VISIONIAS
www.visionias.in

Classroom Study Material

SCIENCE AND TECHNOLOGY

JUNE 2016 – March 2017

NOTE: April 2017 to 15th May 2017 current affairs for PT 365 will be updated on our website on third week of May.

Table of Contents

1. BIOTECHNOLOGY

1.1. HUMAN GENOME PROJECT-WRITE (HGP-WRITE)

Why in news?

On June 2, 2016, scientists from multiple academic institutions in the US published a perspective in the journal Science proposing a second human genome project, called Human Genome Project-Write (HGP-Write)

Background

- The original Human Genome Project was referred to as HGP-Read.
- HGP-read aimed to "read" a human genome. Many scientists now believe that to truly understand our genetic blueprint, it is necessary to "write" DNA and build human (and other) genomes from scratch.

What is the Genome Project-write?

- It will be an open, academic, international scientific research project led by a multi-disciplinary group of scientific leaders who will oversee a reduction in the costs of engineering and testing large genomes, including a human genome, in cell lines by over 1,000-fold within ten years,
- They will also be developing new technologies and an ethical framework for genome-scale engineering as well as transformative medical applications.
- The overarching goal of such an effort is to further our understanding of the blueprint for life provided by the Human Genome Project (HGP-read).

The Human Genome Project (HGP) Read was a large, international and multi-institutional effort that took 13 years [1990-2003] and $2.7 billion to produce a blueprint of the sequence of genes and spaces between genes that make up a typical human genome.

How will HGP-write benefit humanity?

Some potential applications include, but are not limited to:

- Growing transplantable human organs, thus saving the lives of thousands of patients globally who die waiting for donated organs from those who die from disease or accidents
- Engineering immunity to viruses in cell lines
- Engineering cancer resistance into new therapeutic cell lines
- Enabling high-productivity, cost-efficient vaccine and pharmaceutical development using human cells and organoids that makes precision medicine more affordable and universal

How will HGP-write benefit biomedical research?

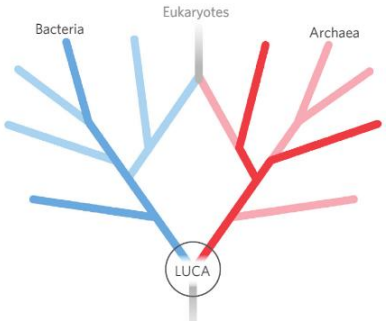
- Similar to sequencing and computation, DNA synthesis is a foundational technology. HGP-write is therefore expected to accelerate research and development across the spectrum of life sciences, supporting basic research and the development of new bio-based therapies, vaccines, materials, energy sources, and foods.
- Additionally, the project will develop enabling tools of broad applicability throughout biomedical research
  - ✓ Computational tools, which allow the redesign of any genome, followed by compilation and testing of the redesigned code in silico before hitting the print button
  - ✓ Phenotypic screening platforms such as organoid cultures, which allow characterization of performance of synthetic DNA and variants of unknown significance
  - ✓ Cheaper, more accurate and longer DNA synthesis and assembly.
  - ✓ Targeted delivery to specific cell types or systemically throughout multiple organ systems.

1.2. LUCA

Why in News?

- A team of scientists led by William Martin from Heinrich Heine University, Dusseldorf have discovered the ancestor of all things on earth and its name is LUCA.

About LUCA



- **LUCA stands for Last Universal Common Ancestor**.
- It is the most recent organism from which all organisms now living on Earth have a common descent. Thus, it is the most recent common ancestor (MRCA) of all current life on Earth.
- As such, it should not be assumed to be the first living organism.

Highlights of the study

- Two of three major life domains: **Bacteria and Archae** share common genetic features with LUCA.
- Scientists went through 6.1 million protein encoded genes and **identified 355 genes that trace to the last ancestor by phylogenetic criteria**.
- LUCA is no less that **4 billion years old** and was a single cell organism.
- The study suggests that LUCA lived in a "geochemically active environment". i.e. it did not necessarily need oxygen and can feed off hydrogen, carbon dioxide and iron.

An autotroph is an organism that produces complex organic compounds from simple substances present in its surroundings, generally using energy from light or inorganic chemical reactions.

- LUCA would have inhabited volcanically active places or areas where tectonic plates are moving apart, ocean basins, and hotspots.
- The study also suggests autotrophic or self-nourishing origin of life.
- It also proves Charles Darwin propose theory of universal common descent through an evolutionary process.

1.3. FIRST HUMAN GENETIC EDITING TRIAL

Why in News?

- **Chinese scientists** are set to perform the **world's first genetic editing trial on humans** in August 2016 in order to find a **cure for lung cancer**.
- Oncologists will inject patients with cells that have been modified using a specific **gene-editing technique**.

What is it?

- The process of genetic editing will be carried out through **CRISPR-Cas9** technique.
- **CRISPR (clustered regularly interspaced short palindromic repeats)** is a collection of DNA sequences that lets scientists to selectively **edit genome parts and replace them with new DNA stretches**.
- **Cas9** is an **enzyme** that can edit DNA allowing the alteration of genetic patterns through genome modification.
- CRISPR directs Cas9 where to cut and paste.

How will it work?

- Doctors will extracts **T-cells (a type of immune cell)** from **lung cancer patients** and edit them.
- The edited cells will then be multiplied in the laboratory before being reintroduced into the patient's body.
- T-cells are then expected to attack **tumour cells**.
- This technique has been approved in the UK as a way to bypass a baby inheriting harmful mitochondrial diseases.

1.4. BIOTECH-KISAN AND CATTLE GENOMICS

Why in News?

- The Ministry of Science and Technology has launched two farmer-centric initiatives known as Biotech-KISAN and Cattle Genomics.

Biotech-KISAN (Krishi Innovation Science Application Network)

- **For Farmers:** The Biotech-KISAN is a Farmer centric scheme launched by of the Department of Biotechnology, where scientists will work in sync with farmers to understand problems and find solutions.

- **By Farmers:** Developed in consultation with the farmers. Biotech-KISAN aims to link farmers, scientists and science institutions across the country in a network that identifies and helps solve their problems in a cooperative manner.
- **Empower women:** The scheme includes the Mahila Biotech- KISAN fellowships, for training and education in farm practices, for women farmers. The Scheme also aims to support the women farmers/ entrepreneur in their small enterprises, making her a grass root innovator.
- **Connects Globally:** Biotech-KISAN will connect farmers to best global practices; training workshops will be held in India and other countries.
- **Hubs and Spoke.** In each of these 15 regions, a Farmer organisation will be the hub connected to different science labs, Krishi Vigyan Kendra and State Agriculture Universities co-located in the region. The hub will reach out to the farmers in the region and connect them to scientists and institutions.

Cattle Genomics

- Through this programme, the government aims to improve the genetic health of the cattle population through genomic selection. Genomic selection will ensure high-yielding, disease-resistant, resilient livestock.
- Genome sequencing of indigenous cattle breeds from all registered cattle breeds of India by involving various stakeholders is to start soon.
- The programme also envisages development of high-density DNA chips. This will reduce the cost and time interval for future breeding programmes and productivity of indigenous cattle would be enhanced.

1.5. BIOFUEL FROM AQUATIC WEEDS

Why in News?

- Scientists at IIT Kharagpur found a way to ramp up yields of biofuel sourced from commonly found aquatic weeds such as water hyacinths.

What is Biofuel?

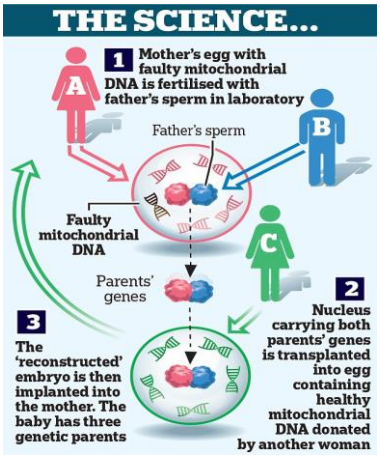
- A **biofuel** is defined as any fuel whose energy is obtained through a process of biological carbon fixation. Biofuel can be characterized on the basis of their source biomass.

What is Aquatic weed?

- Aquatic weeds are those unabated plants which grow and complete their life cycle in water and cause harm to aquatic environment directly.
- Some limitations of Aquatic weed are that it reduces water storage capacity in reservoirs, tanks, ponds. It also impedes flow and amount of water in canals and drainage systems.
- It also reduces fish production by lowering oxygen levels and promoting nutrient assimilation. It also interferes with navigation and aesthetic value of water body. It also promotes habitat for mosquitoes.

1.6. MITOCHONDRIAL GENE THERAPY

Why in news?



- The world's first baby using a controversial new technique developed by US scientists to include DNA from three parents in the embryo has been born.
- **Human Fertilization and Embryology Authority (HFEA**) of United Kingdom has allowed the first mitochondrial replacement therapy (MRT) by allowing creation of a "**three-parent baby**" - a child in which the vast majority of DNA comes from the mother and father and a small amount of DNA comes from a female donor.
- The procedure was done through the pronuclear transfer technique.

About 3- parents' technique

- It is a mitochondrial transfer technique that creates embryos that carry the chromosomes of two parents, but the mitochondrial DNA of a donor.

Significance and types of the MRT

- The benefit of MRT is that it helps in preventing mitochondrial diseases which can be passed on from the affected mother to the offspring.
- The process can be done by two methods - **Pronuclear transfer** and the Spindle **transfer.**

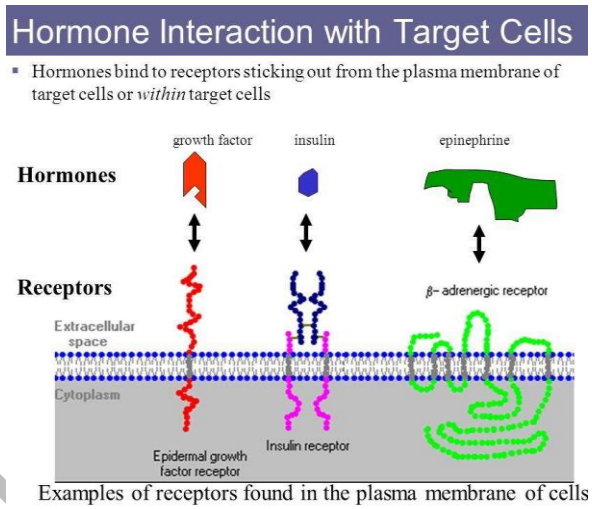
1.7. G-PROTEIN COUPLED RECEPTORS (GPCR)

Why in news?

- Researchers from IIT Kanpur have found that regulation of **GPCRs** by the drug molecules can be far simpler than earlier thought by simply engaging with **end (tail)** of receptor.

Background

- **Presently**, for any drug to be effective it has to bind at **two sites** of receptors – at the tail, outside the cell and at the core, present inside the cell.
- However researchers were able to prove drug could be equally effective by just binding at one of the site i.e. at the tail of receptor. They through specific engineering, made the other site i.e. **core of the receptor** ineffective.



Examples of receptors found in the plasma membrane of cells

How GPCRs works?

- **Receptors** are found on the cell surface with a part of it embedded in the cell membrane and other part protrudes outside membrane and inside of the cell.
- These Receptors reacts to **external stimuli** by changing their shape which brings a corresponding change in the shape of receptors inside the cell. This change in shape inside the cell allows the receptor to bind to a particular protein called **G-Protein** triggering a specific change in the cell which brings physiological changes in our body.(**G- Proteins** are a family of proteins, which act like a **switch mechanism** inside cell and is activated by **GPCRs**).
- These **external stimuli** can be brought about by any hormones, drugs, photons, neurotransmitters, growth factors or glycoproteins.
- In a person with high blood pressure, a prescribed drug binds to receptor and activates corresponding protein inside cell **arrestins (effector proteins of these particular GPCRs**).
- As a result arrestin pulls the receptor inside the cell (Process called **receptor endocytosis**). This prevents the **angiotensin** (**hormone** responsible for increasing blood pressure) from binding to the receptor even if it is present in blood and thus interrupts signaling process, thereby helping in controlling the blood pressure.

1.8. DNA-TAGGING OF CONVICTS

Why in news?

Andhra Pradesh is drafting a legislation that will enable collection and storage of genetic fingerprints in a centralized database to track offenders.

What is DNA fingerprinting?

- DNA fingerprinting is a laboratory technique used to establish a link between biological evidence and a suspect in a criminal investigation.
- DNA fingerprinting is also used to establish paternity, seed stock identification, the authenticity of consumer products, and medical diagnosis.

1.9. THE REGIONAL CENTRE FOR BIOTECHNOLOGY ACT 2016

- To serve members of UNESCO as per its obligation under an agreement by India in 2006 with UNESCO the government had set up the Regional Centre for Biotechnology Training and Education in Faridabad, Haryana through an executive order in 2009.

- The Act gave legislative backing to the Regional Centre. It confers upon it the status of an institution of national importance.
- The objectives of the Regional Centre includes
  - Disseminate knowledge by teaching and research facilities in biotechnology
  - Facilitate transfer of technology and knowledge in the SAARC region and generally Asia
  - Create a hub of biotechnology expertise
  - Promote cooperation at the international level.

1.10. AGRICULTURAL BIOTECHNOLOGY-RICE VARITIES

- Assam Agricultural University (AAU) has developed two rice varieties, namely **Ranjit Sub-1 and Bahadur Sub-1** – it is an extension of the Ranjit and Bahadur varieties being used by the farmers currently in Assam.
- The objective is **to get better yields under submerged conditions** in Assam mainly in the Barak Valley.
- The state is prone to periodical flash floods particularly during the monsoon season.

1.11. BIOMOLECULE SEQUENCER EXPERIMENT

- NASA successfully sequenced DNA in microgravity under **Biomolecule Sequencer experiment.**
- This experiment was done abroad the International Space Station.
- It used a MinION sequencer that is the only real time device for DNA and RNA sequencing.
- With this knowledge, astronauts could diagnose an illness to help protect themselves against health problems during long duration missions like journey to Mars
- Future explorers could also potentially use this technology to identify DNA-based life forms beyond Earth.

1.12. GELATOR

- **Gelator is a compound** developed by researchers at the Indian Institute of Science Education and Research (IISER) Thiruvananthapuram.
- It is a compound to **recover marine oil spills** with a simple, efficient and cost-effective method.
- It is partly hydrophobic and partly hydrophilic - hydrophilic part forms gelator fibres, the hydrophobic part is responsible for diffusion into the oil layer.
- **Gelator congeals oil** i.e. making oil semi-solid, from an oil-water mixture.
- Unlike other alternatives, **the gelators are in a powder form** and can be easily applied over oil-water mixture thus avoiding any environmental damage.
- It can be re-used several times.

1.13. RIDL TECHNOLOGY

- **Release of Insects carrying Dominant Lethal genes (RIDL) technology** is a technology using **genetically modified mosquitoes** to suppress wild female Aedes aegypti mosquito populations that transmit dengue, chikungunya and Zika.
- It uses **genetically modified male Aedes aegypti mosquitoes** carrying a dominant lethal gene.
- When male GM mosquitoes mate with wild female mosquitoes, the lethal gene is passed on to offspring that kills the larvae before they reach adulthood.
- Since male mosquitoes do not bite humans, the release of GM males does not increase the risk of dengue, chikungunya and Zika.

1.14. YAMANAKA GENES

Why in news?

- Recently, scientists have found a 'stress factor,' a pro-inflammatory molecule called interleukin-6 (IL6) that may be responsible for reducing the efficiency of the Yamanaka genes.

About Yamanaka Genes

- They are the four essential genes that can reprogramme the cells in our body and can be used to regenerate old cells or grow new organs.
- Collectively known as OSKM (for the initials of the genes, *Oct4*, *Sox2*, *Klf4* and *Myc*), these Yamanaka genes are named after Japanese scientist Shinya Yamanaka.

- With this finding the Yamanaka genes may finally result in practical therapy.

Significance of Yamanaka genes

- The introduction of these genes can convert adult cells into pluripotent stem cells.
- Can be used for RBC generation as type O red blood cells are synthesized from iPSC developed with Yamanaka genes.
- A big revolution as they can use for investigation of diseases and drugs.
- Can be used to synthesise new from stem cells.
- Can also be used to grow & repair tissues & vascular vessels.

About iPSCs

iPSCs are body (somatic) cells which have been reprogrammed to function like embryonic stem cells, thereby sidestepping the controversial use of killing the embryos while harvesting the stem cells.

- This is done by introducing four regulatory factors (pieces of DNA) into the cells.
- Scientists at the Guangzhou Institutes of Biomedicine and Health, China have claimed that they have improved the efficiency of Shinya Yamanaka's invention of producing induced Pluripotent Stem Cells (iPSC) which won Nobel Prize in Medicine in 2012.

Challenges

- The genes are not very efficient at reversing cell-ageing.
- There is a risk of incomplete programming.
- They may also induce a particular type of tumour (known as teratoma) that makes cell reprogramming incompatible with its potential clinical use.

But the supplies of autologous cells is unlimited & bypass the need for embryos, better understanding of these genes may lead to greatest achievements in medical treatments & research.

1.15. CYBATHLON 2016

Why in news?

- For the first time, Cybathlon was organized in Zurich on October 8 last year.

About Cybathlon

- It will host 74 athletes from 25 countries.
- Unlike the Paralympics, the Cybathlon looks for excellence and innovation in the way of interfacing the human and the robotic components.
- It intends to promote the development and widespread use of **bionic technology.**
- An Indian team, trained and supported by Riselegs (a Bengaluru-based organization that specializes in devising prosthetic legs and mobility devices made of cane) will participate.

- It will feature six disciplines:
  - ✓ Functional Electrical Stimulation (FES) bicycle race
  - ✓ Powered Leg Prosthesis Race
  - ✓ Powered Wheelchair Race
  - ✓ Powered Exoskeleton Race
  - ✓ Powered Arm Prosthesis Race
  - ✓ Brain-computer interfaces game (BCI Race).

Bionics Technology in medicine

- In medicine, Bionics usually means the replacement or enhancement of organs or other body parts by mechanical versions or electrical add ons.
- Bionic implants differ from mere prostheses by mimicking the original function very closely, or even surpassing it.

2. IT AND COMPUTERS

2.1. INTERNET OF THINGS

2.1.1. INDUSTRIAL INTERNET

What is Industrial Internet?

- IoT's industrial applications are called as the 'Industrial Internet'.
- The Industrial Internet closely linked to enterprise IoT is likely to radically transform and overhaul business segments including manufacturing, oil and gas, agriculture, defence, mining, transportation and healthcare etc. Collectively, these sectors account for over two-thirds of the global economy.

How Industrial Internet works?

- The industrial Internet draws together fields such as machine learning, big data, the Internet of things and machine-to-machine communication to absorb data from machines, analyze it (in real-time), and use it to adjust operations.
- It holds great potential for quality control, sustainable and green practices and overall supply chain efficiency.
- The Industrial Internet also is applied to transportation projects, such as driverless cars and intelligent railroad systems.

About The internet of things (IoT)

- The internet of things (IoT) is the network of physical devices, vehicles, buildings and other items-embedded with electronics, software, sensors, and network connectivity that enable these objects to collect and exchange data.
- Thus IoT creates opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefits
- IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems. It can also be used to improve crop yield to help feed the world's growing population.

2.1.2. IOT INDIA CONGRESS

- IOT India Congress aims to bring together stakeholders across the value chain and verticals to collaborate on a common roadmap for IoT implementation.
- First session of IOT India Congress was held at Bengaluru.

2.2. AQUILA

Why in news?

