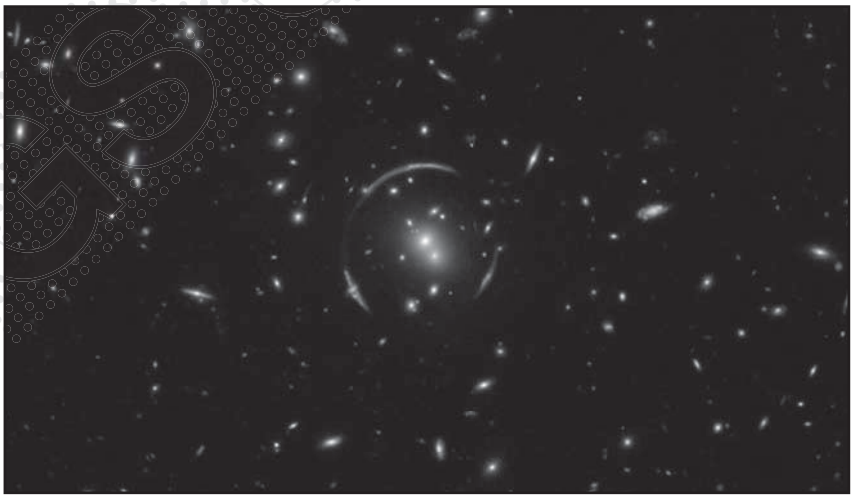
- The test conducted by the NIST physicists is being considered as the most accurate test ever which **confirms the 'earth elevator' phenomenon**. They used the solar system as a laboratory, where they **treated Earth as an elevator falling through the Sun's gravitational field**.
- They monitored 12 high-precision atomic clocks spread around the world for 14 years, from 1999 to 2014. The experiment tested whether all parts of the earth would have the same acceleration at the same rate. **The clocks remained synchronized for over 14 years, proving the earth elevator theory**.

Einstein's Theory: Earth is a Free-Falling Elevator:

- According to Albert Einstein, the earth is a free-falling elevator in Sun's gravity. He theorised that all objects located in such an elevator would accelerate at the same rate as if they were in a uniform gravitational field or no gravity at all. He also predicted that the properties of these objects relative to each other would remain constant during the elevator's free-fall.
- In other words, the general relativity theory carries the principle of local position invariance (LPI), which holds that in a falling elevator, measures of non-gravitational effects are independent of time and place and the test confirmed the same.

10 Einstein Ring

- Hubble **captured a circle of light, called the "Einstein ring,"** which occurs **when light from a background galaxy is diverted and distorted around the massive intervening cluster--making it seem that a galaxy is in multiple places at once**.



- The **glowing ring at the centre of the image is called the Einstein ring.**
- In the above image, the light from a background galaxy is diverted and distorted -- almost like splurged -- **around the massive intervening cluster**, and is forced to travel along many different light paths toward Earth.
- **Why 'Einstein'?-**Gravitational lensing is rooted in **Einstein's Theory of General Relativity**, which is why the resulting light effect is named after him.

11 Sunspot Cycle

- Sunspots are **temporary phenomena on the Sun's photosphere that appear as spots darker than the surrounding areas.**
- They are **regions of reduced surface temperature** caused by **concentrations of magnetic field flux** that **inhibit convection**.
- Sunspots usually **appear in pairs of opposite magnetic polarity**.
- Their **number varies according to the approximately 11-year solar cycle**.
- A team of researchers from IISER Kolkata have developed **a way of predicting the intensity of activity in the next solar cycle (approximately from 2020 to 2031)** using data spread over the last 100 years.

12 Method to simulate, predict solar activity over ten years developed

- Astronomers have observed **sunspots on the surface of the sun for nearly 400 years**. It is known that **sunspots follow a cyclic pattern of growing in number and disappearing in approximately 11 years**, known as the sunspot cycle or the sun's activity cycle. We are currently in the 24th sunspot cycle since the observation began in 1755.
- According to a paper published in Nature Communications, a team of researchers from **IISER Kolkata have developed a way of predicting the intensity of activity in the next solar cycle** (approximately from 2020 to 2031) using data spread over the last 100 years.
- Contrary to other calculations, they find that **the sun's activity would not dip during the next cycle, but it would be similar to the current cycle, perhaps even stronger**. They expect the cycle **to peak around 2024**.
- The researchers simulate the behaviour of the sun using magnetic field evolution models and observational data. They simulate solar activity, and using inputs from observed data from one cycle, predict the behaviour of the sun over the next cycle, about ten years in advance. Comparing their simulations with recorded data from 1913 to present, they show a remarkable agreement in most cases. Using the same method, they predict solar activity over the next cycle, about ten years into the future.

13 ISRO is planning to mine Moon

- Apart from **planning for manned missions to Moon, Mars and even aircraft development,** ISRO is now **working on a plan to help India meet its energy needs from the Moon by 2030**.
- The premier space agency, credited with launching 225 satellites till date, **plans to mine Helium-3 rich lunar dust, generate energy and transport it back to Earth.**
- This comes in the backdrop of **successful testing of lithium-ion batteries developed by Vikram Sarabhai Space Centre** by the Automotive Research Association of India (Arai). This is expected to provide a fillip to India's electric vehicles (EV) push.

14 NASA confirms saturns rings will be gone in 100 million years

- **Saturn is losing its iconic rings at the maximum rate estimated from Voyager 1 and 2 observations made decades ago**, confirms new NASA research that estimates that the rings have less than 100 million years to live.
- The rings are **being pulled into Saturn by gravity as a dusty rain of ice particles under the influence of Saturn's magnetic field**.

15 New Source of Neutrinos in Space discovered

CONTEXT: Scientists have discovered the source of cosmic neutrinos, ghostly subatomic particles that can travel in a straight line for billions of light-years, passing unhindered through galaxies, stars and anything else in their path.

- Neutrinos have **so far only been observed originating from supernovae (exploding stars) and the sun**. Now a giant detector at the South Pole has discovered that a **"blazar", a galaxy with a super massive black hole at its centre, also produces neutrinos.**
- Difficult to detect, neutrinos are extremely tiny particles and are among the most abundant in the universe. They **don't interact much with anything and travel close to the speed of light.**

16 Earth has three moons

CONTEXT: A group of Hungarian scientists has confirmed a long-standing astronomical speculation: the Earth has three natural satellites or moons, not one.

- The presence of the **dust 'moons' or Kordylewski clouds** had been been inferred by researchers since long before
- But the **first glimpse of the clouds was seen only in 1961 by Polish astronomer Kazimierz Kordylewski**, after whom the dust clouds were named
- The new findings note that each **Kordylewski cloud is about 15 by 10 degrees wide, or equal to 30 by 20 lunar disks in the night sky**
- They are **spread over a space area that is almost nine times the width of Earth** -- about 65,000 by 45,000 miles in actual size
- The **dust 'moons' are huge** but they are **made of tiny dust particles that barely measure one micrometre** across
- When sunlight hits the dust particles, they glow very faintly, much like the zodiacal light we receive from the dust scattered in between planetary orbits.
- Since **these satellite dust clouds emit an extremely faint light**, they are **very difficult to find amidst the star light, sky glow, galactic light and zodiacal light in the sky** though they are as close to us as the moon.

17 China unveils 'Heavenly Palace' space station

CONTEXT: China unveiled a replica of its first permanently crewed space station, which would replace the international community's orbiting laboratory and symbolises the country's major ambitions beyond Earth.

- The unveiled model is a 17-metre (55-foot) core module.
- It represented the **living and working space of the Tiangong or "Heavenly Palace"** which **will also have two other modules for scientific experiments and will be equipped with solar panels.**
- Three astronauts will be permanently stationed in the 60-tonne orbiting lab, which will enable the crew to conduct biological and microgravity research.
- Assembly is **expected to be completed around 2022** and the station would have a **lifespan of around 10 years**.
- China will then have the only space station in orbit, though it will be much smaller than the ISS which weighs 400 tonnes and is as large as a football pitch.

18 The International Space Station (ISS) is celebrating its 20th birthday

- **International Space Station (ISS) has been in the space for 20 years now** and while **the space station was launched on a Russian rocket**, the ISS has been part of quite a lot of memorable moments in the history of mankind's journey into space.
- The International space station was **launched a single cargo module in 1998**, however, it has **now become an expansive as well as one-of-a-kind research facility placed orbiting the Earth.**
- **International Space Station (ISS):** The International Space Station is **a habitable artificial satellite in low Earth orbit**. The ISS maintains an orbit with an altitude of between 330 and 435 km (205 and 270 mi) by means of reboost manoeuvres and **circles the Earth in roughly 92 minutes and completes 15.5 orbits per day**.The ISS programme is a joint project between five participating space agencies: **NASA (United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada).**

19 Remove DEBRIS

- **RemoveDEBRIS is a satellite research project** intending **to demonstrate various space debris removal technologies**. The satellite's platform was manufactured by Surrey Satellite Technology Ltd (SSTL) and is a variant of the SSTL X50 series.
- RemoveDEBRIS was launched **aboard the SpaceX Dragon refill spacecraft** on 2 April 2018 as part of the CRS-14 mission, arriving at the ISS on 4 April. Deployment of the satellite from the station's Kibo module via robotic Canadarm-2 took place on 20 June 2018.
- At approximately 100 kg, **RemoveDEBRIS is the largest satellite to have ever been deployed from the ISS**. The **full lifespan of the mission from launch to re-entry is estimated at 1.5 years.**
- On 16 September 2018, it demonstrated its ability to use net to capture a deployed simulated target.
- On 8 February 2019, SSTL **demonstrated the RemoveDEBRIS harpoon which was fired at a speed of 20 metres per second** successfully penetrating a simulated target extended from the satellite on a 1.5-meter (4.9-foot) boom.

20 The case for making Pluto a planet again

CONTEXT: Scientists are arguing that denying Pluto planetary status is invalid and erroneous.

- A team led by Philip Metzger, planetary scientist at the University of Central Florida (UCF) in Orlando, is indicating that **the basis on which Pluto was rejected as a planet does not have any support in research literature**.
- Metzger and his team's research focuses on scientific literature of the past 200 years. Four scientists perused astronomy papers that were published since 1802. They looked **for instances of the word planet that was used in accordance with the 2006 definition - which held that Pluto is not a planet.** The International Astronomical Union (IAU) is responsible for handling astronomical nomenclature.

21 Icarus- farthest star

- The **Hubble Space Telescope** of the National Aeronautics and Space Administration (NASA) has **discovered the most distant star ever seen named 'Icarus'.** This huge blue star is **located**

over halfway across the universe. It took **nine billion years for the Icarus' light to reach the Earth**.

- The team including Jose Diego of the Instituto de Fisica de Cantabria in Spain, and Steven Rodney of the University of South Carolina in the US named the star as **'Icarus'** after the **Greek mythological character** who flew **too near the Sun on wings of feathers and wax that melted.**

22 Cosmic Microwave Background Radiation (CMBR)

CONTEXT: Indian scientists are conducting experiments to confirm occurrence of unusual space signals in the spectrum of Cosmic Microwave Background (CMB) radiation.

- CMB is **an all-pervasive but weak electromagnetic radiation from the early universe when matter was still to be formed.**
- This radiation **does not come from any of the objects that are observed in the universe, like stars or galaxies**, it comes from things that are not formed yet.
- CMB is **a relic from an early universe when matter and radiation were still in thermodynamic equilibrium.**
- Thus when it is observed it is similar to looking at the period in universe after the big bang and before the present objects were formed.

23 Green Propellant

CONTEXT: ISRO is developing green propellants for use in future rocket & satellite propulsion systems.

- All space faring nations have been investigating green propulsion systems **to minimise environmental impact while improving overall efficiency and economy**.
- ISRO has made a beginning by **developing an eco-friendly solid propellant based on Glycidyl Azide Polymer (GAP) as fuel and Ammonium Di-Nitramide (ADN) as oxidizer** at the laboratory level, which will eliminate the emission of chlorinated exhaust products from rocket motors.

24 Plan to Prevent Asteroid Attack

- In a key step **to defend Earth from potentially devastating risks of near-Earth objects (NEOs)** -- asteroids and comets -- whose orbits come within 30 million miles of Earth, NASA has released a federal planning document.
- The 20-page document, titled "National Near-Earth Object Preparedness Strategy and Action Plan" aims **to organise and coordinate efforts related to the NEO efforts within the federal government during the next 10 years to ensure that the nation can more effectively respond in case of such an event**, which has a low-probability but can bring very high-consequence natural disasters.
- The action **plan includes enhancing NEO detection, tracking, and characterisation capabilities; improving NEO modelling prediction, and information integration.**

25 Cooperation in the peaceful uses of outer space

UNISPACE+50

- The countries marked the **50th year of the first UN Conference on the Exploration and Peaceful Uses of Outer Space** — called UNISPACE+50, organised by UNOOSA.

- Three such conferences **held earlier recognized the potential of space and laid the guidelines for human activities and international cooperation** related to outer space. They were:
  - UNISPACE I, Vienna, 1968
  - UNISPACE II, Vienna, 1982 and
  - UNISPACE III, Vienna, 1999

26 'EPIC' planet

CONTEXT: Scientists from **Physical Research Laboratory (PRL), Ahmedabad** have discovered for first time **distant planet revolving around Sun-like star**.

- Both the **planet and the star have been named EPIC**. With this discovery India joins handful of countries which have discovered planets around stars.

EPIC planet

- The planet has been named as **EPIC 211945201b (or K2-236b)** and host star has been named EPIC 211945201 (or K2-236).
- The EPIC planet is **six times bigger than Earth and revolves around host about 600 light years away**. EPIC was found **circling very close to its host star, going around it once in about 19.5 days.**
- EPIC planet is **smaller in size compared to Saturn and but is bigger than Neptune**. Its mass is about 27 times Earth's and six times that of Earth at radius. Its 60% mass may be made up of heavy elements like ice, silicates and iron. The **planet is unlikely to be inhabitable because of its high surface temperature of around 600°C**.

27 Interstellar Mapping and Acceleration Probe

- **The Interstellar Mapping and Acceleration Probe (IMAP) is a heliophysics mission** that simultaneously investigates two important and coupled science topics in the heliosphere: **the acceleration of energetic particles and interaction of the solar wind with the local interstellar medium**.
- These science topics are coupled because **particles accelerated in the inner heliosphere play crucial roles in the outer heliospheric interaction**.
- In 2018, NASA selected an IMAP team led by David J. McComas of Princeton University to implement the mission. The planned launch for IMAP is in October, 2024. The IMAP spacecraft has a science payload of ten instruments and is a simple Sun-pointed spinner in orbit about the Sun-Earth L1 Lagrangian point. IMAP also continuously broadcasts real-time in-situ data that can be used for space weather prediction.
- It is the fifth mission selected in the Solar Terrestrial Probes program, after TIMED, Hinode, STEREO and MMS.

28 Atacama Large Millimeter/submillimeter Array

- Astronomers have obtained stunning, **high-resolution images of 20 nearby protoplanetary disks, depicting the birth of planets**, using **Chile's Atacama Large Millimeter/submillimeter Array (ALMA).**
- The observations are part of a **major ALMA initiative** known as **the Disk Substructures at High Angular Resolution Project, or DSHARP campaign.**

Significance of these observations:

- According to the researchers, **the most compelling interpretation of these observations is that large planets,** likely **similar in size and composition to Neptune or Saturn,** form quickly, much faster than current theory would allow.

- It may also help explain how smaller rocky planets manage to survive in the chaos of young systems.

29 High Resolution Imaging Science Experiment (HiRISE)

CONTEXT: A camera aboard Nasa's Mars Reconnaissance Orbiter (MRO) has captured the image of the InSight lander, which recently touched down on the Red Planet.

- **HiRISE operates in visible wavelengths**, the same as human eyes, but with a telescopic lens that will produce images at resolutions never before seen in planetary exploration missions.
- HiRISE **also makes observations at near-infrared wavelengths** to obtain information **on the mineral groups present**.
- These new, high-resolution images will provide unprecedented views of layered materials, gullies, channels, and other science targets, as well as characterize possible future landing sites.

30 GLONASS of Russia

CONTEXT: Russia has successfully launched a Glonass-M positioning satellite using a Soyuz-2.1b carrier rocket from Plesetsk space center. With this launch, there are now 26 Glonass satellites in orbit.

- GLONASS is an acronym, which stands for Globalnaya Navigazionnaya Sputnikovaya Sistema, or **Global Navigation Satellite System**.
- GLONASS is **Russia's version of GPS** (Global Positioning System).
- GLONASS – launched in 1982, the satellites launched **were intended to work for weather positioning, velocity measuring and timing anywhere in the world** or near-Earth space by the military and official organisations.
- GLONASS-M – launched in 2003 add second civil code. It is important for GIS mapping receivers.
- GLONASS-k – started in 2011 again has 3 more types namely k1, k2 and km for research. Adds third civil frequency.
- GLONASS-K2.
- GLONASS-KM – will be launched after 2025 (currently in research phase).

31 Pakistan's remote sensing satellites PRSS-1 and PakTes-1A

CONTEXT: China successfully launched two remote sensing satellites PRSS-1 and PakTes-1A of Pakistan on board of Long March-2C rocket from Jiuquan Satellite Launch Centre.

- It was overall **279th mission for the Long March rocket series** (mainly used to send satellites into **low Earth or Sun-synchronous orbits**) and first international commercial launch in nearly two decades after it carried Motorola's Iridium satellites into orbit in 1999.
- PRSS-1: It is **China's first optical remote sensing satellite** sold to Pakistan. It can **carry out day and night monitoring**. It also has **viewing capacity even in clouded conditions.** It will be used for **land and resources surveying, agriculture research, urban construction, monitoring of natural disasters and to provide remote sensing information for (CPEC)** under China's ambitious Belt and Road Initiative (BRI).
- It is **China's first optical remote sensing satellite sold to Pakistan** and overall **17th satellite developed by China Academy of Space Technology (CAST)** for an overseas buyer.
- PakTES-1A: It is **Pakistan's indigenously developed scientific experiment satellite** developed by engineers from its space agency SUPARCO (Space and Upper Atmosphere Research Commission).

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- Astronomers have obtained **stunning, high-resolution images of 20 nearby protoplanetary disks, depicting the birth of planets**, using **Chile's Atacama Large Millimeter/submillimeter Array (ALMA).**
- The observations are part of a major ALMA initiative **known as the Disk Substructures at High Angular Resolution Project, or DSHARP campaign**.
- According to the researchers, the most compelling interpretation of these observations is that large planets, likely similar in size and composition to Neptune or Saturn, form quickly, much faster than current theory would allow.
- It may also help **explain how smaller rocky planets manage to survive in the chaos of young systems**.

33 World's fastest man-made spinning object

- Scientists have **developed world's fastest rotor**, which will **help in studying quantum mechanics**. The rotor can spin at more than **60 billion revolutions per minute**, making it world's fastest man-made object. It is more than **100,000 times faster than a high-speed dental drill.**
- To produce fastest rotor, scientists had synthesized nanoscale dumbbell made from silica and had levitated it in high vacuum using laser. The laser (working in straight line or in circle) when is linear, vibrates dumbbell and when it is circular spins dumbbell spins. Spinning dumbbell functions as rotor, and vibrating dumbbell functions like instrument for measuring tiny forces and torques, known as a torsion balance. The nanodumbbell levitated by optical tweezer in vacuum can vibrate or spin, depending on polarization of tincoming laser.

34 India-Based Neutrino Observatory

- It is an underground project, jointly supported by **the Department of Atomic Energy (DAE) and the Department of Science and Technology (DST).**
- It will comprise a complex of caverns – the main cavern, which will **house detector which is 130 metres long, 26 metres wide and 30 metre high.**
- Along with main cavern, there will be two smaller caverns that will be used for setting up experiments for neutrino double detector and dark matters.
- This underground complex will be approached by a 2-kms long tunnel.
- It will **host experiments such as the neutrino-less double beta decay and the search for dark matter.**
- It also involves Inter-Institutional Centre for High Energy Physics (IICHEP) and Iron Calorimeter Detector (ICAL).
- Along with project, government has also approved the construction of a 50,000 tonne magnetised iron calorimeter detector (ICAL). It will **study the properties of the neutrino, in particular the mass hierarchy among different types of neutrino**.
- Neutrino:
  - It is an **electrically neutral, weakly interacting elementary subatomic particle** with half-integer spin. It belongs to the lepton family.
  - There are three types of neutrinos: **electron neutrinos (ve), muon neutrinos(vu) and tau neutrinos (vT)** differing in terms of mass.

35 Human space flight Programme

- The Indian Space Research Organisation (ISRO) successfully conducted test of **Crew Escape System** that provides **escape mechanism for astronauts** if the launch operation is aborted.
- The crew escape system is being **developed as part of the he proposed human spaceflight programme.**
- It was **first pad abort test critical for future human space mission** that demonstrated safe recovery of crew module in case of any exigency at the launch pad.
- The test lasted little more than three minutes and involved aborting space capsule at launch to save astronaut.

36 NASA's Kepler Space Telescope retired

- NASA has **retired Kepler space telescope** after it ran out of fuel needed for further science operations.
- This **brings end of nine-and-a-half year mission of Kepler space telescope** in which it had **discovered over 2,600 intriguing exoplanets from outside our solar system** some of which may harbour life.

Kepler space telescope

- The **unmanned space telescope was launched in 2009** on 3.5-year mission (from 2009 until November 2012), but operated for 9 years.
- It was NASA's first planet-hunting mission. It was named after German mathematician and astronomer Johannes Kepler.
- During its over nine years life, Kepler had observed 530,506 stars and **detected 2,662 planets**. It used transit photometry detection method for searching for exoplanet, which looked for periodic, repetitive dips in visible light of stars caused by planets passing or transiting in front in front of its host star.
- The telescope had suffered mechanical failure in 2013. But it was made functional by changing its field of view periodically. This had paved way for K2 mission.

37 NASA Parker Solar Probe Mission

CONTEXT: NASA's Parker Solar Probe has successfully completed flyby of Venus at distance of about 2,415 kilometres during its first gravity assist from planet. These gravity assists will help spacecraft tighten its orbit closer to Sun over course of the mission. The spacecraft in future will be carrying six Venus gravity assists over the course of the seven-year mission.

- **Parker Solar Probe mission:** Parker Solar Probe is **mankind's first mission to study outer corona of Sun**. It was successfully launched in August 2018 for unprecedented seven-year long journey to unlock mysteries of Sun's fiery outer atmosphere and its effects on space weather. It is **designed and built by NASA's Johns Hopkins University Applied Physics Laboratory**. It is named after solar astrophysicist Eugene Parker, making it first spacecraft of NASA to be named after living person.

38 Dwarf planet 'The Goblin' discovery

CONTEXT: An extremely distant dwarf planet, named The Goblin, has been discovered in observations that are redefining the outer reaches of the solar system.

- A new minor planet called "the Goblin" is **the second most distant known object in the solar system.**
- **Formal Name:** As assigned by the International Astronomical Union's Minor Planet Center, the new dwarf planet would be formally known as **2015 TG387**.
- It is **memorably nicknamed Goblin** because. Astronomers made the discovery while hunting for a hypothetical massive planet, known as Planet Nine.
- The Goblin dwarf planet **appears to be under the gravitational influence of a giant unseen object**, possibly a **hypothetical massive planet referred to as Planet Nine**.
- **Telescope used:**The Japanese Subaru 8-metre telescope located on the dormant Mauna Kea volcano in Hawaii was used.

39 Space X BFR lunar Mission

CONTEXT: A Japanese billionaire Yusaku Maezawa, will be the first private passenger to fly on Space X Big Falcon Rocket (BFR) around the moon as early as 2023.

About

- Space X is building **Big Falcon Rocket**, a next generation rocket and spaceship system to send people to Mars by 2024 and set up a colony on it within next 50 to 100 years.
- BFR could also **launch satellites to Low Earth Orbit, and clean up orbital debris** as well as **transport passengers around earth at record speeds**.
- The rocket system which **is under construction**, will consist of rocket and a spaceship, capable of carrying more than 100 passengers at a time.
- Both **rocket and spaceship will be reusable**.
- **YusakuMaezawa** will be first lunar traveller since last U.S Apollo mission in 1972.

40 Meteorite found in Rajasthan

CONTEXT: A study of two meteorites by the Geological Survey of India (GSI) has concluded that they may contain significant clues to the origins of life

- These meteorites fell in Assam and Rajasthan over a span of 13 hours in 2017.
- Material dates back to the pre-sun era.
- The **Mukundpura (Rajasthan)** meteorite is a **carbonaceous meteorite,** one of the most primitive types.
- They contain grains of calcium and iron which date to a time before the sun came into existence.
- They may contain clues to the formation of early life.

41 Unispace Nanosatellite Assembly & Training programme (UNNATI)

CONTEXT: UNNATI- (Unispace Nanosatellite Assembly & Training) programme organized by ISRO was inaugurated recently in Bengaluru.

UNNATI

- Advanced as a **capacity building programme on Nanosatellite development**, it is an initiative by ISRO to commemorate the 50th anniversary of the first United Nations conference on the exploration and peaceful uses of outer space (UNISPACE-50).

- The programme **provides opportunities to the participating developing countries to strengthen in assembling, integrating and testing of Nano satellite**.
- The programme aims at capacity building in satellite technology for participants from countries interested in developing space programme by providing hands-on experience in building and testing of nano satellites.
- UNNATI programme is planned to be conducted for 3 years by U.R. Rao Satellite Centre of ISRO in 3 batches and will target to benefit officials of 45 countries.

The primary objectives of the programme are:

- To offer a simplified and increased exposure to satellite fabrication technologies, as part of the UNISPACE initiative.
- To provide theoretical course on satellite technology.
- To **provide intensive course on Nanosatellite realisation, covering mission aspects, design, fabrication, assembly, integration & testing.**
- To provide **hands-on training to assemble, integrate and test a low cost, modular nano satellite.**

42 The Lyrid meteor shower

CONTEXT: The Lyrid meteor was seen worldwide on April 21,2018.

- Lyrid meteor shower gets its name from the constellation Lyra, as it appears to originate from Lyra. **This constellation is home to the bright star Vega**, and is set very close to the Pole Star.
- During the shower, stargazers should not look in Lyra's direction, as meteors can be expected from all directions.

43 RAMA (Reconstituting Asteroids into Mechanical Automata)

CONTEXT: NASA to give funds to Made In Space's project- RAMA (Reconstituting Asteroids into Mechanical Automata), for finding ways to turn asteroids into giant, autonomous spacecrafts, which could fly to outposts in space.

- It has been designed **to leverage the advancing trends of additive manufacturing (AM) and in-situ resource utilization (ISRU).**
- The project **aims to enable asteroid rendezvous missions** in which a set of technically simple robotic processes convert asteroid elements into very basic versions of spacecraft subsystems (GNC, Propulsion, Avionics).
- Upon completion, the asteroid will be a programmed mechanical automata carrying out a given mission objective; such as relocation to an Earth-Moon liberation point for human rendezvous.

44 Uakitite

CONTEXT: It is a new mineral discovered in a meteorite in Eastern Russia.

- Uakitite is **composed of vanadium nitride** with formula VN.
- While the **majority of the meteorite is composed of iron and nickel**, a small percentage of the meteorite contains minerals that are **only found in space, including Uakitite**.
- 98% of the Uakitite meteorite is an iron alloy called kamacite, which so far has only been found in other meteorites. The other two percent is comprised of minerals that form in space.
- Scientists don't know a lot more about this mysterious space rock as they were unable to obtain all physical and optical properties of the mineral because of its small size.

45 Draft Space Activities Bill, 2017

CONTEXT: A Bill pending before the Parliament is to encourage both the public and private sectors to participate in the space programme.

- It is a **proposed Bill to promote and regulate the space activities of India**.

Key Provisions of the Bill:

- The provisions of this Act shall **apply to every citizen of India and to all sectors engaged in any space activity in India or outside India.**
- A **non-transferable licence** shall be provided by the Central Government to any person carrying out commercial space activity.
- The Central Government will formulate the appropriate mechanism for licencing, eligibility criteria, and fees for licence.
- The **government will maintain a register of all space objects** (any object launched or intended to be launched around the earth) and develop more space activity plans for the country
- It will **provide professional and technical support for commercial space activity** and regulate the procedures for conduct and operation of space activity
- It will **ensure safety requirements and supervise the conduct of every space activity of India** and investigate any incident or accident in connection with the operation of a space activity.
- It will share details about the pricing of products created by space activity and technology with any person or any agency in a prescribed manner.
- If any person undertakes any commercial space activity without authorisation they shall be punished with **imprisonment up to 3 years or fined more than ₹1 crore or both**.
- **Analysis:** The bill, if passed, will facilitate the overall growth of the space activities in India with higher order of participation of public/ non-governmental/ private sector stakeholders.

46 Resource Prospector Mission

CONTEXT: NASA is developing an exploration strategy to meet the agency's expanded lunar exploration goals. Consistent with this strategy, NASA's Resource Prospector mission, which is in pre-formulation, aims to be the first mining expedition on another world.

Key Facts

- Using a suite of instruments **to locate elements from a lunar polar region,** the planned **rover is designed to excavate volatiles such as hydrogen, oxygen and water from the moon.**
- The mission **consisted of a lander and a solar powered rover** equipped with a drill.

Analysis

- **In-situ resource utilization" (ISRU)**, will foster **more affordable and sustainable human exploration** to many deep-space destinations.
- Launching one pound of any material into space costs thousands of dollars. One gallon of water weighs more than eight pounds, so **the ability to generate water, air and fuel in space could represent enormous cost savings for future deep-space missions**.
- Humans living, working and exploring other planetary bodies must be able to make their own breathable air and potable water.