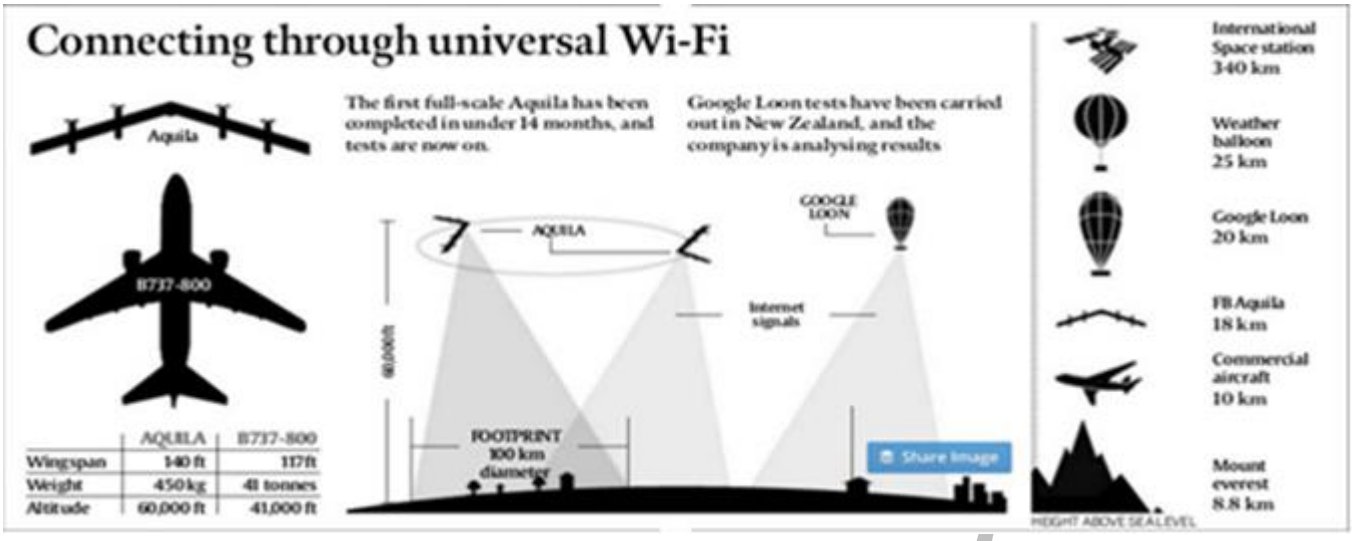
- **Facebook** successfully completed its first test flight of its **solar powered internet drone Aquila.**
- Also, the company hopes to develop a fleet of Aquilas that can fly for at least three months at a height of 60,000 feet and communicate with each other to provide internet access.

Free Basics Banned in India

- Facebook tied up with Reliance Communications to launch the Free Basics program in India in 2015.
- However, the **Telecom Regulatory Authority of India (TRAI)** banned Free Basics in early 2016 supporting **net neutrality** and against **differential data pricing for content services.**

About Aquila

- Aquila project is part of the Facebook's Connectivity Lab, a department which is creating new technologies including aircrafts, satellites and wireless communication systems.
- Facebook is trying to bring internet access to areas where internet connectivity is bad or non-existent.
- One of the other initiatives that the company has taken to achieve this goal is by providing pared down version of the internet in poor areas. It is called **Free Basics or internet.org**.
- Similarly, Google's parent company **Alphabet Inc.** has also invested to provide internet access to under-served areas through **Project Loon**. The project aims to use high-altitude balloons to create an aerial wireless network.



2.3. PARAM-ISHAN SUPERCOMPUTER LAUNCHED

- Union Human Resource Development Minister launched the supercomputer PARAM-ISHAN at IIT Guwahati.
- Param-Ishan has the power of 250 Teraflops and three hundred tera bites capacity.
- This supercomputer can be used in application areas like computational chemistry, computational fluid dynamics, computational electromagnetic, civil engineering structures, nana-block self-assemble, optimization etc.
- It can also be used for weather, climate modelling and seismic data processing.

2.4. FIRST AUGMENTED REALITY (AR) INSTITUTE

About

- India's first augmented reality (AR) education and training institute will be set in Varanasi.
- The institution will be established by the central government in partnership with Eon Reality, an augmented reality company based in the US.

What is Augmented Reality?

- Augmented reality is a computer technology that functions on computer vision-based recognition algorithms to augment sound, video, graphics and other sensor based inputs on real world objects, using your device's camera.
- It layers digital enhancements to enrich an existing real life setting by appealing to the senses.
- Augmented 3D information helps workers on assembly lines, or during maintenance work and repair to carry out required tasks.

2.5. QUANTUM COMMUNICATIONS

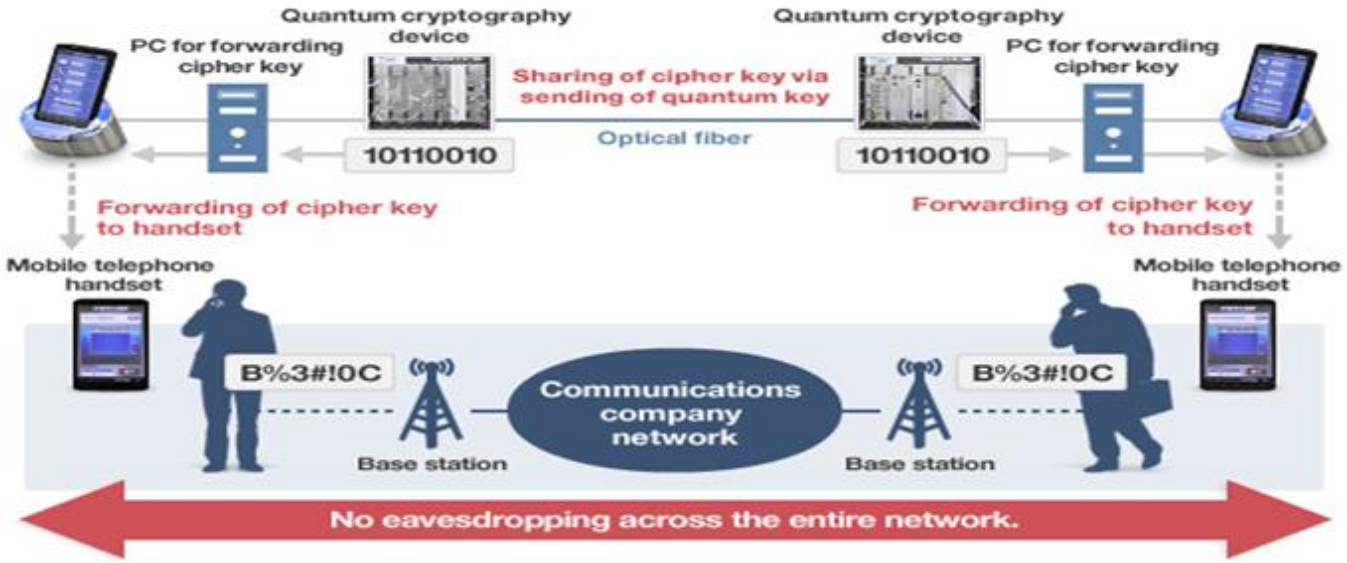
Why in news?

China recently launched a 712-km quantum communication line, stated to be the world's longest secure telecommunications network, which boasts of ultra-high security making it impossible to wiretap, intercept or crack the information transmitted through them.

> Quantum communication is a field of applied quantum physics closely related to quantum information processing & quantum teleportation.

What is it?

- The technology allows one to **distribute sequence of random bit sequence of photons** whose randomness and secrecy are guaranteed by the laws of quantum physics.
- These **sequences can then be used as secret keys** with conventional cryptography techniques to guarantee the confidentiality of data transmissions.



Applications

- Protecting information channels against eavesdropping by means of quantum cryptography.
- Its applications have been found into niche markets, and many university labs are working on futuristic quantum networks.
- Quantum communication, and more generally quantum information science and technologies, are here to stay and will have a profound impact on the 21st century.

2.6. SUNWAY TAIHULIGHT

- It is a **new Chinese supercomputer** that can **make 93 quadrillions calculations per second**.
- It has been developed by **the National Research Centre of Parallel Computer Engineering and Technology (NRCPC)** using **processors entirely designed and made in China**.
- It is twice as fast as **Tianhe-2** (the previous fastest supercomputer) of China. Tianhe-2 is an Intel based Chinese supercomputer but Sunway Taihulight is made of indigenous processors.
- USA's Titan supercomputer is now at third in the Top 500 supercomputer list.
- It is the first time since the inception of the TOP500 that the U.S. is not home to the largest number of systems.

2.7. UNSTRUCTURED SUPPLEMENTARY SERVICE DATA

- Union Bank of India has recently launched USSD based mobile application for banking needs with NCPI.
- USSD (Unstructured Supplementary Service Data) is a Global System for Mobile (GSM) communication technology that is **used to send text between a mobile phone and an application program in the network**.
- It is a protocol used by cellular phones to communicate with a service provider – especially in retail payments for utility bills, money transfers etc.
- With Short Messaging Service (SMS), messages can be stored for several days. USSD is similar SMS, but, unlike SMS, USSD transactions occur during the session only.

2.8. PROJECT ALLOY

- It is a **device made by IBM** that creates **'merged reality'**.
- It is a headset that enables people to **interact with elements of the virtual world**. There is **no need for cables** to connect to the computer.
- It goes beyond virtual reality, in that it **digitizes the real world** and allows people to experience the virtual world without coming into conflict with the real world.

2.9. SOFTWARE ROBOTICS

- **ICICI Bank has deployed 'Software Robotics'** in over 200 business processes across various functions of the bank.
- Software Robotics **emulates human actions to automate and perform repetitive, high volume and time consuming tasks** across multiple applications.
- It would **reduce the response time to customers and increase accuracy,** thus sharply improving the bank's productivity and efficiency.
- It also helps the bank's employees to focus more on value-added and customer-related functions.

2.10. LAKSHMI ROBOT

- It is India's first banking robot. It has been launched by City Union Bank, Kumbakonam.
- It will be capable to answer queries related to account balance, loans, fixed deposits, payments etc. Apart from generic questions, it can also deal with core banking solutions like history of payment transaction by any user etc.
- Sensitive financial information will only be displayed discretely and not announced out loud.
- It is currently adept in English. Also, unlike other banking robots, its speech is more relaxed and casual rather than being formal.
- Since it is based on artificial intelligence, it also has the **capability to learn from the consumers**. It can also **give real time updates** on currency exchange, interest rates etc.

2.11. BHARAT QR CODE

- Bharat QR code has been developed jointly by National Payments Corporation of India (NPCI), Visa, MasterCard and American Express under instructions from Reserve Bank of India (RBI).
- It works as common interface for the MasterCard/Visa/RuPay platforms and also facilitate acceptance of Aadhaar-enabled payments and Unified Payments Interface (UPI).
- It eliminates the need of using card swiping machines for digital payments.
- **Interoperability**-Using BharatQR code, the merchants will be required to display only one QR code instead of multiple ones.
- It will also eliminate the uncertainty of entering a wrong amount as all a customer would have to do is scan and authenticate

QR code (Quick Response code)

- It is a two-dimensional (matrix) machine-readable bar code made up of black and white square. This code can be read by the camera of a smartphone.
- It is capable of 360 degrees (omni-directional), high speed reading.
- QR Code can store up to 7089 digits as compared to conventional bar codes which can store max 20 digits.
- It carries information both horizontally and vertically. It has error correction capability and data stored in it can be restored even if it is partially damaged or dirty.

2.12. MILLIMETER WAVE TECHNOLOGY

- Facebook plans to **bring the internet to new areas without the need to dig holes, install towers, and stretch expensive wire lines** across the planet.
- **Millimeter waves are smaller in wavelength than the radio waves** that transmit cell phone and Wi-Fi signals.
- Since millimeter waves are not as widely used as others, Facebook will now use it to send much larger about of data.
- The only challenge would be the higher power consumption by millimeter wave setup relative to the radio wave technology.

2.13. PRADHAN MANTRI GRAMIN DIGITAL SAKSHARTA ABHIYAN

Why in news?

The Union Cabinet has approved 'Pradhan Mantri Gramin Digital Saksharta Abhiyan' (PMGDISHA).

Background

- **As per the 71st NSSO Survey on Education 2014, only 6% of rural households have a computer.**
- This highlights that more than 15 crore rural households (@ 94% of 16.85 crore households) do not have computers
- Thus a significant number of these households are likely to be digitally illiterate.

About PMGDISHA

- PMGDISHA is expected to be one of the **largest digital literacy programmes in the world**.
- Under the scheme, 25 lakh candidates will be trained in the FY 2016-17; 275 lakh in the FY 2017-18; and 300 lakh in the FY 2018-19.
- To ensure **equitable geographical reach**, each of the 250,000 Gram Panchayats would be expected to register an average of 200-300 candidates.
- The implementation of the Scheme would be carried out under the overall supervision of Ministry of Electronics and IT in active collaboration with States/UTs through their designated State Implementing Agencies, District e-Governance Society (DeGS), etc.
- The PMGDISHA being initiated under Digital India Programme would cover 6 crore households in rural areas to make them digitally literate.
- This would empower the citizens by providing them **access to information, knowledge and skills for operating computers / digital access devices.**

3. SPACE AND DEFENCE TECHNOLOGY

3.1. LATEST DEVELOPMENTS AT ISRO

3.1.1. LAUNCH OF 104 SATELLITES IN A SINGLE FLIGHT BY PSLV-C37

- PSLV-C37, ISRO's Polar Satellite Launch Vehicle has successfully launched the 714 kg Cartosat-2 Series Satellite along with 103 co-passenger satellites.
- The total weight of all the 104 satellites carried on-board PSLV-C37 was 1378 kg.
- This was the thirty eighth consecutively successful mission of PSLV.
- International customer satellites from USA (96) and one each from The Netherlands, Switzerland, Israel, Kazakhstan and UAE were also carried among co-passenger satellites.

PSLV

- The PSLV is one of world's most reliable launch vehicles consisting of four stages.
- It has been in service for over twenty years and has launched historic missions like Chandrayaan-1, Mars Orbiter Mission, IRNSS etc.
- It can take up to 1,750 kg of payload to Sun-Synchronous Polar Orbits of 600 km altitude and payload of 1,425 kg to Geosynchronous and Geostationary orbits.

3.1.2. REMOTE SENSING SATELLITE RESOURCESAT-2A LAUNCHED

Why in News?

- In its 38th flight PSLV-C36 successfully launched **RESOURCESAT-2A** satellite from Satish Dhawan Space Center in Sriharikota.

About RESOURCESAT-2A

- It is a remote sensing satellite which will provide information on water bodies, farm lands, crop extent, forests, mineral deposits, and coasts, rural and urban spreads for the next five years.
- The satellite was launched into the Sun Synchronous Orbit at 825 km height.
- Much like its predecessors RESOURCESAT 1 and 2, RESOURCESAT-2A also has a three tier imaging system.
- It is equipped with an Advanced White Field Sensor (AWiFS) that provides images of 56 metre resolution, (LISS-3) Linear Imaging Self-scanning Sensor and LISS-4 provides image of 23.5m and 5.6m resolution respectively.

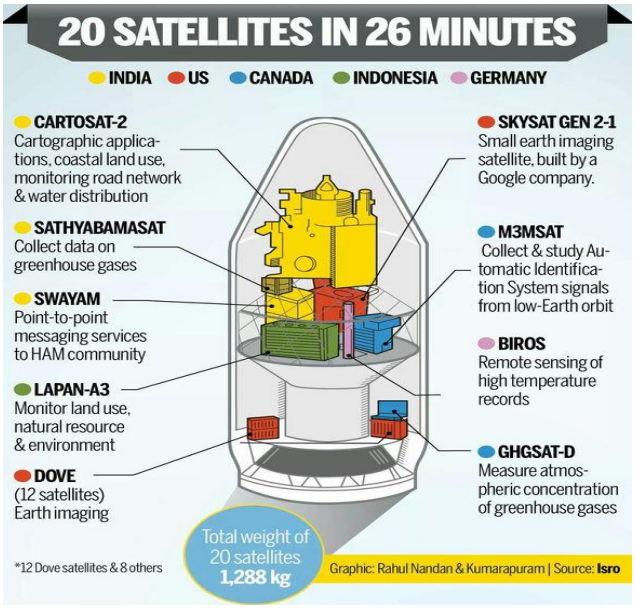
Significance of the Launch

- RESOURCESAT-2A will be useful in crop area and production estimation, drought monitoring, soil mapping, cropping system analysis and farm advisories generation.
- For the first time ISRO used cameras on-board that showed the separation stages during the flight and the deployment of solar panels of the satellite.

3.1.3. ISRO LAUNCHES 20 SATELLITES

Why in news?

- ISRO has created a new record of launching 20 satellites from a single rocket, including those of US, Germany, Canada and Indonesia, from the Satish Dhawan Space Center in Sriharikota.
- This has brought India into the elite club of USA and Russia who have also launched more than 20 satellites in a single launch.
- ISRO has broken its own record of launching 10 satellites in 2008.



About the mission

- The PSLV-34 vehicle was used to launch 3 Indian and 17 commercial foreign satellites.
- Among the 3 Indian satellites there is CARTOSAT-2 series which has potential uses in geological surveying, border management, disaster management etc.
- The other two Indian satellites - SatyabhamaSat and Swayam were made by college students.
- They will be used to collect data on greenhouse gases and provide point-to-point messaging services
- The foreign satellites are LAPAN-A3 from Indonesia, Brios from Germany, M3MSat and GHSSat-D from Canada, SkySat Gen 2-1 and 12 Dove satellites from the United States.
- The payload or total weight of all the 20 satellites carried on-board PSLV-C34 is 1288 kg.

3.1.4. SUCCESSFUL TESTING OF SCRAMJET ENGINE

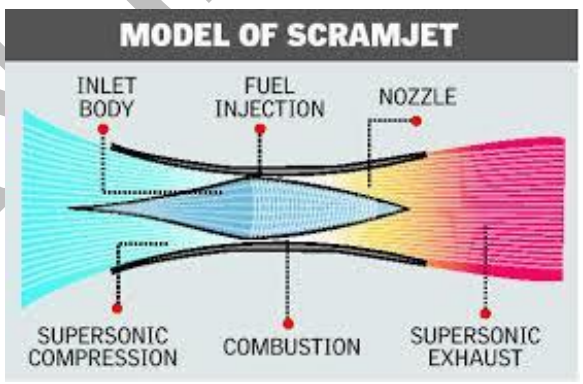
Why in News?

- **ISRO** carried out successful testing of **scramjet engine** from the **Satish Dhawan Space Centre, Sriharikota**.
- India became only the **fourth country** to successfully test the scramjet engine after **United States, Russia and the European Space Agency**.

- SRO'S Advanced Technology Vehicle (ATV) - It is the vehicle which was used to test the scramjet engine. It is a sounding rocket.
- Sounding rocket - Sometimes also called a research rocket, it is an instrument-carrying rocket designed to take measurements and perform scientific experiments during its sub-orbital flight.

What is Scramjet?

- Scramjet stands for **Supersonic Combustion Ramjet**.
- Scramjet breathes air and uses **high speed vehicle** to forcefully compress the incoming air before combustion.
- Conventional aircraft engines on the other hand compresses air using fan before combustion.
- It is also called the **air breathing engine** as it uses **atmospheric oxygen** to burn the **hydrogen fuel.**
- Scramjets are efficient only at **supersonic speed.**



Significance of the Launch

- The fact that scramjet uses atmospheric oxygen to burn the fuel in the first phase will considerably **reduce the amount of oxidiser to be carried aboard.**
- This in turn will reduce **cost-to payload ratio.**
- A rocket using scramjet engine would be significantly **lighter, smaller** and therefore **cheaper.** It will also be able to carry more payloads.
- Scramjet also has many other applications in cruise and other missiles.

3.1.5. GSLV F05 AND INSAT 3DR

- ISRO's GSLV F05 spacecraft has successfully placed INSAT 3DR satellite into a Geostationary Transfer Orbit (GTO) for eventually stationing in geosynchronous orbit.
- **INSAT-3DR:**
  - ✓ It is an advanced weather satellite which is expected to provide a variety of meteorological services to the country.
  - ✓ It can provide imaging in Middle Infrared band to provide night time pictures of low clouds and fog.
  - ✓ It can also provide Imaging in two Thermal Infrared bands for estimation of Sea Surface Temperature (SST) with better accuracy.
- **GSLV F05:**
  - ✓ **GSLV-F05** was the tenth flight of India's Geosynchronous Satellite Launch Vehicle.
  - ✓ This is the third successful launch with the indigenous cryogenic engine in GSLV.
  - ✓ It is a three-staged vehicle and cryogenic engine is used in the third and final stage. GSLVs are used to carry heavy satellites (usually 2 to 2.5 tonnes) into Geostationary Transfer Orbit.

- **Significance**
  - ✓ It was the first operational flight of GSLV carrying Cryogenic Upper Stage.
  - ✓ A successful launch will make ISRO engineers more confident about the GSLV-MkIII.
  - ✓ This successful launch will increase ISRO's market value and confidence in her satellite capabilities**.**
  - ✓ INSAT-3DR satellite continues the mission of the INSAT-3D satellite, which was launched in 2013.
  - ✓ INSAT 3DR will be able to map vertical changes of humidity, temperature and ozone content in Earth's atmosphere. Thus enhancing nation's meteorological capabilities.

3.1.6. PSLV SUCCESSFULLY LAUNCHES 8 SATELLITES

Why in News?

- ISRO (Indian Space Research Organisation) launched eight satellites in orbit in longest ever launch mission.
- It is for the first time that satellites in two different orbits were placed by the same rocket, PSLV-C35 (Polar Satellite Launch Vehicle).
- There was one weather satellite, SCATSAT-1 and seven others.

GSAT Satellites
These satellites are India's indigenously developed technologies of communications satellites used for digital, audio, data and video broadcasting.

More on the Launch

- The advanced weather satellite was placed in polar sun synchronous orbit at an altitude of about 730km.
- **SCATSAT-1** will now succeed the now defunct Oceansat-2 satellite launched in 2009.
- The data sent by the satellite SCATSAT-1 will help provide weather forecasting services.
- The rest of the seven satellites include PRATHAM from IIT Bombay and Pisat from PES University, Bangalore.
- There were five international customer satellites from Algeria, Canada and United States.

3.1.7. GSAT 18 SATELLITE LAUNCHED

- India's latest communication satellite**, GSAT 18** was successfully launched from the spaceport of Kourou in French Guiana, South America.
- It is been built by ISRO and ISRO's Master Control Facility at Hassan, Karnataka is controlling the satellite.
- The Master Facility will also perform the initial raising manoeuvres using the Liquid Apogee Motor (LAM) of the satellite, placing it in a circular Geostationary Orbit.
- India does not have any launcher capable of carrying heavier satellites like GSAT-18.However, Indian scientists are developing GSLV –III to overcome the challenge.

3.1.8. ISRO ROVER ON LUNAR SURFACE

- ISRO is planning to deploy a rover on the lunar surface in the Chandrayaan-2 mission.
- After reaching the 100 km lunar orbit, the Lander, containing the Rover, will separate from the Orbiter.
- The Lander then will soft land on the lunar surface at a specified site and deploy a Rover.
- The six-wheeled Rover will move around the landing site in **semi-autonomous mode** as decided by the ground commands.
- The instruments on the rover will observe the lunar surface and send back data useful for **analysis of the lunar soil**.
- **Collection of soil and rock sediments is not planned** in this mission.

- Chandrayaan 2, India's second mission to the Moon, is an advanced version of the previous Chandrayaan-1 mission.
- It consists of an Orbiter, Lander and Rover configuration.
- It is expected to be launched during the first quarter of 2018.

3.1.9. TELEMETRY AND TELECOMMAND PROCESSOR (TTCP)

- TTCP is used in Integrated Spacecraft Testing of Low Earth Orbit, Geostationary Orbit and Interplanetary Spacecraft.
- The Low earth orbit spacecrafts typically use ISRO formats for telemetry and telecommand, for which indigenous equipments are being used.

- However, the interplanetary spacecraft use an international standard known as CCSDS (Consultative Committee for Space Data Systems).The equipments are being imported for this purpose.
- As part of 'Make in India' campaign, indigenous development of TTCP was taken up by ISRO.
- This system now is able to meet the requirements of both CCSDS and ISRO standards.

3.1.10. ISRO SIGNS DEAL FOR FIRST PRIVATELY BUILT SATELLITE

Why in News?

- ISRO for the first time has signed an agreement with a consortium of six companies to deliver India's first industry-built satellite by 2017.

What is it?

- The deal has been signed between ISAC (ISRO Satellite Center) and six private companies.
- ISAC assembles India's satellites for communication, remote sensing and navigation.
- The agreement includes assembly, integration and testing (ATI) of two spare navigation satellites in a row in around 18 months.

3.1.11. HYPERSONIC WIND TUNNEL

- ISRO commissioned the world's third largest hypersonic wind tunnel at the Vikram Sarabhai Space Centre (VSSC) in Thiruvananthapuram.
- With future missions like the Reusable Launch Vehicle (RLV), Air breathing propulsion systems etc. hypersonic wind tunnel will help in the aero-thermodynamic modelling of such vehicles in a hypersonic environment.
- A wind tunnel is used to:
  - Study the effects of air flowing past a solid object like space vehicles.
  - Simulate the aero-thermal environment
- It has been named after former ISRO chairman Satish Dhawan.
- It has been indigenously designed, developed and made in India with the support of Indian industries.
- One metre hypersonic wind tunnel can simulate flow speeds of Mach 6 to 12.

3.1.12. ISRO'S FUTURE INTERPLANETARY MISSIONS

- Pursuing its interplanetary missions, ISRO is planning to go to VENUS planet apart from revisiting the MARS again.
- The Budget 2017 has allowed MARS mission which is planned by about 2021 or 2022. The French Space Agency CNES might also collaborate with ISRO in this pursuit and may provide with rover for this.
- The Venus mission is proposed to be only an orbiter mission. It is proposed to be a technology demonstrator mission like the MARS mission taken the first time by ISRO.
- ISRO proposes to study Venus's carbon dioxide rich atmosphere for insights into the buildup of the greenhouse gas in our planet's atmosphere.

VENUS

- Venus has a **very inhospitable environment** like it is the hottest **planet in the solar system**, it has a **carbon dioxide pressure of about 100 times than that at Earth** etc.
- But **31 miles above the surface of Venus**, it resembles more Earth-like conditions like optimum temperature (for liquid water to exist), adequate amount of sunlight, CO_2 for plant growth etc.

3.2. INDIA'S FIRST PRIVATE MOON MISSION

Why in News?

- **Team Indus**, a Bengaluru-based private aerospace company will be sending a spacecraft to the Moon on December 28, 2017 aboard an ISRO rocket.

More about the Mission

- The aim of the mission is to land this aircraft on moon, have it travel at least 500 metres, and beam HD videos, images and data back to the Earth.

- Except for the launch vehicles, all the technology to be used under the mission has been developed in-house by the company
- It is one of the four international teams running for the Google **Lunar XPRIZE**, a $30 million competition to encourage private companies to take up space missions.
- ISRO's **PSLV (Polar Satellite Launch Vehicle**) would launch the spacecraft in a three-day window after completing a rotation around the earth.
- The space craft would land on **Mare Imbrium**, a region in the North western hemisphere of the moon.

3.3. GRAVITATIONAL WAVE TELESCOPE: NGARI

Why in news?

- China has started the construction of two-phase **Ngari wave observatory** in Ngari territory of Tibet close to Indian border, which will house world's highest altitude **Gravitational Wave Telescope.**
- The main aim of this project is to find more about the **Big Bang theory** which is about the birth and configuration of the cosmos.

Highlights of the Project

- **Phase 1** of the project consists of a telescope located at **5250**m above sea level and expected to be operational by 2021.
- It will be able to detect and gather data on **gravitational waves** in northern hemisphere.
- **Phase 2** consists of series of telescopes to be constructed at **6000**m above sea level and will expand the observation frequency band to improve accuracy.
- **Ngari** is one of the world's best spot because of high altitude, clear skies and minimum human activity.

3.3.1. CHINA SETS UP FIRST 'DARK SKY' RESERVE

- China has launched its first "dark sky reserve" for astronomical observation in the Tibetan prefecture of Ngari, bordering Nepal and India.
- The reserve covers an area of 2,500 square kilometres and aims to limit light pollution by stepping up protection of dark-sky resources for education and tourism development.

Light pollution is excessive, misdirected, or obtrusive artificial (usually outdoor) light. Too much light pollution washes out starlight in the night sky, interferes with astronomical research, disrupts ecosystems, has adverse health effects and wastes energy.

Why Ngari is famous?

- Ngari is among the best sites for astronomical observation on earth, due to its high altitude and large number of cloudless days throughout the year.
- However, the recent inflow of people from other areas has given rise to increasing urbanisation, and thus the associated risk of more light pollution.

3.4. SPACE TECHNOLOGY FOR ROOFS - CASPOL

Why in News?

- Vikram Sarabhai Space Centre (VSSC), have developed the ceramic-polymer hybrid (CASPOL) that could protect public transport systems and poor men residing in thatched homes from fire accidents.
- The water-based ready-to-coat product was originally developed to protect the rockets from high temperature and fire to which they are exposed during the initial moments of launch.

Potential applications of Caspol

- Caspol can withstand up to 800 degree Celsius. Seats in automobiles, public transport system and seat cushions of railway coaches can be made fireproof when Caspol is applied.
- Besides its ability to protect against fire and high temperature, Caspol can also make surfaces waterproof.

3.5. SOFIA

- The **Stratospheric Observatory for Infrared Astronomy (SOFIA) is a joint German-US space science project**.
- It is the **largest airborne observatory in the world** that makes observations that are impossible for even the largest and highest ground-based telescopes.
- It carries a 2.5-metre **telescope inside a modified Boeing aircraft**.
- It performs astronomical observations in the **infrared and submillimetre wavelengths**, high above the disturbance of Earth's atmosphere.
- **Its scientific objective is to understand** the development of galaxies and the formation and evolution of stars and planetary systems from interstellar clouds of gas and dust.

3.6. FIVE-HUNDRED-METER APERTURE SPHERICAL RADIO TELESCOPE

- It is the **world's largest ground based radio telescope** located in China.
- **Its aim is to gather radio signals** from the cosmos, probe gravitational waves and dark matter and listen for transmissions from aliens.
- **It is located in the Guizhou province** and is built in karst depressions.
- **Its** collecting area is twice of the second largest radio telescope located in Peurto Rico.

3.7. QUESS SATELLITE

- China has launched the world's first satellite under the Quantum Experiments at Space Scale (QUESS) mission, dedicated to test the fundamentals of quantum communication in space.
- It is also called Micius and will try to communicate with earth using the principle of quantum entanglement - whereby subatomic particles become linked or "entangled" in such a way that any change in one disturbs the others too.
- Because of its principle of working, it is also believed to be impossible to hack.
- It will demonstrate **quantum key distribution (QKD)** between the satellite and ground stations. A **quantum key is a string of ones and zeros**, representing the quantum states of particles. These are used to encode and decode messages, which is secure from eavesdroppers.

3.8. MAGNETOSPHERIC MULTISCALE MISSION

- It is a mission by NASA.
- It consists of four spacecrafts that orbit Earth to study a lesser known phenomenon called magnetic reconnection – when magnetic field lines of Earth cross the Sun's magnetic fields and release a burst of energy, reconnection process taps this field energy stored and coverts it into heat and energy in the form of charged particle acceleration and large-scale flows of matter.
- The 4 spacecrafts are arranged in a tetrahedral or a pyramid pattern.
- Magnetic reconnection is a phenomenon unique to plasma, that is, the mix of positively and negatively charged particles that make up the stars and fill up the space.
- It recently set Guinness record for highest altitude fix of a GPS signal.

3.9. JAMES WEBB TELESCOPE

- The construction of the largest ever space telescope – James Webb telescope, has completed and will be launched in further 2 years.
- It has been developed by NASA and would be supported by European space agency and Canadian space agency.
- It would be the successor of the NASA's Hubble space telescope.
- It will rest on the Lagrange point 2, which would be directly behind the Earth from the Sun's perspective.
- One of its main goals is to use spectroscopy to determine the atmospheric components of alien worlds. Webb will especially **seek chemical biomarkers, like ozone and methane that can be created from biological processes**.

3.10. FIRST LIGO SITE

- Maharashtra's Hingoli is proposed to be the first site outside USA to have a Laser Interferometer Gravitational wave Observatory (LIGO) lab.
- LIGO is a large-scale physics experiment aiming to directly **detect gravitational waves**. This detector recently underwent upgradation which would make it ten times more sensitive that would provide a 1000-fold increase in the number of astrophysical candidates for gravitational wave signals.

3.11. CHINA'S FIRST SPACE STATION

- In 2016, China has launched an unmanned Tiangong-2 (Heavenly Palace) space lab to Earth orbit.
- Like Tiangong-1 which ended operations in 2016, Tiangong-2 will act as a testbed for China to test the life support and docking exercises needed to build a permanently staffed space station.
- China aims to have its own permanent space station by 2022.
- **China is the third country**, after the United States and Russia, to carry out its own crewed missions.

3.12. SHERLOC TECHNIQUE

- MIT scientists have developed **a novel spectroscopic technique** to help NASA's new Mars rover, to be launched in 2020, **find signs of present or former extra-terrestrial life on MARS**.
- It will help the rover **quickly and non-invasively** identify sediments that are relatively unaltered, and that maintain much of their original composition.
- The 2020 Mars rover would include **SHERLOC (Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals)**, an instrument that will acquire Raman spectra from samples on or just below the Martian surface.
- It would enable scientists to more accurately interpret the Raman spectra, and quickly **evaluate the ratio of hydrogen to carbon** - an indicator of presence of alien life.

Raman spectroscopy

- It provides **information about molecular vibrations** that can be used for sample identification.
- It involves shining a monochromatic light source on a sample and detecting the scattered light.
  - The majority of the scattered light is of the same frequency as the excitation source - **this is known as Rayleigh or elastic scattering**.
  - A very small amount of the scattered light is shifted in energy from the original frequency due to interactions between the light and the energy levels of the molecules in the sample. **This is Raman scattering**.

3.13. LARGEST METAL ASTEROID-PSYCHE

- Psyche is an asteroid orbiting the sun between Mars and Jupiter. Unlike most other asteroids that are rocky or icy bodies, Psyche is thought to be comprised mostly of metallic iron and nickel, similar to Earth's core.
- It is believed to have originally been an early planet, but through time its rocky exterior was stripped off through collisions with other space material.
- NASA is sending a robot mission to arrive in 2030 at psyche. This mission is part of the Discovery Program, a series of low-cost missions to new places never before explored by man.
- Scientists estimate that the metal Psyche may be worth $10 quintillion which is the same as 100,000 times the GDP of the whole earth.

3.14. PULSAR NAVIGATION SATELLITE

- China launched a navigation satellite - X-ray pulsar navigation satellite called XPNAV-1 - which will conduct in-orbit experiments using pulsar detectors to demonstrate new technologies.
- It would operate in a Sun-synchronous orbit.
- Periodic X-ray signals emitted from pulsars would be used to determine the location of a spacecraft in deep space.
- It will help reduce the spacecraft's reliance on ground-based navigation methods and is expected to lead to autonomous spacecraft navigation in the future.

3.15. KIRAMEKI-2 SATELLITE

- Japan has recently launched its first military communications satellite, Kirameki-2, to provide impetus to the broadband capacity of its Self-Defence Forces.
- The new satellites will allow military units to communicate directly with each other on a high-speed and high-capacity network
- The satellite means 'sparkle' in English.
- It will enable **Japan to quickly share information about ballistic missiles launched by North Korea** or videos of Japanese troops deployed overseas.

3.16. 100 YEARS PROGRAMME

- UAE will build the first city on Mars as part of the 2117 Mars project in collaboration with specialized international organizations and scientific institutes.
- As part of a 100-year national programme, the UAE will set a plan to prepare national cadres that can achieve scientific breakthroughs to facilitate the transport of people to MARS.
- It will involve **scientific research programmes to nurture national cadres** specialized in space sciences at universities in the UAE.

3.17. CHANDRA X-RAY OBSERVATORY

- It is a NASA mission which was launched in 1999.
- It is a space telescope specially designed to detect X-ray emission from very hot regions of the Universe such as exploded stars, clusters of galaxies, and matter around black holes.
- Because X-rays are absorbed by Earth's atmosphere, Chandra must orbit above it and therefore is a space based telescope.
- It has imaged the remains of exploded stars, has observed the region around the super massive black hole in the center of our Milky Way, and found black holes across the Universe till now.
- Recently it was in news for discovery of a never before cosmic explosion for which sufficient research is still pending.

3.18. DEEP SPACE ATOMIC CLOCK MISSION

- The National Aeronautics and Space Administration (NASA) will send its next-generation atomic clock into space by 2017. It will be smaller, lighter with magnitudes more precise than any atomic clock flown in space before.
- The Deep Space Atomic Clock was developed by NASA's Jet Propulsion Laboratory in California.
- Most spacecraft are tracked using "two-way" methods - the ground-based antenna 'pings' the spacecraft and waits for the signal to return. It measures the time taken by the signal to travel and by this the distance to the spacecraft can be calculated.
- But the clock enables "one-way" tracking, where the spacecraft need not send the signal back to Earth. The tracking measurement is taken onboard and determines the path and manoeuvres needed to stay on course,
- The benefits of this would be:
    - It will advance safe navigation for future human exploration of the solar system by providing astronauts with their position and velocity when they need it.
    - It will lighten the load on the antennas in NASA's Deep Space Network, allowing more spacecraft to be tracked with a single antenna.
    - It would also improve the precision and quantity of the radio data used by scientists for determining a planet's gravity field and probing its atmosphere.

3.19. COPERNICUS EARTH OBSERVATION PROGRAMME

- Copernicus earth observation system is set of dedicated satellites (the Sentinel families) designed to meet the needs of the users of European Union. The European Union space agency (ESA) would put up a constellation of almost 20 more satellites in orbit before 2030.

- It can be used to create better forecasts of the ocean and the atmosphere. Maps are created from imagery collected by the Sentinel satellites where features and anomalies are identified of different regions.
- The Copernicus programme is coordinated and managed by the European Commission in partnership with European Space Agency**.**

3.20. CYGNSS Satellites

- NASA's Cyclone Global Navigation Satellite System (CYGNSS) mission has been completely developed.
- It will be a constellation of eight microsatellites and will collect data for the 2017 hurricane season.
- It will make periodic measurements of ocean surface winds in and near a hurricane's inner core to better understand how storms intensify
- Over the years, forecasters have improved hurricane path prediction significantly but predicting the intensity of storms has lagged behind. Because GPS signals are able to penetrate the storm's eye wall, CYGNSS uses these signals reflected off the ocean surface to calculate wind speeds.
- The CYGNSS mission is **led by the University of Michigan.**

3.21. RESTORE-L SPACECRAFT

- Restore-L is a robotic spacecraft equipped with the tools, technologies and techniques needed to service satellites currently in orbit.
- It is a product of NASA.
- It has **recently been involved in the refuelling of the spacecraft** sent by space agencies.

3.22. TANSAT SATELLITE

- China has launched a satellite to monitor carbon dioxide levels called TANSAT satellite.
- By this, China has become the third country (after USA and Japan) to track carbon dioxide emissions leading to global warming from space.
- It will trace the sources of greenhouse gases and help evaluate whether countries are fulfilling their commitments to reduce pollutants under environmental pacts.
- It is a three-year mission that will take readings every 16 days.
- It can distinguish changes in atmospheric CO_2 as small as 1%.
- It will allow China to **collect carbon data from all over the world, all year round**, and record the carbon contributed by both developed countries and the developing countries.

3.23. ALMA TELESCOPE ARRAY

- Atacama Large Millimetre/submillimetre Array (**ALMA)** is an array of radio telescopes being deployed in Chile
- It is composed of 66 high precision antennas.
- It would allow the scientists to unravel important astronomical mysteries, in search of our Cosmic Origins. One of the goals of these new technological innovations is to image a black hole.
- It is an international partnership of the European Southern Observatory (ESO), the U.S. National Science Foundation (NSF) and the National Institutes of Natural Sciences (NINS) of Japan, together with NRC (Canada), NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile.
- It will be a **part of VLBI (Very Long Baseline Interferometry**) to link a group of radio telescopes around the globe.

3.24. LAUNCH OF AGNI-V

Why in News?

- India successfully conducted the final test of its indigenous ICBM, Agni-V from Wheeler Island off Odisha coast.