47 GRACE MISSION

CONTEXT: NASA's GRACE mission has confirmed that a massive redistribution of freshwater is occurring across the Earth, with middle-latitude belts drying and the tropics and higher latitudes gaining water supplies.

GRACE mission:

- The GRACE mission was selected as the second mission under the **NASA Earth System Science Pathfinder (ESSP**) Program in May 1997. Launched in March of 2002, the GRACE **mission mapped variations in Earth's gravity field**. Designed for a nominal mission lifetime of five years, GRACE operated in an extended mission phase till 2017.
- GRACE is a joint partnership between the **National Aeronautics and Space Administration (NASA) in the United States and Deutsche Forschungsanstalt für Luft und Raumfahrt (DLR) in Germany.**
- GRACE consists of **two identical spacecraft** that fly about 220 kilometers (137 miles) apart in a polar orbit 500 kilometers (310 miles) above Earth. GRACE maps Earth's gravity field by making accurate measurements of the distance between the two satellites, using GPS and a microwave ranging system.

Key Findings

- The resulting map of the findings shows an overall pattern, in which **ice sheets and glaciers lose by far the most mass at the poles, but at the same time, middle latitudes show multiple areas of growing dryness even as higher latitudes and the tropical belt tend to see increases in water**.
- The study emphasizes that the 34 separate changes that it detects do not all have the same cause – not even close.
- There's very **strong suspicion that the melting of glaciers and ice sheets is tied to climate change.** On land, it's possible that some droughts and rainfall increases may be also, though the study is cautious about that, noting that natural variability can also be a major factor here.
- There are also **some major cases of humans increasing water storage in the landscape, particularly in China**, where massive dam construction has created enormous reservoirs.
- Mainly, though, what's striking about the map is the way that a combination of human-driven water withdrawals and droughts seem to be punishing the central latitudes of the northern hemisphere in particular, but also the southern hemisphere to a significant extent.

Analysis

- A combination of the **effects of climate change, vast human withdrawals of groundwater and simple natural changes are behind this**.
- If this continues, it could have profound consequences leading to a situation in which some highly populous regions could struggle to find enough water in the future.

48 Gaofen – 11

CONTEXT: China successfully launched Gaofen-11. It is the sixth in Gaofen series launched this year.

- **Gaofen means "high resolution" in Chinese**. It is ambitious space project of China that **aims to launch seven high-definition observation satellites before 2020.**

About Gaofen – 11:

- It is an **optical remote sensing satellite**, as part of the country's high-resolution Earth observation project. It was developed by China Academy of Space Technology (CAST).
- It will become part of China High-resolution Earth Observation System (CHEOS) initiated in 2010 to provide all-weather, all-day coverage by 2020.
- It is placed in **Sun – Synchronous Orbit**
- **Applications**: The satellite can be used for land survey, urban planning, road network design, agriculture, and disaster relief.

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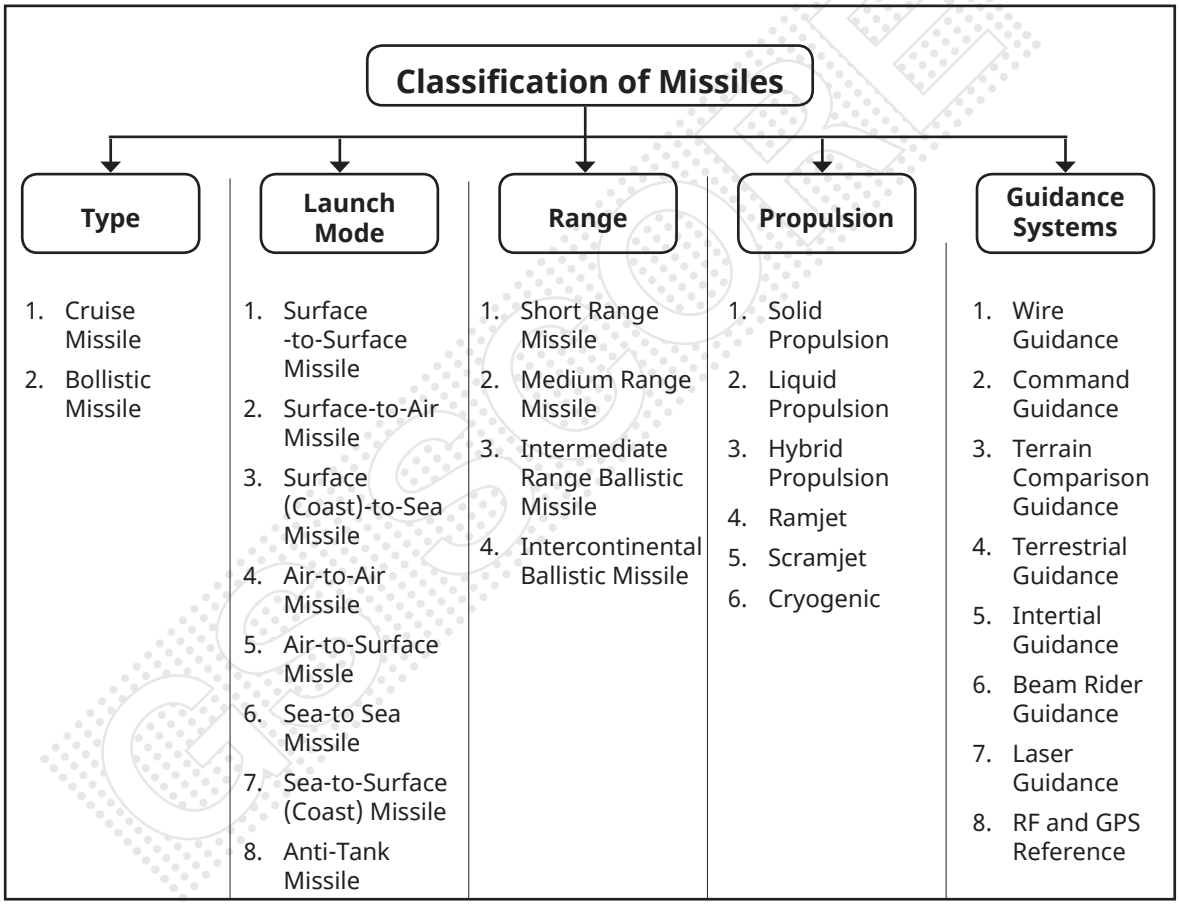
3

Defence Technology

1 India's Missile Development Program



Post-independence, research in missile technology received an impetus from the Government and made steady progress over the years. In early 1980s, the **DEFENSE RESEARCH DEPARTMENT LABORATORIES (DRDL)** had developed sufficient expertise in the fields of propulsion, navigation and manufacture of aerospace materials based on the study of Soviet rocketry technologies. Upgrading this proficiency to the next level was axiomatic and the political leadership felt the need to consolidate this expertise for achieving an integrated and holistic arsenal.

- The **INTEGRATED GUIDED MISSILE DEVELOPMENT PROGRAMME (IGMDP)** was formally instituted under the stewardship of **Dr Abdul Kalam in 1983**.
- This resulted in an evolution of the following missiles simultaneously:
- Short range surface-to-surface missile (PRITHVI).

- Short range low-level surface-to-air missile (TRISHUL).
- Medium range surface-to-air missile (AKASH).
- Third-generation anti-tank missile (NAG).

Significance of India's Missile program and future prospects

- India's missile forces **serve in the first instance to deter Pakistan and China**.
- India's ballistic missile development has largely been indegeneous, but it has recently collaborated with Russia for cruise missile design.
- To **diversify its deterrent**, India has also begun to develop sea launched missile.
- Due to growing acceptance of India as an emerging regional power and a responsible nation, India became the 35th member of the Missle Technology Control Regime (MTCR) in July 2018. India will stand benefitted at many fronts due to it, like Cryogenic technology access to ISRO, sale of Brahmos, procurement of missile technology from Israel and USA etc.

2 PrithviSeries

Prithvi I

- Launched in February 1988.
- **single-stage, liquid-fuelled missile**, **surface-to-surface missile**, **range of 150 km** and a mounting capability of 1000 kg. It was inducted into the Indian Army in 1994.

Prithvi II

Context: India successfully conducted a night trial of its indigenously developed nuclear capable Prithvi-II missile with a strike range of 350 km, from a test range in Odisha in February 2019.

- Prithvi-II is the India's one of the first developed indigenously and inducted indigenous surface-to-surface strategic missile.
- The tactical missile is capable of **attacking targets at range of 350 km.** It is **capable of carrying 500 to 1,000 kg of nuclear as well as conventional warhead**s and is thrusted by liquid propulsion twin engines.
- The missile can deliver warheads deep into enemy territory and inflict heavy damage to forward airfields. It is designed in such a way that it can be taken close to the forward line over any kind of terrain.

Prithvi III

- Prithvi III is the **naval-version missile with a range of 350 km**. A **two-stage surface-to-surface missile, Prithvi III was first tested in 2000.**

3 Agni Series

CONTEXT: A night trial of India's indigenously developed nuclear-capable Agni-1 ballistic missile with a strike range of 700 km was successfully conducted in October 2018.

Agni I

- A **nuclear-capable ballistic missile**
- Agni 1 is the first of the five-missile Agni series launched in 1983 by the Defence Research and Development Organisation.
- It has a **range of 700 km.**

Agni II

- An intermediate-range ballistic missile, the Agni-II was first test fired on April 11, 1999.
- The **surface-to-surface missile** has **a range of 2000 to 2500 km** and can carry conventional or nuclear warheads.

Agni III

- Agni III is an intermediate-range ballistic missile developed as the successor to the Agni II.
- It is an improvement over its previous iteration, and **has a range of 3,500km**, making it capable of engaging targets deep inside neighbouring countries. It was inducted in to the armed forces in June 2011, enhancing its strike capability.

Agni IV

- Carrying forward the success of its predecessor, the Agni III was developed to strike targets within a similar range but with a significantly shorter flight time of 20 minutes.
- The Agni IV, which has a two-phase propulsion system is designed to carry a 1,000 kg payload.

Agni V

Context: India successfully test-fired nuclear-capable ballistic missile Agni-5, which has a strike range of 5,000 km, from Dr Abdul Kalam island off the Odisha coast recently.

- **Agni- 5** is **the intercontinental surface-to-surface nuclear capable ballistic missile**. It is the latest in India's "Agni" family of medium to intercontinental range missiles.
- **It Agni-5 has a range of over 5,000 km and can carry about a 1500-kg warhead**. It can target almost all of Asia including Pakistan and China and Europe.
- The 17-metre long Agni-5 Missile weighs about 50 tonnes and is a very agile and modern weapon system.
- The surface-to-surface missile is **a fire-and-forget system** that cannot be easily detected as it follows a ballistic trajectory. India describes the Agni – 5 missile system as a 'weapon of peace'.
- India has already joined an elite club of nations that possess the ICBM launch capability when the maiden test-firing of Agni-V was successfully conducted in April, 2012. Only the five permanent members of the United Nations Security Council – China, France, Russia, the United States and Britain, along with Israel, have so far possessed such long-range missiles.

4 Akash

- **Surface-to-air** missile with an **intercept range of 30 km**.
- It has **multi-target engagement capability** and is in operational service with the Indian Army and the Indian Air Force.

5 Nag

- Nag is a third-generation **hit-to-kill anti-tank missile** that was first tested in 1990.
- The two-stage solid propellant weapon uses the lock-on before launch system where the target is identified and designated before the weapon is launched.

6 Man Portable Anti-Tank Guided Missile (MPATGM)

CONTEXT: In a major boost for Army, Defence Research and Development Organisation (DRDO) successfully test fired indigenously developed, low weight, fire and forget Man Portable Anti-Tank Guided Missile (MPATGM).

About MPATGM:

- MPATGM is **third-generationanti-tank guided missile (ATGM)** indigenously developed by DRDO.
- It has **strike range of 2.5 km**. It weighs around 14.5 kg to maintain man portability. It is capable of being fired from shoulder and can be used during day and night. It has minimum lateral centre and gravity offset.
- It works on **fire and forget principle** and is known for its top attack capabilities. It is effective against both stationary and moving targets. It will be deployed in infantry and parachute battalions of Indian Army.

7 Trishul

- Trishul is a **short-range surface-to-air** missile equipped with electronic measures against **all known aircraft jammers**.
- It has a range of 9 km and is used as anti-sea skimmer from ships against low-flying attacks.

8 Brahmos

- BrahMos is a **supersonic cruise missile** that is first test-fired on June 12, 2001.
- It was developed as a joint venture between India and Russia and is the **world's fastest anti-ship cruise missile in operation.**

9 Ballistic Missile Defence System

- The Indian Defence Research and Development Organisation (DRDO) is developing a two-tier Ballistic Missile Defence (BMD) system that provides a multi-layered shield against ballistic missile attacks.
- The BMD system consists of a **Prithvi Air Defence (PAD)** missile and an **Advanced Air Defence** (AAD) Missile for high and low altitude interception. **The PAD intercepts missiles at altitudes between 50km-80km and the AAD missile destroys them at altitudes of 15km-30km.**

10 Prithvi Air Defence (PAD)

CONTEXT: PDV interceptor missile was launched from Abdul Kalam Island (earlier known as Wheeler Island) of the Integrated Test Range (ITR) off Odisha coast.India's ballistic missile defence got a fillip with the development of PAD, which has been given the moniker Pradyumna Air Defence.

- PAD is a **two stage missile based on the Prithvi missile**.
- It is designed for engaging targets in **exo-atmosphere region at altitude 50 km** of earth's atmosphere. It is **guided by high-accuracy Inertial Navigation System (INS)** supported by Redundant Micro Navigation System for estimating point of interception. The system has been tested with a **maximum interception altitude of 80 km**, and has been **designed to neutralise missiles within a range of 300-2000 km up to a speed of Mach 5.0.**
- The technology employed in the PAD was the precursor to the indigenously developed Advanced Air Defence (AAD) interceptor missile which was tested in 2007, as well as the Barak-2 which was developed in collaboration with Israel.

11 Advanced Air Defence (AAD)

- Defence Research and Development Organisation (DRDO) conducted successful tested **supersonic endo-atmospheric interceptor missile** developed under Ballistic Missile Interceptor Advanced Air Defence (AAD) System. It is **single stage solid rocket propelled guided missile.**
- It is capable of intercepting incoming targets at **altitude of 15 to 25 km**.

12 K-15 Sagarika

- It forms the **crucial third leg of India's nuclear deterrent vis-à-vis its submarine-launched ballistic missile (SLBM) capability**.
- The K-15 Sagarika, which has a range of 750 km, was successfully tested in February 2008, and was subsequently integrated with India's nuclear-powered Arihant class submarine.

13 Dhanush

- Dhanush is a **liquid propelled sea-based missile** that was envisaged as a **short-range version of the Prithvi II ballistic missile.**
- It has a **range of 350 km** and is capable of carrying nuclear warheads.
- It was successfully test-fired from a naval warship in March 2011, and carries forward the legacy of the K-15 Sagarika.

14 Shaurya

- It was initially conceived as a **surface-to-surface ballistic missile (SSM) variant of the K-15 Sagarika**, that can be stored in underground silos for extended periods and launched using gas canisters as a trigger.
- The nuclear capability of the missile enhances India's second strike capability reduces the dependence on the K-15 ballistic missile which was built with significant Russian assistance.

15 Nirbhay

- Nirbhay is a **subsonic missile which is ancillary to the BrahMos range**.
- It uses a terrain-following **navigation system to reach up to 1,000 km**. Nirbhay is capable of being launched from multiple platforms on land, sea, and air.

16 Prahaar

CONTEXT: Defence Research and Development Organisation (DRDO) has successfully flight tested indigenously developed surface-to-surface short-range tactical ballistic surface-to-surface short-range tactical ballistic missile 'Prahaar', in September 2018.

- Prahaar is a **surface-to-surface missile with a range of 150 km** that was successfully tested for the first time in July 2011.
- Stated to be a unique missile, **the Prahaar boasts of high maneuverability, acceleration and accuracy.**

- Primarily a battlefield support system for the Army, the missile can be fired from a road mobile launchers and is extremely mobile in battle situations owing to its lighter build.
- Prahaar missile fills vital gap between Multi Barrel Rocket systems such as 'Pinaka' and medium range ballistic missiles such as Prithvi.

17 Astra

- Indian Air Force has successfully test-fired indigenously developed **Beyond Visual Range Air-to-Air Missile (BVRAAM) Astra from Su-30 fighter aircraft**developed by DRDO.
- During the test, missile successfully engaged manoeuvring target with high precision meeting mission objectives.
- It is one of the **smallest weapon system** developed by DRDO, having length of 3.8-metre and weighing 154kg.It is a **single stage solid fuelled** missile and has payload capacity of 15 kg conventional explosives.
- It can be **launched from different altitudes and is capable of engaging targets at varying range and altitudes at both short-range targets (up to 20 km**) in tail-chase mode and long-range targets (up to 80 km) in head-on mode.
- It can attain **maximum speed of Mach 4** (four times speed of sound). It possesses high Single Shot Kill Probability (SSKP) making it highly reliable.
- It is an **all-weather missile with active radar terminal guidance**, excellent electronic counter-counter measure (ECCM) features, smokeless propulsion and process improved effectiveness in multi-target scenario.
- It has advance on-board electronic counter-measures that jam radar signals from enemy radar, making tracking of the missile difficult. It is fitted with terminal active radar-seeker and an updated mid-course internal guidance system that helps missile to locate and track targets.
- The missile can be integrated with all fighter aircraft of IAF including Sukhoi-30 MKI, Mirage-2000, MiG-29, Jaguar and the Tejas Light Combat Aircraft (LCA).

Significance

- The flight test assumes significance as it was part of the series of final pre-induction trials.
- In the series of trials held till date, Astra missile has been launched in complete Su-30 flight envelope.
- So far, it has undergone more than 20 developmental trials.

18 Pinaka Rocket

CONTEXT: An upgraded version of Pinaka rocket, with enhanced range and guidance system, was successfully test-fired from Chandipur in Odisha.

Pinaka:

- **Pinaka is a multiple rocket launcher produced in India and developed by DRDO.**
- The guided version is Pinaka mark-II, which evolved from Pinaka mark-I. It can fire a salvo of 12 rockets in 44 seconds.
- The earlier Pinaka system, which was an unguided one, has now been **transformed into a guided version, with a navigation, guidance and control kit** developed by the Research Centre, Imarat (RCI), Hyderabad.RCI comes under the Defence Research and Development Organisation (DRDO).
- Radars, electro-optical systems and telemetry systems at the defence range at Chandipur tracked and monitored the rocket all through its flight path.

Significance

- The **conversion helped in enhancing the range and accuracy of Pinaka. If its range was 40 kilometre earlier, it is more than 70 kilometer now**.
- Pinaka integrates state-of-the-art technologies for delivering superior combat performance.
- Pinaka saw service during the Kargil War, where it was successful in neutralising enemy positions on the mountain tops. It has since been inducted into the Indian Army in large number.

19 Made in India' Artillery boost

- Indian Army and the defence ministry gave **approval for the production of 114 'Dhanush'** artillery guns. It is the latest fillip to India's indigenous gun manufacturing industry.
- The guns, are deemed as the **'Desi Bofors'**, and will form part of a trio of artillery weapons, along with the **K9 Vajra** and the Advanced Towed Artillery Gun System (ATAGS), that will be manufactured in the country.
- **Dhanush guns** will be manufactured by the **Ordnance Factory Board (OFB**), making them the first indigenously-produced long-range artillery gun, the Defence Acquisition Council (DAC) had last year cleared the production of 100 **K9 Vajras** and 150 **ATAGS** at a cost of Rs 3,365 crore.
- **K9 Vajras are being produced by Larsen and Toubro (L&T) and South Korea's Hanwha Tech Win (HTW)** under the 'Make in India' initiative. It is a self-propelled artillery gun that will boost the Indian Army's firepower on the western border.
- Three guns are expected to boost the artillery power of the Indian Army after a lull of nearly 31 years since the Bofors guns were inducted. The Bofors guns were controversially the last piece of artillery imported by India.
- In addition, also India signed a contract for 145 M-777 Ultra-Light Howitzers from the US.

20 Advanced Towed Artillery Gun System (ATAGS)

CONTEXT: India's Defence Acquisition Council approved the purchase of 150 Advanced Towed Artillery Gun Systems.

ATAGS:

- Advanced Towed Artillery Gun System (ATAGS), is **jointly developed by DRDO** and the private sector has set a new world record in range by hitting targets at a distance of 48 km.
- ATAGS is a 155mm, 52 calibre towed artillery gun being developed in mission mode as a part of the **Army's artillery modernisation programme**.
- Along with Defence Research and Development Organisation (DRDO), one prototype is made in partnership with **Tata Power (Strategic Engineering Division)** and the other with **Bharat Forge of Kalyani Group.**
- The gun has several significant features including an all-electric drive, high mobility, quick deployability, auxiliary power mode, advanced communication system, automated command and control system.
- It has a six round magazine instead of a standard three round magazine. Also, the gun weighs slightly more than normal due to the larger chamber.The Defence Ministry has already approved the in-principle purchase of 150 of these guns at an approximate cost of 3,365 crore.

21 Rustom-2

CONTEXT: DRDO carried out successful test flight of its Rustom 2 drone, at Aeronautical Test Range (ATR) Chalakere in Karnataka.

Rustom:

- It is a **medium-altitude long-endurance** unmanned aerial vehicle (UAV).
- Rustom 2 is **capable of carrying different combinations of payloads** like synthetic aperture radar, electronic intelligence systems and situational awareness payloads
- The drone has been designed and developed by Aeronautical Development Establishment of the DRDO, and aerospace major Hindustan Aeronautics Ltd and Bharat Electronics Ltd are its production partners.
- The around Rs 1,500-crore UAV project was initiated considering requirement of the Army, Navy and Air Force.
- The new indigenously built drone has the capability to replace precision drones imported from the United States of America and Israel.

22 Offshore Patrol Vessel ICGS Varaha launched

CONTEXT: ICGS Varaha, the fourth in the series of 98 M offshore patrol vessels (OPVs) of Indian Coast Guard, was launched.

- It is fourth in the series of 98 M OPVs (Offshore Patrol Vessels) developed by Larsen and Turbo (L&T).

ICGS Varsha

- It is equipped with **advanced technology navigation system and communication equipment** with sensor. Its armoury includes one 30 mm and two 12.7 mm guns with fire control system.
- It **can attain maximum speed of 26 knots and has endurance of 5,000 nautical miles**.
- It also equipped with an Integrated Bridge System (IBS), Automated Power Management System (APMS), Integrated Platform Management System (IPMS), and High Power External Fire Fighting (EFF) system.

Off shore Patrol Vehicles (OPVs):

- They are **patrolling vehicles which are deployed by Indian coast guards** to patrol maritime boundary of India.
- Coast guard vessel Vikram was the first in the class of seven new-generation offshore patrol, out of which four have been commissioned including Varha.
- All OPVs have been made indigenously **under "Make in India" initiative**.

23 Vijaya: Indigenously built patrol vessel commissioned by Indian Coast Guard

CONTEXT: Recently, Indian Coast Guard has commissioned indigenously built patrol vessel ICGS Vijaya in Chennai, Tamil Nadu.

ICGS Vijaya:

- It is **second in the series of 98 m offshore patrol vessels (OPVs)** commissioned by Indian Coast Guard.It is designed and built indigenously by Larsen & Toubro (L&T).
- The vessel is fitted with advanced technology navigation and communication equipment and sensors.It is **capable of carrying limited pollution response equipment to contain oil spill in sea.**
- It can carry one twin engine helicopter and four high speed boats, including two inflatable boats for boarding.It is fitted with 30 mm gun with fire control.
- It will be deployed extensively for Exclusive Economic Zone surveillance and other duties as enshrined in Coast Guard charter.On joining ICG fleet, ICGS Vijaya will be based at Paradip, Odisha.

Significance

- It will help to enhance ICG's operational capability to discharge its multifarious maritime tasks- search & rescue, law enforcement and maritime patrol operations (particularly around maritime states of Odisha and West Bengal, and eastern seaboard in general).

24 INS Chakra

CONTEXT: Russia will be delivering the Akula class submarine, to be known as Chakra III, to the Indian Navy by 2025.

INS Chakra:

- **India had earlier leased two nuclear submarines from Russia**. They are **INS Chakra** leased in 1988 under a three-year lease and second INS Chakra was taken in lease in 2012 for a period of 10 years.
- **INS Chakra is Indian Navy's only nuclear-powered submarine**. It is propelled by a 190 MW nuclear reactor.
- **Russia will lease Akula class submarine (Chakra III) for the period of 10 years** at the cost of USD 3 billion.
- It is one of the quietest nuclear submarines around, with **noise levels next to zero**.
- Chakra III will be equipped with Indian communication systems and sensors; including the **indigenously-developed USHUS integrated sonar system and Panchendriya sonar**.

Significance

- **Panchendriya sonar** suite has been developed by DRDO, India for the submarines of the Indian Navy. It has been described as India's "**first indigenously developed sonar system for submarines"**
- The induction of the nuclear-powered submarine clearly indicates India's intentions in the Indian Ocean Region and South East Asia which has recently seen increasing assertive Chinese presence. It will also a **send a strong reassuring message** to south east Asian nations like Indonesia, Vietnam and Malaysia who want **India to play a more active role in the region to counter the assertiveness of China in the area.**
- The induction of the INS Chakra is likely to be **followed by the induction of the indigenous INS Arihant, which will be capable of launching nuclear weapons** and therefore complete the nuclear triad. INS Arihant, is undergoing sea trails at Vizag.
- The only other nations possessing nuclear-powered submarines are - US, Russia, UK, France and China. India is back in this elite club after over a decade. In 1988, the Indian Navy had leased a Charlie Class nuclear-powered submarine for three years till 1991. The expertise gathered then was lost as most officers who had trained to operate nuclear submarines have retired.

25 Scorpene Submarine Programme

CONTEXT: Indian Navy has launched Scorpene submarine INS Karanj at the Mazagon Dock Shipbuilders Ltd (MDL), Mumbai, Maharashtra. It the third Scorpene class submarine built by MDL under ambitious Project 75 of the Indian Navy.

Scorpene class submarine:

- The submarines, designed by French naval defence and energy company DCNS, are being built by MDL in Mumbai as part of **Project-75 of the Navy.**

- **Kalvari** is the first of the six Scorpene-class submarines. INS Kalvari was commissioned in December 2017 and second, INS Khanderi is undergoing sea trials. Remaining 4 submarines will be inducted gradually by 2020.
- **INS Khanderi** (2017) is the second of the Indian Navy's six Kalvari-class submarines being built in India. The submarine began its sea trials in June 2017
- **INS Karanj** (2018) is the third submarine of the first batch of six Kalvari-class submarines for the Indian Navy. It is a diesel-electric attack submarine based on the Scorpène class, designed by French naval defence and energy group DCNS and manufactured by MDL, an Indian shipyard in Mumbai. The ship was launched in January 2018.
- These are diesel-electric attack submarines equipped with anti-ship missile. The first four submarines will be conventional, while last two will be equipped with the **Air Independent Propulsion (AIP) system**, which will enable them to stay underwater for longer duration.

Significance

- The Scorpene class is the Navy's first modern conventional submarine series in almost two decades since **INS Sindhushastra** which was procured from Russia in July 2000.
- MDL is manufacturing six Scorpene submarines under technology transfer from Naval Group of France under a 2005 contract worth $3.75 bn. The first of the class, INS Kalvari, joined service in December 2017.
- The state-of-the-art Scorpene submarines have superior stealth and ability to launch crippling attacks with precision-guided weapons. The attacks can be carried out with torpedoes both while submerged or on surface in all war theatres, including the tropics.

26 Maritime boundary

- Maritime boundary of a country is defined by **United Nations Convention on Laws of Seas (UNCLOS)**
- **UNCLOS**: Also known as the Law of the Sea Convention or the Law of the Sea treaty, is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III)

It defines international water in following ways:

- **Internal waters**: It covers all water and waterways on the landward side of the baseline. The coastal state is free to set laws, regulate use, and use any resource.
- **Territorial waters**: Out to 12 nautical miles (22 kilometres; 14 miles) from the baseline, the coastal state is free to set laws, regulate use, and use any resource.
- **Contiguous zone**: Beyond the 12-nautical-mile (22 km) limit, there is a further 12 nautical miles (22 km) from the territorial sea baseline limit, the contiguous zone, in which a state can continue to enforce laws in four specific areas: customs, taxation, immigration and pollution, if the infringement started within the state's territory or territorial waters, or if this infringement is about to occur within the state's territory or territorial waters.[10] This makes the contiguous zone a hot pursuit area.
- **Exclusive Economic Zone**: These extend 200 nautical miles (370 kilometers; 230 miles) from the baseline. Within this area, the coastal nation has sole exploitation rights over all natural resources. In casual use, the term may include the territorial sea and even the continental shelf.
- **Archipelagic water**: The convention set the definition of Archipelagic States in Part IV, which also defines how the state can draw its territorial borders. A baseline is drawn between the outermost points of the outermost islands, subject to these points being sufficiently close to one another. All waters inside this baseline are designated Archipelagic Waters. The state has sovereignty over these waters (like internal waters), but subject to existing rights including traditional fishing rights of immediately adjacent states. Foreign vessels have right of innocent passage (regulated passage) through archipelagic waters (like territorial waters).

Significance

- India's maritime security has been constantly enhanced after Mumbai attacks during which terrorists breached the national boundary through sea route.
- It is essential to safeguard maritime boundaries from illegal immigrants such as Rohingyas, who are constantly evading the porous border.
- China's string of pearls which envisages surrounding India from all sides by building offshore naval bases has forced India to build technically capable Indian coastguard who are equipped with advanced OPVs.
- Constant intrusion by Sri Lankan and Pakistani fishermen in Indian waters has been effectively prevented by Coast Guards.

27 Vehicle Location Tracking Devices and Emergency Buttons

CONTEXT: The Ministry of Road Transport and Highways has mandated vehicle location tracking (VLT) and emergency buttons in all public transport vehicles.

Vehicle Location Tracking:

- All new public service vehicles except auto rickshaws and e-Rickshaws, registered on and after 1st January 2019, will have to be equipped with Vehicle Location Tracking (VLT) with emergency buttons.
- The **VLT device manufacturers would assist in providing the back end services for monitoring**. This regulation is being brought in to ensure safety of passengers especially women.
- In case of older public service vehicles, those registered up to 31December, 2018, the respective State/ UT Governments will notify the date by which these vehicles have to install Vehicle Location Tracking Device and Panic Buttons. The Ministry has sent an advisory to the states in this regard.
- **The details of each VLT device will be uploaded on the VAHAN database** by the VLT device manufacturer using its secured authenticated access.
- The **VLT device manufacturers** or their authorised dealers will install the VLT devices in public service vehicles and register the devices along with details of vehicle on the corresponding backend systems in real-time.
- **Command and Control Centres** will be setup by the State or VLT manufacturers or any other agency authorised by the State Government, and these centres will provide interface to various stakeholders such as state emergency response centre, the transport department or Regional Transport Offices, Ministry of Road Transport and Highways and its designated agencies etc.
- These centres will also provide feed to the VAHAN data base or the relevant data base of the State with regard to the over speeding, device health status.

28 LCA TEJAS clears maiden mid-air refuelling trial

CONTEXT: The Indian Air Force successfully carried out first ever mid-air refuelling of indigenously developed Light Combat Aircraft (LCA) Tejas MK-1.

- With this trial, **India joins in elite group of countries which have successfully developed air-to-air refuelling system for military aircraft**.
- The trial was first wet mid-air refuelling of LCA Tejas carried out by transferring 1,900 kg of fuel at an altitude of 20,000 feet.

Significance

- Air-to-air refuelling capability for LCA will be **a force multiplier for IAF as it enhances potential of aircraft to stay airborne for much longer periods of time, thus increasing its range and endurance.**

- LCA will get much closer to acquiring final operational clearance (FOC), an important battle-ready tag with this trial.
- It will also enable IAF options to exploit operational potential of LCA as well as to participate in international exercises without having to stop or stage through several locations en-route.
- IAF currently operates nine LCA Tejas fighters built to Initial Operating Clearance (IOC) standard indigenously built by Hindustan Aeronautical Limited.

29 India's first missile tracking ship

CONTEXT: India's first missile tracking ship is readying for sea trials.

- The **VC 11184 isIndia's first missile tracking ship**, which will also be the first dedicated resource in Phase-II of India's ballistic missile defence.
- It is built by **Hindustan Shipyard Ltd.**
- It is being built for the National Technical Research Organisation, the technical intelligence agency working directly under the supervision of the Prime Minister's Office and the National Security Adviser.

30 Solid Fuel Ducted Ramjet (SFDR)

CONTEXT: Defence Research and Development Organisation (DRDO) successfully flight tested the second indigenously developed 'Solid Fuel Ducted Ramjet (SFDR)' propulsion based missile system in February, 2019. It is a missile propulsion technology jointly developed by India and Russia.

What is ramjet?

- Ramjet is **a form of air-breathing jet enginethat uses the vehicle's forward motion to compress incoming air for combustion without a rotating compressor**. Fuel is injected in the combustion chamber where it mixes with the hot compressed air and ignites. A ramjet-powered vehicle requires an assisted take-off like a rocket assist to accelerate it to a speed where it begins to produce thrust.

Significance:

- It will **help both India's surface-to-air and air-to-air missiles to perform better and enhance their strike range, making them more lethal.**
- With it, **India can have fastest long-range missiles in two categories**, providing full-fledged and multi-layered aerial protection from hostile attacks.
- **Its successful use in missiles will mark India's entry into select club of nations that use next-generation missile technology against manoeuvring targets**, compromising effectiveness of conventional missiles.

31 Defence Innovation Hubs

CONTEXT: The Defence Innovation Organisation set up under iDEX has announced setting up of two Defence Innovation Hubs (DIHs) in Tamil Nadu (Coimbatore) and Maharashtra (Nashik).

iDEX:

- The Innovations for Defence Excellence (iDEX) framework of the **Government envisagessetting up and managing independent DIHs.**

- These DIHs will **serve as platforms where innovators can get information about needs and feedback from the Services** directly and create solutions for India's major defence platforms.
- This structure is also **geared towards attracting more innovators** to work for the defence sector in India.

Innovations for Defence Excellence (iDEX):

- It was launched by the Government in April 2018, primarily **aims at creation of an ecosystem to foster innovation and technology development in Defence and Aerospace**
- It **aims at engaging Industries including MSMEs, start-ups, individual innovators, R&D institutes & academia for defence technology** to be made and fostered in India.
- It will **provide them grants/funding and other support to carry out R&D** which has good potential for future adoption for Indian defence and aerospace needs.
- iDEX is **funded and managed by a 'Defence Innovation Organization (DIO)'** which has been formed as a 'not for profit' company as per Section 8 of the Companies Act 2013 for this purpose. DIO has been created by the two founder members i.e. Defence Public Sector Undertakings (DPSUs) - HAL & BEL.
- **iDEX functions as the executive arm of DIO**, carrying out all the required activities while DIO will provide high level policy guidance to iDEX.

Key Functions of iDex:

- Co-Innovation/co-creation
- Indigenization of various defence and aerospace related platforms being manufactured in the country based on ToT.

Defence India Start Up Challenge

- Taking the iDEX initiative further, Defence India Startup Challenge "has been launched by Ministry in partnership with Atal Innovation Mission.
- It aims at supporting Startups/MSMEs/Innovators to create prototypes and/or commercialize products/solutions in the area of National Defence and Security.
- The vision of the Challenge is two-fold:
- Help create functional prototypes of products/technologies relevant for national security (prototyping), and spur fast-moving innovation in the India defence sector
- Help new tech products/technologies find a market and early customer (commercialization) in the form of the Indian Defence Establishment.

32 India's first indigenous anti-nuclear medical kit

CONTEXT: Scientists at Institute of Nuclear Medicine and Allied Sciences (INMAS) in New Delhi, has developed first indigenous medical kit that may ensure protection from nuclear warfare.

Anti-nuclear medical kit:

- India's first indigenous medical kit may **ensure protection from serious injuries and faster healing of wounds resulting from nuclear warfare or radioactive leakage.**
- It has over 25 items, including radio-protectors that provide 80-90 per cent protection against radiation and nerve gas agents, bandages that absorb radiation as well as tablets and ointments.
- Contents include an advanced form of **Prussian blue tablets, highly effective in incorporating Radio Cesium (Cs-137) and Radio Thallium, a**mong the most feared radioisotopes in nuclear bombs that destroy human body cells.

- The kit has been developed for the armed, paramilitary and police forces only as they are the first ones likely to get exposed to radiation — be it during nuclear, chemical and biomedical (NCB) warfare or a rescue operation after a nuclear accident.
- The kit has an **Ethylene diamine tetra acetic acid (EDTA**) injection that traps uranium in the guts and blood of victims during a nuclear accident or warfare.
- **Ca-EDTA Respiratory Fluid**, which is the inhalation formula for chelation, or grabbing, of heavy metals and radioactive elements deposited in lungs through inhalation at nuclear accident sites.
- The kit also has **a radioactive urine/biofluid collector which is cost-effective, easy to store and can safely dispose of the urine of a person affected by radiation**.
- The collector has silk at its base, more than enough to jellify 500 millilitre of urine, which could be disposed of safely.
- The medicine in the form of a tablet is **Indranil 150 mg**. It is being introduced as a reserve emergency drug for services, rescue workers and places where high acute exposures are expected and lives will be at stake.

Significance

- It's a potent alternative to similar kits that were till now being procured from strategically advanced nations such as the US and Russia at much higher prices.
- Part of the kit is the amifostine injection, a US Food and Drug Administration (FDA) approved conventional radiopharmaceutical that limits damage from gamma radiation. However, due to a very small market, availability is a major issue.

33 Defence Industry Corridor

CONTEXT: India inaugurates a Defence Industrial corridor in Tamil Nadu.

Defence Corridor:

- A defence corridor **refers to a route or a path along which domestic productions of defence equipment by public sector, private sector and MSMEs are lined up to enhance the operational capability of the defence forces.**
- Defence is **part of the 10 'Champion Sectors'** that have been identified for focused attention because of their "potential to become global champions, bring double digit growth in manufacturing, and generate employment opportunities.
- **TN Defence Industrial Corridor is a mega corridor**, which will link leading military manufacturing units in five cities of South India, including Chennai, Hosur, Coimbatore, Salem and Tiruchirappalli.
- The corridor is the second defence corridor being set up by the government to support. Various defence manufacturing units. The first one is being established in Uttar Pradesh.
- The **majority of the investments will come from public sector undertakings (PSUs**) as Ordinance Factory Board, Bharat Electronics Limited and Bharat Dynamics Limited.
- Besides, private companies such as TVS, Data Patterns and Alpha Designs have also committed to make investments worth Rs 50 crore, Rs 75 crore and Rs 100 crore respectively.

Significance

- With the need to indianise defence production. DIC will help in participation of private players.
- There is a need to keep our armed forces modernised to deal with security concerns from China and Pakistan.
- **India is the largest arms importer in the world and spends annually on an average about $3.6 billion**, which is more than the combined imports of both Pakistan and China. This means that we are not only sending our money abroad but also depend on foreign countries. DIC will help to reduce such dependence.

34 Bhabha Kavach

CONTEXT: The Bhabha Atomic Reseach Centre (BARC) has developed a next-generation bulletproof jacket for the Indian armed forces.

Bhabha Kavach:

- The **jacket weighs just 6.6 kg in comparison to the 17-kg jackets in use, and has passed over 30 tests carried out by certified agencies**.
- The jacket **is made using extremely hard boron carbide ceramics** that is **hot-pressed with carbon nano-tubes and composite polymer**. BARC has been using boron carbide in the control rods of its nuclear reactors.
- Jackets would be needed in large numbers and will be **manufactured by Mishra Dhatu Nigam Limited, a defence PSU**.

35 Mission Raksha Gyan Shakti

CONTEXT: Raksha Mantri has launched 'Mission Raksha Gyan Shakti'.

- The event showcased salient **inventions and innovations achieved by Defence Research and Development Organisation (DRDO), Defence Public Sector Undertakings (DPSUs), and Ordinance Factories (OFs)** which have resulted in successful filing of **Intellectual Property** Rights (IPR) applications.
- The **Directorate General of Quality Assurance (DGQA**) has been entrusted with the responsibility of coordinating and implementing the programme.
- It was highlighted the need to migrate from the culture of seeking **Transfer of Technology (ToT**) from foreign sources to **generating Intellectual Property in India**, to achieve the goal of self-reliance in Defence sector.
- An IP Facilitation Cell was established in April this year to achieve ambitious targets of training 10,000 personnel of Ordnance Factories (OFs) and Defence Public Sector Undertakings (DPSUs) on IPR.

According to the **World Trade Organization (WTO**), 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.

36 Intermediate Range Nuclear Forces Treaty, 1987

CONTEXT: United States has decided to pull out from the INF treaty with Russia and alleged that Moscow has violated the agreement.

Intermediate-Range Forces Treaty:

- The treaty was signed in Reykjavik, Iceland, in 1987 by President Ronald Reagan and Soviet leader Mikhail Gorbachev, and **led to the destruction of more than 2600 missiles by 1991.**
- It **originally banned only the U.S. and the Soviet Union (later Russia) from deploying all ground-launched nuclear and conventional missiles with a range of 500 to 5500kms**. After 1991, treaty also covered Russia, Belarus, Kazakhstan, and Ukraine under it.
- Through the treaty, the superpowers for the first time, agreed to reduce their nuclear arsenals, eliminate an entire category of nuclear weapons, and utilize extensive on-site inspections for verification.

- As a result of the INF Treaty, the United States and the Soviet Union destroyed a total of 2,692 short-, medium-, and intermediate-range missiles by the treaty's implementation deadline of June 1, 1991.

Why to pull out from treaty?

- Since the inception of 21st century, both Russia and the US have alleged each other for violating the treaty.
- In the past, Russia has raised the possibility of withdrawing from the INF Treaty. It contended that the treaty unfairly prevents it from possessing weapons while its neighbours, such as China, are developing and fielding weapons.
- Russia has suggested that the proposed U.S. deployment of strategic anti-ballistic missile systems in Europe might trigger a Russian withdrawal from the accord, presumably so as to deploy missiles targeting any future U.S. anti-missile sites.

Other motives

- According to US, Cold War-era treaty did not address new missile threats from countries such as China, Iran and North Korea, and is therefore redundant.
- A withdrawal will allow the U.S. to have new weapon options, which are not bound by the INF treaty, in the Pacific region where growing influence of China in the past decade ischallenging the dominance of US in the region. In the recent past, China's growing military might has become the strategic centrepoint of US nuclear strategy.
- According to US, the existence of the INF Treaty creates hindrance in establishing a line of total U.S. domination and supremacy in the military sphere all over the world.

Implications if US pulls out

- US may deploy intermediate-range nuclear missiles in Europe to counter Russia and in the retaliation Russia may deploy in its exclave of Kaliningrad. This could once again turn Europe into one of the potential nuclear battlefields.
- It is also likely to negatively impact the increasingly embattled U.S.-Russia arms control enterprise. The U.S.-Russia New START treaty, governing strategic offensive nuclear weapons, was concluded on the assumption that Washington and Moscow would refrain from deploying systems of intermediate range. Any change to the nuclear balance would destabilize the strategic calculations that underpin New START, potentially placing that treaty in jeopardy.
- US may deploy ground-based missile system in Asia and the Indo-Pacific region. This could embolden China to speed up its missile installation in the strategic areas of the region including South China Sea.
- It could lead to form a bad precedent for the nuclear power countries like North Korea, Pakistan, Iran and Israel. These countries may accelerate the process of acquiring more nuclear weapons by resorting to an excuse that responsible nuclear powers like US and Russia do not even adhere to their own treaties of non-proliferating of nuclear weapons.
- The abrogation of treaty will further accelerate the nuclear armed race. INF abrogation will raise questions regarding the United States' commitment to arms control in general, lending further weight to the sense that the 21st century will be an era of arms racing rather than negotiation.

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Health& Biotechnology

1 Rare Diseases

CONTEXT: The national policy for treatment of rare diseases (NPTRD) has been withdrawn, and the Union health ministry announced a 'one-time financial assistance'.

Rare Diseases

- Rare diseases refer to those **medical conditions which affect a very small number of the population.**
- They are characterised by a broad diversity of disorders and symptoms that vary not only from disease to disease but also from patient to patient suffering from the same disease.
- The **most common rare diseases recorded in India are Haemophilia, Thalassemia, sickle-cellanaemia and primary immuno deficiency in children, auto-immune diseases, Lysosomal storage disorders such as Pompe disease, Hirschsprung disease, Gaucher's disease, Cystic Fibrosis, Hemangiomas** and **certain forms of muscular dystrophies.**

- **80% of rare diseases have identified genetic origins** while others are the result of infections, allergies and environmental causes. Some are degenerative and proliferate while 50% of rare diseases affect children.
- In most of the cases, there are **no existing effective cures adding to the high level of pain and suffering** endured by patients and their families.
- **Last day of February each year** is marked as **Rare Disease Day**. It is celebrated worldwide to draw attention to various kinds of diseases that affect a specific number of people and there are still no definite cure for them.

2 Thalassaemia

CONTEXT: Thalassaemia is the most common genetic blood disorder that is prevalent in India.

- While there is a high incidence of inherited diseases in South Asia, **India has the highest number of thalassaemia majors and carriers** (or those who are asymptomatic).
- It is estimated that there are more than 100,000 thalassaemia majors in the country or an average prevalence rate of **3-4% carriers in the general population**.
- Each year, there are 10,000 children born with thalassaemia major.

- The disorder '**reduces the production of functional haemoglobin,** causing a **shortage of red blood cells** and **low levels of oxygen in the bloodstream'**, and patients require **lifelong blood transfusion**, **iron chelation therapies** and other treatment.
- There is still no cure other than a bone marrow transplant. As **bone marrow transplant** has to be done in **early childhood**, it is **not a workablecure** as yet **for adults** and their only curative option is **gene therapy.**
- **Gene therapy research and clinical trials** have been going on for the past 25 years or so in an effort **to correct the mutated 'globin' gene** that is responsible for normal haemoglobin production.
- A biotechnology company in the U.S., **Bluebird Bio,** has been conducting clinical studies to investigate the potential for **LentiGlobin gene therapy** as a final cure for transfusion-dependent **ß-thalassaemia (TDT).**

3 Down Syndrome

- Down's syndrome, also known as **trisomy 21.**
- It is a **genetic disorder** caused by the presence of all or part of **a third copy of chromosome 21.**
- Down's syndrome is the **most common chromosome abnormality in humans**. It is typically **associated with a delay in cognitive ability** (mental retardation, or MR) and **physical growth**, and a particular set of facial characteristics.
- An 18-month-old boy with Down syndrome has been named by baby food maker Gerber as its **"Spokesbaby"** for 2018.

4 New Classification of Diabetes

CONTEXT: Scientists unveiled a revised classification for diabetes.

- There are **five distinct types of diabetes** that can occur in adulthood, rather than the two currently recognized.
- **People with diabetes have excessively high blood glucose, or blood sugar**, which comes from food.
- Some **420 million people around the world today suffer from diabetes**, with the number expected to rise to 629 million by 2045, according to the International Diabetes Federation.

Two sub-types:

- Currently, the disease is divided into two sub-types.
- **With type-1** — generally **diagnosed in childhood and accounting for about 10% of cases** — **the body simply doesn't make insulin**, a hormone that helps regulate blood sugar levels.
- **For type-2**, the body makes some insulin but not enough, which means glucose stays in the blood.
- This form of the disease **correlates highly with obesity** and can, over time, **lead to blindness, kidney damage, and heart disease or stroke.**
- It has long been known that type-2 diabetes is highly variable, but classification has remained unchanged for decades.

Five Clusters of Diabetes

Cluster	Characteristics	Name
1	Early disease onset (at a young age), essentially corresponds with type 1 diabetes and LADA, relatively low BMI, poor metabolic control, insulin deficiency (impaired insulin production), GADA+	Severe Autoimmune Diabetes (SAID)

2	Similar to cluster 1 but GADA–, high HbA1c, highest incidence of retinopathy	Severe Insulin-Deficient Diabetes (SIDD)
3	Insulin resistance, high BMI, highest incidence of nephropathy	Severe-Insulin Resistant Diabetes (SIRD)
4	Obesity, younger age, not insulin resistant	Mild Obesity-related Diabetes (MOD)
5	Older age, modest metabolic alterations	Mild Age-related Diabetes (MARD)

5 Maturity-Onset Diabetes of the Young (MODY)

CONTEXT: As per the paper published in the BMC Medical Genetics journal, a team led by researchers in Chennai has isolated a gene named NKX6-1 that causes a rare form of diabetes, called Maturity-Onset Diabetes of the Young (MODY).

- So far **14 known gene variants** have been identified that cause MODY.
- Diabetes involves a disruption of how blood sugar is kept in check by the hormone insulin.
- Type-2 diabetes is the most common form of the disorder.
- **In MODY, any one of the 14 genes, if defective, can hamper the body's insulin usage and trigger Type-2 diabetes**.

Of the 14 MODY genes already identified, largely from European studies, MODY 1–3 are the most common. Some forms of MODY can easily be treated with sulphonylurea, an inexpensive drug. In a paper published in the BMC Medical Genetics journal, researchers outlined that variants of the NKX6-1 gene found in MODY patients were "functionally impaired".

6 Lymphatic Filariasis

CONTEXT: A pilot project to administer triple drug therapy with the long term aim of eradicating lymphatic filariasis was launched in Nagpur.

- Since 2004, two drug therapy for lymphatic filariasis has been in place but the addition of the third drug now will give boost to the overall campaign.
- The third drug used in this therapy will help control adult worms of lymphatic filariasis.

Lymphatic filariasis

- It is a **tropical disease**.
- Infection occurs when **filarial parasites are transmitted to humans through mosquitoes**.
- Infection is usually acquired in childhood causing hidden damage to the lymphatic system.
- The painful and profoundly disfiguring visible manifestations of the disease, lymphoedema, elephantiasis and scrotal swelling occur later in life and can lead to permanent disability.

Causes and transmission

- Mosquitoes are infected with microfilariae by ingesting blood when biting an infected host. Microfilariae mature into infective larvae within the mosquito.
- When infected mosquitoes bite people, mature parasite larvae are deposited on the skin from where they can enter the body.The larvae then migrate to the lymphatic vessels where they develop into adult worms, thus continuing a cycle of transmission.

- It is transmitted by different types of mosquitoes for example **by the Culex mosquito**, widespread across urban and semi-urban areas, Anopheles, mainly found in rural areas, and Aedes, mainly in endemic islands in the Pacific.

WHO response

- To eliminate lymphatic filariasis as a public health problem **in 2000, Global Programme to Eliminate Lymphatic Filariasis (GPELF) was launched**.
- WHO's strategy is based on 2 key components:
  - Stopping the spread of infection through large-scale annual treatment of all eligible people in an area or region where infection is present; and
  - Alleviating the suffering caused by lymphatic filariasis through provision of the recommended basic package of care.

7 New Influenza Research Programme

CONTEXT: The Department of Biotechnology (DBT), Government of India, and the European Union (EU), joined hands for research programme to develop a Next Generation Influenza Vaccine to protect citizens worldwide. Both have also committed EUR 15 million each to fund this joint call for the program named "Horizon 2020".

- **Influenza**, commonly known as the **flu**, is an **infectious disease** caused by an **influenza virus**.
- The most common symptoms include: **High fever, runny nose, sore throat, muscle pains, headache, coughing, sneezing,** and **feeling tired.**
- The symptoms typically begin two days after exposure to the virus and most last less than a week. The cough, however, may last for more than two weeks.
- In **children**, there may be **diarrhea and vomiting**, but these are not common in adults.

- Improved influenza vaccines would help the international community to better prepare in the event of an influenza pandemic.
- While the projects require **three applicants** from both **three European member states** and **India** respectively, the call which will remain open until April 16, 2019, also **allows applicants from other countries to join the EU-India consortia.**

8 Drug-resistant Superbug Spreading

CONTEXT: Researchers at the University of Melbourne discovered three variants of the multidrug-resistant bug in samples from 10 countries, including strains in Europe that cannot be reliably tamed by any drug currently on the market.

- The bacteria-**Staphylococcus epidermidis** - is related to the better-known and more deadly **MRSA superbug.**
- It's found naturally on **human skin** and most **commonly infects the elderly or patients** who have had **prosthetic materials implanted**, such as catheters and joint replacements.
- It can be deadly, but it's usually in patients who already are very sick in hospital and it can be **quite hard to eradicate** and the infections can be severe.

9 Zoonotic Diseases

CONTEXT: The emergence of zoonotic, or infectious diseases, such as the Nipah Virus Infection (NiV) in Kerala, is being seen as a litmus test for the preparedness of the Indian healthcare system to deal with such challenges.

- As per WHO, **Zoonoses** are "**those diseases and infections which are naturally transmitted between vertebrate animals and man".**
- Zoonoses include only those infections where there is either a proof or a strong circumstantial evidence for transmission between animals and man.
- Zoonotic diseases are resulting from ecological changes such as **urbanization, industrialization** and **diminishing proportion of persons working** in the so-called primary sector.
- Reference may be made to various types of **encephalitis, eosinophilic meningitis,**

According to the etiological agents:

- **Bacterial zoonoses;** e.g. anthrax, brucellosis, plague, leptospirosis, salmonellosis, lyme disease.
- **Viral zoonoses;** e.g. rabies, arbovirus infections, KFD, yellow fever, influenza, CCHF.
- **Rickettsial zoonoses;** e.g. murine typhus, tick typhus, scrub typhus, Q-fever.
- **Protozoal zoonoses;** e.g. toxoplasmosis, trypanosomiasis, leishmaniasis.
- **Helminthic zoonoses;** e.g. echinococcosis (hydatid disease), taeniasis, schistosomiasis, dracunculiasis.
- **Fungal zoonoses;** e.g. deep mycosis-histoplasmosis, cryptococcosis, superficial dermatophytes.
- **Ectoparasites;** e.g. scabies, myiasis.

- **capillariasis, anisakiasis, lyme disease, monkeypox diseases in humans, lassa fever, Marburg disease** and **Ebola** for all of which an animal link has been established.
- Poorly documented, zoonotic diseases are a **major public health problem in India** because of inadequate diagnostic facilities, unfamiliarity of physicians with these diseases and lack of co-ordination between physicians, veterinarians, and epidemiologist, the extent of their existence is obscured.
- Major public health zoonotic diseases in India include **Rabies, Brucellosis, Toxoplasmosis, Cysticercosis, Echinococcosis, Japanese Encephalitis (JE), Plague, Leptospirosis, Scrub typus, Nipah, Trypanosomiasis, Kyasanur forest disease (KFD) and Crimean-Congo haemorrhagic fever (CCHF).**
- According to the **National Centre for Disease Control (NCDC),** about 75% of emerging and re-emerging infections are zoonotic, and new pathogens (viruses) continue to emerge and spread across countries.
- Controlling and preventing zoonotic diseases in a country like India is challenging because of a huge human population and its frequent interactions with animals.
- Poverty-struck communities are primarily dependent on rearing animals as a means of livelihood and, therefore, the intimate human-animal contact puts them at risk for this category of diseases.
- There is need for developing a **modern disease surveillance system** using new approaches and tools such as syndromic surveillance, geographic information system, remote sensing, molecular epidemiology, information technology, bioinformatics, economics and sociology.
- Considering the situation of zoonotic diseases, the government has decided to form a **national task force** comprising medical, veterinary and environmental experts, and plans to **make veterinary public health a part of the national health mission.**
- The government also plans to **study the economic impact of zoonotic disease outbreaks in humans** so that prevention and control guidelines are framed well in advance by both medical and veterinary fraternities.

10 Nipah Virus

CONTEXT: In May 2018, a Nipah virus disease (NiV) outbreak was reported from Kozhikode district of Kerala, India.

- Nipah virus is a zoonotic virus (it is transmitted from animals to humans) and can also be transmitted through contaminated food or directly between people.

- Nipah virus belongs to a **genus of paramyxoviruses (Henipavirus**), including the **highly pathogenic Hendra virus** found in Australia with mortality rates in excess of 70%.
- Since its first detection in Malaysia, a closely related Nipah virus has emerged in Bangladesh/ India region since 2001.
- **Pteropus bats** (**fruit eating bats)** are likely the main animal reservoir for Nipah virus, although there is evidence suggesting that other bat species are also susceptible to Nipah virus infection in nature.
- **Molecular tests** (both **qPCR** and **next generation sequencing**) are the most rapid and accurate tools available to confirm Nipah virus infection. **Acute-phase serum, CSF, throat swabs, saliva, and urine** can be used for these tests.
- There is also an **IgM ELISA test** based on whole viral antigen.

- In infected people, it causes a range of illnesses from **asymptomatic (subclinical) infection** to **acute respiratory illness** and **fatal encephalitis.**
- The virus can also cause severe **disease in animals** such as pigs, resulting in significant economic losses for farmers.
- Studies have shown that the virus can be transmitted to human by three different routes:
  - From **bats to humans** who come in contact with **virus-contaminated material** (e.g., date palm sap);
  - From **intermediate hosts** such as **pigs** and **horses**; and
  - From **infected humans**.
- There is also epidemiological evidence that **companion animals (including dogs and cats) can be infected with these viruses** and they can in theory transmit viruses to humans as well.
- Clinical symptoms include **fever** and **headaches**, which can progress to **drowsiness, disorientation, mental confusion, and finally encephalitis (brain swelling)** in less than a week.

11 Lassa Fever

CONTEXT: Following a joint epidemiological review by the Nigeria Centre for Disease Control and the World Health Organisation, Nigeria has announced the end of the emergency phase of the 2018 Lassa fever outbreak.

- Lassa fever is an acute **viral haemorrhagic illness** of 2-21 days duration that occurs in **West Africa**.
- The Lassa virus is transmitted to humans via contact with food or household items contaminated with **rodent (Mastomys rats)urine or faeces**.
- Lassa virus may also be spread between humans through **direct contact with the blood, urine, faeces, or other bodily secretions of a person infected** with Lassa fever.

Symptoms and Effects

- The onset of the disease, when it is symptomatic, is usually gradual, starting with **fever, general weakness, and malaise**, and after a few days**, headache, sore throat, muscle pain, chest pain, nausea, vomiting, diarrhoea, cough,** and **abdominal pain** may follow.
- In severe cases **facial swelling, fluid in the lung cavity, bleeding from the mouth, nose, vagina or gastrointestinal tract** and **low blood pressure** may develop.
- **Protein** may be noted in the urine. **Shock, seizures, tremor, disorientation,** and **coma** may be seen in the later stages.
- **Deafness occurs in 25% of patients** who survive the disease. In half of these cases, hearing returns partially after 1–3 months.
- **Transient hair loss** and **gait disturbance** may occur during recovery.
- **Death** usually occurs **within 14 days** of onset in fatal cases.
- The disease is especially severe late in pregnancy, with **maternal death** and/or **fetal loss** occurring in **more than 80% of cases** during the third trimester.