About AGNI V

- The nuclear-capable missile has a strike range of over 5,000-km.
- It has been developed by DRDO
- It can be transported and swiftly launched from anywhere on land. It can even be launched from canisters.
- It is a surface-to-surface missile having new technologies incorporated than previous Agni counterparts in terms of navigation and guidance, warhead and engine.
- It is one of the most accurate ballistic missile in the world and therefore has high kill efficiency.

Integrated Guided Missile Development Programme

- It was conceived by Dr. APJ Abdul Kalam for self-sufficiency in missile technology in 1983
- DRDO is its implementing agency
- It has a time bound objective to develop the following missiles -
  - ✓ Short range surface to surface ballistic missile - **PRITHVI**
  - ✓ Intermediate range surface to surface ballistic missile - **AGNI**
  - ✓ Short Range low level surface to air missile - **TRISHUL**
  - ✓ Medium range surface to air missile - **AKASH**
  - ✓ Third generation anti-tank missile - **NAG**
- In 1990s the programme was expanded to include Sagarika (ballistic missile), Dhanush (naval version of Prithvi) and Surya missiles
- In 2008 DRDO announced the successful completion of the program

3.25. LAUNCH OF AGNI IV MISSILE

India successfully conducted the test firing of its indigenous strategic **ballistic** missile, Agni IV from **Dr. Abdul Kalam** Island formerly known as **Wheeler Island** off Odisha coast.

About Agni IV

- This nuclear capable missile has a strike range of 4000 Km.
- It is two stage, surface to surface missile with both stage powered by solid propellants.
- The missile has the capacity to carry a one-tonne nuclear warhead.
- It is equipped with **Ring Laser Gyro-based Inertial navigation** system and has features to correct and guide itself for in-flight disturbances
- Before this Agni-IV has undergone five successful flight tests over the course of five years

3.26. OTHER IMPORTANT NEWS

3.26.1. PLANET 9

- Astronomers have claimed that the mysterious Planet 9 may have been stolen from its original star by our Sun some 4.5 billion years ago, possibly making it the first exoplanet to be discovered inside the solar system.
- Planet Nine is a hypothetical large planet in the far outer Solar System, the gravitational effects of which would explain the improbable orbital configuration of a group of trans-Neptunian objects that orbit mostly beyond the Kuiper belt.
- The predicted planet would be a super-Earth, with an estimated mass of 10 Earths, a diameter two to four times that of Earth, and a highly elliptical orbit with an orbital period of approximately 15,000 years

3.26.2. LISA PATHFINDER

Why in News?

- ESA's LISA Pathfinder mission has demonstrated the technology needed to build a space-based gravitational wave observatory.
- Results from LISA Pathfinder, show that the two cubes at the heart of the spacecraft are falling freely through space under the influence of gravity alone, to a precision more than five times better than originally required to detect gravitational waves.

About LISA

- LISA would be the first dedicated space-based gravitational wave detector. It aims to measure gravitational waves directly by using laser interferometry.
- The LISA has a constellation of three spacecraft, arranged in an equilateral triangle with million-kilometer arms flying along an Earth-like heliocentric orbit. The distance between the satellites is precisely monitored to detect a passing gravitational wave.
- As a prelude to the massive LISA mission, the smaller LISA Pathfinder was launched by ESA in 2015.

3.26.3. MOU FOR GEO-TAGGING ASSETS

- A MoU has been signed between the Rural Development Ministry and ISRO, for geo-tagging the assets created under MGNREGA in each gram panchayat.
- It will help in online recording and monitoring of assets to check leakages and for effective mapping of terrain for future developmental works.
- A Gram Rozgar Sahayak or junior engineer will take a photo of an asset created by beneficiaries of the scheme and through a mobile app created by ISRO, upload the photo on the Bhuvan web portal run by ISRO's National Remote Sensing Centre.
- When the photo is uploaded, the location and time will get encrypted and there will be an option to add more information according to a few parameters.

3.26.4. EINSTEIN RING

Why in news?

- Einstein Ring has been discovered at the **Instituto de Astrofísica de Canarias** in Chile. The team used a spectrograph on the Gran Telescopio CANARIAS to confirm the discovery, which is now being called the "Canarias Einstein ring."
- A pair of distant galaxies 10,000 and 6,000 million light years away happen to be in the perfect position relative to Earth to create a rare 'Einstein ring'.

What is an Einstein ring?

- "Einstein Ring", first predicted by Einstein's theory of General Relativity, is a rarely observed, astronomical phenomenon that occurs when two distant galaxies are perfectly aligned, millions of light years apart.
- It is a distorted image of a very distant galaxy, which is termed 'the source'. The distortion is produced by the bending of the light rays from the source due to a massive galaxy, termed 'the lens', lying between it and the observer.
- Because the two galaxies are aligned so perfectly, light from the most distant, or source galaxy, is being bent by the gravity of the closer one. This makes the light from the furthest galaxy appear as an almost perfect circle when viewed from Earth.

3.26.5. CIRCUMBINARY PLANET

- Scientists, using NASA's Kepler Space Telescope, have discovered a Jupiter-like planet Kepler1647b, orbiting a system of two stars, making it the largest transiting circumbinary planet ever found.
- Planets that orbit two stars are known as circumbinary planets.
- The planet Kepler1647b, located in the constellation Cygnus is 3,700 light-years away and about 4.4 billion years old, roughly the same age as the Earth.
- Like Jupiter, Kepler-1647b is a gas giant, making the planet unlikely to host life

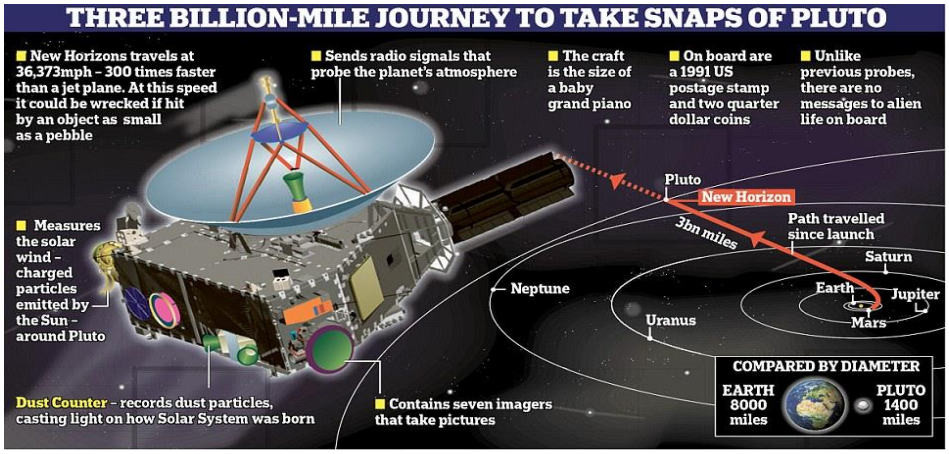
3.26.6. NEW HORIZON'S MISSION

Why in news?

- Following its historic first-ever flyby of Pluto, NASA's New Horizons mission will now fly onward to an object deeper in the Kuiper Belt, known as 2014 MU69.
- 2014 MU69 is considered one of the early building blocks of the solar system

What is Kuiper belt?

- Kuiper belt is flat ring of icy small bodies that revolve around the Sun beyond the orbit of the planet Neptune.
- It comprises hundreds of millions of objects-presumed to be leftovers from the formation of the outer planets-whose orbits lie close to the plane of the solar system.



- The Kuiper belt is thought to be the source of most of the observed short-period comets, particularly those that orbit the Sun in less than 20 years

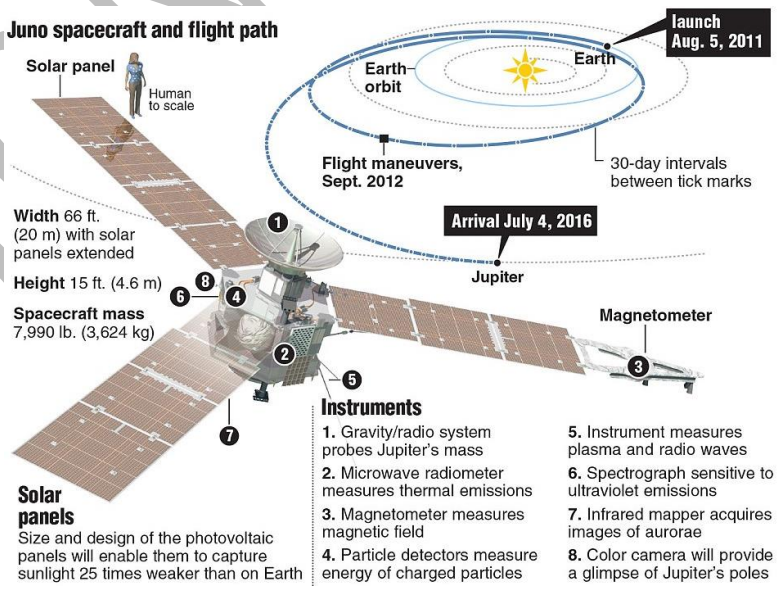
3.26.7. NASA'S JUNO BEGINS ORBIT OF JUPITER

Why in news?

NASA's Juno spacecraft has successfully entered into the orbit of Jupiter and started orbiting it.

Salient features

- The spacecraft's name comes from Greco-Roman mythology.
- It will orbit Jupiter from pole to pole, 5,000 kilometers above planet's cloud tops.
- Mission Life: Juno will have mission life of 20 months from July 2016 to Feb 2018.
- It is second spacecraft to orbit Jupiter, after Galileo probe that had orbited from 1995–2003.



Aim

- To understand the **origin and evolution of Jupiter.**
- Investigate the existence of a solid planetary core.
- Map Jupiter's intense magnetic field,
- Measure the amount of water and ammonia in the deep atmosphere and
- observe the planet's aurora

Galileo probe in its mission had found evidence of subsurface saltwater on Jupiter's moons Europa, Ganymede and Callisto.

3.26.8. THE DWARF PLANET CERES

Why in News?

- Pictures from the **NASA's Dawn Mission** show permanently shadowed regions on Ceres.
- The permanently shadowed regions do not receive direct sunlight and are identified as extremely cold. They have been cold enough to trap water ice for billions of years.
- The pictures indicate that water could exist in these shadowed craters even today.

Significance of Dawn Mission

- The goal of the Dawn Mission is to characterize the conditions and processes of the earliest history of the giant proplanet Vesta and the dwarf planet Ceres.

- In March, 2015, Dawn Spacecraft became first probe to orbit the two solar bodies.
- It explored the giant proplanet Vesta in 2011-2012. Now, it is studying Ceres.

More about Ceres

- Ceres is a **dwarf planet**, the only one located in the inner circle of the solar system, rest all are located on the outer edges.
- It is the largest object in the **asteroid belt.**

3.26.9. FLOODED CANYONS FOUND ON SATURN'S MOON TITAN

Why in News?

- **NASA's** spacecraft **Cassini** has discovered **steep sided canyons flooded with hydrocarbons on Saturn's Moon Titan.**
- The canyons have been found to be hundreds of metres deep.
- The findings are **the first evidence of both liquid filled channels and deep canyons on Titan.**

NASA's Cassini-Huygen's Mission

- NASA's Cassini's Mission is one of the most ambitious missions ever launched into space.
- The spacecraft was launched in two elements: the **Cassini orbiter** and the **Huygens probe**.
- The spacecraft is loaded with powerful instruments and camera.
- It is capable of **taking accurate measurements and detailed images in a variety of atmospheric conditions and light spectra.**
- Cassini-Huygens **reached Saturn and its moons in July, 2004**.

3.26.10. STEPHEN HAWKING'S PREDICTION ABOUT BLACK HOLES

- Scientists who created a virtual black hole in the lab claim to have observed **for the first time a phenomenon** according to which **some particles can escape black holes.**
- **It was predicted by British physicist Stephen Hawking** more than 40 years ago.
- Before this, it was believed by scientists that nothing could ever escape from a black hole, not even light.
- However, in 1974, Stephen Hawking suggested **particles, that are now called Hawking radiation,** could escape black holes.
- As per him if a particle and its antimatter appeared spontaneously at the edge of a black hole, one of the pair might be pulled into the black hole while the other escaped, **taking some of the energy from the black hole** with it.

Antimatter-**Antimatter** is a material composed of antiparticles, which have the same mass as particles of ordinary matter but opposite charges, as well as other particle properties.

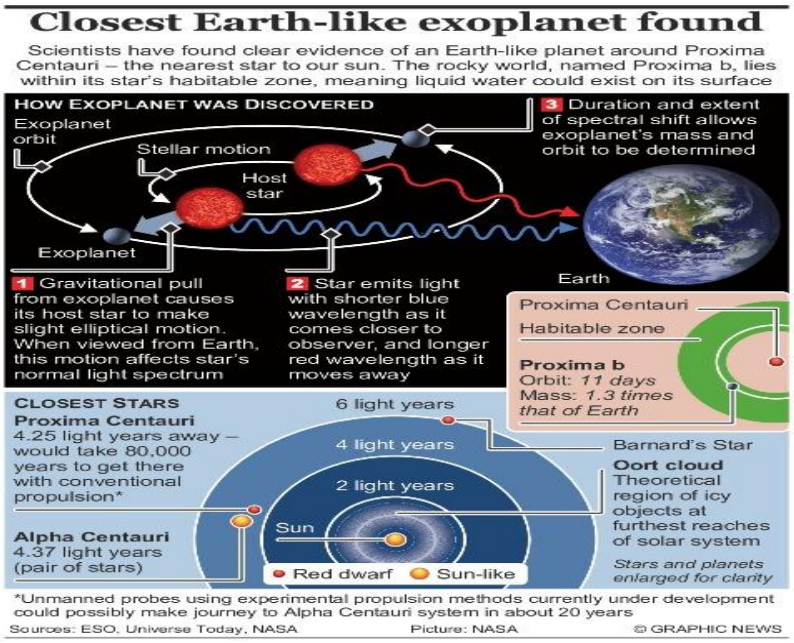
3.26.11. PROXIMA B

Why in news?

It is recently discovered Earth-like planet orbiting Proxima Centauri (the closest star to our solar system), in its Goldilocks Zone.

Features

- It is 4.22 light-years away.
- Its "year" is only 11 days.
- The planet is in a "temperate" zone compatible with the presence of liquid water.
- It is 25 times closer than Earth is to our sun, but since its star is only 12 percent



as massive as our sun and much dimmer so it's in the habitable zone.
- The find has been called "the biggest exoplanet discovery since the discovery of exoplanets."

Associated fact: "Breakthrough Starshot"

- The mission by Russian billionaire Yuri Milner who pledged US$100 million toward a plan to visit another star system.
- Initially their destination was to be Alpha Centauri. But the recent discovery of a nearby planet Proxima b could switch things up for Starshot.

3.26.12. OSIRIS-REX

- NASA has successfully launched a space probe - OSIRIS-Rex (Origins, Spectral Interpretation, and Resource Identification-Regolith Explorer) for a near earth asteroid Bennu.
- This will be NASA's first asteroid sampling mission.
- This spacecraft will reach Bennu by 2108 and then without landing on the asteroid capture 2 ounces of dust with its robotic arm and then begun its return trip to earth.
- This $1 billion mission will help scientists unravel how life began on Earth, how the solar system formed, and how to protect our planet from stray asteroids like Bennu.

3.26.13 WORLD'S LARGEST RADIO TELESCOPE BEGINS OPERATIONS

Why in News?

- World's largest telescope**, Aperture Spherical Telescope or FAST** began operations from China's Ghinzou Province.

What is it?

- Measuring 500 metres in diameter, the telescope is stationed in a natural basin in the county of Pintang.
- It took five years and an investment of $180 million to complete.
- The telescope surpasses the 300 meter Arecibo Observatory in Peurto Rico.

Significance

- The telescope would search for signals from stars and galaxies as well as extra-terrestrial life.
- The project demonstrates China's rising ambitions in space.

3.26.14. MORE THAN A BILLION STARS MAPPED

Why in news?

- A European satellite named **Gaia space probe** has mapped the precise positions and brightness of more than 1.14 million stars in the Milky Way.
- It is being lauded as the most accurate three dimensional map of the Milky Way.
- It has also pinned down the distances and motions of more than 2 billion stars.

More about the Mission

- **Gaia**, the European space probe was launched in 2013 and started collecting data in July 2014.
- It was launched to log the position, colour and brightness of a billion stars sending it an orbit around the sun, close to 1.5 million km from Earth.
- It has been able to map the star with so much accuracy thanks to its twin telescopes and a billion pixel camera.
- Gaia has not only mapped the distribution of the stars but also the neighbouring Small and Large Magellanic Clouds.

3.26.15. ROSETTA: UPDATES

- Europe's Rosetta spacecraft, carried eleven scientific instruments and a lander named Philae to sniff and photograph the comet, 67P/Churyumov-Gerasimenko from all angles for 12 years.

- Rosetta's cameras show that comet 67P resembled a rubber bath duck with a distinct "body" and "head", and a crack through its "neck", a shape created by a low-velocity impact billions of years ago between two objects which fused.
- The comet's surface surprisingly was less "fluffy" and much harder than expected, and was super-dark and non-reflective by a thin layer of dust.
- The comet had much less water ice than thought, was littered with pebbles and rocks ranging in size from a few centimetres (inches) across to five metres (18 feet), and pocked with deep craters.
- The water on comet is of a very different "flavour" than that on our planet, with three times more deuterium, a heavy hydrogen isotope.
- 67P has no measurable magnetic field which implied that magnetism played no part in debris in the early Solar System clumping together to form planets, comets, asteroids and moons.

3.26.16. SLOWEST MAGNETAR SPOTTED

- NASA astronomers have found the slowest magnetar- magnetised neutron.
- The magnetar known as 1E 1613 is at the centre of RCW 103, the remains of a supernova explosion located about 9,000 light years from Earth.
- Neutron stars are created when giant stars die in supernovas and their cores collapse, with the protons and electrons essentially melting into each other to form neutrons.
- Magnetars have magnetic fields a thousand times stronger than the average neutron star. The resulting drag causes the star to take longer to rotate.

3.26.17. POINT NEMO-THE POINT OF INACCESSIBILITY ON EARTH

- The furthest point from land also known as the "oceanic pole of inaccessibility" is nicknamed as Point Nemo, meaning "no-one" in Latin and was first discovered in 1992.
- This remote oceanic location is 2,688 kilometers from the nearest land—Ducie Island.
- As Point Nemo lies in the South Pacific Gyre and the region is so isolated from land masses that wind does not carry much organic matter, there is little to feed for survival.
- Thus, no material falls from above as "marine snow", turning the seafloor lifeless and making the region, one of the least biologically active regions of the world ocean.
- In this extreme environment, some bacteria thrive, gaining their energy from chemicals released by the eruptions as the region marks the boundary of the Pacific and Nazca tectonic plates, which are gradually moving apart.

3.26.18. MYSTERY BEHIND BIRTH OF SATURN'S RINGS SOLVED

Why in news?

- A study conducted by researchers at Kobe University and Tokyo Institute of Technology, Japan have concluded that planetary rings that surround Saturn, Neptune and Uranus were formed 4 billion years ago.
- Researchers believe that these were formed when large objects passed very close to the planets and got destroyed by them.

What is it?

- The giant planets in the solar system have very diverse rings.
- While that of Saturn is made mostly of icy particles, the rings of Uranus and Neptune are darker and may have higher rock content.
- Researchers used computer simulations to study the disruption of kupier belt objects by tidal force when they passed by the planets.
- Researchers calculated that this happened during the Late Heavy Bombardment.
- It is thought that Pluto-sized objects from the Kupier belt existed beyond the Neptune.

3.26.19. NASA PROBE TO HUNT FOR 'TROJAN' ASTEROIDS

Why in News?

- National Aeronautics and Space Administration's (NASA) OSIRIS-REx spacecraft is set to search for elusive "Trojan" asteroids.

About OSIRIS-REx spacecraft

- The full form of OSIRIS-REx spacecraft is Origins, Spectral Interpretation, Resource Identification, and Security–Regolith Explorer.
- The OSIRIS-REx spacecraft by NASA is on a seven-year journey to rendezvous with, study and bring a sample of asteroid Bennu to Earth. This sample of a primitive asteroid will help scientists understand the formation of our solar system more than 4.5 billion years ago.

What are asteroids?

- Asteroids, sometimes called minor planets, are rocky remnants left over from the early formation of our solar system about 4.6 billion years ago. Most of this ancient space rubble can be found orbiting the sun between Mars and Jupiter within the main asteroid belt
- As they revolve around the sun in elliptical orbits, the asteroids also rotate, sometimes quite erratically. Scientists continuously monitor Earth-crossing asteroids, whose paths intersect Earth's orbit, and near-Earth asteroids that approach towards Earth. NASA's Dawn spacecraft, launched in 2007, orbited and explored asteroid Vesta for over a year.

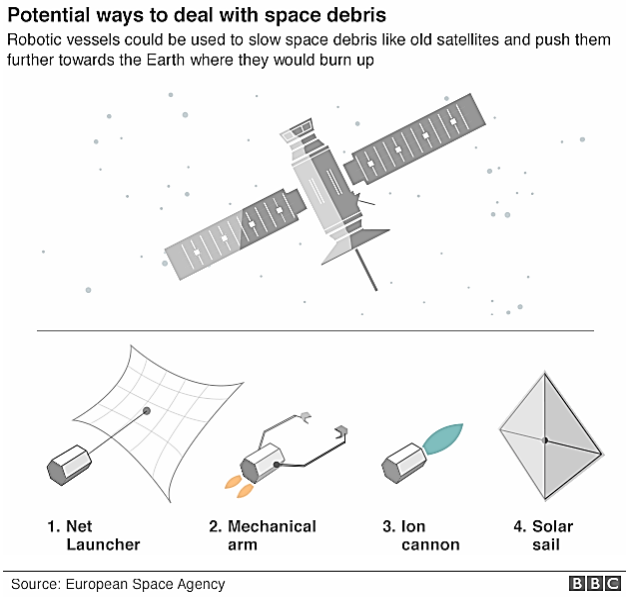
About Trojan Asteroids

- Trojans are asteroids that are constant companions to planets in our solar system as they orbit the Sun, remaining near a stable point 60 degrees in front of or behind the planet.
- Since they constantly lead or follow in the same orbit, they will never collide with their companion planet.
- There are six planets in our solar system with known Trojan asteroids—Jupiter, Neptune, Mars, Venus, Uranus and Earth. The Earth Trojan is elusive; to date, scientists have only discovered one Earth trojan asteroid—2010 TK7

3.26.20. INNOVATIVE MAGNETIC TETHER FOR SLOWING SPACE JUNK

Why in news?

- Japan has launched a cargo ship which will use a half mile long tether to remove some of the debris from Earth's orbit.
- The tether, made of aluminium strands and steel wire, is designed to slow the debris, pulling it out of orbit.
- The automated cargo ship - called Stork or Kounotori - which is carrying the junk collector is bound for the International Space Station and blasted off from Tanegashima Space Center in the North Pacific.
- The junk collector is the latest in a series of ideas put forward to tackle the problem, including harpooning, sweeping, lassoing and dragging debris into the atmosphere for burning.
- **Limitation:** Japanese scheme will only work for bigger pieces of junk.



What is space junk?

- Space junk is the term used to describe man-made rubbish floating in space – often litter from space exploration (even natural objects like asteroids are a part of space debris).
- The majority of the debris in space is believed to consist of small particles but some objects are larger
- They all travel at speeds up to 17,500 mph, fast enough for a relatively small piece of orbital debris to damage a satellite or a spacecraft.

3.26.21. CHINA OPENS FIRST FULLY-OWNED SATELLITE GROUND STATION

- China has launched its first fully- owned overseas satellite ground station in Sweden which will enable China to collect satellite data at a very high speed than its current capability.
- This would play an important role in China's **Gaofen project** - a network of observation satellites orbiting the Earth to provide global surveillance capabilities - which is due to be completed in 2020.
- This project would halve the time taken to download the satellite data from present scenario.

Gaofen Project
It is an ambitious space project of China that aims to launch seven **high-definition observation satellites** before 2020. It will also support Beidou project which is a navigation project to give a domestic positioning system of China as an alternative to GPS.

3.26.22. EXOPLANET: WOLF1061C

- Recently astronomers have studied an **Exoplanet** called **Wolf 1061c** and found that this celestial body could be habitable in the future as it in within habitable zone **(goldilocks zone)** of its star.
- **Wolf 1061c** is a rocky planet more than **4 times** the mass of earth, and part of **Wolf 1061** system.
- Wolf 1061c might have a **chaotic climate** because it changes orbit at much faster rate than earth which have slower variations in its orbit around sun. It could cause freezing or heating of the planet quite frequently.
- They believed that **Wolf 1061c** could sustain life only under one condition – the short time scales over which its orbit changes could be enough that it could actually cool the planet off.
- More research needs to be conducted to fully understand this exoplanet surface and atmosphere.

Exoplanet (Also known as Extrasolar planet)

- It is any planet that orbits a star other than the Sun, they can orbit their stars at any distance.
- Some of them orbit just at the right distance from star that they are in **"habitable zone"**, which means they have the right temperature to have **liquid water** at their surface.

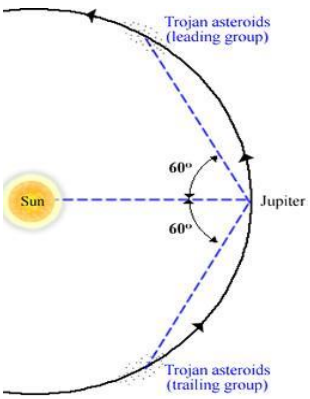
Wolf 1061 system

- It is an **M class red dwarf star** located 14 light years away in constellation **Ophiuchus.**
- It has 3 planets called Wolf1061 b, Wolf 1061c and Wolf 1061d.
- All there planets are super earths (**Super-Earth** is an **exoplanet** with a mass between 1 and 10 times that of Earth. The super-Earth classification refers only to the mass, and not surface conditions or habitability).

3.26.23. NASA MISSION TO EXPLORE ASTEROIDS

Why in news?

- NASA has announced launch of two missions to explore asteroids in search of clues about early solar system.
- The first mission named **Lucy**, scheduled to launch in 2021, will explore Jupiter's Trojan asteroids while second named **Psyche**, to be launched in 2023, will explore a giant metal asteroid known as 16 Psyche.
- Lucy is slated to arrive at its first destination, a main belt asteroid, in 2025. From 2027 to 2033, Lucy will explore six Jupiter Trojan asteroids.



About 16 Psyche Asteroid

- It is **massive asteroid** in the primary asteroid belt between Mars and Jupiter.
- Its distance from the sun is three times the distance of the earth from the sun. It measures **130 miles (210 km)** in diameter.
- It is made of mostly **iron** and **nickel**, not ice and rock like other asteroids.
- Some researchers think that it may be the **exposed core** of early planet that lost its rocky exterior during a series of violent collisions not long after it was formed.

Significance

- This mission will help in gaining more information about our earth core like how it separated into layers of crusts, mantle and core.
- It will also help in understanding how the sun and its family of planets formed, changed over time, and became places where life could develop and be sustained and what the future may hold.

3.26.24. THE GREAT RED SPOT

NASA has released a new view of a crescent Jupiter which shows the iconic Great Red Spot, along with a series of storms shaped oval known as the 'string of pearls'.

What is Great Red Spot?

- The Great Red Spot is a giant, spinning and persistent storm in Jupiter's atmosphere.
- It is like a hurricane on Earth, and is more than twice the size of our planet and is observed since 400 years.
- These are found in southern hemisphere of Jupiter.

String of Pearls
These are massive counterclockwise rotating storms that appear as white ovals in Jupiter's southern hemisphere. Since 1986, these white ovals have varied in number from six to nine. There are currently eight white ovals visible.

JUNO
Juno is a NASA space probe orbiting Jupiter to measure its composition, gravity field, magnetic field.

3.26.25. MARS ICE HOME

- NASA scientists have suggested an ingenious concept of constructing a sustainable habitation on red planet for astronauts using planet's own water ice called **Mars Ice Home.**
- It will be large inflatable torus, a shape similar to an inner tube that will be surrounded by a shell of **ice.**
- To control temperature inside the Ice home, layer of **carbon dioxide gas**, also available on Mars, would be used to provide **insulation** between the living space and ice layer.
- This concept balances the need to provide protection from radiation, without the drawbacks of an underground habitat that would require heavy robotic equipment to be transported from earth.

3.26.26. BLAZARS

Why in news?

NASA's Fermi Gamma-ray space telescope has identified the farthest gamma-ray blazars.

What are blazars?

- A blazar is a **galaxy** which, like a quasar, has an **intensely bright central nucleus** containing a supermassive black hole.
- **In a blazar, however, the emitted light sometimes includes extremely high energy gamma rays, sometimes over a hundred million times more energetic than the highest energy X-rays.**
- **The overall emission has several other unique properties as well, including that its intensity can vary dramatically with time.**

3.26.27. "VAMPIRE" STAR

- India's first dedicated space observatory, ASTROSAT, has captured rare phenomenon of a small, 6-billion-year-old "vampire" star **"preying"** on a bigger celestial body.
- The smaller star sucks mass and energy out of the bigger companion star and it becomes bigger, hotter &bluer and hence is called a vampire star.

ASTROSAT is India's first dedicated multi wavelength space observatory.

ASTROSAT observes universe in the optical, UV, low and high energy X-ray regions of the electromagnetic spectrum, whereas most such satellites are capable of observing only a narrow range of wavelength band.

3.26.28. ISRO AIDED BY INDIA'S ENTRY INTO MTCR

- MTCR has facilitated **access to high-end testing technology for its solid rocket booster propulsion system**, which fires up the first stage of the Polar Satellite Launch Vehicle (PSLV).
- Earlier, testing this system was a slow process due limited technology access.
- Many **key components to upgrade the technology were in controlled items lists** under MTCR due to their **dual military use**.
- Access to MTCR's controlled items has led to **major efforts in making India a bigger player** in the $300-billion satellite launch market.

3.26.29. TRAPPIST-1

- Recently NASA has discovered a **new Exoplanet system** having seven **earth sized planets** orbiting a cool dwarf-star known as **TRAPPIST-1**, which is 39 light years from Earth.
- **TRAPPIST-1** (The Transiting Planets and Planetesimals Small Telescope) is named after a robotic telescope in the Atacama Desert of Chile used to study the star.
- It is a **small star** with **8 per cent** the mass of the sun and only slightly bigger than the **planet Jupiter,** lyingin the constellation Aquarius. It is an **"ultracool dwarf planet"** with surface temperature much less than sun.
- Six of the planets of the system lie in the **habitable** or **goldilocks** zone with ambient surface temperature to support life.
- Out of these six planets at least three planets classified as **TRAPPIST-1 e**, **1 f** and **1 g** have an ocean.
- All **seven** planets' planetary orbits are closer to their host star, than **Mercury** is to our sun.
- This is the first time so many habitable-zone planets found around a single star outside our solar system.

3.27. GRAPES-3 EXPERIMENT

- The GRAPES-3 (Gamma Ray Astronomy PeV EnergieS phase-3) experiment is a special telescope-array established in Ooty.
- Its aim is to detect muons from cosmic ray showers.
- It is an Indo-Japanese collaboration where Tata Institute of Fundamental Research of India and the Japanese Osaka City University and Nagoya Women's University are collaborating with each other.
- I**t can be used to study solar storms** and space weather at distances up to two times the earth's radius, **unlike satellite-based studies** that give information only about what is happening in their vicinity.

Solar Storms

- Sun gives out bursts of energy because of its fusion reactions, in the form of solar flares and coronal mass ejections.
- This phenomenon can disrupt satellites and various electronic communications present on Earth.
- It sends a stream of electrical charges and magnetic fields toward the Earth.

4. HEALTH

4.1. POTASSIUM BROMATE

- The government banned the use of potassium bromate as a food additive following a Centre for Science and Environment (CSE) study that found its presence in bread caused cancer.
- As far as potassium iodate is concerned, it has been referred to a scientific panel."
- Potassium iodate is also used as a food additive and it too is said to be carcinogenic, it has been also referred to a scientific panel
- A CSE study had found that 84 per cent of 38 commonly available brands of pre-packaged breads, including pav and buns, tested positive for potassium bromate and potassium iodate.
- The two food additives are banned in many countries and are listed as "hazardous" to public health.
- According to the CSE, potassium bromate typically increases dough strength, leads to higher rising and gives uniform finish to baked products. Potassium iodate is a flour treatment agent.

According to the CSE, potassium bromate typically increases dough strength, leads to higher rising and gives uniform finish to baked products. Potassium iodate is a flour treatment agent.

4.2. MALTITOL

- Indian Institute of Science (IISc) has developed a bone reconstruction method similar to Joints of bone.
- They have used maltitol- derived from maltose, a sweetening agent found in most sugar-free foods such as ice-creams.

How it Works?

- Maltitol is combined with other components to make long chain-like structures that become plastic. This is then used to fill in the bone gap caused by fracture, instead of the traditional rod.
- Maltitol would be a huge advantage over metal rods, which do not allow growth of the bone, especially in infants and adolescents.Drugs can also be injected into it for faster healing.

4.3. ZIKA VACCINE: DNA VACCINE (GLS-5700)

- The first Phase-1 human clinical trial of a vaccine for the Zika virus is set to begin soon.
- The DNA vaccine (GLS-5700) has already been tested on animals and found to elicit "robust" antibody and T cell responses.
- The human trial will be carried out on 40 healthy adults to evaluate safety, tolerability and immunogenicity and the interim results are expected before the end of the year.

About Zika virus

- Zika virus disease is caused by a virus transmitted primarily by Aedes mosquitoes. It is a cause of microcephaly and Guillain-Barré syndrome.
- Microcephaly is a condition where a baby's head is much smaller than expected. Guillain-Barre syndrome is a rare condition in which immune system attacks nerves, leading to muscle weakness and even paralysis.

4.4. YAWS FREE STATUS FOR INDIA

Why in news?

- Recently, India received the official citation from WHO and UNICEF for being YAWS-free.
- India is the first country to be officially acknowledged as being Yaws-free.
- India has achieved this important milestone of being Yaws-free much before the WHO global target year of 2020.

What is yaws?

- Yaws is a chronic infection that affects mainly the skin, bone and cartilage.
- The disease occurs mainly in poor communities in warm, humid, tropical areas

- It affects mainly children below 15 years of age.
- It is caused by the bacterium - Treponemapallidumm and transmitted by skin contact.
- Yaws occurs in overcrowded communities, with limited access to basic amenities, such as water and sanitation, as well as health care.

4.5. CHARGE SYNDROME

Why in news?

- Scientists from the Delhi-based CSIR-Institute of Genomics and Integrative Biology are a step closer to bringing hope to children born with CHARGE syndrome.
- The results of a study were published recently in the journal Human Molecular Genetics.

What is Charge Syndrome?

- It is a rare disorder in which multiple life-threatening problems such as deafness and blindness, heart defects, genital problems and growth retardation and facial bone and nerve defects that cause breathing and swallowing difficulties.
- A mutation in the CHD7 gene is responsible for 60-70 per cent of all CHARGE defects. The expression of the gene peaks in the early stages of embryo development, starting from 2-4 cells.
- There is a high death rate in the very first year in children born with CHARGE.
- About 1 in 20,000 people in the world, and an estimated 50,000 in India alone, are born with CHARGE syndrome.

4.6. NEED FOR AN HPV VACCINE

Why in News?

- It is being debated whether **HPV (Human Papilloma Virus) Vaccine** should be included in the **universal immunisation programme** or not.

What is it?

- The vaccine offers **protection against sexually transmitted Human Papilloma Virus**.
- The vaccine also averts the risk of contracting **cervical cancer**.
- It needs to be administered before the first intercourse**.**
- **WHO (World Health Organisation)** recommends two doses of the vaccine preferably in the age of 9-13 years.

4.7. MADE-IN-INDIA LEPROSY VACCINE

Why in news?

A first-of-its-kind leprosy vaccine developed in India is to be launched on a pilot basis in Bihar and Gujarat.

Significant Facts

- Vaccine name is **Mycobacterium Indicus Pranii** (MIP).
- It is developed by National Institute of Immunology (NII).
- This vaccine will be administered as a preventive measure to those staying in close contact with leprosy patients.

Important facts about leprosy

- Leprosy, caused by Mycobacterium leprae, affects around 127,000 people in India every year. About 59 per cent of the world's leprosy patients live in India.
- National Leprosy Eradication Programme was launched in 1983.
- India achieved the goal of elimination of leprosy as a public health problem in Dec 2005.
- Chhattisgarh and Dadra & Nagar Haveli have still not achieved elimination.

4.8. FOOT & MOUTH DISEASE (FMD)

Ministry of Agriculture has allocated 100.00 crore rupees for FMD control under Rashtriya Krishi Vikas Yojana in order to achieve the objective of FMD Mukt Bharat' in next few years.

Background

- Foot & Mouth Disease (FMD) is one of the **most economically devastating contagious viral animal diseases** affecting all susceptible cloven-footed animals.
- In order to prevent economic losses due to Foot and Mouth Disease, a programme named 'Foot and Mouth Disease Control Programme (FMD-CP)' is under implementation **since 10th Plan Period.**

4.9. KLEBSIELLA PNEUMONIAE BACTERIA

Why in News?

- A US woman died from an infection that was resistant to all 26 available antibiotics, raising new concerns about rise of dangerous superbugs.
- The bacterium found was **Klebsiella pneumonia** that contained the enzyme called as **New Delhi metallo-beta-lactamase** (NDM-1) in its gene.

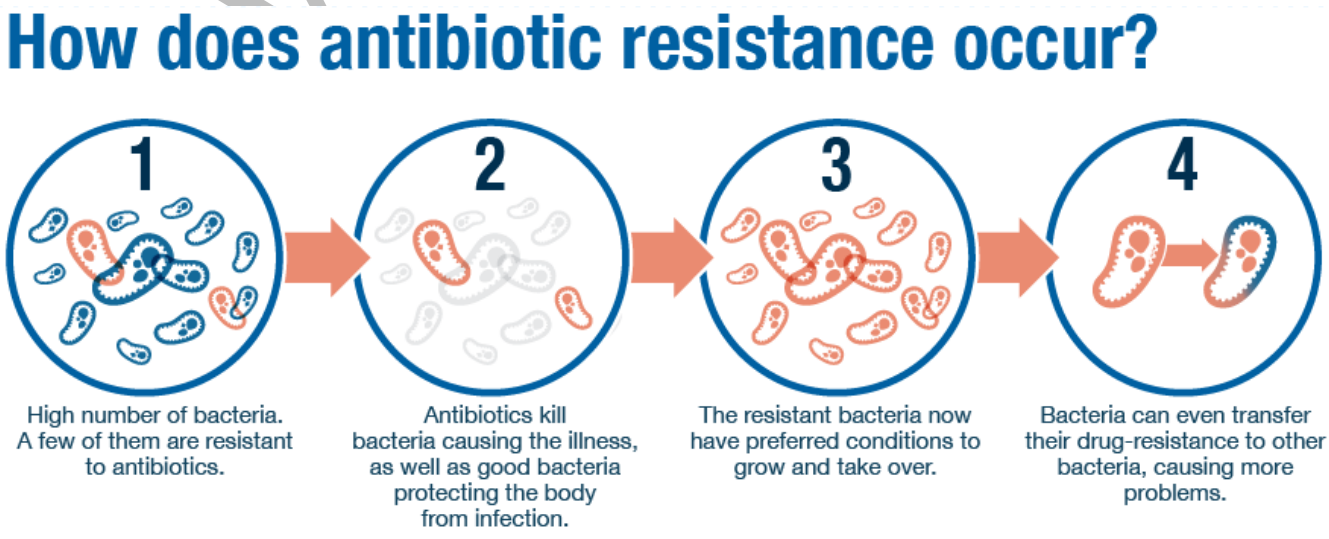
What is a superbug?

- Bacteria can carry genes that allow them to survive exposure to the antibiotics we currently have. These are called superbugs or antibiotic resistant.
- There are two reasons for emergence of resistance:
  - Spontaneous mutation of bacterium's DNA
  - Transfer of ABR genes from one bacteria to another
- Major reason for increasing number of superbugs' emergence is the misuse or overuse of antibiotics.