- Because the symptoms of Lassa fever are so varied and non-specific, **clinical diagnosis is often difficult,** especially early in the course of the disease.
- Lassa fever is **difficult to distinguish from otherviral haemorrhagic fevers** such as **Ebola virus** disease as well as other diseases that cause fever, including malaria, shigellosis, typhoid fever and yellow fever.
- Lassa virus infections can only be diagnosed definitively in the laboratory using the following tests:
  - **Reverse transcriptase polymerase chain reaction (RT-PCR) assay.**
  - **Antibody enzyme-linked immunosorbent assay (ELISA).**
  - **Antigen detection tests.**
  - **Virus isolation by cell culture**.
- The **antiviral drug ribavirin** has been found to be an effective treatment for Lassa fever if given early on in the course of clinical illness.
- There is currently **no vaccine** that protects against Lassa fever.
- Prevention of Lassa fever relies on promoting **good "community hygiene"** and to **discourage rodentsfrom entering homes**.

12 Nepal, first country in South-East Asia to Eliminates Trachoma

Context: The World Health Organization (WHO) has validated Nepal for having eliminated trachoma as a public health problem – a milestone, as the country becomes the first in WHO's South-East Asia Region to defeat the world's leading infectious cause of blindness.

About the Disease

- **Trachoma**, an eye disease caused by infection with the **bacterium Chlamydia trachomatis**, is spread through **contact with infective eye or nose discharges**. Infection is particularly common in young children.
- Ocular or nasal discharge can be **transmitted directly from person to person**, or be **mediated by flies** which have been in contact with the eyes and noses of infected people.
- Transmission is associated with **poor sanitation and hygiene**, which increase the availability of eye discharges and encourage the breeding of flies.

- Trachoma puts more than **190 million people at risk of blindness** in 41 countries and is responsible for the **blindness or visual impairment of around 1.9 million people** worldwide.

- Trachoma was the **second leading cause of preventable blindness** in Nepal in the 1980s.
- In 2002, the Government of Nepal stepped up efforts to eliminate the disease with the establishment of a **national trachoma programme**.
- From 2002 to 2005, following the implementation of sustained control activities, the prevalence of active (inflammatory) trachoma fell by 40%.

Several criteria are used to assess a country's claim for having **eliminated trachoma** as a public health problem. These include:

- **Less than 5% of children aged 1–9 years** have signs of **active trachoma (trachomatous inflammation–follicular),** which can be treated with antibiotics, in each previously-endemic district;
- **Less than 0.2% of people aged 15 years and older** have **trachomatous trichiasis**, which requires eyelid surgery, in each previously-endemic district; and
- A health system which can identify and manage new cases of trachomatous trichiasis.

GET 2020

- In 1996, **WHO** launched the WHO Alliance for the **Global Elimination of Trachoma** by the **year 2020(GET2020).**
- With other partners in the Alliance, WHO supports country **implementation of the SAFE strategy (Surgery for trichiasis, Antibiotics to clear infection, Facial cleanliness, and Environmental improvement to limit transmission)** and strengthening of national capacity through **epidemiological assessment, monitoring, surveillance, project evaluation and resource mobilization**.
- Elimination of trachoma is inexpensive, simple and highly cost-effective, yielding a high rate of net economic return.
- **Azithromycin** (a macrolide-type antibiotic used to treat a wide variety of bacterial infections) is donated by the pharmaceutical company **Pfizer** through the **International Trachoma Initiative**.

13 Measles Rubella Vaccination

CONTEXT: The New Delhi High Court stopped the implementation of the 'Measles and Rubella Vaccine Immunization Campaign' by the Delhi government.

- Court's order said that 'measles vaccination cannot be administered "forcibly" and without the consent of parents,' **it introduced a dimension to vaccination — the question of consent** — that had not been adequately dealt with earlier.

Different views on consent:

- **Parents**: It is settled principle that choice of an individual, even in cases of life-saving medical treatment, is an inextricable part of dignity which ought to be protected.
- **Government:** Consent in routine immunisation is implied because it is the parents or members of the family who bring the child to the hospital or healthcare centre. For public good and for a vaccine that is tried and tested, there is ample evidence on safety and efficacy and something which is already a part of the universal immunisation programme, written consent should not be essential.
- **Global practice**: Parental consent should be obtained prior to vaccination. This is the standard practice around the world. Although, World Health Organization recognises oral, written, and implied consent for vaccination, but countries are encouraged to adopt procedures that ensure that parents have been informed and agreed to the vaccination.

What is MR vaccine?

- Measles-Rubella (MR) Vaccine was introduced in **Universal Immunization Programme in 2017**, as Measles-Rubella combination vaccine to provide protection against congenital birth defects caused by Rubella infection for children aged between 9 months and 15 year
- **Measles is a serious and highly contagious disease that can cause debilitating or fatal complications, including encephalitis, severe diarrhoea and dehydration, pneumonia, ear infections and permanent vision loss**. The disease is preventable through two doses of vaccine.

14 Zearalenone, a fungal toxin

CONTEXT: A Journal of Food Science study detected Zearalenone a fungal toxin in wheat, rice, corn and oats from markets in Uttar Pradesh.

Zearalenone

- Zearalenone is a **fungal toxin infesting cereals such as wheat, maize and barley**. It attacks crops while they are growing, but can also develop when cereals are stored without being dried fully.

- Grains represent a significant source of food-borne contaminants, the main ones being; mycotoxins including (A) aflatoxin B1; (B) ochratoxin A; (C) fumonisin B1; (D) deoxynivalenol; (E) zearalenone; toxic metals like arsenic, cadmium and lead; as well as process contaminants such as acrylamide.
- In Zearalenone's case, there is no strong evidence of toxicity in humans so far, though several research groups are investigating. As a result, the IARC classifies it as a **Group 3 carcinogen, which means evidence is not sufficient for an evaluation yet.**

Why does it matter?

- **Zearalenone behaves like oestrogen, the female sex hormone, and could cause endocrine disturbances in humans**. Its nasty effects in animals, such as pigs, are documented. When fed with mouldy corn, pigs develop inflamed vaginas, infertility and other symptoms.
- This is why countries like Brazil regulate Zearalenone levels in animal feed. In humans, the data are fuzzier.
- Some experiments suggest its ill-effects: in one, when oestrogen-sensitive breast cancer cells were exposed to the chemical in a lab, they proliferated.
- In 2014, a Tunisian case-control study found a correlation between a Zearalenone metabolite in urine and breast-cancer risk in women. But other studies did not find similar links.

15 Oxytocin

CONTEXT: The central government moved Supreme Court against the Delhi high court order which quashed the ban on sale of Oxytocin by private manufacturers and retail chemists.

- Oxytocin has been moved to the **Schedule H1 Drugs**, which means retailers must maintain record of sales. It also figures **in the National List of Essential Medicines**.

What is Oxytocin and what are its uses?

- Oxytocin is naturally secreted **by the pituitary glands of mammals** during sex, childbirth, lactation or social bonding, and is sometimes called "**love hormone**".

- It is used **as a drug during childbirth** because it can **contract the uterus and induce delivery**, control bleeding, and **promote the release of breast milk**.
- Oxytocin can be administered to humans as an injection or a nasal solution.
- It is **chemically synthesised** and sold by pharmaceutical companies across the world.

Why was it banned?

- The government's ban order referred to a 2016 Himachal Pradesh High Court judgment, which said **daily oxytocin injections made cattle barren and reduced their lifespans**.
- In addition, drinking milk from oxytocin-treated cattle **led to male impotence**, **early puberty among women and cancers.**

Why is oxytocin important for India?

- Around 45,000 women die due to causes related to childbirth each year. Synthetic version of a human hormone is used to induce labour in pregnant women and to stem postpartum bleeding.
- WHO recommends it as the drug of choice in postpartum haemorrhage.

Schedule H Drugs: Only the required amount of medications mentioned in the prescription can be dispensed. These drugs **can be supplied only to the licensed parties**. The drug label must exhibit the text "Rx" and Schedule H drug warning. To be sold by retails on the prescription of a registered medical practitioner only.

Schedule H1 Drugs: These **include 3rd & 4th generation antibiotics, anti-tuberculosis drugs** and certain habit-forming drugs like psychotropic drugs.

Schedule X drugs: That stipulates prescription in duplicate, separate license requirement and meticulous storage and dispensing records)

16 WHO Publishes Essential Diagnostics List

CONTEXT: WHO published its first Essential Diagnostics List, a catalogue of the tests needed to diagnose the most common conditions as well as a number of global priority diseases.

- An accurate diagnosis is the first step to getting effective treatment.
- Today, many people are unable to get tested for diseases because they cannot access diagnostic services. Many are incorrectly diagnosed. As a result, they do not receive the treatment they need and, in some cases, may actually receive the wrong treatment.
- Similar to the **WHO Essential Medicines List,** which has been in use for four decades, **the Essential Diagnostics List** is intended to serve as a **reference for countries to update or develop their own list of essential diagnostics.**
- In order to truly benefit patients, national governments will need to ensure appropriate and quality-assured supplies, training of health care workers and safe use. To that end, WHO will provide support to countries as they adapt the list to the local context.

- The list concentrates on in **vitro tests** - i.e. **tests of human specimens like blood and urine**. It contains **113 products**:
  - 58 tests are listed for detection and diagnosis of **a wide range of common conditions**, providing an essential package that can form the basis for screening and management of patients.
  - 55 tests are designed for the detection, diagnosis and monitoring of **"priority" diseases** such as **HIV, tuberculosis, malaria, hepatitis B and C, human papillomavirus and syphilis**.
- Some of the tests are particularly suitable for primary health care facilities, where laboratory services are often poorly resourced and sometimes non-existent as these tests do not require

electricity or trained personnel. Other tests are more sophisticated and therefore intended for larger medical facilities.

- The list also provides links to **WHO Guidelines or publications** and, when available, to prequalified products.
- WHO will **update the Essential Diagnostics List on a regular basis** and the list will expand significantly over the next few years, as it incorporates other important areas including antimicrobial resistance, emerging pathogens, neglected tropical diseases and additional non-communicable diseases.

17 Generic Drugs: New Rules Soon for Labelling

CONTEXT: In a bid to promote low-cost generic medicines, the health ministry plans to make it mandatory for pharma firms to carry the generic names of drugs in letters that are two font sizes larger than the brand name.

- Once notified under the **Drugs and Cosmetics Act**, any violation will be punishable under the law. Fixed dose combinations (FDCs) of vitamins and other drugs containing three or more drugs, will be exempted from the new labelling rules.
- Earlier, the Drug Technical Advisory Board (DTAB), the advisory body on drugs, approved an amendment to Rule 96 of the Drugs and Cosmetics Act that sought changes in the labelling of drugs to boost generic drugs. Rule 96 deals with the manner of labelling drugs.

Generic Drugs

- A generic drug is a **pharmaceutical drug that is equivalent to a brand-name product in dosage, strength, route of administration, quality, performance and intended use, but does not carry the brand name.**
- The generic drug **may differ from the original in non-essential characteristics such as colour, taste and packaging.**
- Although they may not be associated with a particular company, generic drugs are usually subject to government regulations in the countries where they are dispensed. They are labelled with the name of the manufacturer and a generic non-proprietary name.
- In most cases, generic products become available after the patent protections afforded to a drug's original developer expire.
- Generic medicines tend to **cost less than their brand-name counterparts because they do not have to repeat animal and clinical (human) studies** that were required of the brand-name medicines to demonstrate safety and effectiveness. In addition, multiple applications for generic drugs are often approved to market a single product; this creates competition in the marketplace, typically resulting in lower prices.

18 Fixed Dose Drug Combinations (FDCs)

CONTEXT: The Ministry of Health and Family Welfare pruned a list of banned combination medicines and added restrictions to the dosages or uses for six more types of such drugs, saying their ingredients had no therapeutic value and were risky for consumption.

Combination Medicines

- **Combination products**, also known as **fixed dose drug combinations (FDCs),** are **combinations of two or more active drugs in a single dosage** form.

- Fixed ratio combination products are acceptable only when the **dosage of each ingredient meets the requirement of a defined population group** and when the combination has a **proven advantage over single compounds** administered separately in therapeutic effect, safety or compliance.
- FDCs are highly popular in the Indian pharmaceutical market and have been particularly flourishing in the last few years.
- **The rationality of FDCs should be based on certain aspects such as :**
  - The drugs in the combination should act by different mechanisms.
  - The pharmacokinetics must not be widely different.
  - The combination should not have supra-additive toxicity of the ingredients.
- **Most FDCs have the following demerits:**
  - Dosage alteration of one drug is not possible without alteration of the other drug.
  - Differing pharmacokinetics of constituent drugs pose the problem of frequency of administration of the formulation.
  - By simple logic there are increased chances of adverse drug effects and drug interactions compared with both drugs given individually.

Recent Decision

- The **Ministry of Health and Family Welfare** has banned **328 combination medicines**.
- Brands going off pharmacy shelves include **Saridon, Panderm Plus** and **Taxim AZ.**
- The ministry's decision is based on the observations of its **Drugs Technical Advisory Board (DTAB)** that the ingredients of these FDCs have no therapeutic justification and they may be risky to consume.
- Health experts have long maintained that many FDC combinations in the market **neither boast any advantage over individual drugs nor are safe.**
- Chances of adverse drug effects and drug interactions can go up if medicines are combined instead of being taken separately.
- Some of the drugs reportedly **boast dangerous side-effects**, unnecessary use of combination drugs makes the **human body resistant** to treatment.
- Published studies have long claimed that **FDCs are often prescribed to cover up for diagnostic imprecision**-likely making them extremely popular with quack doctors.
- The ministry first banned **349 FDCs in 2016 and 2017**, claiming they were "**unsafe" and "irrational"** for human use.

19 World's first Bio-electronic medicine

CONTEXT: Recently scientists from the US have developed the first bio-electronic medicine - an implantable, biodegradable wireless device that speeds nerve regeneration and improves the healing of a damaged nerve.

- The technology called as "bio-electronic medicine" p**rovides therapy and treatment over a clinically relevant period of time and directly at the site where it's needed,** thereby reducing side effects or risks associated with conventional, permanent implants.
- While the device has not been tested in humans, the findings offer promise as a future therapeutic option for nerve injury patients.

Bio-electronic medicine:

- Researchers at the **Washington University** in the US have developed a device **that delivers regular pulses of electricity to damaged peripheral nerves in rats after a surgical repair process, accelerating the regrowth of nerves in their legs and enhancing the ultimate recovery of muscle strength and control.**

- The device is of the size of a dime and the thickness of a sheet of paper and operates for about two weeks before naturally absorbing into the body.
- The device is powered and controlled wirelessly by a transmitter outside the body that acts much like a cell-phone charging mat.

Significance

- The researchers envision that **such transient engineered technologies one day could complement or replace pharmaceutical treatments** for a variety of medical conditions in humans.
- These engineered systems **provide active, therapeutic function in programmable, dosed format and then naturally disappear into body, without trace.**
- With this device, it has been shown that electrical stimulation given on scheduled basis during surgery can further enhance nerve recovery.
- No adverse biological effects from device and its re-absorption were found.

20 5th Global Forum on TB Vaccines

CONTEXT: The Global Forum on TB Vaccines is the world's largest gathering of stakeholders striving to develop new vaccines to prevent TB.

- It provides a unique opportunity to review the state of the field, share the latest research and findings, and identify new and innovative approaches to TB vaccine R&D, with the end goal of developing and deploying new TB vaccines as quickly as possible.

TB

- Tuberculosis (TB) is caused by bacteria (**Mycobacterium tuberculosis**) that **most often affect the lungs**. Tuberculosis is **curable and preventable.**
- TB is spread from person to person through the air. When people with lung TB cough, sneeze or spit, they propel the TB germs into the air. A person needs to inhale only a few of these germs to become infected.
- People infected with TB bacteria have a 5–15% lifetime risk of falling ill with TB. However, persons with compromised immune systems, such as people living with HIV, malnutrition or diabetes, or people who use tobacco, have a much higher risk of falling ill.

New Initiative for TB Control:

NIKSHAY-A web based solution for monitoring of TB patients

- To monitor Revised National Tuberculosis Programme (RNTCP) effectively, a web enabled and case based monitoring application called NIKSHAY has been developed by National Informatics Centre (NIC).
- This is used by health functionaries at various levels across the country in association with Central TB Division (CTD), Ministry of Health & Family Welfare.

NIKSHAY covers various aspects of controlling TB using technological innovations. Apart from web based technology, SMS services have been used effectively for communication with patients and monitoring the programme on day to day basis.

20 Drug Eluting Stents

CONTEXT: The National Pharmaceuticals Pricing Authority (NPPA) increased the price of bare metal stents (BES) to Rs. 7,660 from Rs. 7,260 and reduced the price of drug-eluting and biodegradable stents to Rs. 27,890 from Rs. 29,600.

- NPPA's original price cut imposed in February last year radically lowered the prices of stents, which are mesh tubes placed in arteries to improve blood flow. Before the cap, bare metal stents sold for Rs. 45,000 and drug-eluting stents for Rs. 1.21 lakh.

Stent

- A stent is a **tiny wire mesh tube.** It props open an artery and is left there permanently.
- When a **coronary artery (an artery feeding the heart muscle)** is narrowed by a buildup of fatty deposits **called plaque,** it can reduce blood flow.
- If blood flow is reduced to the heart muscle, chest pain can result. If a clot forms and completely blocks the blood flow to the part of the heart muscle, a heart attacks results.
- Stents help keep coronary arteries open and reduce the chance of a heart attack.

What is Drug-eluting Stents?

- Stents are small mesh tubes inserted to keep arteries open after a procedure called angioplasty (percutaneous coronary intervention, or PCI).
- Drug-eluting stents have a polymer coating over mesh that **emits a drug over time to help in stopping the blockage from occurring again.**

Drug-eluting stents, however, require longer treatment with blood thinners to prevent the stents from closing because of blood clotting.

22 Dual Mechanism for Embryonic Stem Cells to Maintain Pluripotency

CONTEXT: Researchers at Pune's National Centre for Cell Science (NCCS) have found a dual mechanism that keeps specific genes off, which helps the embryonic stem cells maintain pluripotency— their ability to give rise to all the cell types.

- The dual mechanism functions in such a way that even if one mechanism fails, the other can function as a back-up and **help the embryonic stem cells maintain pluripotency**.

Stem Cells

- Stem cells have the **remarkable potential to develop into many different cell types in the body during early life and growth.**
- When a stem cell divides, each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell.

About Embryonic Stem Cells:

- Embryonic stem cells are **obtained from the inner cell mass of the blastocyst,** a mainly hollow ball of cells that, in the human, forms five to six days after an egg cell is fertilized by a sperm.
- **Embryonic stem cells are pluripotent, meaning they can give rise to every cell type in the fully formed body, but not the placenta and umbilical cord.**
- They provide a renewable resource for studying normal development and disease, and for testing drugs and other therapies.

Applications of Embryonic Stem Cells:

- Embryonic Stem Cell therapies have been **proposed for regenerative medicine and tissue replacement after injury or disease.**
- It can help in treatment of diseases that could potentially be treated by pluripotent stem cells including a number of blood and immune-system related genetic diseases, cancers, and disorders; juvenile diabetes.

- It can also help in investigation of early human development, study of genetic disease and as in vitro systems for toxicology testing.

23 Scientists Grow Human Oesophagus in Lab

CONTEXT: A team from the Cincinnati Children's Hospital in Ohio successfully generated fully formed human oesophageal organoids tiny version of an organ produced in vitro in three dimensions using pluripotent stem cells (PSCs).

- PSCs are **master cells** that can potentially **produce any cell or tissue the body** needs to repair itself.
- Disorders of the oesophagus and trachea are prevalent enough in people to whom organoid models of human oesophagus could be greatly beneficial.
- In addition to being a new model to study birth defects like **oesophageal atresia**, the organoids can be used to study diseases like **oeosinophilicoesophagitis** and **Barrett's metaplasia**, or to **bioengineer genetically matched oesophageal tissue** for individual patients.

- The team focused on the **gene Sox2 and its associated protein** -- known to trigger oesophageal conditions when their function is disrupted.
- The scientists used **mice, frogs and human tissue cultures** to identify other genes and molecular pathways regulated by Sox2 during oesophagus formation.
- During critical stages of embryonic development, the Sox2 gene blocks the programming and action of genetic pathways that direct cells to become respiratory instead of oesophageal.
- The Sox2 protein inhibits the signalling of a molecule called **Wnt** and promotes the formation and survival of oesophageal tissues.
- Conversely, the absence of Sox2 during the development process in mice can result in oesophageal agenesis a condition in which the oesophagus terminates in a pouch and does not connect to the stomach.
- Those tests showed the bioengineered and biopsies tissues were strikingly similar in composition

24 Three-Parent Babies Permitted in U.K

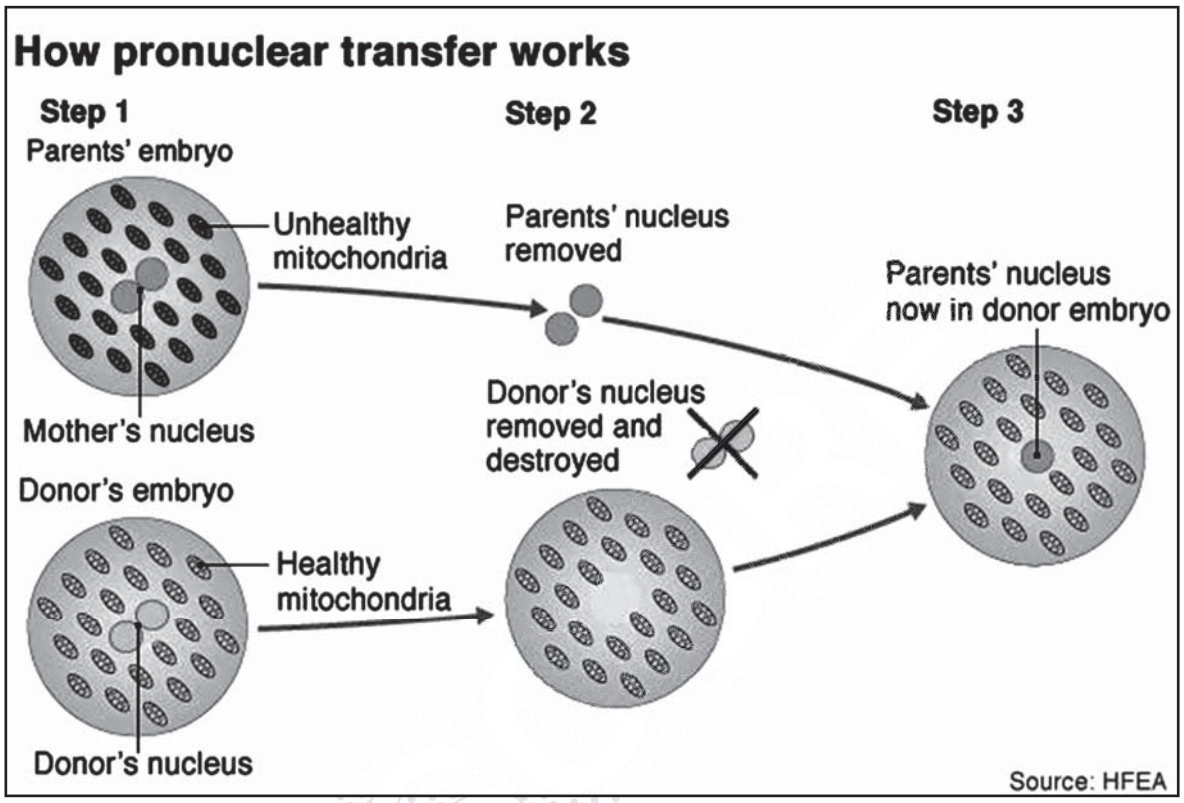
CONTEXT: In a move aimed at preventing passage of incurable genetic diseases from mothers to offspring, authorities in the UK have permitted doctors to create the country's first three-parent babies.

- The babies are still conceived from two parents, but genetic material from one woman is inserted into another's egg to prevent the child from being born with an inherited disease.
- The **procedure will use mitochondrial donation therapy for the women**, who know that any children they have could inherit a **neurodegenerative disorder**, which causes problems with movement or mental functioning.

Three Parent Babies

- A number of children each year are born with **faults in their mitochondrial DNA** which can cause diseases. Due to it, the parts of the body that need most energy are worst affected: The brain, muscles, heart and liver. Faulty mitochondria have also been linked to more common medical problems, including Parkinson's, deafness, failing eyesight, epilepsy and diabetes. Thus 3-parent babies mechanism has been evolved to decrease the number of children born with diseases.

- 3-parent babies are human offspring with 3 genetic parents. The procedure replaces a small amount of faulty DNA in a mother's egg with healthy DNA from a second woman, so that the baby would inherit genes from 2 mothers and 1 father.
- The procedure is intended to prevent mitochondrial diseases including diabetes, mellitus and deafness and some heart and liver conditions.
- The world's first three-parent baby has been born in Mexico, second in Ukraine.



25 New Sheep Insemination Technique

CONTEXT: Scientists at the Central Sheep and Wool Research Institute (CSWRI), Avikanagar, Malpura (Rajasthan) have come up with a new laparascope-assisted insemination technique for sheep, which has resolved the difficulties involved in freezing of semen andinability to transitthe tortuous reproductive tract of the ruminant mammals kept as livestock.

- The minor **invasive laparascopic technique** involves **passing a rigid fibre-optic laparoscope** into the abdomen through a **small incision**. The reproductive tract is located through camera and the frozen semen is deposited into the uterus.
- The success with **frozen semen in the sheep** was earlier very low because of its **poor freezability**.
- The complete operation takes about **five minutes for each animal** with the **near-total absence of any complications.**
- The new technique would help achieve up to **60% survival in the birth of lambs** and would have an immense potential for rapid multiplication of elite germplasm.
- As many as **40 females** can be **inseminated from a single ejaculate** using the technique.
- The new technique's invention would be of great help in the **breed improvement programmes**.

26 Mass Embryo Transfer

CONTEXT: Department of Animal husbandry, Dairying and Fisheries in co-operation with 12 States has undertaken a Mass Embryo Transfer programme in Indigenous Breeds under the scheme, National Mission on Bovine Productivity.

- The programme is **implemented with the objective of conservation and development of indigenous breeds under Rashtriya Gokul Mission**.
- Through the use of ETT, (i) a farmer can get a 5-6 fold increase in number of offsprings , (ii) the calves so born will be of high genetic merit and (iii) the offsprings born will be free from diseases.
- Under this programme, embryos of higher genetic merit indigenous bovines such as Sahiwal, Gir, Red Sindhi, Ongole, Deoni, and Vechur were transferred into surrogate cows. These cows were identified by UID and are under observation.

Embryo Transfer Technology

- Embryo transfer is a **specialized technique of breeding**.
- A sexually mature female referred to as the donor is injected with exogenous hormones to produce ova (the female reproductive cell or gamete of animals, which is capable of developing, into a new individual) which are fertilized inside her either by natural or artificial service.
- These are then removed prior to their implantation and transfer to the reproductive tracts of synchronized surrogate mothers of the same species referred to as the recipients.
- The fertilized ova, thus are developed in the recipient body and resulting offspring derive their genes from the donor and from the male to which donor was bred.

27 CRISPR Technology

CONTEXT: CRISPR technology is a simple yet powerful tool for editing genomes which allows easily altering DNA sequences and modifyinggene function. In popular usage, "CRISPR" (pronounced "crisper") is shorthand for "CRISPR-Cas9."

- Its many potential applications include **correcting genetic defects**, **treating and preventing the spread of diseases** and improving crops. However, its promise also raises ethical concerns.
- **CRISPRs are specialized stretches of DNA**. The protein **Cas9 (or "CRISPR-associated")** is an enzyme that acts like a pair of **molecular scissors**, **capable of cutting strands of DNA**.
- These organisms use **CRISPR-derived RNA** and various **Cas proteins,** including **Cas9**, to foil attacks by viruses and other foreign bodies. They do so primarily by chopping up and destroying the DNA of a foreign invader. When these components are transferred into other, more complex, organisms, it allows for the manipulation of genes, or "editing."
- CRISPR technology was adapted from the **natural defense mechanisms of bacteria and archaea** (the domain of single-celled microorganisms).

28 Telerobotic Surgery

CONTEXT: India became the world's first to successfully perform a telerobotic coronary intervention in December 2018 by an Ahmedabad base cardiologist in Gujarat. The intervention was performed by operating robotically controlled instruments from a distance of 32 kms.

- **Telerobotic Coronary intervention** is a **robotic method of performing surgery**. With the help of the internet and a robotic tower, a surgeon is able to treat patients from a distance. **Da Vinci system** is the leading surgical robotics technology provider.
- In telerobotic operations, if any failure or delay in the internet speed is noted, the surgeons present would be able to take over the operation manually within 30 seconds.

Commercialising telerobotic operations

- To improve results in patients, **Corindus Vascular Robotics** has pioneered the world's **first remote telerobotic interventional platform** to deliver highly specialized and timely cardiovascular care to underserved patient populations.
- After studying the results of telerobotic interventional performed in India, the company is also planning to commercialize the system and expand its interventional platform to address stroke care.

Benefits

- Cardiovascular diseases like stroke are a major cause of death worldwide result in about **18 million deaths per year.**
- The telerobotic operation has a potential to contribute largely in the cardiovascular medical emergencies.
- This technology is especially **important for high emergency situations of heart attacks and stroke,** where ideal treatment must be received within 90 minutes or 24 hours
- This technology will benefit specially to those groups, who have geographical barriers and socio-economic status.