How can we stop the spread of superbugs?

There is a lot we can do as individuals and as a community, through our governments, to improve the situation and reduce the risk of being infected with a superbug.

- Reducing individual risk
  - Maintain good personal care and hygiene
  - Limit the antibiotics you receive
- Use in this in animals to be avoided: Worldwide, about 80% of all antibiotics are used in **food animals** but many a times antibiotics provide no or marginal benefit.
- Renew our focus on safe water- NDM-1 is found in New Delhi's chlorinated water supply.
- Research and development can only be the long term solution for the problem
- Awareness among the individuals regarding the spread of superbugs and International cooperation.

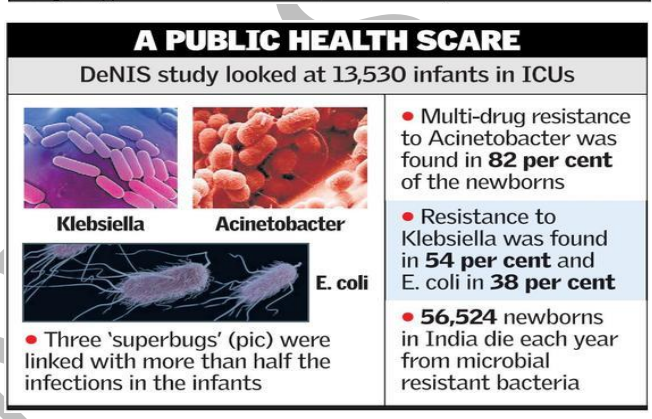


4.10. SUPERBUGS

Why in news?

- **World Health Organization(WHO)** has recently provided a list of twelve **"Superbugs"** which pose an enormous threat to human health.
- **WHO** further urged medical experts and pharmaceutical researchers to focus first on fighting the most dangerous among these pathogens.

Species	Type of Antibiotic Resistance
Critical*	
Acinetobacter baumannii	Carbapenem resistant
Pseudomonas aeruginosa	Carbapenem resistant
Enterobacteriaceae†	Carbapenem resistant Third-generation cephalosporin resistant
High	
Enterococcus faecium	Vancomycin resistant
Staphylococcus aureus	Methicillin resistant Vancomycin intermediate and resistant
Helicobacter pylori	Clarithromycin resistant
Campylobacter	Fluoroquinolone resistant
Salmonella spp	Fluoroquinolone resistant
Neisseria gonorrhoeae	Fluoroquinolone resistant Third-generation cephalosporin resistant
Medium	
Streptococcus pneumoniae	Penicillin nonsusceptible
Haemophilus influenzae	Ampicillin resistant
Shigella spp	Fluoroquinolone resistant



Superbugs

- They are a **strain of bacteria** that has become resistant to battery of antibiotic drugs after their prolonged exposure to antibiotics.
- Hence, the medicines become **ineffective** and infections persist in the body, increasing the risk of spread to others.
- **Overuse** (consuming more antibiotic than prescribed) and **Misuse** (taking prescribed antibiotic incorrectly or taking antibiotic to treat viral infection) of antibiotics are the major reason for formation of Superbugs. **Human consumption** of **antibiotic-treated chicken** and **livestock** further increasing resistance.
- Few prominent superbugs highlighted by WHO are **MRSA** (methicillin-resistant Staphylococcus aureus), **Neisseria gonorrhoeae**, **Klebsiella**, **E. coli.**
- **Klebsiella Bacteria** has recently developed resistance to a powerful class of antibiotics called **carbapenems.**

4.11. ANTI-MALARIA BATTLE

Why in News?

- Scientists have discovered a new compound named ***bicyclic azetidine series*** that was found to act on all three stages of the malaria parasite, according to a study published in the journal Nature.

About The Discovery

- The compound was found to cure the disease with a single, low dose treatment.
- Also, it can provide prophylaxis; prevent disease transmission both in lab and in animals.
- The compound works by targeting the parasite's protein translation machinery. Protein translation is vital at every stage of the plasmodium life cycle.
- Since protein translation is quite vital for the parasite's functioning, mutation is quite unlikely. Therefore, there are less chances of parasite developing drug resistance against the compound.
- This discovery can be a stepping stone in the treatment of the disease and will also pave way for more therapeutic arsenals in the coming year.

4.12. GENES BEHIND INTELLECTUAL DISABILITY

Why in News?

- Researchers have for the first time identified 30 recessive inherited genes that play a role in intellectual disability as well as other brain disorders, according to the journal, Molecular Psychiatry.
- The research was carried out by scientists from Radboud University Medical Centre in Netherlands and University of Health Sciences in Pakistan.
- The research was carried out for five years and across three continents.

Intellectual Disability: Fact File

- Intellectual disability or ID (previously known as mental retardation) limits an individual's intellectual ability and practical skills.
- As many as 213 million people are affected by neuro-developmental disorder.
- It is measured by intelligent quotient below 70.
- Today, close to 1-3 percent population has some form of ID.
- Half of ID can be linked to poor nutrition and environmental causes while the other half is due to genetic disorders such gene mutations.
- This research can be applied for DNA screenings and determine the possibility of a couple producing an ID child.

4.13. MCR-1 ISOLATED IN INDIA

Why in News?

- Scientists have isolated resistance causing mcr-1 gene in a strain of E.coli in India.

What is it?

- Mcr-1 gene is responsible for resistance against the antibiotic, Colistin- the last mile antibiotic that the human race has currently access to.
- Colistin belongs to a group of antibiotics called polymixins which are termed "critically important by WHO. It is used when no other antibiotic works.
- Colistin resistance has been previously detected only in mutations in the chromosomal/genetic path. And mutations do not spread from one patient to another.
- On the other hand, mcr-1, the gene is found in the plasmid medium, a small DNA molecule outside of the chromosomal DNA.
- In other words, the infection can spread in hospitals and the community now.
- Mcr-1 has already been detected in China, USA and Brazil.

4.14. COALITION FOR EPIDEMIC PREPAREDNESS AND INNOVATIONS

Why in News?

- India will lead the global fight against epidemics as it is a member of the newly formed Coalition for Epidemic Preparedness Innovations (CEPI). It will be headquartered in Norwegian Institute for Public Health, in Oslo.

Why the need?

- Recent outbreaks: **SARS, Ebola and Zika** - reveal gaps that partnerships like CEPI should fill.

About the coalition

- It was officially launched in Jan 2017 at World Economic Forum (WEF) at Davos with an initial investment of $460 million from the Germany, Japan and Norway including Bill & Melinda Gates Foundation.
- CEPI aims to finance and coordinate the development of new vaccines to contain infectious disease epidemics that are usually neglected (like some neglected tropical diseases)
- The coalition will not focus on diseases that already have adequate attention like rotavirus, but will be guided by WHO's R&D blueprint (2016), which lists eleven illnesses to focus on like Chikungunya, Middle East Respiratory Syndrome (MERS) etc.
- The steering agencies of the coalition are - Department of Biotechnology, Ministry of Science & Technology, GOI; Government of Norway; Wellcome Trust; Bill & Melinda Gates Foundation; and World Economic Forum.

Benefits of the Coalition

- It will provide a permanent, sustainable model for epidemic vaccine development through sharing of risk and benefits of vaccine development.
- CEPI would provide the opportunity to leverage vaccine development capacities in India,
- CEPI will increase access to vaccines. It will also bolster India's status of pharmacy of the world.

- It will help protect our population and help lower preventable deaths.
- It will boost our ability to have a competitive vaccine industry and help India build on its pharmaceutical economy.
- In the era of antibiotic resistance, this initiative will help finance the development of vaccines for resistant infections.

4.15. CHIKUNGUNYA VACCINE

Why in news?

- US researchers have developed a vaccine for chikungunya made from an insect-specific virus Eilat virus since it only infects insects and has no impact on people, making the vaccine safe and effective.

About Chikungunya

- It is caused by virus. The virus is transmitted by the bites of infected female mosquitoes, commonly *Aedes aegypti* and *Aedes albopictus.*
- It is characterized by fever and severe joint pain in hands and feet, and may include headache, muscle pain, joint swelling or rash.
- The disease shares some clinical signs with dengue, and can be misdiagnosed.
- There is no cure for the disease. Treatment is focused on relieving the symptoms. This is the first vaccine treatment which may become a viable treatment in future

Significance of the vaccine

- There is currently no commercial chikungunya vaccine.
- Traditionally, vaccine development involves trade-offs between how quickly the vaccine works and safety.
- The newly-developed vaccine quickly produces a strong immune defence and completely protects mice and nonhuman primates. It is still unable to prove effectiveness in humans.

4.16. DIAGNOSIS OF DENGUE AND CHIKUNGUNYA

Why in News?

Biomarker: A biologic feature that can be used to measure the presence or progress of disease or the effects of treatment.

- Researchers have identified specific metabolites that can potentially be used as **biomarkers for distinguishing dengue and chikungunya infections** as well as co-infections by these two viruses.
- The research was carried out at Delhi's International Centre for Genetic Engineering and Biotechnology and has been published in the journal **Scientific Reports**.

Background

Antibody is a protein produced by immune system to fight outside invaders. Since the enemy substance triggers the production of antibodies, such substances are called antigens-anti- being short for antibody, and-genmeaning "producer". (Similarly, an allergen produces an allergy, and a pathogen produces a pathology or disease.)

- **Antigen and Antibody-based diagnostic tools** are available for dengue and the diagnosis can be made within the first few days of infection.
- However, antigen-based diagnostic tools are not approved by the government and are therefore not used in government hospitals.
- On the other hand, only antibody-based diagnostic tools are available to detect chikungunya making it difficult to diagnose it early. (Antibodies take time to develop).
- Both chikungunya and dengue exhibit similar and overlapping symptoms making it challenging to diagnose and more so in the case of a co-infection.
- Currently, there are no tools for the diagnosis of a co-infection by chikungunya and dengue.

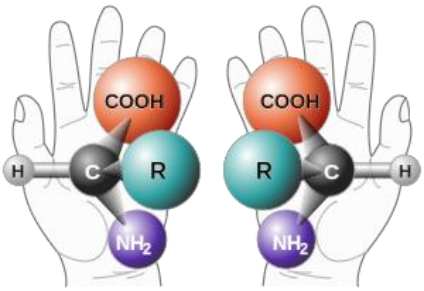
Significance

- Diagnostics based on metabolites is highly sensitive making it easier to detect even the minor changes at the molecular level both in case of mono and co-infection.
- The metabolic clusters can be used for various applications- biomarkers, studying disease progression, evaluating therapeutic potential of drugs and disease management.

4.17. CURBING THE GROWTH OF MALARIA PARASITE

Why in News?

- Scientists are using chirality of molecules to cheat the malaria parasite from causing infection in humans.



What is Chirality?

- Biomolecules are symmetrical in nature. This property is called chirality.
- In case of a chiral structure, the carbon atom is central to the molecule while all other elements can be arranged in left handed or right handed way.

How This Property is Being Used?

- The constituents of proteins i.e amino acids have a chiral structure and all naturally occurring proteins are made up of L-amino acids.
- Chiral properties of the L-amino acids are being used to curb the life cycle of Plasmodium Falciparum
- Plasmodium Falciparum is one of the malaria parasites that causes particularly virulent form of the disease.
- This parasite has a complex life cycle and one of the important steps is the invasion of red blood cells by this parasite.
- During the invasion of RBCs, two proteins (AMA1 and RON2) form a junction known as apical membrane.
- It is at this juncture chiral property of biomolecules can be used by cheating the malarial parasite.
- Chemically synthesized mirror image of the protein is replaced with the L-amino acid rendering the protein dysfunctional for forming the junction.

4.18. EBOLA VACCINE

Why in News?

- A new Ebola vaccine has been proved to give 100 percent protections in its final test results.
- The trial was carried out in Guinea and the test results were released in **The Lancet**.

What is it?

- The vaccine called rVSV-ZEBOV was developed over a decade ago by the Public Health Agency of Canada and United States Army.
- The Ebola trial of this vaccine was led by **World Health Organization, The Guinean Health Ministry and the Norwegian Institiute of Public Health.**

4.19. JEEVAN REKHA: E-HEALTH PROJECT

Why in news

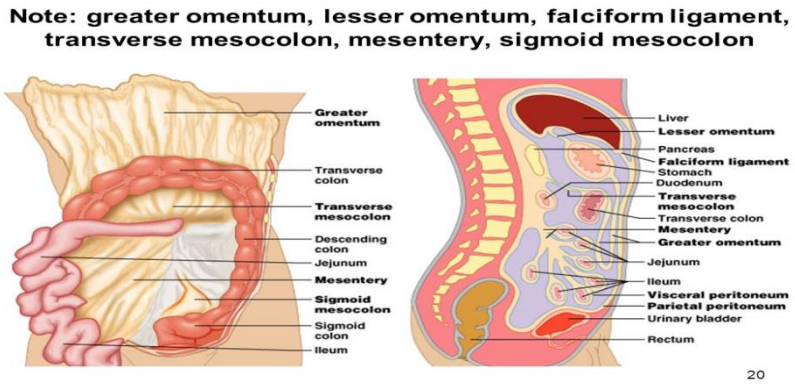
- Recently Kerala government launched the **World Bank** aided **e-health project** called **JEEVAN REKHA.**

About the project

- This is first of its kind initiative in the country. It has two components –**public health component** and **hospital automation module**.
- Main aim of the project is to create **integrated healthcare cloud** that will contain the health records of all its citizens in electronic form.
- Public health component envisage the development of **Electronic health records (EHR)** of the population while hospital automation module envisage the **digitization** of all government hospitals.
- System will automatically provide a **unique identification number** for any person who will access the healthcare system and also store his health record in electronic form **(EHR)** in central server.
- It has a privacy clause to ensure that patient health records are not leaked in public domain.

4.20. NEW HUMAN ORGAN FOUND: MESENTERY

- A new human organ has been classified by Ireland scientists, known as the **Mesentery**.
- It's a double fold of peritoneum - the lining of the abdominal cavity - that attaches our intestine to the wall of our abdomen, and keeps everything locked in place.
- This new organ is found in our digestive systems, and earlier thought to be made up of fragmented, separate structures. But recent research has shown that it's actually a one continuous organ.
- It carries blood and lymphatic fluid between the intestine and the rest of the body. It also maintains the position of the intestine so that it's connected with the abdominal wall without being in direct contact.
- Its reclassification will help in better understanding about what kind of role does it play in abdominal and digestive diseases which could further lead to less invasive surgeries, fewer complications, faster patient recovery and lower overall costs.



4.21. HYPERBILIRUBINEMIA

- Researchers from IIT Kharagpur developed a technology that uses thumbprint to detect **Hyperbilirubinemia.**
- Hyperbilirubinemia is a condition when there is too much bilirubin in the blood and turns sclera of eye, urine and even skin yellow.
- It is commonly seen in people and newborns suffering with jaundice when the bilirubin concentration in the blood typically exceeds 12 ppm in adults and 50 ppm in a newborn.
- Researchers have used Luminescence property of Gold Nanoclusters which are extremely sensitive to presence of molecules in the environment.
- When a person has jaundice, bilirubin gets deposited on the surface of skin. So when she presses the thumb on gold nanocluster coated membrane having copper deposited on its surface, bilirubin forms a complex with copper and restores the luminescence curtailed by copper.

4.22. INDIA'S NATIONAL VACCINE REGULATORY AUTHORITY

WHO recently declared **Indian National Regulatory Authority** functional and awarded it highest rating 4 which means 100% compliance with the WHO benchmarking , good result with sustained improvement trend and stringent regulator of vaccine as per developed countries and European Union.

What is NRA?

- As Specified by WHO, NRAs are national regulatory agencies responsible for ensuring international standards of quality and safety in vaccine production either for export or for public distribution.
- It comprise of Central drugs standard control organization, State Drug Regulatory Authorities, Pharmaco-vigilance Programme of India (PvPI) and Adverse Events Following Immunization (AEFI) structures at the Central and States levels.

4.23. PREDATOR FOUND FOR DENGUE CAUSING MOSQUITO

- Dengue affects more than 390 million people each year. In 2016, more than 1 lakh confirmed cases of dengue were reported in India (WHO Estimate).
- Researchers at the Calcutta University recently found that the **Lutzia fuscana larvae** demonstrated a preference for feeding on Aedes aegypti larvae (the dengue-causing mosquito)
- "Lutzia fuscana" mosquito is a natural predator of Aedes aegypti.

- Thus, Lutzia larvae, being a potential biological control method, can be the better solution than using dangerous chemicals to kill Dengue mosquito.
- Since 1928 India has been using **Gambusia afinis** or mosquito fish as a biological control agent against mosquito larvae. It is an exotic species and has been distributed throughout the warmer and some temperate parts of the world.

4.24. PFSPZ VACCINE

- PfSPZ (Plasmodium falciparum sporozites) is an **injectable vaccine being developed by Sanaria Inc**.
- It is undergoing clinical trials and recently it got US FDA fast track designation to help to develop this vaccine earlier for the patients.
- It will be able to use it to halt transmission and **eliminate Plasmodium falciparum malaria** from geographically defined regions.
- It would help provide **protection against malaria to travelers and military personnel** visiting malaria endemic regions

Malaria

- Malaria is caused by Plasmodium parasites which spread to people through the bites of infected female Anopheles mosquitoes, called "malaria vectors."
- There are 5 parasite species that cause malaria in humans.
- 2 of these species – P. falciparum and P. vivax – pose the greatest threat.
- P. falciparum is the most prevalent malaria parasite on the African continent.
- P. vivax is the dominant malaria parasite in most countries outside of sub-Saharan Africa.

4.25. CYSVAX VACCINE

- It is a vaccine to fight tapeworm in pigs – first such in the world.
- It has been developed by India Immunologicals Inc., a wholly owned subsidiary of the National Dairy Development Board.
- This would help in improving the food safety of processed foods like pork. Sometimes humans can get infected by ingesting the eggs of the tapeworm in meats like pork.

4.26. BGR-34

- CSIR launched BGR-34 - India's first anti-diabetic ayurvedic drug.
- Its full form is Blood Glucose Regulator 34 where 34 represents the number of active phyto-constituents from herbal resources.
- BGR-34 is designed for Type 2 Diabetes mellitus.
- BGR-34 has been jointly developed by National Botanical Research Institute (NBRI) and Central Institute for Medicinal and Aromatic Plants (CIMAP).
- The modern diabetes drugs cause side-effects and toxicity while **BGR-34 works by controlling blood sugar and limiting the harmful effects of other drugs**.

Lukoskin

- It is a drug launched by the partnership of DRDO and Aimil Pharceuticals (PPP).
- It is used for the safe treatment of leucoderma.

4.27. ZIKA REPLICON SYSTEM

- Replicons are segments of viral genome that can replicate on their own, independent of the cellular chromosome.
- University of Texas has developed a Zika replicon system which replicates the basic structure of the Zika virus, stripping it of the genes that makes the virus infectious. It was engineered by attaching genes allowing researchers to tag the interested parts of the virus.
- The altered Zika virus is no longer infectious, lowering the safety risk.
- It **uses genetic tools to study how the virus multiplies** and causes disease. This is especially important because the Zika virus behaves differently than many other viruses.

5. NANOTECHNOLOGY

5.1. DRAFT GUIDELINES ON SAFE HANDLING OF NANOMATERIALS

- The **Nano Mission** under the Department of Science and Technology has come out with the draft "Guidelines and Best Practices for Safe Handling of Nanomaterials in Research Laboratories and Industries".
- The guidelines, intended as standard operating procedure (SOP) for handling nanomaterials in research laboratories and industries, prescribe a combination of engineering controls, work practices and personal protective equipment as part of a robust exposure control strategy.
- These lay down the process for identifying hazards, taking note of the specific effect of surface chemistry, shape, size and morphology on toxicity caused to various organs.
- The guidelines also lay down set of best practices related to the making and handling of Nanopowders and use of products relating to food and healthcare.

Few Applications of Nanotechnology

- Desalination of water
- Wastewater treatment
- Other Nanoremediation.
- Nanomedicine is being used to treat disease and prevent health issues.
- Nanoparticles are used in sunscreen, cosmetics and food packaging.