29 Bionic mushrooms

CONTEXT: Scientists, including those of Indian origin, have created a bionic device that generates green power by 3D-printing clusters of cyanobacteria on an ordinary white button mushroom.

- The research by the **Stevens Institute of Technology** in the U.S. is part of a broader effort to better improve our understanding of **cells biological machinery** and how to use them to **fabricate new technologies and useful systems** for defence, healthcare and the environment.
- The researchers used ordinary white button mushroom and made it bionic, **supercharging it with clusters of cyanobacteria** that create **electricity and swirls of graphene nanoribbons** that can collect the current.
- **Cyanobacteria's** ability to produce electricity is well known. However, researchers have been limited in using these microbes in bioengineered systems because **cyanobacteria do not survive long on artificial bio-compatible surfaces.**

30 Biosensor Technique to Detect Chikungunya Virus

CONTEXT: Indian scientists have developed a biosensor technique which can be potentially help in detecting Chikungunya virus. The technique

- This technique is based on **molybdenum disulphide nanosheets** and can be used to develop a point of care device for rapid identification of the dreaded disease.
- The researchers **synthesized the nanosheets by chemical route** and characterized them by using **scanning electron microscopy, transmission electron microscopy, UV-visible spectroscopy, Raman spectroscopy** and **X-ray Diffraction**.
- Molybdenum disulphide nanosheets were then subjected to **physical adsorption onto the screen printed gold electrodes** and then employed for the **detection of chikungunya virus DNA using electrochemical voltammetric techniques.**

- This study has been jointly carried out by researchers of **Amity University,Noida**, **Jamia Millia Islamia University**, **Delhi** and **Maharishi Dayanand University**, **Rohtak**.
- Conventionally, Chikungunya is detected through **RT-PCR (Real-time polymerase chain reaction)** from serum samples or by **determination of serum antibodies**. These methods are **time consuming** and the **procedure is cumbersome**.

31 Mitra Clip

CONTEXT: A small device called Mitra Clip can help repair damaged heart valves, reducing the risk of deaths among patients with a grim prognosis.

- **A tiny clip inserted into the heart can restores regular function of the valve**.
- By joining two wayward flaps of the damaged **mitral valve** together in the middle, it makes a valve regulate blood flow in and out of the heart.
- This **can greatly lower death rates for patients with severe heart failure**.
- **In India, more than 17 lakh people die of heart diseases every year**. Current estimates show that the county will soon have the highest number of heart disease cases in the world.

The device will be an avatar of new hope to a large number of people with severe heart attack and could be a game changer for severe heart failure which affects millions of people across the world.

32 Blockchain Technology in Drug Supply-chain

- **Blockchain technology** helps to **permanently register a drug's record** in the **manufacturer's drug supply chain** (serial number, labelling, scanning), leaving no scope for record tampering.
- At every point of hand change, it records the drug's movement **– from manufacturer to logistics, to stockiest to hospital, or pharmacy to consumer**.
- In case of a fake drug, the **software will detect irregularity**.
- Additionally, critical information such as **chemical ingredients** of the drug or **maintenance of temperature control in case of life saving drugs or vaccines** can also be tracked.

33 Rosehip neurons: The newest neuron in the human brain

CONTEXT: Scientists have uncovered a new type of human brain cell, named as rosehip that has never been seen in mice and other well-studied laboratory animals.

Rosehip neurons:

- The new finding is the result of collaboration between Allen Institute for Brain Science in Seattle and researchers at the University of Szeged in Hungary. The new neuron is **named after the small, red fruits of a rose plant, called rosehips (defragmented rose).**
- Distinctive shape: Rosehips **have long branches called dendrites that receive signals from other neurons. In the rosehip cells, these dendrites are very compact with lots of branch points, resembling a rosehip**.
- Diverse connections with other neurons: It make up about 10% of the first layer of the neocortex — the most recently evolved part of the cortex that's involved in sight and hearing. They are also connected to neurons called pyramidal cells, a type of excitatory neuron that makes up two-thirds of all the neurons in the cortex.

Significance:

- **Human Cell Atlas**: It is a significant contribution to the massive project to compile transcriptomic data on all the cells in the human body to understand how they organize into tissues, how they talk to each other, how they age, and how things can go wrong.

Individuality of human brain: The absence of the rosehip neuron in mice brains might serve as a cautionary reminder that the results of some brain studies done on rats can't be translated to humans. Mice have been a wonderful model organismfor understanding how brains work in general and can help us understand how human brains work but finding a part of that circuit that is not seen in a mouse that points to needing to study actual human tissue.

34 Nerve Agent

CONTEXT: The former Russian spy Sergei Skripal and his daughter have been exposured to an unknown nerve agent.

What are Nerve Agents?

- Nerve agents, sometimes also called nerve gases, are **a class of organic chemicals that disrupt the mechanisms by which nerves transfer messages to organs.** The disruption is caused by the blocking of acetylcholinesterase, an enzyme that catalyzes the breakdown of acetylcholine, a neuro-transmitter.
- **Poisoning by a nerve agent leads to constriction of pupils, profuse salivation, convulsions, and involuntary urination and defecatio**n, with the first symptoms appearing in seconds after exposure.
- Death by asphyxiation or cardiac arrest may follow in minutes due to the loss of the body's control over respiratory and other muscles. Some nerve agents are readily vaporized or aerosolized, and the primary portal of entry into the body is the respiratory system.
- Nerve agents take different forms - including powder and gas - but they tend to be a liquid, which can seep through the skin.

Antidotes:

- **Antidotes do exist, one being atropine**, but have to be administered quickly, otherwise the effect of the nerve agent cannot be reversed. Some antidotes can be administered as prophylactics to troops about to go into battle, if there is a risk of nerve agents being employed.

Chemical Weapons Convention:

- The (CWC) is a universal non-discriminatory, multilateral, disarmament treaty that bans the development, production, acquisition, transfer, use, and stockpile or retaining Chemical Weapons (CW).

The treaty puts all the States Parties on an equal footing. Countries having stockpiles of chemical weapons are required to declare and destroy them in a specified timeframe and those, who produce and use chemicals that can be converted into chemical weapons have to be open and transparent about the use they put these chemicals to.

35 WHO called for the Elimination of the so-called 'One Centimetre Per Hour' Benchmark

CONTEXT: The World Health Organization (WHO) has revised a benchmark used by health professionals worldwide in caring for women during child-birth because it has caused a surge in interventions like caesarean sections that could be unnecessary.

What Causes Cervical Dilation?

- At the end of pregnancy, when the baby drops down into the pelvis, the baby's head puts pressure on the cervix. This constant pressure causes human body to release oxytocin, which is the hormone that causes contractions.
- The contractions push the baby even farther down onto the cervix, which causes it to dilate, which causes more contractions and so on. It's the combination of hormones and pressure from the baby's head that cause cervix dilation.

One Centimeter Per Hour Benchmark

- **Dilation of the cervix is measured in centimeters**. During labor, cervix stretches from 0 cm to a fully dilated 10 cm.
- During a vaginal exam, cervix dilation is measured by how many finger widths fit into the opening of the cervix. If the tip of one finger fits, the cervix is 1 cm dilated. If 2 finger tips fit, that signifies 2 cm. The distance the two fingers can stretch wide indicates further dilation.
- While rates of interventions like c-sections vary among regions, WHO has seen what it considers a worrying rise in such practices worldwide. Interventions that were once used to manage complicated childbirths have become commonplace, the agency warned.
- However, what has been happening over the last two decades is that more and more medical interventions being applied unnecessarily to women and there have been situations where several woman are getting too many interventions that they do not need.

36 Earth BioGenome Project

- The Earth BioGenome Project (EBP) is an initiative that aims to **sequence and catalog the genomes of all of Earth's currently described eukaryotic species** over a period of ten years.
- The initiative would produce an **openDNA database of biological information** that provides a platform for scientific research and supports environmental and conservation initiatives.
- The project officially launched November 1, 2018 and the initiative was inspired by Human Genome Project.
- The project is projected to cost US $4.7 billion. It includes already ongoing projects such as **i5K (insects), B10K (birds), 10KP (plants), and the Darwin Tree of Life,** which aim to sequence the estimated **66,000 eukaryotic species in the United Kingdom.**
- The project is aiming to sequence and annotate the roughly 1.5 million known eukaryotic species in three phases, with first to create "**annotated chromosome-scale reference assemblies for at least one representative species of each of the 9,000 eukaryotic taxonomic families".**

37 100k Genome Asia Project

CONTEXT: India is planning a major mission to sequence the genes of a "large" group of Indians — akin to projects in the United Kingdom, China, Japan and Australia — and use this to improve health as well as buck a global trend of designing 'personalised medicine.'

- The **Ministry of Health and Family Welfare** and the **Department of Biotechnology** would be closely associated with the project.
- Ever since the **Council of Scientific and Industrial Research** in **2009** announced that it had **sequenced the genome** of an Indian, then making India one of **six countries** to achieve such a feat, several research labs have analysed genes from Indians for disease susceptibility. However, no compendium of genes that differentiate Indian populations from, say Caucasian or African genomes exist.

- A group of Indian scientists and companies are involved with a **100k GenomeAsia project**, led out of the **Nanyang Technological University (NTU), Singapore**, to sequence the whole **genomes of 100k Asians,** including 50,000 Indians.

38 Human Microbiome

CONTEXT: The Human Microbiome Project (HMP) will map trillions upon trillions of microbes — bacteria, fungi, viruses, archaea — that are found in Indians.

- The ambitious project aims, at the end of it, to generate the baseline **microbiome data of Indians**. It will also **define the core microbiome of tribal populations** that are unaffected by modern lifestyle.
- It will even help us understand the **links between microbial composition and disease risks** and also create a **repository of microbial samples** from healthy individuals to help develop probiotic-like solutions.
- The HMP is a collaborative effort between 11 research institutes and universities across the country, both public and private, including the **All India Institute of Medical Sciences** in New Delhi, the **Insitute of Advanced Study in Science and Technology** in Guwahati and **Symbiosis International University** in Pune.
- The study is being **led by Pune's National Centre for Microbial Resource (NCMR),** which is part of the National Centre for Cell Science.

- In a one-of-a-kind project in the country, researchers will take **skin and oral swabs** and collect **blood and faecal samples** from 20,600 individuals who belong to 103 endogamous communities (which marry within the group).
- These will include 32 tribes as well — from **Changpa in Ladkah to Warli in Maharashtra and Mankidia in Odisha, and from Ao in Nagaland to Koya in Telangana**. After collecting the samples, scientists will sequence the genome of these microorganisms.
- These microbes are called human microbiota and their genetic material are collectively referred to as the human microbiome.
- The Union government is funding Rs 150 crore for the project which aims to map the microbiome composition of India's different communities — and how genetics, diet and environment impact it differently.

39 Integrated Health Information Platform (IHIP)

CONTEXT: An Integrated Health Information Platform (IHIP) is being setup by the Ministry of Health and Family Welfare (MoHFW).

- The Integrated Health Information Platform (IHIP) is a **web-enablednear-real-time electronic information system** that is embedded with all applicable Government of India's e-Governance standards, Information Technology (IT), data & meta data standards to provide state-of-the-art single operating picture with geospatial information for managing disease outbreaks and related resources.
- The primary objective of IHIP is **to enable thecreation of standards compliant Electronic Health Records (EHRs) of the citizens on a pan-India basis** along with the **integration and interoperability of the EHRs through a comprehensive Health Information Exchange (HIE)** as part of this centralized accessible platform.

Key features of Integrated Health Information Platform (IHIP)

- **Real time data reporting** (along through mobile application); accessible at all levels (from villages, states and central level).

- **Advanced data modelling** & **analytical** tools.
- GIS enabled **Graphical representation of data** into integrated dashboard.
- Role & hierarchy-based feedback & alert mechanisms.
- **Geo-tagging** of reporting health facilities.
- Scope for **data integration** with other health programs.

- IHIP is envisaged to enable better continuity of care, secure and confidential health data/records management, better diagnosis of diseases, reduction in patient re-visits and even prevention of medical errors, better affordability, optimal information exchange to support better health outcome, better decision support system, and thus eventually facilitating improvement in the reforms of treatment and care of public health at National-Level.
- In the first phase, Integrated Disease Surveillance Programme (IDSP) module of Integrated Health Information Platform (IHIP) was **soft launched in selected districts of 7 States** (**Karnataka, Andhra Pradesh, Himachal Pradesh, Odisha, Uttar Pradesh, Telangana& Kerala**).
- For effective implementation of the platform, 32,000 people at block level, 13,000 at district level and 900 at state level have been trained.
- The success of this platform will depend primarily on **quality of data shared** by the states.
- Adopting this platform will help states to strengthen early outbreak detection and informed public health response.

40 Eat Right India Movement

CONTEXT: Alarmed by the increase in lifestyle diseases, Food Safety and Standards Authority of India (FSSAI) launched the Eat Right India movement with an aim to empower citizens by improving their health and well-being.

Significance

- The recently published **Global Burden of Diseases** report indicates **ischemic heart disease, chronic obstructive pulmonary disease, stroke, asthma, diabetes,** and **chronic kidney disease** have seen a 49.8 percent, 39.4 percent, 37.1 percent, 6.2 percent, 53.8 percent, 35.9 percent increase, respectively, since 2007 to 2017.
- The projected cumulative **loss of national income for India due to NCD mortality** from **2006 to 2015** is expected to be **USD 237 billion**. By **2030**, this productivity loss is expected to equate to **17.9 million years of lost human life**. By **2020**, projections indicate that **NCDs will account for 75 percent of all deaths**.

- The **'Eat Right India' Campaign** aims to **reduce the burden of non-communicable diseases**.
- Eat right movement rests on **five key pillars**: i.e.,
  - Eating healthy.
  - Eating safe.
  - Eating fortified.
  - No food waste
  - Physical activity
- **Eat Right India movement** or **Swasth Bharat Yatra** has been given the slogan **'Dandi Se Handi Tak'** which has been inspired by **Mahatma Gandhi's 'Dandi March' and 'Salt Satyagraha' of 1930.**
- This movement is **collective effort of key stakeholders and citizens.**

41 Food Fortification

CONTEXT: The Food Safety and Standards Authority of India (FSSAI)has made the Food Safety and Standards (Fortification of Foods) Regulations, 2018 which have been notified in the Gazette of India.

Food Safety and Standards (Fortification of Foods) Regulations, 2018

- In October 2016, **FSSAI operationalized the Food Safety and Standards (Fortification of Foods) Regulations, 2016** for fortifying staples namely **Wheat Flour** and **Rice** (with **Iron, Vitamin B12** and **Folic Acid**), **Milk** and **Edible Oil** (with **Vitamins A** and **D**) and **Double Fortified Salt** (with **Iodine** and **Iron**) to reduce the high burden of micronutrient malnutrition in India.

Major Features

- Fortification of staples stated in the Food Safety and Standards (Fortification of Foods) Regulation 2018 is **not compulsory.**
- The fortification of the products **and use of+F logo** is allowed to FBO only if the enrichment of the food is done according to the standards laid down by the Food Safety and Standards (Fortification of Foods) Regulation, 2018.
- According to the Food Safety and Standards (Prohibition and Restriction on sales) Regulations, 2018, **adding iodine to commercial salt is mandatory** in India.
- Whenever the food articles standards stated under 'Food Safety and Standards Regulations' instructs for adding specific minerals or vitamins as an obligatory demand of that particular standard, the same shall comply, but +F logo shall not be used.
- With the regulations being notified in the Gazette of India, FSSAI has firmly **placed food fortification on the national agenda** which has created an enabling environment and encouraged food businesses to adopt food fortification.
- New standards now provide a minima and a maxima range for fortification of staples like wheat flour (atta), maida, rice, salt, vegetable oil and milk.
- The **dosage of the micronutrients** has been adjusted so that they provide **30 to 50 percent** of the **daily requirements**.
- In milk and oil, the unit of dosage has been changed to **micrograms Retinol Equivalentfor Vitamin A** and **micrograms for Vitamin D from IU.**
- In Wheat Flour and Rice fortification, other sources of Iron have been added, Vanaspati fortification has been excluded.

Global Scenario

- As defined by the **World Health Organization (WHO)** and the Food and Agricultural Organization of the United Nations (FAO), fortification refers to "**the practice of deliberately increasing the content of an essential micronutrient, ie. vitamins and minerals (including trace elements) in a food irrespective of whether the nutrients were originally in the food before processing or not, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health**", whereas enrichment is defined as "synonymous with fortification and refers to the addition of micronutrients to a food which are lost during processing".
- Food fortification was **identified as the second strategy of four by the WHO and FAO** to begin **decreasing the incidence of nutrient deficiencies** at the global level.
- As outlined by the FAO, the **most common fortified foods are cereals** (and cereal based products), **milk** (and milk products), **fatsandoils**, accessory food items, **tea** and other beverages, and **infant formulas**.
- In 1992, **159 countries** pledged at the **FAO/WHO International Conference on Nutrition** to make efforts to help combat these issues of micronutrient deficiencies, highlighting the importance of decreasing the number of those with iodine, vitamin A, and iron deficiencies.
- Food Fortification is a **scientifically proven, cost-effective, scalable and sustainable global intervention** that addresses the issue of micronutrient deficiencies.

42 Transgenic Rice with Reduced Arsenic Accumulation

CONTEXT: To address the problem of Arsenic accumulation in rice grains, researchers at Lucknow- based CSIR-National Botanical Research Institute have developed transgenic rice by inserting a novel fungal gene, which results in reduced arsenic accumulation in rice grain.

- Researchers **cloned Arsenic methyltransferase (WaarsM)gene** from a **soil fungus, Westerdykellaaurantiaca** , and inserted the same into the rice genome with the help of **Agrobacterium tumefaciens, a soil bacterium** which has natural ability to alter the plant's genetic makeup.
- The newly developed transgenic rice along with normal rice was then treated with arsenic.
- Comparison of transgenic and non-transgenic rice showed that transgenic plants accumulated less arsenic in root as well as shoot as compared to non-transgenic lines.
- The resulting transgenic plant acquired the potential for **methylating inorganic arsenic** to a variety of harmless organic species, including **volatile arsenicals**.
- This could be potential strategy for developing transgenic rice capable of low arsenic accumulation not only in grain but also in straw and feed which are used for livestock.

43 Fighting Fake Drugs through Blockchain

CONTEXT: In order to fight the growing problem of counterfeit drugs in India, NITI Aayog and Oraclesigned a Statement of Intent (SoI) to pilot a real drug supply-chain using blockchain distributed ledger and Internet of Things (IoT) software.

- **Apollo Hospitals** and **Strides Pharma Sciences** will partner in this effort.
- The **problem of fake and counterfeit drugs** is a major issue, costing the Indian pharma industry billions and at the same time, it's putting patients at higher risk.
- The major advantages of blockchain software will be its ability to allow the sharing of information across the drug supply chain securely with every exchange of information getting recorded, inability to tamper with any record of the drug movement and inability to delete any records so there can be no dispute, if an offender is caught.

44 Project Dhoop

CONTEXT: In order to address rising incidence of Vitamin 'D' Deficiencies, particularly amongst the young people, Food Safety and Standards Authority of India has launched a unique initiative, 'Project Dhoop' in association with NCERT, NDMC and North MCD Schools in Delhi.

- Micronutrients including vitamins are needed by people in only very small amounts, but these enable the body to produce enzymes, hormones and other substances essential for proper growth and development.
- As tiny as the amounts are, the consequences of their absence are severe particularly children and pregnant women in countries like India.
- **Vitamin D deficiency** occurs due to overuse of sunscreen, wearing clothes that cover most of the skin, working all day in an air-conditioned atmosphere, and other factors.

- There is a popular belief that morning sunshine is the best for our bones, however, it is actually the sunshine from **11am to 1pm that is most beneficial in increasing Vitamin Dlevels** in human body because of the best **ultraviolet B (UVB) radiation**.

- Project Dhoop's **Noon Assembly** is an innovative and effective concept to ensure that school students get adequate Vitamin D through sunlight, while also opting to choose food products like milk and edible oils that are fortified with Vitamins A and D.
- This unique initiative **urges schools to shift their morning assembly to noon** time mainly **between 11:00 a.m. to 1:00 p.m.** to ensure maximum absorption of Vitamin D in students through natural sunlight.

45 Eliminate Trans-fats by 2022

CONTEXT: Food Safety and Standards Authority of India (FSSAI)has launched a new mass media campaign calling for the elimination of industrially produced trans-fat in the food supply.

Trans-fat

- Trans-fat are made by adding **hydrogen to liquid vegetable oils** to make them more solid, and to **increase the shelf life of foods**.
- Trans-fat are largely present in **Vanaspati, margarine** and **bakery shortenings**, and can be found in **baked and fried foods**.
- **Globally**, trans-fat intake leads to more than **500,000 deaths** of people from **cardiovascular disease** every year.
- In May 2018, **WHO** launched a **comprehensive plan to eliminate industrially-produced trans-fat from the global food supply by 2023.**
- **REPLACE** provides a roadmap about how countries can remove and replace all trans-fat from their food supplies with the intention to eradicate it from the globe.

- "FSSAI is committed to reducing the industrially produced trans fatty acids to less than 2% by the year 2022 in a phased manner. This is in line with FASSI's objective to get **Freedom from'Trans Fat: India@75.**
- FSSAI's plan to lower the levels of trans fat in India's food supply from the present **<5 per cent to <2 per cent.**
- **Called "Heart Attack Rewind",** the **30 second public service announcement (PSA)** - the first mass media campaign of its kind – will support FSSAI's global target **of eliminating trans-fat in India by the year 2022,a year ahead of the global target by the World Health Organization** (WHO) for complete elimination of trans fat.
- **"Heart Attack Rewind"** warns citizens about the health hazards of consuming trans-fat and offers strategies to avoid them through healthier alternatives.
- **"Heart Attack Rewind"** will be broadcast in 17 languages for a period of four weeks on major digital platforms such as YouTube, Facebook, Hotstar, and Voot.
- Additionally, the campaign will also be placed on **radio channels and outdoor hoardings in Delhi/NCR.** A corresponding **social media campaign** will also highlight the harmful effects of trans fat on people's health.

46 New Norms for Labelling Packaged GM food

CONTEXT: For the first time that the Central government [Food Safety and Standards Authority of India (FSSAI)] has laid down guidelines for labelling genetically modified food.

Background

- Current laws prohibit any GM food—unless cleared by the **Genetic Engineering Appraisal Committee**, **a Environment Ministry body**-- from being sold in the country.
- Through a 2007 notification, the Union Health Ministry exempted processed foods from this requirement which has been stayed by the courts.
- There was also dispute between the **FSSAI**, **a Union Health Ministry body**, and the **Environment Ministry** on who checks if a particular food had a GE provenance.
- The **new norms** propose that the **companies will check the GM content** and **FSSAI will conduct further tests and checks**.

- All packaged food with **at least 5% content from genetically engineered sources** need to be labelled so.
- Foods that **exceed norms of sugar and fat should carry 'red' and 'green' labels** specifying the extent to which they do so,
- Food packs would have a designated space coloured **Red** in case:
  - The **value of energy from total sugar is more than 10 per cent** of the total energy (kcal) provided by the 100 g/100 ml of the product;
  - The value of energy (kcal) from **trans-fat is more than 1 per cent** of the total energy (kcal) provided by the 100 g/100 ml of the product; and
  - **Total fat or sodium** content provided by the 100 g/100 ml of the product is more than certain specified threshold values.

47 Animal-Free Testing for Drugs

CONTEXT: The Indian Pharmacopoeia Commission has approved modern, animal-free tests for drug manufacturers. In the 2018 edition of Indian Pharmacopoeia, that provides guidelines on tests for drugs manufactured and marketed in India, the IPC has replaced the pyrogen test carried out on rabbits and the abnormal toxicity test carried out on guinea pigs and mice with tests that can be done in test tubes.

Pyrogen Test

- It is carried out to **check impurity or substance** that can cause **adverse side-effects**. For the test, the drug is injected into a rabbit and the animal is closely observed for feverish symptoms.
- The **abnormal toxicity test** is carried out to check potential **hazardous biological contamination in vaccine formulations** by injecting the vaccineinmice or guinea pigs to observe if there is death of any animal.This batch test is done before the product is approved for marketing.

- With the Indian Pharmacopoeia Commission's new mandate, the pyrogen test will be replaced by a **bacterial endotoxin test** or **a monocyte activation test** which can be carried out in test tubes.
- Vaccine manufacturers can apply for **waiver for the abnormal toxicity test** by getting a **compliance certificate** from the **National Control Laboratory**.
- **People for the Ethical Treatment of Animals (PETA)** India has been pushing for doing away with the cruel methods of testing on animals for the past several years.
- Tests like the one for abnormal toxicity have been **removed by the U.S. and European pharmacopoeia** as they are not an efficient marker.

48 Elysia chlorotica

CONTEXT: Figuring out how the slug, Elysia chlorotica, keeps algae-made solar panels functioning could lead to innovations in developing green machines that need only sunlight to generate energy or bioproducts that could be used as biodiesel.

About Elysia chlorotica

- Elysia chlorotica is a **green sea slug** has the **ability to suck out an algae's parts that generate energy from sunlight** — and incorporate them into its own biology. In doing so, it becomes an **animal with the photosynthetic ability of a plant**.
- It **steals thealgae's plastids** and then directs them without the help of the **algal nucleus.**"
- The sea slug Elysia chlorotica appear as **wide, rippling, green leaves** with **snail-like heads.**
- They are found in **the shallow inlets and salt marshes** along the **Atlantic coast of North America from Florida to Nova Scotia**.
- They have a **life span** of **8 to 10 months**.

- As a juvenile, Elysia chlorotica sucks in the **brown algae, Vaucheria litorea**, whose structure lends itself to efficient sucking since it has no walls between the cells in its body.
- The slug then digests the algae's nuclei, but stows the algae's plastids in the lining of its gut and once the slug has ingested the algae's solar panels, it survives off photosynthesis for the remaining six to eight months of its life.
- Other animals, including corals and some salamanders, are known to incorporate algae to benefit from algae's ability to photosynthesize, or generate energy from the sun.
- What makes Elysia chlorotica unique is **it takes only the plastids**, or the **organelles that contain chlorophyll and perform photosynthesis,** from the algae. The slug then uses its own genome to keep the plastids operating within its own body throughout the rest of its life.

49 Quadrivalent Influenza Vaccine

CONTEXT: In 2018, for the first time, the WHO issued an official recommendation for a quadrivalent vaccine.

Indian Scenario

- Since 2011, there have been about 97,000 H1N1 cases and over 7,100 deaths in India according to the Integrated Disease Surveillance Project (IDSP) data.
- The years 2015 and 2017 witnessed a sharp increase in the number of cases and deaths. There were 42,592 and 38,811 cases and 2,990 and 2,270 deaths in 2015 and 2017, respectively.
- Despite the high number of infections and mortality each year, **India does not havea national policy for influenza immunisation**.
- Pregnant mothers, children aged below five and young people with asthma, cardiovascular disease, diabetes and high blood pressure are at a greater risk of infection and death.
- The Ministry of Health issues only H1N1 vaccination guidelines for different vulnerable groups including healthcare workers.

- **Sanofi Pasteur's injectable influenza vaccine (FluQuadri)** containing two A virus strains — H1N1 and H3N2 — and two B virus strains — Victoria and Yamagata — for active immunisation of adults of age 18 to 64 years has been approved by the Drug Controller General of India (DCGI).
- **Sanofi's quadrivalent influenza** vaccine was **licensed for use by the U.S. Food and Drug Administration (FDA) in 2013**; it is licensed in 26 countries.

- A **trivalent influenza** vaccine contains both **A subtype viruses**, it has **only one of the B subtype virus**, whereas the quadrivalent vaccine offers greater protection as it includes **both B subtype viruses**.
- The viruses used in the vaccine are killed and this eliminates the possibility of the virus in the vaccine itself causing infection.
- In India, the vaccine will be available as single dose pre-filled syringe. Eventually, it will be available in a vial for public health use.
- In the case of **H1N1**, there are **two strains — California and Michigan** — that cause influenza.
- Each year, the vaccine changes to reflect the different strains in circulation. Year round, scientists across the globe track, analyse and classify the viral strains causing illness. This allows the **WHO to select the strains in February** for the upcoming season's vaccine.

50 Fortified Rice

CONTEXT: The government will provide fortified rice (enriched vitamins and minerals) to all the poor under National Food Security Act (NFSA) across the country.

Significance of Rice Fortification:

- **Fortification** is the practice of **deliberately increasing the content of an essential micronutrient**, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health.
- **Micronutrient deficiencies of public health significance are widespread in most countries consuming high levels of rice**; thus rice fortification has the potential to help aid vulnerable populations that are currently not reached by wheat or maize flour fortification programmes.
- However, rice production is often done domestically or locally which could make reaching all those in need with mass fortification programs challenging.
- Rice can be fortified by adding a **micronutrient powder** to the rice that adheres to the grains or **spraying of the surface of ordinary rice grains** in several layers with a vitamin and mineral mix to form a protective coating.
- Rice kernels can be fortified with several micronutrients, such as **iron, folic acid** and other **B-complex vitamins, vitamin A** and **zinc.**

- The proposal has been prepared by **Ministry of Consumer Affairs, Food and Public Distribution** with the support of **Niti Aayog** under the **National Nutrition Mission**.
- The scheme will continue for the **period of three years beginning from 2019-20** with total budget outlay 147.61 crores.
- The **pilot scheme** will be funded by the **government of India** in the ratio of **90:10** with respect of **northeast, Hilly and island area**, and **75:25** in respect of the **other states**.
- The **Food, Safety and Standard Authority of India (FSSAI)** have set the **Fortification standards**.
- To begin with the scheme is likely to cover the **115 'aspirational' districts** across the country.
- The scheme **aims to curb** the rising number of **cases ofanemia** and **micronutrient deficiency.**
- In India, as many as **14.6 million women** are suffering from **anemia**. It is caused due to **iron deficiency** in the body. One of the factors of of anemia is that women do not consume or are unable to have basic nutritious food.