About Nano Mission

- The Government of India, in May 2007, has approved the launch of a Mission on Nano Science and Technology (Nano Mission) with an allocation of Rs. 1000 crore for 5 years.
- The Department of Science and Technology is the nodal agency for implementing the Nano Mission.
- Capacity-building in this upcoming area of research will be of utmost importance for the Nano Mission so that India emerges as a global knowledge-hub in this field.
- Equally importantly, the Nano Mission will strive for development of products and processes for national development, especially in areas of national relevance like safe drinking water, materials development, sensors development, drug delivery, etc.

5.2. NANOGENERATOR

About

- Pune based Indian Institute of Science Education and Research (IISER) and the National Chemical Laboratory have developed a nanogenerator that could produce up to 14 volts of electric power when thumb pressure is applied.
- To produce the nanogenerator, the researchers electrospun a piezoelectric polymer [P(VDF-TrFE)] directly onto a flexible, conducting carbon cloth.
- The carbon cloth was produced by heating a cotton cloth at 800 C for several hours in an inert atmosphere

Piezoelectricity is the electric charge that accumulates in certain solid materials (such as crystals, certain ceramics, and biological matter such as bone, DNA and proteins) in response to mechanical stress. It refers to electricity resulting from pressure.

Significance

- Currently, there is considerable research emphasis to develop flexible or wearable devices like digital watches, health gear etc. Such devices should be portable, lightweight, shock-resistant, and inexpensive.
- An essential condition for these devices is that they should be powered by harvesting easily available mechanical or vibration energy, making battery or related wiring redundant.
- Thus, the development of such piezoelectric material is increasing. This invention can pave the way for further development in this field.

6. AWARDS AND INDIGENIZATION OF TECHNOLOGY

6.1. INSPIRE AWARDS

Why in News?

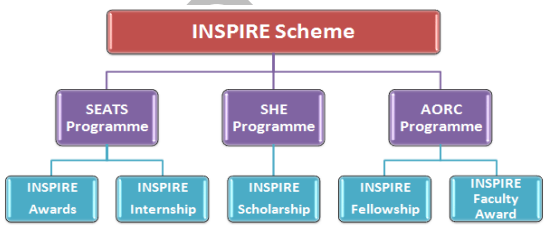
- The Inspire Awards have been renamed as **MANAK (Million Minds National Aspirations and Knowledge).**The Inspire Awards is part of the larger Inspire programme.

What Are the Inspire Awards?

More on Inspire Programme

- The programme aims to attract talent towards the excitement and study of science at an early age and to build the critical resource required for expanding the S&T system and the R&D base. The programme has three components:
- Scheme for Early Attraction of Talent
- Scholarship for Higher Education
- Assured Opportunity for Research Careers.

- The **Inspire Awards** is an **outreach programme of Department of Science and Technology that was started in 2010** to encourage children to develop interest in science and research through innovation.



- Every year 2 lakh students between the ages of 10-15 years are identified for the Inspire Awards. Each Inspire Award envisions an investment of Rs. 5000/- per child.
- Since its inception, it has funded 13.85 lakh students.
- In 2016, 60 of the best ideas would be worked by professional engineers and designers for potential commercial development with intellectual property right for children.
- The programme aims to bring out ideas that use science and innovation to solve problems. To be certain that this happen, the programme will employ **National Innovation Fund (NIF)**. NIF is to make sure that recycled ideas are eliminated and original ones emerge.

6.2. NIDHI

- NIDHI **(National Initiative for Development and Harnessing Innovations)** is an umbrella programme pioneered by the Department of Science and Technology.
- It works towards nurturing knowledge-based and technology-driven ideas and innovations into successful start-ups.
- It also aims to provide technological solutions to the pressing needs of the society and create new avenues for wealth and job creation.
- NIDHI, by design connects and strengthens all the links of the innovation chain- scouting, sustaining, securing, scaling and showcasing.
- The key stakeholders of NIDHI includes various departments and ministries of the central government, state governments, academic and R & D institutions, mentors, financial institutions, angel investors, venture capitalists, industry champions and private sectors.
- Components of NIDHI that support each stage of a budding start-up are:
  - ✓ **PRAYAS** (Promoting and Accelerating Young and Aspiring Innovators & Start- ups), which aims to support innovators to build prototypes of their ideas by providing a grant up to Rs.10 lakhs and an access to Fabrication Laboratory (Fab Lab).
  - ✓ **The Seed Support System** which provides up to One Crore rupees per start-up and is implemented through Technology Business Incubators.
- With a view to drive the innovation and start-up centric new initiatives in a scaled up manner for its wider outreach across the country, a 450% increase in allocation (Rs. 180 crores) has been made in the Department's budget.

6.3. SHANTI SWARUP BHATNAGAR AWARD

- The government announced the recipients of the prestigious Shanti Swarup Bhatnagar Award for Science and Technology, which is the most coveted award in multidisciplinary science in India since 1958.

- It is given annually by the Council of Scientific and Industrial Research (CSIR) for notable and outstanding research, applied or fundamental, in biology, chemistry, environmental science, engineering, mathematics, medicine and Physics.
- **Partha Sarthi Mukherjee** bagged the award in the Chemical Sciences category while **Sunil Kumar Singh** in the Earth, Atmosphere, Ocean and Planetary Sciences category.
- Avinash Kumar Agarwal from IIT Kanpur and Venkata Narayana Padmanabhan of Microsoft Research India have bagged the award in Engineering Sciences category.
- Amlendu Krishna from Mumbai-based Tata Institute of Fundamental Research (TIFR) and Naveen Garg from IIT Delhi have been selected in the Mathematical Sciences category.
- Subramanian Anantha Ramakrishna from IIT Kanpur and Sudhir Kumar Vempati from IISc have jointly bagged the award in the Physical Sciences category.

6.4. ADVANCED ULTRA SUPER CRITICAL TECHNOLOGY (AUSC)

Why in news?

- Govt. approved Rs 1,554 crore to develop advanced ultra-super critical (AUSC) technology for power plants.
- It will be used for thermal power plants of future, envisaging reduced coal consumption and CO2 emission.
- This will be the first time large power plant equipment will be manufactured with advanced technologies without any technological collaboration/licensing agreement with foreign companies.

Other important facts

- Conventional coal-fired power plants, which make water boil to generate steam that activates a turbine, have efficiency of about 32%.
- Supercritical (SC) and ultra-supercritical (USC) power plants operate at temperatures and pressures above the critical point of water, at which point there is no difference between water gas and liquid water. This results in higher efficiencies of above 45%.
- SC and USC power plants require less coal per megawatt-hour, leading to lower emissions (including carbon dioxide and mercury), higher efficiency and lower fuel costs per megawatt.

6.5. SOLAR POWER TREE

- It has been developed by the CSIR-Central Mechanical Engineering Research Institute (CSIR-CMERI).
- It will harness the solar energy to produce electricity with an innovative vertical arrangement of solar cells.
- It thus reduces the requirement of land as compared to conventional Solar Photovoltaic layout. Eg. It takes only 4 square feet of land for a 5 KW Solar Power tree, whereas in a conventional layout, it requires 400 square feet of land.
- Even the cultivable land can be used in this arrangement along with farming at the same time. The innovation finds its viability both in rural and urban areas.
- As a future prospect, the Solar Power Tree would be developed in a rotatable module, which would have a motorized mechanism to align itself with the movement of the Sun during the day. Hence, it would be possible to harness 10-15% more power over and above the current capacity.

6.6. DIVYA NAYAN

- It is a standalone **text to speech portable reading machine** that has been developed for the visually impaired to help them read normal texts without any third person involvement.
- It has been developed by a CSIR lab - Central Scientific Instruments Organization (CSIO), Chandigarh.
- It is based on the principle of contact scanning of a printed document and converts into speech.
- Presently, it supports English and Hindi language. It will be further programmed for other Indian and Foreign language.
- It will be **completely wireless device**. It uses **open source hardware and software**.

7. IPR

7.1. COPYRIGHT INFRINGEMENT: GOVT POLICY AND MEASURES

Why in News?

- The government has planned for strict enforcement of **copyright law** to tackle **piracy** in the country through its **IPR (Intellectual Property Rights) Policy**.
- A **nation-wide awareness campaign** is set to be launched on **IPR** by the **Department of Industrial Policy and Promotion (DIPP).**
- The government has issued strict warning against copyright infringement online stating the punishable offences under its copyright law.

Penal Provisions of the Copyright Act

- **Section 63** deals with **offence of infringement. It** provides that any person who 'knowingly' infringes copyright or is party to it may be punished with **imprisonment and fine.**
- The minimum imprisonment is of 6 months (extendable up to 3 years) and a fine up to Rs. 3 lakhs.
- **Section 63-A** deals with **repeat offences** and provides for a higher fine and imprisonment for a repeat offenders.
- **Section 65** deals with the **possession of plates** for the purposes of making infringing copies.
- Section 65-A deals with **digital rights management.**

Common Copyright Infringements

- **Making infringing copies** for sale or hire or selling or letting them for hire.
- **Permitting any place for the performance of works in public** where such performance amount to copyright infringement.
- **Distributing infringing copies for the purpose of trade** or to such an extent that is harmful to the interest of the owner of copyright;
- **Public exhibition of infringing copies** by way of trade.
- **Importation of infringing copies** into India.

Positives of the Government Initiative

- **Awareness campaigns** are expected to sensitize the public about **intellectual property rights.**
- The new IPR policy puts a **legal framework** in place for the IPR regime.
- It has also reduced the time taken by govt. to approve a **trademark** from about a year to a month by 2017.

7.2. RIGHT TO PHOTOCOPY

Why in news?

Delhi High Court handed out a landmark verdict for IP and Access to Knowledge, holding that the educational **exception under Section 52(1)(i)** – the reproduction of a work by a "teacher/pupil in the course of instruction" – of the Copyright Act was broad enough to cover the photocopying and creation of course packs.

Copyright Law in India

- The **Copyright Act, 1957** governs the subject matter of copyright law in India.
- It has been **amended 6 times** since 1957, the latest being in **2012.**
- India is a member of many important international conventions governing the area of copyright law. They are **Berne Convention of 1886**, **The Universal Convention of 1951**, **The Rome Convention 1961** and the **Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).**

Arguments supporting Delhi HC verdict

- To balance copyright protection with public interest in ensuring access.
- Ensures affordable access to expensive foreign quality educational material.
- Already Section 52(1) of copyright protection permits making of copies of literary works by a teacher or pupil in the course of instruction. Photocopying is just an extension as the material is mostly limited to university campus.

8. SOME RECENT DEVELOPMENTS IN SCIENCE AND TECHNOLOGY

8.1. EXPLORING METALS IN INDIAN OCEAN

- Cabinet approved signing of a 15 year contract between its Earth Sciences Ministry and the International Seabed Authority (ISA) for undertaking exploration and other developmental activities related to **polymetallic sulphides** in the Indian Ocean.
- The exploration will be done in the allotted area of 10,000 sq km in parts of Central and South - West Indian Ridges (SWIR), in the Indian Ocean.
- This comes after the ISA, under the United Nations Convention on Law of the Sea (UNCLOS), approved an application submitted by India for allotment of 10,000 square km area along with 15 years plan of work for exploration of polymetallic sulphide (PMS) along these two areas.
- The program will be implemented by the Ministry of Earth Sciences with the participation from various national institutes and research laboratories and organizations.

Related Information:

International Seabed Authority (ISA)

- The International Seabed Authority is an autonomous international organization established under the 1982 United Nations Convention on the Law of the Sea and the 1994 Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea.
- The Authority, which has its headquarters in Kingston, Jamaica, came into existence on 16 November 1994, upon the entry into force of the 1982 Convention.
- It was established to organize, regulate and control all mineral-related activities in the international seabed area beyond the limits of national jurisdiction, an area underlying most of the world's oceans.

Polymetallic nodules (manganese nodules)

- These are small potato-sized (from millimetres to tens of centimetres in diameter) lumps of material precipitated from seawater and sediment pore water at slow rates over millions of years and occur mainly on the deep-seafloor.
- They contain approximately 24% manganese, compared to 35 to 55% manganese in land ore bodies, so they do not offer solid economics as a manganese source, but they also contain iron (14%), copper (>1%), nickel (>1%), and cobalt (0.25%).

Cobalt-rich ferromanganese crusts

- Cobalt-rich ferromanganese crusts occur at shallower depths of <400 to about > 5000 meters in areas of significant volcanic activity.
- The crusts grow on hard-rock substrates of volcanic origin by the precipitation of metals dissolved in seawater in areas of seamounts, ridges, plateaus and where prevailing currents prevent deposition of unconsolidated sediments and occupy large areas on top of these topography highs.
- In many cases, the deposits occur within the exclusive economic zone (EEZ) of the countries.
- Similar in general composition to the polymetallic nodules, cobalt crusts are attracting investment in exploration for higher cobalt percentage (up to 2%), platinum (0.0001%) and Rare Earth Elements (REE) besides Nickel and Manganese.

Polymetallic sulphides (PMS)

- PMS are formed by precipitation of metals leached by hydrothermal fluid as it interacts with the cooler ambient seawater at or beneath the seafloor at hydrothermal vent sites.
- PMS are typically composed of iron pyrite, but contain varying proportions of pyrrhotite, pyrite/marcasite, sphalerite/wurtzite, chalcopyrite, bornite, isocubanite and galena.

- Copper and zinc are the most likely metals to be recovered, but some deposits exhibit significant gold (0–20 ppm) and silver (0–1200 ppm) grades as well.
- Submarine massive polymetallic sulphide bodies are principally found along the earth's major tectonic belts.

8.2. LIDAR

Why in News?

- Unprecedented new details of medieval cities in Cambodia near Angkor Wat have been revealed using Lidar, shedding new light on the civilisation.
- In Telangana, the State government proposes to use LiDAR (Light Detection and Ranging) technology in preparation of high resolution maps for use in various engineering works and projects that the State is planning.
- Last year, the Telangana State government had conducted Light Detection and Ranging (LiDAR) survey on the river flow of Godavari last year
- Recently Google has accused Uber of stealing its **LIDAR designs** in developing its own autonomous vehicles. Autonomous vehicles use LIDAR for obstacle detection and avoidance to navigate safely through environment. LIDAR is highly sought after technology used by companies like Google and Uber.

Light Detection and Ranging (LIDAR)

What is it?

- It is a **remote sensing method** that uses **narrow beam of lightinstead** of radiowaves in the form of a pulsed laser to build a 3-D image of surrounding landscape. The narrow beam of laser makes it possible to map objects with high degree of resolution.
- It **measures**and **analyses**the distance from the sensor to the object by determining the time between the release of laser pulse to receiving of the reflected pulse.
- For terrestrial mapping LIDAR uses near **infrared wavelength laser**(900–1064 nanometers) and water penetration like **sea bed mapping** it uses **green light** (532 nanometers).
- A typical **LIDAR instrument** principally consists of a **laser**, a **scanner**, and a **specialized GPS receiver.**
- There are three ways to collect **LIDAR data** – airborne, satellite and ground. **Airborne LIDAR data** are the most commonly available LIDAR data.

Utilities of LIDAR

LIDAR data has multiple applications. Like:

- **Urban planning:**Helps in creation of large area models in short time. It is also used to create digital elevation models and surface models of surrounding buildings.
- **Coastline management:** Producing accurate shoreline maps, detecting coastal erosion.
- **Archeology:** Help in creation of high resolution digital elevation models to reveal micro-topography.
- **Oil and Gas exploration:**It is used totrace amount of gases above the hydrocarbon region. This tracking helps to find exact area which has Oil and Gas deposits. Thus saves both time and money.
- **Quarries and Minerals:**
  - ✓ Helps in quick surveying the mining area to check its suitability.
  - ✓ Give an accurate indication of environment impact.
- **Cellular network planning:** Can be used to provide analysis for determining line of sight for proposed cellular antenna.
- **Forestry management and planning:** It provides the height of canopy, its density and ground elevation. It is also increasingly used for managing forest fire by mapping possible fire area.
- **Flood modeling:**
  - ✓ Helps in creation of accurate flood prediction models.
  - ✓ Can be incorporated into relief, rescue and flood simulation software to provide advanced topographical information.
- **Pollution modeling:**
  - ✓ Helpsin detection of pollutants like carbon dioxide, sulphur dioxide and methane.
  - ✓ Detection of noise and light pollution.
- **Mapping and Cartography:**
  - ✓ Assist in mapping of roads, buildings and vegetations.
  - ✓ Useful in developing high-resolution contour maps.
- **Transport planning:** Help in mapping transport corridor facilitating seamless navigation.
- **Agriculture:**

- ✓ Helps in crop mapping and indicate which areas to need fertilizers for maximum crop yield.
- ✓ Helps in creating a topographical map of the fields and reveals the slope and sun exposure of the farm land.

- **Spaceflight and Astronomy:**
  - ✓ It may be used in mapping the surface of any celestial body.
  - ✓ It is used for atmospheric studies from space.
- **Atmospheric remote sensing:**It is used to determine cloud profiles, measuring winds, studying aerosols and quantifying various atmospheric components.

8.3. BIONIC LEAF

- A team of scientists from Harvard University has created a unique "bionic leaf" that uses solar energy to split water molecules into oxygen and hydrogen, and hydrogen-eating bacteria to produce liquid fuels.
- Bionic leaf 2.0 can convert solar energy to biomass with 10 percent efficiency - a number far higher than efficiency of photosynthesis in the plant.
- The bionic leaf 2.0 is placed in water and, as it absorbs solar energy, it's able to split the water molecules into hydrogen and oxygen. These can be harvested and used in fuel cells to generate electricity.
- With the help of an engineered bacterium, the hydrogen can also be used to produce liquid fuels.

8.4. BIO-INK FOR 3D PRINTING

- Scientists have developed a new stem cell-containing bio-ink that allows 3D printing of complex living tissues that may be used for surgical implants.
- The bio-ink contains two different polymer components: a natural polymer extracted from seaweed, and a sacrificial synthetic polymer used in the medical industry.
- The special bio-ink formulation was extruded from a retrofitted benchtop 3D printer, as a liquid that transformed to a gel at 37 degrees Celsius, which allowed construction of complex living 3D architectures.

Potential Applications of Bio-ink
It can be used for printing complex tissues using the patient's own stem cells for surgical bone or cartilage implants, which could be used in knee and hip surgeries.

How it works?

- The synthetic polymer causes the bio-ink to change from liquid to solid when the temperature is raised, and the seaweed polymer provides structural support when the cell nutrients are introduced.
- The team was able to differentiate the stem cells into osteoblasts - a cell that secretes the substance of bone- and chondrocytes, cells that have secreted the matrix of cartilage and become embedded in it, to engineer 3D printed tissue structures over five weeks.

8.5. DNA: DATA STORAGE

- A team from Microsoft and the University of Washington along with Twist Bioscience, a San Francisco start-up, reached a milestone by successfully storing 200 MB of digital data in DNA.
- DNA has been carrier of genetic data for generations.
- Significance
  - ✓ DNA possesses some of the attractive properties important for storing data.
  - ✓ It is very stable; synthetic DNA can remain intact for thousands of years.
  - ✓ DNA is never going to become obsolete as it holds blueprint of the living system.
  - ✓ It has high packing density- 1 kg of DNA is enough to store all the data available in the world.
- Limitations
  - ✓ Encoding and decoding data in DNA is a complex task, it requires more time and money.
- However this limitation is fast erasing as with technological advancements storing data into DNA structure will only become cheap, quick and less complicated.