51 Coloured X-Ray on Human

CONTEXT: New Zealand scientists have performed the first-ever 3-D, colour X-ray on a human, using a technique that promises to improve the field of medical diagnostics. Europe's CERN physics lab contributed imaging technology.

- The new device, **based on the traditional black-and-white X-ray**, incorporates **particle-tracking technology** developed for **CERN's Large Hadron Collider**.
- The colour X-ray imaging technique could produce clearer and more accurate pictures and help doctors give their patients more accurate diagnoses.
- The CERN technology, dubbed **Medipix**, works like a camera detecting and counting individual sub-atomic particles as they collide with pixels while its shutter is open. This allows for high-resolution, high-contrast pictures.
- The images very clearly show the difference between bone, muscle and cartilage, but also the position and size of cancerous tumours, for example.
- The technology is being commercialised by New Zealand company **MARS Bioimaging**, linked to the **universities of Otago and Canterbury** which helped develop it.

52 'P Null' Phenotype

CONTEXT: A team of doctors, led by Shamee Shastry from the Blood Bank of Kasturba Medical College (KMC) identified a rare blood group called "pp" or "P null"phenotype.

- **ABO** and **Rh D** are the commonly typed blood group systems, however, there are more than **200 minor blood group antigens** known besides A, B and Rh.
- **A blood type is considered rare if fewer than one in 1,000 people have it.** A person is said to have rare blood group when he **lacks the high frequency antigen** or **multiple common antigens**.
- With the help of the **International Blood Group Reference Laboratory (IBGRL), Bristol, U.K.,** which performed the **serological test,** rare "**pp" phenotype** was confirmed.

53 Bacteria Wolbachia

CONTEXT: Ongoing research on a bacterium called wolbachia, if introduced in mosquitoes, could stop disease-spreading viruses from growing and spreading. The experiment has proved remarkably effective in a small town in Australia, preventing fresh outbreaks of dengue.

The Bacterium

- **Wolbachia** is a tiny bacterium that is present in up to **60% of all species of insects**, including several mosquito species, **but not usually in the Aedes aegypti mosquito**, the primary species responsible for transmitting **dengue, chikungunya** and **Zika**.
- Wolbachia is one of the **world's most common parasitic microbes** and possibly the **most common reproductive parasite in the biosphere**.

- Australian researchers were able to protect the 1.87 lakh population of Townsville, Queensland, from dengue for the last four years.
- **Mosquitoes** were specially **bred to carry wolbachia** and were let loose over 66 square km in places where they could naturally breed.

- In the four monsoon seasons since these mosquitoes were introduced, **dengue ceased to be a problem.**
- At present, large-scale trials are under way in **Rio de Janeiro (Brazil), Medellin (Colombia)** and **Yogyakarta (Indonesia).**
- Long-term monitoring at international project sites have shown that wolbachia is self-sustaining at high levels and there has not been local dengue transmission.

India Scenario

- This is a safe and effective approach and needs to be tested at different settings in India.
- The **ICMR** is collaborating with **Monash University** for Phase-I laboratory studies to use these strains of **Aedes aegypti for the control of dengue and chikungunya**.
- As of now, mosquito eggs with wolbachia have been imported and are being bred at **the Vector Control Research Centre at Puducherry.**
- In **2017**, there were **1.9 lakh dengue cases** and **325 deaths** in the country and until **July 2018**, there have been **15,000 cases** and **38 deaths**. There has been a reduction due to various preventive measures and participation of the community in controlling this vector.

54 Affordable Water Disinfection System- Oneer

CONTEXT: An innovative technology for "Drinking Water Disinfection System" with trade name "Oneer" has been developed by Council of Scientific and Industrial Research, Indian Institute of Toxicology Research (CSIR-IITR), Lucknow.

- The **device will continuous treat water and eliminate all disease causing pathogens such as virus, bacteria, fungi, protozoa and cyst to provide safe drinking water** to domestic and communities settings as per national and international standards prescribed for potable water (BIS, WHO etc.).
- It will **provide access to safe and clean drinking water at a cost of just 2 Paise / Ltr**.
- Its community level model has capacity of 450 LPH which can be scaled up to 5000 to 1 lakh L/ day and is also maintenance and membrane free.
- The smaller unit of Oneer is particularly suitable for homes, street food vendors, and small establishments.

55 Bisphenol A (BPA)

CONTEXT: Scientists have created tiny spheres that can catch and destroy bisphenol A (BPA), a synthetic chemical used to make plastics that often contaminates water.

- **Bisphenol A (BPA):** BPA is commonly used to coat the insides of food cans, bottle tops and water supply lines, and was once a component of baby bottles.
- **Concerns:** While BPA that seeps into food and drink is considered safe in low doses, prolonged exposure is suspected of affecting the health of children and contributing to high blood pressure.

Functioning of Tiny spheres to trap BPA:

- The **micron-sized** spheres developed resemble tiny flower-like collections of **titanium dioxide petals.**
- The supple petals provide plenty of surface area for researchers to **anchor cyclodextrin** — a benign sugar-based molecule often used in food and drugs.
- It has a **two-faced structure**, with **a hydrophobic (water-avoiding) cavity** and a hydrophilic (water-attracting) outer surface.

BPA is hydrophobic and naturally attracted to the cavity. Once trapped, reactive oxygen species (ROS) produced by the spheres degrades BPA into harmless chemicals.

56 NIFTEM

CONTEXT: The Union Cabinet has approved the introduction of National Institutes of Food Technology, Entrepreneurship and Management Bill, 2019.

Provisions of Bill:

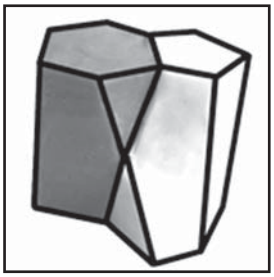
- The Bill declares certain institutes of food technology, entrepreneurship, and management as **institutions of national importance**.
- These institutes are:
  - The National Institute of Food Technology Entrepreneurship and Management Kundli,
  - The Indian Institute of Food Processing Technology, Thanjavur.
- The functions of the institutes include:
  - providing for instruction, research, and knowledge dissemination in the field of food science and technology,
  - holding examinations and granting degrees, diplomas, certificates and other academic distinctions or titles,
  - determining and collecting fees and other charges
  - Instituting and making appointments for academic and other posts, except that of the Director.
- The Bill provides for a Board of Governors, which will be the principal executive body of the institute. The Board will consist of 16 members.
- The **Senate** will be the institute's **principal academic body**. It will be responsible for maintenance of standards of instruction, education, and examination in the institute.
- The Bill requires each institute to maintain a fund for meeting its expenses. It will be credited with funds received from the central government and other sources, including fees and other charges.
- Under the Bill, any dispute arising out of a contract between the institute and any of its employees will be referred to a **Tribunal of Arbitration**.

57 Scutoid: A New Shape Discovered

CONTEXT: Scientists have identified new shape called scutoid while studying epithelial cells

Epithelial tissue:

- Epithelial tissue is one of four kinds of tissue that forms human body, which acts as safety shield of body and that make up cell walls lining of our blood vessels and organs.
- A scutoid is a solid geometric shape, like a cube or a pyramid, which had not been described until now. The epithelial cells adopt this form when the tissue curves, giving it a more stable structure. It could be said that they look like 'twisted prisms'.
- These new and beautiful shapes are the solution that nature has found to fold and curve the epithelia, which lines the outer surfaces of organs.



Analysis

- This study opens the door to understanding how organs are formed during their development and what might be missing in some diseases in which this process is altered.

58 Concept of Living Will

- Supreme Court of India has held that right to die with dignity is a fundamental right. The Bench also held that passive euthanasia and a living will also be legally valid. Under passive euthanasia the doctors treating such a patient will withdraw medical support provided the patient has left behind a "living will" for pulling the "plug" in such situations.
- The decision was in response to a petition by a non-government organization, which argued that a person with terminal illness should be given the right to refuse being placed on life support.

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5

Alternative Technologies

1 Methanol as cooking fuel

CONTEXT: The NITI Aayog has prepared a comprehensive plan advocating adoption of methanol as the preferred cooking fuel in households as well as commercially.

Methanol:

- It is also **known as methyl alcohol**, it is **colourless, light, and flammable liquid**.
- It is an **alternative fuel for internal combustion and engines**, either in combination with gasoline or directly. It is **less expensive to produce sustainably** and is a less expensive way to reduce the carbon footprint.
- Recently, methanol fuel has been produced using renewable energy and carbon dioxide as a feedstock. It can be manufactured industrially, derived from coal, oil or biomass, wood, bagasse, grass, or agricultural wastes.
- **Its uses- Antifreeze, solvent, and fuel. Pure methanol** has been used in open wheel auto racing since the mid-1960s

Benefits of methanol as cooking fuel:

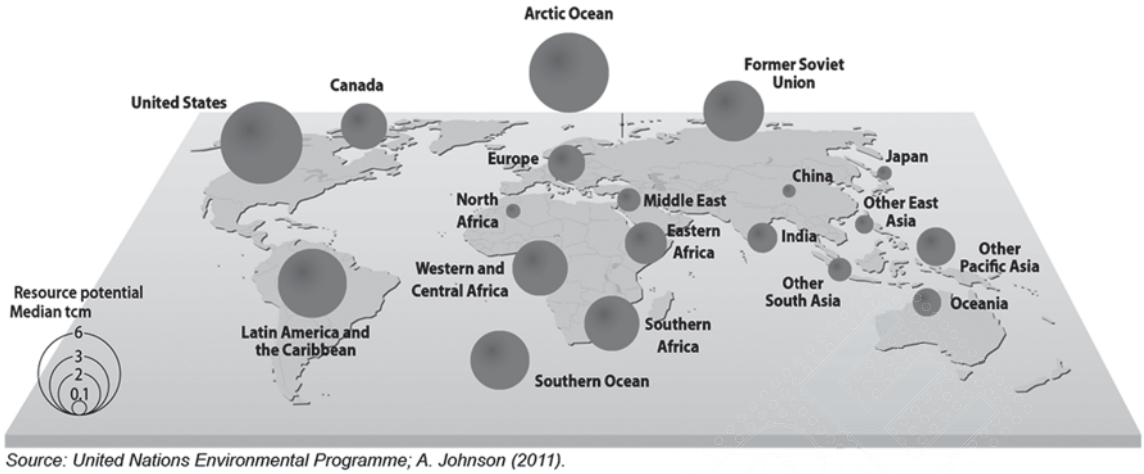
- It estimates that even partial use of methanol **could help reduce India's import bill $100 billion and pollution 40%.**
- **In terms of heat value, a 14-kg LPG cylinder is equivalent to about 20 kg of methanol**. But estimates show methanol is 30% cheaper and saving on an equivalent quantity of LPG is expected to be Rs 350.

In contrast to the present cooking fuel, which is used in liquefied gas form, the methanol fuel will come in vapour form. Unlike LPG, which can explode if it combusts, the methanol canister will burn without explosion and will be safer.

2 Gas Hydrates or Flammable Ice:

CONTEXT: Researchers at Indian Institute of Technology (IIT) Madras have experimentally shown that methane and carbon dioxide (CO_2) can exist as gas hydrates.

- **Natural Gas Hydrates** - They are formed when a gas such as **methane gets trapped in well-defined cages of water molecules** forming crystalline solids. It is a solid ice-like form of water that contains gas molecules in its molecular cavities.
- They occur on **continental margins and shelves** worldwide from Polar Regions to the tropics.



Source: United Nations Environmental Programme; A. Johnson (2011).

- It is estimated that total amount of carbon in the form of methane hydrates, far exceeds the carbon content in all the fossil fuel reserves put together.

- According to the latest estimates of the US Geological Survey, **India has the second largest gas hydrate reserves after America**. The Krishna-Godavari (KG), Cauvery and Kerala basins alone have 100-130 trillion cubic feet of estimated reserves.
- **Extraction of Gas Hydrates: The natural gas from gas hydrate can be produced via:-**
  - **Depressurization:** Drilling of hole into the layer of hydrate and reducing the pressure beneath. This technique is implemented for hydrates only in polar regions beneath the permafrost.
  - **Thermal stimulation:** via steam injection, hot brine solution etc. that raises the temperature of the local reservoir outside the hydrate region to cause the dissociation of the hydrate, thus releasing free gas which can be collected.
- However, no country in the world has so far developed the technology to produce gas hydrates commercially and economically.

3 World's first hydrogen train

CONTEXT: Germany rolled out the world's first hydrogen-powered train, signalling the start of a push to challenge the might of polluting diesel trains with costlier but more eco-friendly technology.

- Hydrogen trains are **equipped with fuel cells that produce electricity through a combination of hydrogen and oxygen, a process that leaves steam and water as the only emissions**.
- Excess energy is stored in ion lithium batteries on board the train.

4 Repurposed Used Cooking Oil (RUCO)

CONTEXT: Dehradun-based Indian Institute of Petroleum has successfully finished a pilot test to convert used cooking oil into bio-aviation turbine fuel (Bio-ATF), which can be blended with conventional ATF and used as aircraft fuel.

- The initiative has been launched nearly a month after the food safety regulator notified standards for used cooking oil. According to FSSAI regulations, **the maximum permissible limits for Total Polar Compounds (TPC) have been set at 25%, beyond which the cooking oil is unsafe for consumption.**

What are Total Polar Compounds (TPC)?

- In many countries, TPC is used to measure the **quality of oil**. **The level of TPC increases every time oil is re-heated**. Some of the studies show that TPC accumulation in oil without food is slower than that in oil frying with food.
- **Higher level of TPC in cooking oil leads to health issues like hypertension, atherosclerosis, Alzheimer's disease and liver disease**. One of the studies also noticed high levels of glucose, creatinine and cholesterol with declined levels of protein and albumin in cooking oil.

RUCO:

- The Food Safety and Standards Authority of India (FSSAI) had launched RUCO (Repurpose Used Cooking Oil), **an initiative that will enable collection and conversion of used cooking oil to bio-diesel.**
- Under this initiative, **64 companies at 101 locations have been identified to enable collection of used cooking oil**. For instance: McDonald's has already started converting used cooking oil to biodiesel from 100 outlets in Mumbai and Pune.
- FSSAI wants businesses using more than 100 litres of oil for frying, to maintain a stock register and ensure that UCO is handed over to only registered collecting agencies.
- **Analysis:** FSSAI believes India has the potential to recover 220 crore litres of used cooking oil for the production of biodiesel by 2022 through a co-ordinated action. While biodiesel produced from used cooking oil is currently very small, but a robust ecosystem for conversion and collection is rapidly growing in India and will soon reach a sizable scale.

5 Hydrogen-CNG

CONTEXT: Nearly 16 years after Delhi's entire bus fleet started to run on CNG to reduce air pollution, authorities have started pitching for an even cleaner alternative, hydrogen-CNG (H-CNG).

- CNG is compressed natural gas. With natural gas mainly composed of methane, CNG emits less air pollutants — carbon dioxide, carbon monoxide, nitrogen oxides and particulate matter — than petrol or diesel.
- **H-CNG is a blend of hydrogen and CNG**, the ideal **hydrogen concentration being 18%.** Compared to conventional CNG, use of H-CNG can **reduce emission of carbon monoxide up to 70%, besides enabling up to 5% savings in fuel**, tests by the Automotive Research Association of India and Indian Oil Corporation Ltd (IOCL) have found.
- H-CNG has not yet gained worldwide currency. Trials have been held in countries such as the US, Canada, Brazil and South Korea.

6 Europe's first solar panel recycling plant

Need for Solar panel recycling plant?

- Solar panels have an estimated **lifespan of 25 to 30 years, meaning that many of the first generation built in the 1990s are now being decommissioned**. The huge growth in solar power in recent years also means that finding a sustainable and circular solution to ageing panels is of prime importance.
- The International Renewable Energy Agency estimates that by 2050 there will be between 60 to 78 million tonnes of PV panel waste around the world. China and the US, as leaders in solar installation, will also need to establish recycling plants to deal with this waste, but that this could

unlock significant economic benefits. At the moment, however, only the European Union has adopted waste regulations specifically aimed at tackling future solar PV waste.

7 Bengaluru Maps its Solar Wealth

CONTEXT: Bengaluru has started the initiative of mapping the solar potential of rooftops.

- Flying over villas, high-rises, independent, smaller houses and large apartment complexes, the 'web-based rooftop photovoltaic tool using aerial LIDAR (Light Detection and Ranging) project', being executed by the Centre for Study of Science, Technology and Policy (CSTEP) for the Bangalore Electricity Supply Company (Bescom), has been mapping rooftop solar prospects.

LIDAR:

- LIDAR, which stands for **Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth**. These light pulses—combined with other data recorded by the airborne system—generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.
- A LIDAR instrument principally consists of a laser, a scanner, and a specialized GPS receiver. Airplanes and helicopters are the most commonly used platforms for acquiring LIDAR data over broad areas. Two types of LIDAR are topographic and bathymetric. Topographic LIDAR typically uses a near-infrared laser to map the land, while bathymetric lidar uses water-penetrating green light to measure seafloor and riverbed elevations.

- The data, which will be put in the public domain, could help people reduce their electricity bills and also make some money by consuming and/or selling the solar energy generated.
- The helicopter has a camera that emits laser pulses. Reflections from the ground get captured, creating a rough 3D map.
- The raw data will be sent to the Defence Ministry for vetting, after which will begin the process of shadow analysis and creation of a model city map.
- In about seven months, the outcome of the project could be a game-changer for both Bescom and its consumers.

8 Shakti Shala Solar Park

CONTEXT: The world's largest solar park set up at an investment of Rs. 16,500 crore at Pavagada in Karnataka's Tumakuru district was launched .

- The first phase Shakti Sthala solar park having total capacity of 2,000 megawatts (MW) was inaugurated in **drought-prone Pavagada region of Tumkur district**.
- It has been executed within record time of two years, with zero land acquisition. The **move was intended to curb the mass migration of people from the region** which has been declared drought-hit in 54 of the last 60 years.
- The park's development is anchored by the Karnataka Solar Power Development Corp. Ltd (KSPDCL), an entity formed in March 2015 as a joint venture between Karnataka Renewable Energy Development Ltd (KREDL) and Solar Energy Corp. of India (SECI).
- The park will create employment and act as an incentive for natives and farmers to explore new opportunities of socio-economic growth in the region.

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power. Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect.

9 Global Centre for Nuclear Energy Partnership

CONTEXT: Recently, India and Vietnam committed to enhancing joint co-production in defence, including transfer of technology from India in their ongoing defence cooperation, during the visit of President Tran Dai Quang of Vietnam.

- The two sides also built on previous statements on maritime security in the "**Indo-Pacific" region, calling for free and open sea lanes.**
- India and Vietnam exchanged three agreements on enhancing trade and agricultural research and a MoU on Cooperation between the Global Centre for Nuclear Energy Partnership (GCNEP) and the Vietnam Atomic Energy Institute (VINATOM).
- The two countries had signed a civil nuclear cooperation agreement in 2016 and the MoU will enhance training and research collaboration possibilities.

Global Centre for Nuclear Energy Partnership (GCNEP)

- Government of India approved the establishment of Global Centre for Nuclear Energy Partnership (GCNEP) near Bahadurgarh, District Jhajjar, Haryana, in September 2010. GCNEP is the sixth R&D unit under the aegis of Department of Atomic Energy (DAE).
- GCNEP will help in capacity building, in association with the interested countries and the IAEA, involving technology, human resource development, education & training and giving a momentum to R&D in enlisted areas. The main objectives of the centre include:
- Development of enhanced nuclear safeguards to effectively and efficiently monitor nuclear materials and facilities. Promoting the development of advanced, more proliferation resistant nuclear power reactors. Training manpower in the field of Nuclear Security and Radiological Safety.
- Educating in the field of Advanced Nuclear Energy Systems, Isotopes and Radiation Technologies, nuclear forensic. Establishing accreditation facilities for radiation monitoring.

10 Apsara – U Reactor

CONTEXT: Bhabha Atomic Research Centre (BARC), Trombay has recommissioned India's oldest nuclear research reactor named 'Apsara', which was shut down permanently in 2009 for repair.

- The **refurbished version of this reactor has been named as 'Apsara-upgraded' (Apsara-U)** and also has double capacity compared its earlier version. It is located within India's nuclear weapons facility at BARC's Trombay campus (Maharashtra).
- The upgraded version, like its ancestor, is indigenously made. It uses plate type dispersion fuel elements made of **Low Enriched Uranium (LEU**).
- It will **help to increase indigenous production of radio-isotopes for medical application by about 50% mainly due to higher neutron flux.**
- It will also be extensively used for research in nuclear physics, material science and radiation shielding.
- The radioisotopes produced by it will be also used in the field food preservation, agriculture, and other industries apart from medicine for diagnosis and therapy.

11 Experimental Advanced Superconducting Tokamak (EAST)

CONTEXT: It is an experimental superconducting tokamak magnetic fusion energy reactor in Hefei, China. The Hefei-based Institute of Plasma Physics is conducting the experiment for the Chinese Academy of Sciences.

- The Experimental Advanced Superconducting Tokamak **(EAST**), **nicknamed the "Chinese artificial sun," achieved an electron temperature of over 100 million degrees** in its core plasma during a four-month experiment this year. That's about seven times greater than the interior of the sun, which is about 15 million degrees C.
- The experiment was conducted by the EAST team at the Hefei Institutes of Physical Science of the Chinese Academy of Sciences (CASHIPS) in collaboration with domestic and international colleagues.
- EAST is the first fully superconducting tokamak with a non-circular cross section in the world. It was designed and constructed by China with a focus on key science issues related to the application of fusion power. Since it began operating in 2006, EAST has become a fully open test facility where the world fusion community can conduct steady-state operations and ITER-related physics research.

12 World's first Hyperloop passenger capsule unveiled

CONTEXT: US-based Hyperloop Transportation Technologies (HTT) has unveiled its first full-scale transportation capsule at Puerto de Santa Maria, Spain.

What is Hyperloop?

- Hyperloop is a new form of ground transport currently in development by a number of companies, which could see passengers **travelling at 700 miles an hour in floating pods within low-pressure tubes.**
- The pods carrying passengers travel through tubes or tunnels from which most of **the air has been removed to reduce friction.**
- Rather than using wheels like a train or car, the pods are designed to float on air skis, using the same basic idea as an air hockey table, or use magnetic levitation to reduce friction.

- The unveiled capsule is named as **'Quintero One' and weighs about 5 tonnes**.
- It has been made completely out of HTT's "Vibranium", a specially made dual layer smart composite material.
- The capsule will be fully optimized and ready for passengers by 2019.

Hyperloop in India:

- In September 2017, Andhra Pradesh government signed a memorandum of understanding MoU with Hyperloop Transportation Technology to develop a hyperloop between Amravati and Vijayavada.
- In February 2018, Maharashtra government has signed a memorandum of understanding with Hyperloop One, an American company to develop a hyperloop between Pune and Mumbai.

Significance

- Hyperloop technology is revolutionary intervention in transportation technology. Once developed fully, it could make the transportation of people and goods easier, faster and less expensive.
- The Pune-Mumbai hyperloop route will be an economic catalyst for the region and would create tens of thousands of jobs for India's world-class manufacturing, construction, service, and IT sectors. It also aligns with Make in India initiatives.

13 Hyperloop between Mumbai and Pune

CONTEXT: Maharashtra government has signed an agreement with Virgin group to build a Hyperloop.

- Hyperloop is a proposed system of **transport that would see pods or containers travel at high speeds through a tube that has been pumped into a near-vacuum**.
- The train pods would either float **using magnetic levitation technology**.
- The pods would be able to travel at immense speeds with a projected top speeds of 760mph.
- The pod would initially launch using an electric motor before levitation takes place and the pod can glide at cruising speed in the low-pressure environment.
- The proposed Hyperloop route in India will be connecting Mumbai and Pune in Maharashtra.
- The proposed system will cut travel time between Mumbai and Pune to 25 minutes from the 3 hours it now takes by road.
- Mumbai-Pune Hyperloop is estimated to connect 26 million people, support 150 million passenger trips per year, and reduce greenhouse gas emissions by up to 86,000 tonnes over 30 years.

14 Aerogel- Super-insulating gel

CONTEXT: Scientists have developed Aerogel, a transparent heat-resistant super-insulating gel using beer waste.

- It may be used to **build greenhouse-like habitats for human colonised on extraterrestrial habitats such as Mars or Moon.**
- It could also be **used on buildings on Earth to help make huge savings on energy costs**.
- Aerogels defining feature is air, as it comprise at least 90% gas by weight.
- Their thin films are made up of crisscrossing patterns of solid material that trap air inside billions of tiny pores, similar to bubbles in bubble wrap. This trapping capacity makes them good insulators.

15 Thermal Battery

CONTEXT: The world's first-ever thermal battery plant owned by Bharat Energy Storage Technology Private Limited (BEST) was inaugurated in Amravati, Andhra Pradesh.

- This plant **aims to create new energy storage form that is expected to have commercial applications,** while also maintain low carbon footprint and less dependent on external factors like weather.
- The plant will begin its commercial operations from May 2019.
- Thermal battery use thermal energy to operate i.e. energy created by temperature differences. The energy transfer in in this battery helps to store heat when heat travels from one part of battery setup to other.

16 India's first coal-gastification fertilizer plant

CONTEXT: India's first coal-gasification based fertilizer plant with pet coke blending set up in Talcher, Odisha.

- The coal gasification based fertilizer plant is being developed by Talcher Fertilizers Limited (TFL). TFL is a joint venture company of GAIL (India) Limited, Coal India Limited, Rashtriya Chemicals & Fertilizers Limited and Fertilizer Corporation of India Limited.
- The coal-gasification based fertilizer plant will use **gas produced from coal, thus reducing dependence on urea and gas imports.**
- In an **attempt to reduces import of urea and deepens the market for natural gas, government**, as a policy priority, has also been reviving sick fertiliser units.
- It will **promote alternative use of domestic coal in environment friendly manner**, thereby supporting India's commitments under COP-21 Paris Agreement.

17 Quadricycles

CONTEXT: Quadricycles can now be bought for personal usage, with the Ministry of Road Transport and Highways notifying insertion of the item 'Quadricycle' as a 'non-transport' vehicle under the Motor Vehicles Act 1988.

Quadricycles

- A quadricycle is **a vehicle of the size of a three-wheeler but with four-tyres and is fully covered like a car.**
- It has an engine like that of a three-wheeler.
- This makes it a **cheap and safe mode of transport for last-mile connectivity**.

- Though the government permitted the use of quadricycles for commercial purpose in June, the latest notification opens the door for their use for personal purpose.
- **Bajaj Auto** is the only company that makes the vehicle named '**Qute'**, which it exports to countries like Turkey.
- Quadricycles may signal the beginning of a new era in public transportation as currently three-**wheelers remain a highly unsafe mode for commuting.**

Analysis

- The introduction of such category also raises a lot of questions about the government's thought process.
- On the one hand, it is talking about road safety and the need for environment-friendly vehicles and therefore stressing on features such as ABS and airbags.
- On the other, it is promoting vehicles like quadricycles which do not have such safety mechanisms.

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6

Nano Technology

1 Graphene

CONTEXT: Scientists have found a potential new application of graphene for detecting Amyotrophic Lateral Sclerosis (ALS) — a progressive brain disorder for which there is currently no objective diagnostic test.

Graphene:

- It is the **thinnest (one atom thick) compound known to man, the lightest material known (1 sq mt weighing around 0.77mg),** the strongest compound discovered (between 100-300 times stronger than steel and with a tensile stiffness of 150,000,000 psi).
- It is the **best conductor of heat at room temperature and also the best conductor of electricity known** (electron mobility is more than 200,000 cm2·V−1·s−1).

Applications

- Graphene is being used to **boost not only the capacity and charge rate of batteries but also the longevity.** Currently, while such materials as silicone are able to store large amounts of energy, that potential amount diminishes drastically on every recharge.
- With graphene tin oxide being used as an anode **in lithium ion batteries** for example, batteries can be made to **last much longer between charges** (potential capacity has increased by a factor of 10), and with almost no reduction in storage capacity between charges, effectively making technology such as electronically powered vehicles a much more viable transport solution in the future. This means that batteries (or capacitors) can be developed to last much longer and at higher capacities than previously realised. Also, it means that electronic devices may be able to be charged within seconds.
- Graphene is highly inert and so can **act as a corrosion barrier between oxygen and water diffusion**. Future vehicles could be made to be corrosion resistant as graphene can be made to be grown onto any metal surface (given the right conditions).
- Due to its strength, graphene is also being developed **as a potential replacement for Kevlar in protective clothing, and will eventually be seen in vehicle manufacture** and possibly even used as a building material.

2 IIT-Madras unveiled word's first remotely operable LEAP microscope

CONTEXT: The Indian Institute of Technology (IIT)-Madras has commissioned remotely operable Local Electrode Atom Probe (LEAP) microscope.

- It is **claimed to be world's first remotely operable LEAP microscope**, as it can be remotely operated through special terminal by researchers divided geographically.
- LEAP is high-performance microscope that can **provide a precise atom-by-atom view of materials.**
- It provides atomic-scale insights into metallic, which will influence wide spectrum of industries ranging from steel to automobiles and energy to transportation sector.
- It will also **give major thrust to research in nanotechnology, among other fields**.

3 Particle Decay

CONTEXT: Six years after its discovery, the Higgs boson has at last been observed decaying into fundamental particles known as bottom quarks.

Higgs Boson

- The Higgs boson is an elementary particle in the **Standard Model of particle physics**, produced by the quantum excitation of the Higgs field, one of the fields in particle physics theory. It is named after physicist **Peter Higgs,** who in **1964**, along with six other scientists, proposed the mechanism, which suggested the existence of such a particle.
- Its existence was confirmed by the **ATLAS and CMS collaborations** based on collisions in the Large Hadron Collider at CERN.

Standard Model of Particle Physics

- One of the most complete models that comes anywhere near producing a "**theory of everything**," is the Standard Model of Fundamental Particles and Interactions, which describes how particles and forces interact. The standard model also includes an explanation for **3 of the 4 fundamental forces of nature** on a subatomic scale.
- **Theory of Everything** - This theory postulates how all the subatomic particles in the universe operates and how they interact to comprise the Universe as we know it.
- The **Four Fundamental Forces of Nature** are **Gravitational force, Weak Nuclear force, Electromagnetic force and Strong Nuclear force**.

Large Hadron Collider (LHC):

- LHC is the world's largest and most powerful particle accelerator situated in a tunnel beneath the **France Switzerland border near Geneva**.
- **Built by**: European Organization for Nuclear Research (CERN)
- **Aim**: to allow physicists to test the predictions of different theories of particle physics and high-energy physics, and particularly prove or disprove the existence of the theorized Higgs boson and of the large family of new particles predicted by super symmetric theories.
- The LHC consists of a 27-kilometre ring of superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way.

Analysis

- The finding, presented by the ATLAS and CMS collaborations at the Large Hadron Collider (LHC), is consistent with the hypothesis that the all-pervading quantum field behind the Higgs boson also gives mass to the bottom quark.
- The Standard Model of particle physics predicts that about 60% of the time a Higgs boson will decay to a pair of bottom quarks, the second-heaviest of the six flavours of quarks.Testing this prediction is crucial because the result would either lend support to the Standard Model – which is built upon the idea that the Higgs field endows quarks and other fundamental particles with mass – or rock its foundations and point to new physics.

4 Rydberg Polarons

CONTEXT: Scientists have observed a new class of quantum matter at the very smallest scales in one of the coldest environments ever made. This discovery could pave the way for new technologies including innovations in superconductivity and other cutting-edge fields.

- This is an intricate experiment that builds upon several advances that were achieved over the past two decades.
- It uses ideas from two different fields, which have already been discovered:
- Bose Einstein Condensation, and Rydberg atoms.
- A particularly interesting implication is for cosmology. We know that our universe is filled with a mysterious 'dark matter' which exerts a gravitational force on other forms of matter.
- Some theories of dark matter postulate that it is a cosmic Bose Einstein Condensate, perhaps composed of an as-yet-unknown type of particle. If we are indeed living in an invisible all-pervading Bose Einstein Condensate, this experiment can suggest ways to detect it.

5 KATRIN experiment

CONTEXT: Researchers in Germany with the Karlsruhe Tritium Neutrino experiment collected data to determine the mass of the universe's lightest particle- neutrino.

- Those are sometimes called "**ghost particles**" because they're so difficult to detect.
- The KATRIN experiment is currently set up and commissioned **on the Campus North of the Karlsruhe Institute for Technology.**
- The experiment is collaboration between national and international partners with currently more than 150 scientists, engineers, technicians and students.
- KATRIN measures the neutrino mass in a model-independent way via ultrahigh precision measurements of the kinematics of electrons from beta-decay.

6 Cyclone-30 India's biggest cyclotron facility becomes operational

CONTEXT: India's biggest cyclotron facility named Cyclone-30 became operational at Kolkata-based Variable Energy Cyclotron Centre (VECC), which comes under Department of Atomic Energy (DAE).

- Cyclotron is **used to produce radioisotopes for diagnostic and therapeutic use** for cancer care. Radiations from these isotopes are used to destroy cancer cells.
- Cyclone-30 will **produce radioisotopes** vital for diagnosis and treatment of cancer.
- It will be first and only cyclotron facility in country to **produce Germanium-68 radioisotopes**, which is used in diagnosis of breast cancer.
- The **high-energy and high-yielding Cyclone-30 machine will provide for affordable radio isotopes and related radiopharmaceuticals** for entire country, especially for eastern states like West Bengal.
- It will also help in bringing down imports, while raising possibility of exporting radioisotopes in the future.

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7

Schemes & Initiatives

1 Prime Minister's Science Technology And Innovation Council (PM-STIAC)

CONTEXT: The Prime Minister's Science, Technology and Innovation Council (PM-STIAC) has identified nine national missions to address major scientific challenges to ensure India's sustainable development.

About PM – STIAC

- The **council will advise PM on science, technology, as well as innovation**. It will also coordinate implementation of PMs scientific vision.
- It has **nine members, including Chairperson**. Apart from nine members, it will also have twelve special invitees .

Nine Missions Identified:

- **Natural Language Translation** - Through a combination of machine and human translation, the mission aims to enable access to teaching and research material bilingually i.e. in English and one's native Indian language.
- **Quantum Frontier -** This mission aims to initiate works in control of the quantum mechanical systems, with a large number of degrees of freedom, as one of the great contemporary challenges in fundamental science and technology.
- **Artificial Intelligence -** The mission focuses on efforts that will benefit India in addressing societal needs in areas such as healthcare, education, agriculture, smart cities and infrastructure, including smart mobility and transportation
- **National Biodiversity Mission -** This mission involves Comprehensive documentation of India's biodiversity with the potential for cataloguing and mapping all lifeforms in India including associated cultural and traditional practices and Assessment of the distribution and conservation status of India's biodiversity.
- **Electric Vehicles** - The mission aims to reduce India's fossil fuel emissions and mitigate emissions by making Electric Vehicles economical and scalable through focused research, development and innovation and building of indigenous capacity.
- **BioScience for Human Health** - The mission through the use of healthy and disease samples aims to understand the impact of nature and nurture on health. The mission aims to construct comprehensive reference maps of genomes and to understand the dynamics of how exposure to different environments have an impact on our bodies.
- **Waste To Wealth** - The mission aims to identify, develop and deploy technologies to treat waste to generate energy, recycle materials and extract worth. The mission will work to identify and support the development of new technologies that hold promise in creating a clean and green environment.

- **Deep Ocean Exploration** - The mission aims to scientifically explore the deep oceans towards improving our understanding of the blue frontier. The information from this mission will address issues arising from long term changes in the ocean due to climate change.
- **Agnii** - This mission aims to support the national efforts to boost the innovation ecosystem in the country by connecting innovators across the industry, individuals and the grassroots to the market and helping commercialise innovative solutions.

2 Young Scientist Programme

CONTEXT: Indian Space Research Organisation (ISRO) has announced Young Scientist Programme.

- Aim:**Inculcate and nurture space research fervour in young minds**.
- It would be a **one month programme**. The students will be exposed to the practical experience of **building small satellites**.
- **Eligibility**: Mostly **8th standard passed out students** will be given lecturers and access to research laboratories. 3 studentsfrom each of the 29 States and 7 Union Territories will be selected for the Young Scientist program.

3 Innovate India Platform

Context – Innovate India Platform was launched recently

Innovate India Platform:

- It is a **citizen centric platform** of the Government of India which will **serve as the common point for all the innovation happening across the nation.**
- It is developed in collaboration between the **Atal Innovation Mission and MyGov**.

Some of the features of this platform are:

- The platform is open to all Indian citizens.
- The **users can View, comment, share, and rate the innovations crowdsourced on the #Innovate India platform.**
- View the leader board which is calculated based on the votes on each innovation.
- Citizens can share their/organizations/someone else's innovation on the platform by login to the MyGov website.
- These innovations can also be shared on various social media platforms such as WhatsApp, Facebook, and Twitter.

Analysis

- India has been a very innovation-oriented society, but our challenge has been a structured approach to innovation, capturing them and building an ecosystem to take them global. This initiative aims to capture and support innovation from ground up, is aimed at creating a structured ecosystem to encourage, enhance and develop India's innovative character.

4 Innovation Cell

CONTEXT: The Innovation Cell and Atal Ranking of Institutions on Innovation Achievements (ARIIA) at AICTE were launched recently.

Innovation Cell

- Innovation cell is MHRD's initiative and has been **established at AICTE premises** with a purpose to systematically **foster the culture of Innovation in all Higher Education Institutions** (HEIs) across the country.
- The primary mandate of Innovation Cell is to encourage, inspire and nurture young students by exposing them to new ideas and processes resulting in innovative activities in their formative years.
- **Major Programs**
  - Network of Innovation Clubs (NIC)
  - Atal Ranking of Institutions on Innovation Achievements (ARIIA)
  - Smart India Hackathon (SIH) 2019
  - National Student Startup Policy (NSSP)

About Atal Ranking of Institutions on Innovation Achievements (ARIIA)

- It has been launched for the **assessment of what is being done to promote innovation**.
- It will encourage healthy competiveness among Higher Educational Institutions.

Key Facts:

- India has already been improving on global stage in terms of Innovation ranking (Global Innovation Index) from 86th place, 5 years ago, to 57th place this year (2018).

5 National Statistics Day

CCONTEXT: "Statistics Day" was celebrated on 29th June, 2018

- **29th June, 2017** marked the beginning of the **125th year of birth of Prof. P.C. Mahalanobis.** ISI has held year-round celebrations which will be **culminated on 29th June, 2018**.
- The objective of celebration of this Day is to create public awareness about the importance of statistics in socio-economic planning and policy formulation, to acknowledge the contribution of Prof. Mahalanobis, and to pay homage to him.
- The theme selected for the Statistics Day this year is ''**Quality Assurance in Official Statistics'**.
- The **Indian Statistical Institute (ISI)** at Kolkata, set up by **Prof. Mahalanobis** in **1931**, and was declared an **autonomous "Institute of National Importance**" through an act of Parliament in 1959, celebrates **29th June as the "Worker Day**".

Contribution of PC Mahalanobis:

- Mahalanobis set up the **Indian Statistical Institute** as a learned society on 17 December 1931
- The early statistical studies included analyses of data on stature of Anglo-Indians, meteorological data, rainfall data, data on soil conditions, etc.
- His analysis of anthropometric data led to the famous concept in Statistics known as "**Mahalanobis Distance**".
- Mahalanobis's contributions to **large scale sample surveys** are among his most significant and lasting gifts to statistics.
- **The three notable contributions to the theory and practice of sample surveys by Mahalanobis are "pilot surveys, optimum survey design and Inter Penetrating Network of sub-samples technique (IPNS).**
- Mahalanobis raised important and difficult p**hilosophical questions on randomness and representativeness of a sample**, which remain relevant and challenging even today.
- He was elected **Chairman of the United Nations Sub-Commission on Statistical Sampling in 1947**, and held this post until 1951.

- He helped establish the **Central Statistical Organisation (CSO)**, the **National Sample Survey (NSS)** and the **Annual Survey of Industries (ASI**), all of which were run from ISI in the early years.

6 Children's Science Congress

CONTEXT: Nobel Laureates Avram Hershko from Israel and F.Duncan M.Haldane from USA Inaugurated Children Science Congress at the Ongoing Indian Science Congress, 2019.

Background

- National Children's Science Congress (NCSC) is a nationwide **Science Communication programme** started in the year **1993**.
- It is a programme of **National Council for Science and Technology Communication (NCSTC)**, Department of Science and Technology, New Delhi.
- It is a forum children of the **age-group of 10-17 years**, both from formal school system as well as from out of school, to exhibit their creativity and innovativeness and more particularly their ability to solve a societal problem experienced locally using by method of science.

About National Council for Science and Technology Communication:

- It is mandated to communicate science & technology to masses. The programmes of the Council aim at building capacity for informed decision making in the community.
- NCSTC encourages research in areas of S & T communication, training of communicators, development of books, manuals, posters, exhibitions, films, radio programmes, and television programmes on different facets of science & technology and recognizing outstanding efforts through awards and incentives all over the country.
- It is a **registered body guided by a Board of Governors with headquarters at Delhi**. It has about eighty members spread in all states and union territories. Volunteers in districts lend it great strength and capability for implementing projects that reach the common man and woman.

- About 120 projects made by students and finalised by DST are being showcased and students will have the opportunity to listen and interact with the Young Scientists and Nobel Laureates.
- Students from all parts of the country are participating in this event.
- Expert lectures, including lectures through video conferences, by eminent scientists will be held every day during the course of three days of Children Science Congress.

7 Imprint II

CONTEXT: In a major boost for research and innovation in the country, the Central Government has sanctioned a sum of Rs. 1,000 crore for the phase two of the Impacting Research Innovation and Technology (IMPRINT) India programme.

- Under the IMPRINT-II, a **fund is being created** by the Department of Science and Technology and Ministry of Human Resource Development together,
- Contribution will also come from industry and other interested Ministries.

About IMPRINT India:

- The initiative, '**IMPRINT India', is a pan-IIT and IISc joint collaboration to develop a blueprint for research of immediate relevance to society requiring innovation, Direct scientific research into identified areas**, and to ensure higher funding support for research into these areas.

- This novel initiative with twofold mandate is aimed at:
  - Developing new engineering education policy.
  - Creating a road map to pursue engineering challenges.
- IMPRINT provides the overarching vision that guides research into areas that are predominantly socially relevant.

8 Bharatnet Covers 1 Lakh Gram Panchayats

CONTEXT: Government has achieved a significant milestone under the BharatNet by completing Phase-1 of the project by connecting over one lakh Gram Panchayats (GP) across the country with high speed optical fiber network as per the declared deadline of 31 Dec 2017.

Bharat Net Project

- Broadband access to every citizen is a **key pillar of Digital India**.
- BharatNet has a vision to establish a **scalable Broadbank network by 2017** towards providing affordable broadband **connectivity of 2 Mbps to 20 Mbps to all rural households and institutions**.
- This project has evolved from the earlier **National Optical Fibre Network (NOFN) project of providing 100 Mbps to all gram panchayats (GPs).**
- At present, a special purpose vehicle, **Bharat Broadband Network Ltd (BBNL),** under the telecom ministry is handling the roll out of optical fiber network. The project is being executed by BSNL, Railtel and Power Grid.
- A committee constituted reviewed the earlier project and proposed a modified project called BharatNet.

Funding:

- Bharat Net is being **funded through Universal Service Obligation Fund (USOF).** The Universal Service Obligation Fund (USOF) was **established with the fundamental objectives of providing access to 'Basic' telegraph services to people in the rural and remote areas** at affordable and reasonable prices.
- Subsequently the scope was widened to provide subsidy support for enabling access to all types of telegraph services including mobile services, broadband connectivity and creation of infrastructure like OFC in rural and remote areas.
- The first phase of BharatNet was scheduled to be completed by the end of the year 2017.
- **Under the second phase, the government will lay down optical fiber network across 1.5 lakh village Panchayats**.

9 National Viral Hepatitis Control Program

CONTEXT: Ministry of Health and Family Welfare has launched the 'National Viral Hepatitis Control Program', with the goal of ending viral hepatitis as a public health threat by 2030 in the country.

Viral hepatitis in India

- Hepatitis is an **inflammatory disease of the liver, caused due to viral infection**. In 2015, it led to nearly 1.34 million deaths worldwide; most of the viral hepatitis deaths being due to chronic liver disease/primary liver cancer.

- Viral hepatitis is a public health problem caused by any of the known five hepatotropic viruses, namely - **hepatitis A, B, C, D and E which are highly divergent in their structure**, epidemiology, mode of transmission, incubation period, signs/symptoms, diagnosis, prevention and treatment options.
- **Hepatitis A Virus (HAV)** and **Hepatitis E Virus (HEV)** are important causes of **acute viral hepatitis** and **Acute Liver Failure (ALF).**
- **HAV** is responsible for **10-30% of acute hepatitis** and 5**-15% of acute liver failure cases** in India.
- **HEV** accounts for **10-40% of acute hepatitis** and **15-45% of acute liver failure**.
- Approximately **40 million** people are chronically infected with **Hepatitis B** and **6-12 million** people with **Hepatitis C**.
- **Chronic HBV infection** accounts for **40% of Hepato-cellular Carcinoma (HCC)** and **20-30% cases of cirrhosis** in India.
- **Chronic HCV infection** accounts for **12-32% of HCC** and **12-20% of cirrhosis**.

Aim:

- Combat hepatitis and achieve country wide **elimination of Hepatitis C by 2030.**
- Achieve significant reduction in the infected population, morbidity and mortality associated with Hepatitis B and C viz. Cirrhosis and Hepato-cellular carcinoma (liver cancer).
- Reduce the risk, morbidity and mortality due to Hepatitis A and E.

Key Objectives:

- Enhance **community awareness** on hepatitis and lay **stress onpreventive measures** among general population especially high-risk groups and in hotspots.
- Provide **early diagnosisand management of viral hepatitis** at all levels of healthcare.
- Develop **standard diagnostic and treatment protocols** for management of viral hepatitis and its complications.
- Strengthen the existing infrastructure facilities, build capacities of existing human resource and raise additional human resources, where required, for providing comprehensive services for management of viral hepatitis and its complications in all districts of the country.
- **Develop linkages with the existing National programmes** towards awareness, prevention, diagnosis and treatment for viral hepatitis.
- Develop a **web-based "Viral Hepatitis Information and Management System**" to maintain a registry of persons affected with viral hepatitis and its sequelae.

The key components include:

- **Preventive component:** This remains the cornerstone of the NVHCP. It will include:
  - Awareness generation.
  - Immunization of Hepatitis B (birth dose, high risk groups, health care workers).
  - Safety of blood and blood products.
  - Injection safety, safe socio-cultural practices.
  - Safe drinking water, hygiene and sanitary toilets.
- **Diagnosis and Treatment:**
  - Screening of pregnant women for HBsAg to be done in areas where institutional deliveries are < 80% to ensure their referral for institutional delivery for birth dose Hepatitis B vaccination.
  - Free screening, diagnosis and treatment for both hepatitis B and C would be made available at all levels of health care in a phased manner.
  - Provision of linkages, including with private sector and not for profit institutions,for diagnosis and treatment.
  - Engagement with community/peer support to enhance and ensure adherence to treatment and demand generation.

- Monitoring and Evaluation, Surveillance and Research Effective linkages to the surveillance system would be established and operational research would be undertaken through Department of Health Research (DHR). Standardised M&E framework would be developed and an online web based system established.

- **Training and capacity Building:**
  - It will be supported by **NCDC, ILBS and state tertiary care institutes** and coordinated by **NVHCP**.
  - Hepatitis induction and update programs for all level of health care workers.

10 National Biopharma Mission

CONTEXT: Industry-academia collaborative missions for accelerating discovery research to early development of Biopharmaceuticals innovate in India.

- The program named **Innovate in India** is an **industry-academia collaborative mission** of **Department of Biotechnology (DBT)** in collaboration with **World Bank** for accelerating discovery research to early development of Biopharmaceuticals and to be implemented by **Biotechnology Industry Research Assistance Council (BIRAC).**
- **Aim of the Mission:** To **enable and nurture an ecosystem** for preparing **India's technological and product development capabilities** in biopharmaceutical to a level that will be **globally competitive over** the next decade, and **transform the health standards of India's population** through affordable product development.
- The initial focus will be on **Vaccines for HPV, Dengue** and **biosimilars for cancer**, **diabetics and rheumatoid arthritis** and medical devices and diagnostics.

- The program will specifically focus on the **development of new vaccines, bio-therapeutics, diagnostics** and **medical devices** to address the rising burden of diseases in the country.
- It will also bring **isolated centers of excellence** together, enhance **regional capabilities** and strengthen the **current bio-clusters network** in terms of capacities as well as quantity and quality of output.
- The Mission will strengthen and create shared infrastructure for product development and validation of **Centre of Excellences for knowledge generation and skill development for Technology Strengths and Technology Management.**
- This mission will **develop platform technologies** for product validation, **link institutions** to strengthen clinical trial networks**, promote partial de-risking** for novel products, and **build capacities** in emerging areas such as translational bioinformatics, bioethics etc.
- This will be a great platform which will offer buoyancy as well as **universal support to biotechnological innovation**, and **transform India into a global hub for cutting-edge biotechnology research and development**.
- The programme will help deliver 6-10 new products in the next five years, create several dedicated facilities for next-generation skills, and hundreds of jobs in the process.
- It intends to collectively **fill the missing link between** the discovery and development and bring together **private sector, Government and academia** which we can call triple helix of medical innovation which can spur further development.
- It promises to boost the **growth curve for domestic biopharma** in India by accelerating the **translation of research concepts into viable products**, enabling **sustainable networks forcollaboration between industry and academia**, and supporting **entrepreneurial ecosystem** amongst many others.
- The program has a great potential to move the idea of **Make in Indiato Innovate in India.**

11 Agmark online system

CONTEXT: Recently Minister of Agriculture and Farmers' Welfare launched the online software for Agmark.

About AGMARK

- AGMARK is a certification mark employed on agricultural products in India, assuring that they conform to a set of standards approved by the **Directorate of Marketing and Inspection**, an agency of the Government of India.
- The AGMARK is **legally enforced** in India by the **Agricultural Produce (Grading and Marking) Act of 1937 (and ammended in 1986).**
- The Agmark certification is employed through fully **state-owned Agmark laboratories** located across the nation which act as testing and certifying centres.

About the Agmark Online System:

- The application processes related to Agmark certification are being done online by the Directorate of Marketing & Inspection (DMI).
- The process of application will be simple, quick, transparent and 24×7.
- Online system is being implemented across the country to conduct quality control functions.
- Through the Agmark online system, certificate of authorisation (domestic), permission of printing press, permission of laboratories (domestic) and services related to laboratory information management system will be provided online.
- The use of modern technologies by the National Informatics Center has made these processes easy, reliable and cost effective by providing online electronic mode.

12 World Intellectual Property Organization (WIPO) treaties

CONTEXT: Cabinet approves accession to WIPO Copyright Treaty, 1996 and WIPO Performance and Phonograms Treaty, 1996. The treaties extend coverage of copyright to the internet and digital environment.

World Intellectual Property Organization (WIPO).

- The World Intellectual Property Organization (WIPO) is one of the **17 specialized agencies** of the United Nations.
- It was created in 1967 "to encourage creative activity, to promote the protection of intellectual property throughout the world."
- It has currently **188 member states**, administers 26 international treaties, and is headquartered in **Geneva, Switzerland**.
- Non-members are the states of Marshall Islands, Federated States of Micronesia, Nauru, Palau, Solomon Islands, South Sudan and Timor-Leste. Palestine has observer status.
- India is a member of WIPO and party to several treaties administered by WIPO.

WIPO Copyright Treaty

- It came in force on March 6, 2002 and has been adopted by 96 contracting parties till date
- It has provisions to extend the protection of copyrights contained therein to the digital environment.
- Further it recognises the rights specific to digital environment, of making work available, to address "on-demand" and other interactive modes of access.

WIPO Performances and Phonograms Treaty

- It came in force on May 20, 2002 and has 96 contracting parties as its members
- WPPT deals with rights of two kinds of beneficiaries, particularly in digital environment – (i) **Performers (actors, singers, musicians etc.) (ii) Producers of Phonograms (Sound recordings**).

Benefits:

Meeting the demand of the copyright industries, these treaties will help India:

- To enable creative right-holders enjoy the fruit of their labour, through international copyright system that can be used to secure a return on the investment made in producing and distributing creative works;
- To facilitate international protection of domestic rights holder by providing them level-playing field in other countries as India already extends protection to foreign works through the International Copyright order and these treaties will enable Indian right holders to get reciprocal protection abroad;
- To instil confidence and distribute creative works in digital environment with return on investment; and
- To spur business growth and contribute to the development of a vibrant creative economy and cultural landscape.

13 National Intellectual Property (IP) Award 2018

CONTEXT: Council of Scientific and Industrial Research (CSIR) was awarded National Intellectual Property (IP) Award 2018

CSIR:

- The Council of Scientific & Industrial Research (CSIR) is a contemporary **R&D organization**.
- It has been ranked **9th in the world** amongst the 1207 government institutions, with an **overallglobal ranking of 75 in the world**, covering 5250 institutions.
- CSIR Laboratories have been developing and providing Technology focused at the unmet need and the cutting edge knowledgebase and human resource on the other, for socio-economic development in the Country.

World IP Day

- Every **April 26** is celebrated as World Intellectual Property Day to learn about the role that intellectual property (IP) rights play in encouraging innovation and creativity.
- The **Indian Intellectual Property Office** confers National Intellectual Property (IP) Award on outstanding innovators, organizations and companies in the fields of patents, designs, trademarks and geographical indications on the occasion of **World IP Day every year**.

Key Facts

- The Council of Scientific and Industrial Research (CSIR) is awarded the National Intellectual Property (IP) Award 2018 in the category "**Top R&D Institution / Organization for Patents and Commercialization**".
- A function was organized by the Indian **Intellectual Property Office** and **Confederation of Indian Chambers of Commerce (CII**) in New Delhi, to celebrate the World IP Day.

14 Intellectual Property Rights Mascot

CONTEXT: The Minister of Commerce and Industry launched the Intellectual Property (IP) mascot – IP Nani

- **Mascot IP Nani is a tech-savvy grandmother** who helps the government and enforcement agencies in combating IP crimes with the help of her grandson "**Chhotu" aka Aditya**.

- The IP mascot will spread awareness about the importance of Intellectual Property Rights (IPRs) among people, especially children, in an interesting manner.
- This character is also in line with the World Intellectual Property Organization's (WIPO) campaign for the **World IP Day (26 April**)

- **Cell for IPR Promotion and Management (CIPAM**), a professional body under the Department of Industrial Policy and Promotion (DIPP) collaborated with the **European Union Intellectual Property Office (EU-IPO**) to produce a series of **animated videos on IPRs** for children with IP Nani as their central character.
- CIPAM also engaged with the National Council of Educational Research & Training (NCERT) to curate content on IPRs.

Analysis:

Piracy is a serious crime which should not go unpunished. lPRs are increasingly becoming crucial drivers of social and economic growth by encouraging creativity and innovation. The first and foremost objective of the National IPR Policy is "IPR Awareness: Outreach and Promotion". Under this objective, one of the key focus areas is awareness on IPR for school children, as it is essential to nurture creativity and the ability to innovate starting out from a young age.

15 GI Tag

- **Alphonso from Ratnagiri, Sindhudurg, Palghar, Thane and Raigad districts of Maharashtra, is registered as Geographical Indication (GI).**
  - The king of mangoes, Alphonso, better known as 'Hapus' in Maharashtra, is in demand in domestic and international markets not only for its taste but also for pleasant fragrance and vibrant colour.
- **Bihar's Shahi litchi has received the geographical indication tag, the director of the National Research Centre on Litchi confirmed to IANS.**

- The fruit is mostly grown in Muzaffarpur and its neighbouring districts of East Champaran, Vaishali, Samastipur and Begusarai.
- The registration was done in the name of the Muzaffarpur-based Litchi Growers Association of Bihar, which had applied for the tag.
- The state produces 40% of the litchis grown in India on 38% of the area.

- **The Chau mask of Purulia, the wooden mask of Kushmandi, the Patachitra, the Dokras of Bengal, and Madhurkathi (a kind of mat) have been presented with the Geographical Indication (GI) tag by the Geographical Indication Registry and Intellectual Property India.**
  - GI tags for these five rural crafts would not only help the artisans create their own brand but would also provide legal protection to artisans practising the crafts against attempts to duplicate them in other regions. It will also have a direct impact on the occupation of 5,000-6,000 families in the State.
- **Madhya Pradesh has received the Geographical Indications (GI) tag for Kadaknath, a chicken breed whose black meat is in demand in some quarters**
  - The breed is native to **Jhabua, Alirajpur, and parts of Dhar district of Madhya Pradesh**
  - It is also known as "**Kali masi"**
  - The Kadaknath is popular mainly for its adaptability, and the good-tasting black meat, which is believed to infuse vigor.

Geographical Indication:

- A Geographical Indication or a GI is an indication used on products that have a specific geographical origin and possess qualities or a reputation that are **due to that origin**.
- Darjeeling Tea, Mahabaleshwar Strawberry, Blue Pottery of Jaipur, Banarasi Sarees and TirupatiLaddus are some of the GIs.
- Recently, Union Minister of Commerce and Industry, launched the logo and tagline for the Geographical Indications (GI) of India
- Tagline – Invaluable Treasures of Incredible India
- The first product to get a GI tag in India was the **Darjeeling tea in 2004**. There are a total of **325 products from India** that carry this indication.
- The registration of a geographical indication is valid for a **period of 10 years.**

Chau mask of Purulia

Wooden Mask of Kushmandi

Patachitra Painting

Madhurkathi Mat

Dokras of Bengal

19 India to expand polar research to Arctic

CONTEXT: Three decades after its first mission to Antarctica, the government is refocusing priorities to the other pole — the Arctic

Arctic mission of India:

- India only has **one Arctic observation** station near Norway (**Himadri Station**)
- India presently has **two research stations** at Antarctica namely '**Maitri' and 'Bharati'**. New station 'Bharati' has just been constructed and established in March, 2013
- India is already an **observer at the Arctic Council** — a forum of countries that decides on managing the region's resources and popular livelihood.
- India in 2015 set up an **underground observatory**, called **IndARC,** at the Kongsfjorden Fjord, half way between Norway and the North Pole.

Steps taken by the Government

- Government has renamed the National Centre for Antarctic and Ocean Research (NCAOR) — since 1998, charged with conducting expeditions to India's base stations to the continent — as the **National Centre for Polar and Ocean Research**.
- It's also in talks with Canada and Russia, key countries with presence in the Arctic Circle, to establish new observation systems, according to a source.

Rationale Behind the Move:

- Climate change was a decisive factor in India re-thinking priorities. Sea ice at the Arctic has been melting rapidly — the fastest in this century.
- That means several spots, **rich in hydrocarbon reserves, will be more accessible through the year via alternative shipping routes**.

20 Deep Ocean Mission (DOM)

CONTEXT: Ministry Of Earth Sciences Plans Rs 8000 Crore 'Deep Ocean Mission' To Boost India's Sea Exploration Capabilities.

Pollymetallic Nodules:

- Polymetallic nodules (also known as manganese nodules) are potato-shaped, **largely porous nodules** found in abundance **carpeting the sea floor** of world oceans in deep sea. Besides **manganese and iron**, they contain **nickel, copper, cobalt, lead, molybdenum, cadmium, vanadium, titanium**.

International Seabed Authority (ISA):

- International Seabed Authority (ISA) is a UN body set up to regulate the exploration and exploitation of marine **non-living resources of oceans** in international waters. India actively contributes to the work of International Seabed Authority. Last year, **India was re-elected as a member of Council of ISA**. India's nominees on Legal and Technical Commission and Finance Committee of the ISA were also elected last year.

Key Facts:

- The **focus of the mission will be on deep-sea mining, ocean climate change advisory services, underwater vehicles and underwater robotics** related technologies.
- Two key projects planned in the 'Deep Ocean Mission' report include a desalination plant powered by tidal energy and a **submersible vehicle** that can explore depths of at least 6,000 metres.
- India has been allotted **75,000 square kilometres** in the **Central Indian Ocean Basin (CIOB**) by UN International Sea Bed Authority for exploration of poly-metallic nodules.

Analysis

- The 'Deep Ocean Mission' plan will enable India to develop capabilities to exploit resources in the Central Indian Ocean Basin (CIOB).

21 Chai Sahay App by Tea Board of India

CONTEXT: The Tea Board of India is planning to launch an Artificial Intelligence (AI)-driven multilingual mobile app — pilot-named as 'Chai Sahay'.

- The mobile app ***Chai Sahay*** **will help monitor and inspect all tea-based projects, regulatory activities, subsidies, workshops, awareness programmes and advisories in an easily navigable manner.**
- It will also multicast weather data (rainfall, sunshine, humidity, temperature) as part of its notification services and suggest suitable time for fertilizer applications on a real-time basis.
- The government-run tea watchdog - Tea Board of India - has started the process for hunting a technology outfit that can design, develop, host and maintain an Android-based mobile app in as many as six languages — Assamese, Bengali, English, Hindi, Malayalam and Tamil.
- The small growers would be able to post queries with photographs for obtaining advisory on pest and diseases on the app.
- The Minimum Benchmark Price (MBP) and green leaf price will also be uploaded in the app every month.

Tea Board of India

- Tea is one of the industries, which by an Act of Parliament comes under the control of the Union Govt.
- The genesis of the Tea Board India dates back to 1903 when the Indian Tea Cess Bill was passed. The Bill provided for levying a cess on tea exports - the proceeds of which were to be used for the promotion of Indian tea both within and outside India.
- The Tea Board is set up under the Tea Act 1953. It has succeeded the Central Tea Board and the Indian Tea Licencing Committee which functioned respectively under the Central Tea Board Act, 1949 and the Indian Tea Control Act, 1938 which were repealed.
- The Tea Board is functioning as a statutory body of the Central Government under the Ministry of Commerce.

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8

Miscellaneous

1 Glass Fibre Reinforced Gypsum Concrete

CONTEXT: Glass Fibre Reinforced Gypsum Concrete, developed by IIT Madras over the last decade is now being considered by the Kerala government for the housing needs of those whose homes were ravaged by the floods in August 2018.

Glass Fibre Reinforced Gypsum Concrete:

- Glass Fibre Reinforced Gypsum (GFRG) Panel known as **Rapidwall is a building panel made-up of calcined gypsum plaster, reinforced with glass fibers.**
- The panel is manufactured to a thickness of 124mm, length of 12m and height of 3m, under carefully controlled conditions, contains cavities that may be unfilled, partially filled or fully filled with reinforced concrete as per structural requirement.

- Experimental studies and research in Australia, China and India have shown that GFRG panels, suitably filled with plain reinforced concrete possesses substantial **strength to act not only as load bearing elements but also as shear wall, capable of resisting lateral loads due to earthquake and wind.**
- The panels can be used with confidence as it has the potential for adequate strength, stiffness, ductility and energy dissipating capacity, if suitably designed. Because of higher ductility ratio, this can be used as an efficient structural system.

Why is it important for India?

- The **demand for conventional building materials used in the housing sector such as burnt clay bricks, cement and steel is growing every year**.
- Reduction in the use of these energy intensive construction materials and speedy delivery of housing units at affordable cost are the key challenges faced in the mass housing sector today.
- Buildings using Glass Fibre Reinforced Gypsum (GFRG) panels hold promise as a rapid, affordable and sustainable mass housing solution.

2 EyeROV TUNA India's first underwater robotic drone handed over to NPOL

CONTEXT: India's first underwater robotic drone EyeROV TUNA has been handed over to Naval Physical and Oceanographic Laboratory (NPOL) of Defence Research and Development Organisation (DRDO).

- It has been designed and developed indigenously by Kochi-based start-up IROV Technologies Pvt Ltd (EyeROV).
- IROV Technologies Pvt Ltd is backed by Kerala Start-Up Mission, oil and gas firm BPCL and Department of Science and Technology.
- **It is a smart micro-ROV (Remotely Operated Vehicle) or underwater drone.**
- It can be controlled using laptop or joystick. It is fitted with camera that helps to give live HD video feed of the submarine environment.
- It is equipped to **perform variety of functions, including inspection of ship hulls, undersea cables, fish farms, dams, port structure, and bridge foundations**.
- It will be used by NPOL for R&D activities which in turn would result in its commercialization for defence purposes.
- Its commercial use will eliminate need for costlier and riskier manual inspection by divers.

3 Nobel Prize 2018

CONTEXT: The prestigious Nobel Prize winners of year 2018 in the category of Physics, Chemistry, Medicine, Peace and Economics were declared recently.

Medicine:

- The 2018 Nobel Prize in Physiology or Medicine has been jointly conferred **to James P. Allison and Tasuku Honjo for their discovery of cancer therapy by inhibition of negative immune regulation.**
- The duo successfully established an entirely new principle for cancer therapy by stimulating the ability of immune system to attack tumour cells. It is called Immune checkpoint therapy. They showed how different strategies for slowing down the brakes on the immune system can be used in the treatment of cancer. Their discoveries are landmark in fight against cancer.

Chemistry

- The Royal Swedish Academy of Sciences has selected **US scientists Frances Arnold and George Smith and British researcher Gregory Winter** for the 2018 Nobel Prize in Chemistry.
- They were selected for **harnessing power of evolution to develop enzymes and antibodies that have led to new pharmaceuticals and biofuels**. Frances Arnold shared the half price and George Smith and Gregory Winter share other half of the prize.

Physics

- Three scientists **Arthur Ashkin (USA), Gerard Mourou (France) and Donna Strickland** (Canada) have won the 2018 Nobel Prize in Physics. They were selected for **ground breaking inventions in the field of laser physics.**

Peace

- **Norwegian Nobel Committee has selected Dr. Denis Mukwege (63), Nadia Murad (25**) to jointly award 2018 Nobel Peace Prize. They were given award for their **efforts to end use of sexual violence as a weapon of war and armed conflict.**

Economics

- The 2018 Nobel Memorial Prize in Economic Science was awarded to **the American economists William D. Nordhaus and Paul M. Romer for reshaping the understanding of the long-term determinants of economic growth, innovation and climate**.

Literature

- The Nobel Prize in Literature **has been postponed** for this year.

4 Prof. SN Bose 125th Anniversary

CONTEXT: Government has started a year-long celebration to mark the 125th birth anniversary of eminent physicist Satyendra Nath Bose who was born on 1st January in 1894.

- The celebrations are being spearheaded by S.N.Bose National Centre for Basic Sciences (SNBNCBS), Kolkatta.
- **A theoretical physicist, Bose is known for his path breaking work on foundations of Quantum Statistics, laying the basis for the modern atomic theory.**
- His contribution is **Bose Einstein Condensation**. Bose was also a crusader for teaching of science in vernacular languages, besides being an accomplished musician.
- The class of particles that obey Bose–Einstein statistics, Bosons, was named after Bose by Paul Dirac. In 1937, Rabindranath Tagore dedicated his only book on science, Visva–Parichay, to Satyendra Nath Bose.
- A Fellow of the Royal Society, he was awarded India's second highest civilian award, the Padma Vibhushan in 1954 by the Government of India. In 1958, he became a Fellow of the Royal Society. He was nominated as member of Rajya Sabha.
- In 1959, he was appointed as the National Professor, the highest honour in the country for a scholar, a position he held for 15 years.

Although several Nobel Prizes were awarded for research related to the concepts of the Boson, Bose–Einstein statistics and Bose–Einstein condensate, Bose himself was not awarded a Nobel Prize.

5 Stephen Hawking

CONTEXT: Stephen William Hawking died on 14 March (Albert Einstein's birthday) at the age of 76 after decades of battling the incurable disease amyotrophic lateral sclerosis (ALS).

Contributions of Stephen Hawking

- He predicted **theoretically that black holes emit radiation**, this is often called Hawking radiation. Sub-atomic particle pairs — such as photons and neutrinos — near that point of no return could result in one particle being ejected. This became known as Hawking radiation.
- For the first time **he showed how quantum fluctuations** (i.e. minuscule variations in the distribution of matter), might give rise to the spread of galaxies in the universe.
- In 1983, together with Jim Hartle at Chicago University, he proposed a "wave function of the universe" that, in theory, could be used to calculate the properties of the universe we see around us.
- Existence of millions of Mini Black Holes formed by the force of the original Big Bang explosion.He also answered the famous unified field theory, which was one of the Einstein's unanswered theories.

What is Amyotrophic Lateral Sclerosis?

- Amyotrophic lateral sclerosis (ALS) is a group of rare neurological diseases that mainly involve the nerve cells (neurons) responsible for controlling voluntary muscle movement.
- Voluntary muscles produce movements like chewing, walking, and talking. The disease is progressive, meaning the symptoms get worse over time.
- Currently, there is no cure for ALS and no effective treatment to halt, or reverse, the progression of the disease.

6 Raman Effect

- Raman effect is **change in the wavelength of light that occurs when a light beam is deflected by molecules**. When a beam of light traverses a dust-free, transparent sample of a chemical compound, a small fraction of the light emerges in directions other than that of the incident (incoming) beam. Most of this scattered light is of unchanged wavelength. A small part, however, has wavelengths different from that of the incident light; its presence is a result of the Raman effect.
- **The Raman effect is feeble; for a liquid compound the intensity of the affected light may be only 1/100,000 of that incident beam**. The pattern of the Raman lines is characteristic of the particular molecular species, and its intensity is proportional to the number of scattering molecules in the path of the light. Thus, Raman spectra are used in qualitative and quantitative analysis.
- **Raman work is concerned with vibrational transitions**, which give larger shifts observable for gases, liquids, and solids. Gases have low molecular concentration at ordinary pressures and therefore produce very faint Raman effects; thus liquids and solids are more frequently studied.
- It was discovered by C. V. Raman and K. S. Krishnan (who was a student of C.V. Raman) in liquids, and independently by Grigory Landsberg and Leonid Mandelstam in crystals. The effect had been predicted theoretically by Adolf Smekal in 1923.

About C.V. Raman:

- Chandrasekhara Venkata Raman was an Indian scientist who was born in Madras, Tamil Nadu on November 7, 1888.
- He completed Bachelor of Arts with a gold medal in physics in 1904. He held a Master of Science degree from the University of Madras.
- Besides winning the Nobel in 1930, he was awarded Bharat Ratna in 1954.

7 Li-Fi

- Li-Fi (Light Fidelity) is a **high-speed wireless communication technology that uses visible light to transmit information.**
- Wi-Fi and Li-Fi are similar because both technologies are wireless, but also very different, because unlike Wi-Fi, which relies on radio waves, Li-Fi uses visible light communication (VLC) or infrared and near-UV spectrum waves.

Working of Li-Fi

- Li-Fi is a Visible Light Communications (VLC) system. This means that it accommodates a photo-detector to receive light signals and a signal processing element to convert the data into streamable content.
- Here, data is fed into an LED light bulb (with signal processing technology), it then sends data (embedded in its beam) at rapid speeds to the photo-detector (photodiode).
- The tiny changes in the rapid dimming of LED bulbs is then converted by the 'receiver' into electrical signal.
- The signal is then converted back into a binary data stream that the user would recognise as web, video and audio applications that run on internet enables devices.

Potential applications

- **RF Spectrum Relief**: Excess capacity demands of cellular networks can be off-loaded to Li-Fi networks where available. This is especially effective on the downlink where bottlenecks tend to occur.

- **Smart Lighting**: Any private or public lighting including street lamps can be used to provide Li-Fi hotspots and the same communications and sensor infrastructure can be used to monitor and control lighting and data.
- **Mobile Connectivity**: Laptops, smart phones, tablets and other mobile devices can interconnect directly using Li-Fi. Short range links give very high data rates and also provides security.
- **Hazardous Environments**: Li-Fi provides a safe alternative to electromagnetic interference from radio frequency communications in environments such as mines and petrochemical plants.
- **Hospital & Healthcare**: Li-Fi emits no electromagnetic interference and so does not interfere with medical instruments, nor is it interfered with by MRI scanners.

8 Vaterite

CONTEXT: A team of biologists from the University of Cambridge, UK, has found that a very rare and unstable mineral called Vaterite is a dominant component of the protective silvery-white crust that forms on the leaves of a number of alpine plants.

- It was named after the German mineralogist Heinrich Vater.
- It is also **known as mu-calcium carbonate**. **Vaterite was often associated with outer space and had been detected in planetary objects in the Solar System and meteorites.**
- Vaterite is not very stable in the Earth's humid atmosphere as it often reverts to more common forms of calcium carbonate, such as calcite.
- Naturally occurring vaterite — a form (polymorph) of calcium carbonate — is rarely found on Earth.
- Small amounts of vaterite crystals have been found in some sea and freshwater crustaceans, bird eggs, the inner ears of salmon, meteorites and rocks.
- It can be used for drug delivery as vaterite has special properties that make it a potentially superior carrier for medications due to its high loading capacity, high uptake by cells and its solubility properties that enable it to deliver a sustained and targeted release of therapeutic medicines to patients.

9 Impact Based Forecasting Approach

CONTEXT: India Meteorological Department (IMD) has developed new technology called 'Impact Based Forecasting Approach' to assess rise of water level in rivers and reservoirs by rain.

- It shows **pre-event scenario will help state governments authorities to minutely monitor impact of rainfall and take real-time decisions.**
- It will **help to avoid disastrous situation similar to Kerala floods**.
- It can generate scenario to help take decisions to release water or not from reservoirs after heavy downpour.
- It will be helpful for every state authority to take decision. This system can be run in pre-event scenario.

10 India's first engine-less train

CONTEXT: Train 18, is the country's first engine-less train which is being regarded as a successor to the 30-year-old Shatabdi Express.

- **Driven by a self-propulsion module sans** a separate locomotive, the train, capable of running at a speed of up to 160 kmph, comes with technical features for enhanced quick acceleration.
- Developed by the city-based Integral Coach Factory in 18 months, the full AC train is designed in such a way that passengers can have a look at the driver's cabin.

It has a potential to travel up to the speed at 160 kmph as against 130 kmph of Shatabdi and would result in the travel time being reduced by around 15 per cent once the tracks are fit to suit Train 18's speed.

11 Other Scientific Achievements in India in 2018

- **World's thinnest material with novel technique**: It is a material that is 100,000 times thinner than a sheet of paper. Researchers synthesized a two-dimensional material of just one-nanometre in thickness using **Magnesium diboride**—a compound of boron. This is said to be the **world's thinnest material**. It can find a range of applications—from next-generation **batteries** to **ultraviolet absorbingfilms**.
- **Faster diagnostic tests for tuberculosis**: Scientists have developed highly sensitive and rapid tests for detection of tuberculosis infection in lungs and surrounding membranes. Unlike current tests that use antibodies for detection of bacterial proteins in sputum samples, new tests use **Aptamer Linked Immobilized Sorbent Assay (ALISA) and Electrochemical Sensor (ECS**) for detection of a **bacterial protein in the sputum**.
- **A gel that can protect farmers from toxic pesticides**: It is a protective gel—**poly-Oxime**—that can be applied on skin and can break down toxic chemicals into safe substances, preventing farmers from going deep into the skin and organs like the brain and the lungs.
- **Hope for Alzheimer's and Huntington's patients**: Scientists at the Indian Institute of Science (IISc), Bengaluru, have figured out the way memory deficit develops in early stages, resulting in Alzheimer's disease. They have found that early breaking down of a protein, fibrillar actin or F-actin, in the brain leads to disruption in communication among nerve cells and consequently memory deficits.
- **Green technique can address plaster of Paris pollution**: A team of scientists at Pune-based **National Chemical Laboratory (CSIR-NCL)** has developed a technique that helps recycle plaster of Paris waste from hospitals in an eco-friendly and economical way. The new technique disinfects waste and converts it **into useful products like ammonium sulphate and calcium bicarbonate**. The technique can also be used to disintegrate PoP waste from idols immersed in water bodies.
- **New tool developed for autism screening**: In many cases, autism is misdiagnosed as mental retardation and attention deficit hyperactivity disorder (ADHD). Early identification and interventions may help children with autistic disorders. To help this process, scientists have developed an Indian tool for screening children for autism.
- **Stone Age tools, genetic studies throw new light on early civilisation in India**: The Stone Age tools discovered in a village near Chennai suggest that a Middle Palaeolithic culture was present in India around 385,000 years ago—roughly the same time that it is known to have developed in Africa and in Europe. The discovery pushes back the period when populations with a Middle Palaeolithic culture may have inhabited India, and challenges popular theory that the Middle Palaeolithic was brought to India by modern humans dispersing from Africa only around 125,000 years ago or later.
- **Sikkim gets real-time landslide warning system**: A real-time landslide warning system has been set up in the Sikkim-Darjeeling belt of north-eastern Himalayas which is highly vulnerable to landslides. The warning system consists of over 200 sensors that can measure geophysical and hydrological parameters like rainfall, pore pressure and seismic activities. The system is capable of warning about 24 hours in advance. It has been **deployed by researchers of Kerala-based Amrita University and Sikkim State Disaster Management Authority**.
- **Computing capacity for weather forecasting gets a boost**: During the year, the Indian Institute of Tropical Meteorology (IITM) upgraded its computing capacity for weather forecasting and climate monitoring, taking its total high performance computing (HPC) power to as high as 6.8 Petaflop. With this, **India rose to the fourth position**, next only to United Kingdom, Japan and USA in terms of dedicated capacity for HPC resources for weather and climate proposes.

- **Scientists use silk polymer to develop artificial vertebral disc**: Scientists at Indian Institute of Technology, Guwahati, developed a silk-based bioartificial disc that may find use in disc replacement therapy in future. The group has developed a fabrication procedure for a silk-based bioartificial disc adopting a "directional freezing technique". The disc mimics internal intricacy of human disc and its mechanical properties too are similar to those of the native ones. The use of a silk biopolymer to fabricate a biocompatible disc can reduce the cost of artificial discs in future.
- **Flowering mustard**: TERI School of Advanced Studies has developed an early flowering transgenic variety of mustard.
- **Gene editing applied to banana genome**: Using the gene editing technique—CRISPR/Cas9—researchers at the National Agri-Food Biotechnology Institute, Mohali, edited the banana genome. This is the first such work in any fruit crop in India. Banana is the fourth most important food crop after wheat, rice and corn in terms of gross value of production. Gene editing could be deployed to improve nutritional quality, agronomical important traits as well as pathogen resistance in banana.

12 Dry Sorbent Injection (DSI)

CONTEXT: In a first, a thermal power plant decides to use DSI technology to curb SO2 emission.

- **DSI is the practice of injecting a dry alkaline mineral into a flue gas stream to reduce acid gas emission.**
- DSI offers advantages in comparison to traditional acid gas scrubber technology: **lower capital cost, wide range of favourable operation conditions, and much lesser time for completing installation and commissioning.**
- While conventional wet limestone flue gas desulphurisation (WLFGD) takes over two years, DSI takes only 12-14 months to be up and running. It also reduces emissions of other acidic gases and **heavy metals like mercury.**
- In a significant development, the National Thermal Power Corporation (NTPC)'s Dadri Power Plant is opting for a Dry Sorbent Injection (DSI) system for controlling sulphur dioxide (SO2) emissions and ensuring compliance with the 2015 environmental norms within the stipulated deadline.

13 Microcystallites

CONTEXT: These are a new type of gold in the form of very small crystals developed by researchers from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru.

- The newly **formed microcystallites, about 3 micrometre in length were found to be of a** different crystal structure.
- Normal gold has a (face-centered) cubic structure, while the new ones exhibit deformed cubic structure — tetragonal and orthorhombic cells.
- The microcrystal gold has been found to be nobler than gold — it do not dissolve in mercury and Aqua regia (a mixture of nitric acid and hydrochloric acid), and showed the least interaction with copper.
- Microcystallites are also more stable than the normal gold.

14 SARAS

- SARAS PT1N, the **new upgraded version of indigenous transport aircraft SARAS** has been developed by National Aeronautics Laboratory (NAL).

- SARAS PT1N is a **14-seater passenger aircraft** designed and developed by CSIR-NAL, a frontline aerospace research laboratory. The production version aircraft will have 19-seat capacity.
- The first prototype of the plane had made its first flight in May 2004. SARAS PT1N is upgraded version of plane, after second prototype of SARAS that had crashed during test flight killing all three crew members on board in March 2009.

15 Silver Copper Telluride

CONTEXT: Researchers have developed silver copper telluride (AgCuTe), a novel compound that exhibits poor thermal conductivity but shows good electrical conductivity.

- The new material having thermoelectric properties is **made from silver, copper, and tellurium.**
- It shows **high levels of thermoelectric performance** i.e. exhibits poor thermal conductivity in 25-425 degree C range but shows good electrical conductivity like metal at same time.
- The compound shows ideal promise as thermoelectric material **for converting waste heat into electricity.**
- Its potential applications as thermoelectric technology **are in automobile industry, thermal, chemical and steel power plants where large quantities of heat are wasted**.

16 Ice VII

- **Commonly used is called as ice-I.** When water freezes, the oxygen atoms move into a hexagonal arrangement. That's why ice expands and has lower density than water. Compressing ice can change the shape of the crystals, turning ice-I into ice-II (rhombus-shaped crystals), ice-III (tetragonal crystals), and so on.
- **Ice-VII, with its cubic crystals, is unique in that it remains stable even as pressure increases dramatically. It's 1.5 times more dense than ice-I as well.**
- There's (almost) nowhere on Earth for ice-VII to form, because it **requires both low temperatures and high pressure exceeding 30,000 atmospheres (3 gigapascals**). The only place you can reach that pressure is **deep in the Earth's mantle**, but it's too hot for ice to form there.
- The formation of ice-VII doesn't require freezing temperatures — as long as the pressure is high enough, ice-VII can form at room temperature.
- Diamonds often pick up molecules during their formation deep in the Earth. These so-called inclusions can affect the quality or color of the diamond, but sometimes the inclusion is just water. One interesting property of diamonds is the internal structures don't relax when they leave the high-pressure mantle. So, the water inside a diamond remains compressed, even though it's technically in a liquid state.

17 2019 - International Year of the Periodic Table of Chemical Elements

CONTEXT: The United Nations General Assembly during its 74th Plenary Meeting proclaimed 2019 as the International Year of the Periodic Table of Chemical Elements

Background:

- 1869 is considered as the year of discovery of the Periodic System by Dmitri Mendeleev.
- 2019 will be the 150th anniversary of the Periodic Table of Chemical Elements.

Structure of Periodic Table:

- The current table holds **117 elements** in a very distinct order for the purpose of showing similarities and differences in chemical properties.
- **94 are found in nature** and the other **24 were synthetically produced** with particle accelerators.
- Elements are placed in order of **increasing atomic number**, which is **the number of protons** in the nucleus of the element's atom.
- The rows are also organized so that **elements with similar properties are found in the same columns**.
- At the bottom of the periodic table is a two row block of elements that contain the **lanthanoids and actinides**. These groups are classified as **inner transitional metals**.

CLASSIFICATION in Periodic Table:

- The chemical elements classified into **groups, periods, and blocks.**
- **Groups** are the **vertical columns** located on the periodic table. Many groups contain elements with very similar properties.
- **Periods** are made up of the **horizontal rows** of the table.
- Like Groups, periods also contain specific trends in similar properties.
- **Blocks** are important as different regions of the periodic table due to the **outer shell of electrons** within the elements' atoms. The blocks of the periodic table include the s-block, p-block, d-block, and f-block.

Chemical Properties

- Properties of an element can actually be **predictedbased on its table location.** Trends within groups are explained by **common electron configuration** in their valence shells.
- From the top of the group to the bottom, atomic radii of the elements increase.
- Moving from the left of the periodic table to the right, atomic radii decreases which causes the ionization energy to increase.
- moving left to right, electronegativity and electron affinity increase.

- The initiative for IYPT2019 is supported by IUPAC in partnership with the International Union of Pure and Applied Physics (IUPAP), European Association for Chemical and Molecular Science (EuCheMS), the International Council for Science (ICSU), International Astronomical Union (IAU), and the International Union of History and Philosophy of Science and Technology (IUHPS).

18 New Element with Magnetic Properties Discovered

CONTEXT: Scientists have discovered that the chemical element ruthenium (Ru) is the fourth element to have unique magnetic properties at room temperature.

Ruthenium:

- Ruthenium is a member of the platinum group.
- It is a hard, white transition metal.
- It does not tarnish at room temperatures but oxidizes explosively. It can be attacked by halogens and hydroxides.

- Atomic Number: 44

So far only three periodic table elements have been found to be ferromagnetic at room temperature: **iron (Fe), cobalt (Co), and nickel (Ni**).

Significance:

- The discovery could be used to improve sensors, devices in the computer memory and logic industry or other devices using magnetic materials

World's standard definition of kilogram now redefined

Context - The Definition of the Kilogram is changed by redefining the International system of units(SI).

Background

- There are seven fundamental units and every other unit of measurement can be derived from one or more of these seven units.
- Three of the seven fundamental units are already based on unchanging properties of nature.
- These are the second, meter, and the candela.

The Seven Fundamentals Units		
Unit	**Quantity**	**How is/will be defined**
Meter*	Distance	Based on speed of light
Kilogram **	Mass	To be used on Planck constant
Second*	Time	Based on radiation of caesium-133 atom
Amere**	Current	To be based on anelectron's Charge
Kelvin**	Temperature	To be based on Boltzmann constant
Mole**	Amount of substance	To be based on Avolgadro constant
Candela*	Luminous intensity	From efficacy of light of specific frequency

*Current definition stands **Being redefined

- Since the 19th century, scientists have based their definition of the fundamental unit of mass on a physical object — a **shining platinum iridium cylinder stored in a locked vault in the bowels of the International Bureau of Weights and Measures (BIPM) in Sevres, France**.
- A kilogram was equal to the heft of this aging hunk of metal, and this cylinder, by definition, weighed exactly a kilogram
- If the cylinder changed, even a little bit, then the entire global system of measurement had to change, too.

How the existing Definition is redefined?

- Scientists redefined the kilogram for the 21st century by tying it to a **fundamental feature of the universe** — a small, strange figure from quantum physics known as **Planck's constant**, which describes the **smallest possible unit of energy**
- Planck's constant will be defined as **6.62607015×10^{-34} joule seconds**.

Analysis:

- The change in the kilogram will be better for technology, retail and health. For most people, everyday life will carry on as normal despite the redefinitions. But some of these changes will mean practical advantages for scientists making very precise measurements.

19 Indian National Centre for Ocean Information Service (INCOIS)

CONTEXT: India, along with 23 other Indian Ocean Nations, participated in a major Indian ocean-wide tsunami mock exercise (drill) on 4th& 5thSeptember, 2018.

Key Facts

- The Exercise was known as **IOWave18**,was organized by **the Intergovernmental Oceanographic Commission (IOC) of UNESCO.**
- IOWave18 was completed focused on simulating an **earthquake with magnitude of 9.3** at Northern Sumatra, Indonesia at 0830 IST.
- In India, IOWave18 is being coordinated by the Indian **National Centre for Ocean Information Services (INCOIS)**, with support from **National Disaster Management Authority (NDMA**), **National Disaster Response Force (NDRF**) and the **Coastal States/UTs**.
- All coastal states tested communication modes for receipt of bulletins from INCOIS.
- The end-to-end warning system from tsunami detection and forecast, threat evaluation and alert formulation, alert dissemination to public and their awareness and response was put to test during this exercise.

About INCOIS:

- **ESSO-INCOIS** was established as an autonomous body in 1999 under the **Ministry of Earth Sciences (MoES)** and is a unit of the **Earth System Science Organization (ESSO**).
- HQ : Hyderabad
- ESSO- INCOIS is mandated to provide the best possible ocean information and advisory services to society, industry, government agencies and the scientific community through sustained ocean observations and constant improvements through systematic and focussed research.

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