8.6. SELF-DRIVEN CARS

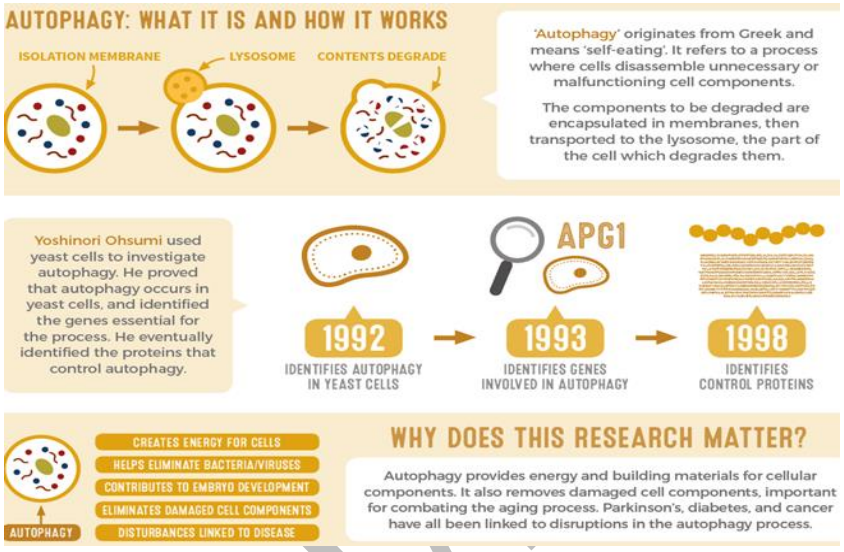
- nuTonomy, a small firm, made history of sorts when it introduced a self-driving taxi service in Singapore.
- These cars powered by AI (Artificial Intelligence) can revolutionize the transport industry worldwide.

- An autonomous car (driverless car, self-driving car, robotic car) is a vehicle that is capable of sensing its environment and navigating without human input. Autonomous cars can detect surroundings using a variety of techniques such as radar, lidar, GPS, odometry, and computer vision.

8.7. NOBEL PRIZE IN MEDICINE/PHYSIOLOGY

Why in News?

Yoshinori Ohsumi, a Japanese cell biologist was awarded the 2016 Nobel Prize in Physiology or Medicine for **"his discoveries of mechanisms for autophagy".**



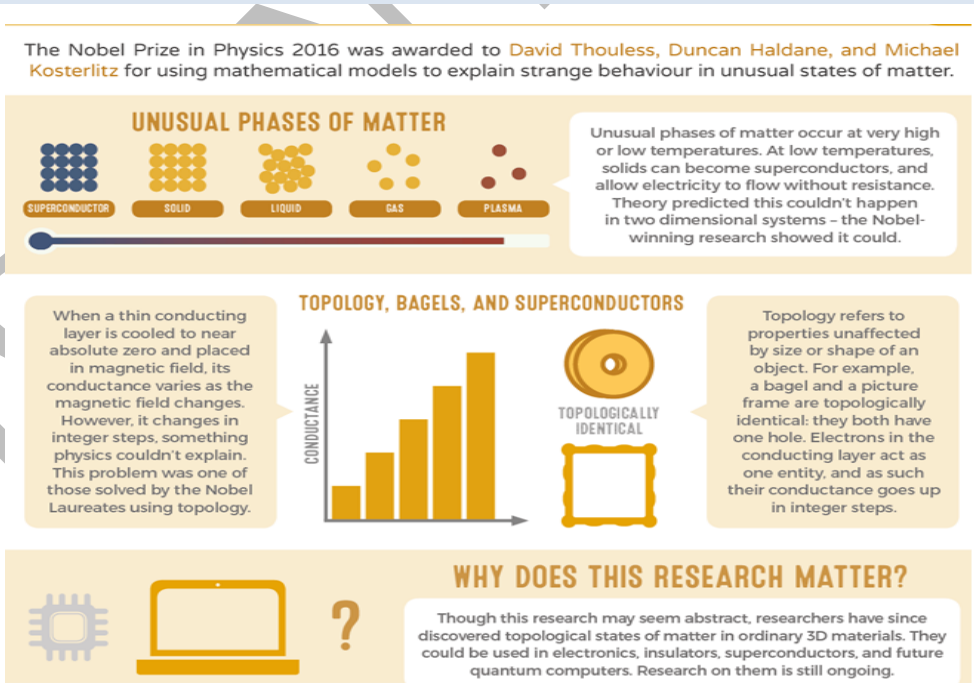
About Autophagy

- Autophagy is a greek term for "self-eating".
- It is a fundamental process for degrading and recycling cellular components.
- This discovery of the mechanism of autophagy will aid in the fight against diseases such as cancer, Parkinson's disease and Alzheimer's.

8.8. NOBEL PRIZE IN PHYSICS 2016

Why in News?

The Nobel Prize 2016 in Physics was awarded to David J. Thouless, F. Duncan M. Haldane and J. Michael Kosterlitz for **"theoretical discoveries of topological phase transitions and topological phases of matter."**



What is it?

- Topology refers to the study of geometrical properties and spatial relations unaffected by the continuous change of shape or size of figures.

Significance

- The study is being applauded as the meeting point of topology and phase transitions.
- It will help make the study of phase transitions easier.

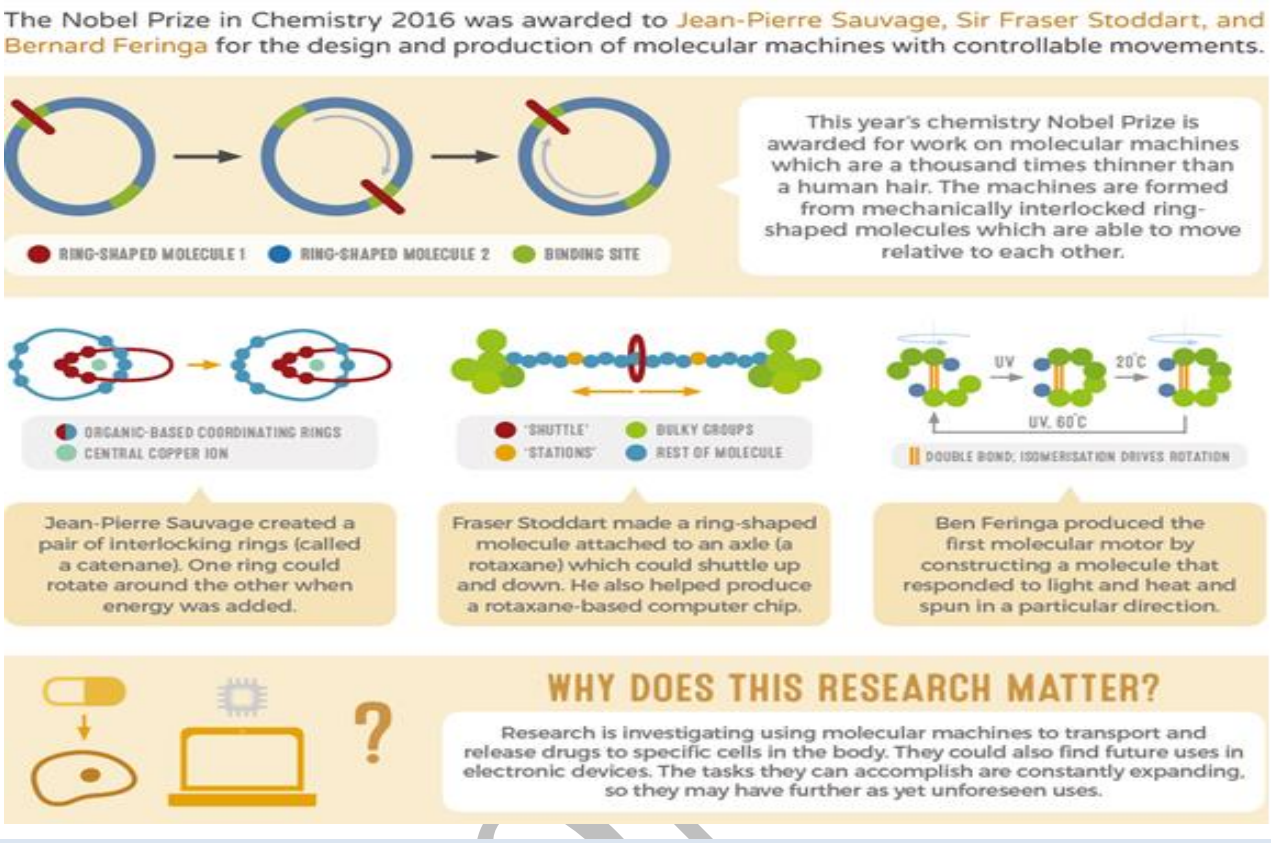
8.9. NOBEL PRIZE IN CHEMISTRY 2016

Why in News?

- The Nobel Prize in Chemistry 2016 was awarded to Frenchman Jean-Pierre Sauvage, British-born Fraser Stoddart and Dutch scientist Bernard "Ben" Feringa for **"developing miniscule machines at the molecular level."**

Significance

- These molecular machines with controllable movements can perform a task when energy is added.
- Machines will eventually prove to be invaluable - doing things no other machines can do.



8.10. HIMANSH

Why in News?

A **high-altitude research station in Himalaya called HIMANSH** has been established by the National Centre for Antartic and Ocean Research, under the Ministry of Earth Sciences at 13,500 ft (4000m) in a remote region in Sipti in Himachal Pradesh.

Objective

The centre has been established as a part of Indian government's initiative to study and quantify the Himalayan glacier responses towards the climate change.

Significance of HIMANSH

- Help researchers to quantify the glacier melting and its relation to changing climate.
- For undertaking surveys using Terrestrial Laser Scanners (TLS) and Unmanned Aerial Vehicles (UAV).
- Help in**digitizing the glacier motion and snow cover variations with utmost precision.**
- Some of the glacier that are already being studied under this project include Bada Shigri, Samudra Tapu, Sutri Dhaka, Batal, Gepang Gath and Kunzam.

8.11. OTHER IMPORTANT NEWS

8.11.1. RESEARCHERS DISSOLVE SILVER USING GLUCOSE WATER

- IIT Madras researchers have found that silver can slowly dissolve in water if heated to about 70 degree C in the presence of glucose. As much as 0.5 weight per cent of a silver plate can get dissolved in glucose water within a week.

- Like gold, silver is a noble metal and is therefore supposed to be inert (resistant to chemical corrosion, especially to chemical reagents used in daily life).
- But, IIT Madras team found that silver atoms gets released from a plate in a simple, two-step mechanism — silver ions are first formed at the metal surface, which later form specific metal complexes with sugar.
- The team has been studying the effect of metals in food and how toxic metals get into our food chain from soil, water and fertilizers.
- An offshoot of the study is that the method can be used for developing novel and green extraction processes for noble metals. In general, toxic chemicals such as cyanide are used for extracting silver.

8.11.2. COGNITIVE DIGITAL RADIO

- A new app calculator has been found on smart phones of terrorists infiltrating into Jammu and Kashmir which helps them to remain in touch with their handlers in Pakistan occupied Kashmir (PoK) without being detected by technical surveillance by army.
- The technology is based on the concept of cognitive digital radio that enables users to turn their smartphones into peer-to-peer, off-grid communication tools. It was first used by a US-based company during Hurricane Katrina so that the affected could remain in touch with each other.
- The Army's signal unit relies largely on technical intercepts - usage of wireless and mobile phones.

8.11.3. SCIENTISTS RECYCLE CO2 TO CREATE USABLE FUEL

Why in News?

- According to a study published in journal **Science**, Scientists have developed a highly effective method of converting **carbon dioxide into methanol.**
- **Methanol** can be used as **low emission fuel** for vehicles.

What is it?

- The gas produced by the burning of **fossil fuels can be converted** into **usable energy** source by using **sunlight**, similar to the way plants convert CO2 into sugar.
- Plants use catalysts in the conversion; similarly here scientist used **tungsten diselenide as catalyst** to convert **carbon dioxide to carbon monoxide**. **Carbon monoxide** being highly reactive can then easily converted into useful fuel such as **methanol.**
- **Significance:** This method directly targets the conversion of CO2 making it highly effective for **environment protection.**

8.11.4. MAHARASHTRA GOVT TO USE DRONE TO MONITOR TRAFFIC

Why in News?

- **Drones** were used for the first time on the **Mumbai-Pune expressway** to **monitor vehicular traffic.**

Need

- Drones are being used keeping in mind the increasing number of accidents on the Mumbai-Pune expressway due to rash driving and indiscipline of vehicles.
- Also, drones are better at monitoring the traffic than CCTV cameras.

8.11.5. USE OF FUNGI TO RECYCLE BATTERIES

- Scientists are working to use naturally-occurring fungi for a green recycling process to extract cobalt and lithium from waste batteries.
- Fungi naturally generate organic acids, and the acids work to leach out the metals.
- About 85 per cent of the lithium and up to 48 per cent of the cobalt - from the cathodes of spent batteries were extracted using the organic acids generated by the fungi.
- Three strains of fungi - Aspergillus niger, Penicillium simplicissimum and Penicillium chrysogenum are to be used for the purpose.

8.11.6. MAKING BRACKISH WATER POTABLE

Why in News?

- Researchers at IIT Madras have devised a method that can convert brackish water into potable water in less than 12 paise per litre.

What is it?

- Researchers used a stack of tissue paper to make graphene.
- Graphic electrodes were then covered with graphene.
- The electrodes are then dipped in brackish water.
- A potential of 1.8 volt is applied to the electrodes, the water gets deionised to become potable water.

8.11.7. SOLUTION TO MARINE OIL SPILLS

- Indian researchers have developed a **membrane with exceptional hydrophobic and high oil-loving (oleophilic) properties.**
- The membrane acts like a filter. When water-oil mixture is passed through the membrane, the oil permeates by rapid absorption while water is retained above the membrane. The oil permeation is 100 percent in the case of oil-water mixture.
- Water-oil emulsification takes place in the seas when water gets mixed with oil under high water current conditions. The membrane is effective in separating oil and water from an emulsion and in solving the problem of oil spills.

8.11.8. HYPERELASTIC BONE

Why in News?

Researchers from Northwestern University in Illinois have developed a 3D printable ink that produces a **synthetic bone implant that rapidly induces bone regeneration and growth.**

Hyperelastic vs autograft

- An autograft is an option where a bone piece is taken from the patient's body usually from hip or rib, and implanted where it's needed elsewhere in the same patient's skeleton.
- Hyperelastic bone is a synthetic material that can be implanted under the skin for new bone to grow on, or used to replace lost bone matter altogether.

Significance

- Hyperealstic bone is made of hydroxyapatite, a naturally occurring mineral in our bones and teeth will provide strength to create bones.
- The hyperelastic material can be easily customized to any shape.
- This discovery is a breakthrough in reconstructive surgery.

8.11.9. INDIAN RESEARCHERS PRODUCES STABLE SOLAR CELLS

Why in news?

- In a first, a researcher from Pune's Indian Institute of Science Education and Research (IISER) has successfully produced a stable, high-efficiency, all-inorganic perovskite nanocrystal solar cells.
- The team replaced methyl ammonium, the organic component, with cesium to produce the material of cesium lead iodide. The size and developed nanocrystals was reduced which made the now all-inorganic material stable.
- Reducing the size of material to nanometer range, increases the surface to volume ratio tremendously, resulting into high surface energy making the high-temperature cubic phase crystal structure stable even at room temperature

Significance

- Silicone-based solar cells available currently are extremely expensive, so research to reduce their cost and increase efficiency is going on.
- Traditional research on solar cells has been around a hybrid organic-inorganic halide-perovskite material which has a high efficiency of 22%, but is stable under ambient conditions for a very short time.
- In earlier efforts on such a material the scientific community was developing bigger size crystals which made the product undesirable. Materials with perovskite structure have been the frontrunners in order to make solar cells cost-effective.
- The researcher was able to remove the organic element and introduce nanocystals of cesium to develop a completely inorganic material which was also thermally stable.

8.11.10. NASA'S NEW INSTRUMENT- BILI

Why in News?

- NASA has developed a new instrument that could search for signatures of life on Mars.

What is it?

- NASA will be using BILI- Bio Indicator Lidar Instrument, fluorescence based remote sensing instrument.
- It is similar to radar in principle and operation but instead of using radio waves, it uses light to detect and ultimately analyze the composition of particles in the atmosphere.
- This instrument is currently in use by the U.S military to remotely monitor the air to detect potentially life threatening chemicals, toxins and pathogens.
- Although NASA has used fluorescence-instruments to detect chemicals in Earth's atmosphere, it has never been employed in planetary studies.

How does it work?

- Positioned on a rover's mast, BILI would first detect dust plumes.
- Once detected, two ultraviolet lasers from the instrument would pulse light at the dust.
- The illumination would cause the particles inside these dust clouds to resonate or fluorescence.
- By analysing the fluorescence, scientist could determine whether the organic particles in the dust have been created recently or in the past.
- BILI can detect small levels of complex organic materials from a distance of several hundred metres.
- Therefore, it could detect bio-signatures in plumes above recurring slopes – even the areas that are not easily accessible by a rover.
- Also, it could do ground-level aerosol analysis from afar. This reduces the chances of contamination of sample.
- BILI's measurements do not require consumables other than electric power and can be conducted over a broad area.

8.11.11. CSIR'S TECHNOLOGY FOR LEATHER PROCESSING

Why in News?

- Central Leather Research Institute has come out with a game changing technology to make leather processing environmentally stable and to reduce chromium pollution load.
- The technology is called "**Waterless Chrome Tanning Technology**" and is a first of its kind.

Significance

- CSIR "Waterless Chrome Tanning Technology has been accepted PAN India.
- This technology completely eliminated two processes after and before tanning.
- It also eliminates the use of water in tanning.
- This process reduces the total dissolved solids in wastewater by 20%.
- It also brings down the usage of chromium by 15-20% resulting in material saving.
- Such technological interventions will help realise the vision of Make-in India.

- It will promote environment friendly leather processing.
- It will help promote global fashion forecasting for colours, design thus leading to increased trade and exports.

8.11.12. SOLAR CELLS FROM HUMAN HAIR

About

- Researchers at the Indian Institute of Science Education and Research (IISER) in Kolkata have used human hair to produce cost-effective, metal-free cathodes for use in solar cells.
- Metal-free cathodes or carbon cathodes have been produced in the past however they lag behind the metal ones in terms of efficiency and performance. This human hair based graphitic porous carbon cathode, on the other hand, is at par with the metal ones and more commercially viable.
- The porosity, along with high surface area to volume ratio, plays an important role in adsorption-desorption of electrolyte.

Significance

- This is a simpler, quicker and relatively cheaper process. Unlike in the case of other synthetic porous carbons, no physical or chemical activation process or templates is required.
- The cathode was found to generate high open-circuit voltage, which is at par with conventional platinum and activated carbon cathodes. Thereby, the power conversion efficiencies can also be enhanced.
- This is the first instance where a bio-waste-derived electrode has been used as cathode in a quantum dot sensitized solar cell device.

8.11.13. ELECTRIC PAPER

What is it?

- E-paper is a technology that mimics the appearance of ordinary ink on paper. The “paper” is similar to the Kindle tablet.

How does it work?

- The e-paper is less than a micrometre thin, bendable and gives all the colours that a regular LED display does.
- It isn’t lit up like a standard display, but rather **reflects the external light** which illuminates it. Therefore, it works very well where there is bright light, such as out in the sun, in contrast to standard LED displays that work best in darkness.
- At the same time, it needs only a tenth of the energy that a Kindle tablet uses, which itself uses much less energy than a tablet LED display.

8.11.14. EM DRIVE

What is it?

The EmDrive (Electro Magnetic Drive) is a microwave thruster developed by British engineer Roger Shawyer that aims to replace the rocket engines of today.

How does it work?

- **Conventional rocket engines** require propellant fuel like liquid oxygen and kerosene to be burnt in the engine in order to make them move forward.
- **EmDrive** requires **no propellant** at all. Instead of using heavy, inefficient rocket fuel, it **bounces microwaves back and forth** inside a cone-shaped metal cavity to generate thrust.

Controversy

- Some academics argue that the EmDrive cannot possibly work because according to the law of conservation of momentum (every action has an equal and opposite reaction).

- In order for a thruster to gain speed in one direction, a propellant must be expelled in the opposite one, and since the EmDrive is a closed system with no propellant, it is seen to violate understanding of physics.

8.11.15. WORLD'S FIRST WATER-WAVE LASER

Why in news?

- Scientists of Technion Institute (Israel) have created the first 'water-wave laser' that emits a beam through the interaction of light and water waves. The biggest impediment till now was the large difference in frequencies of water waves and light waves.

What is a laser?
Laser is an acronym for **"Light Amplification by Stimulated Emission of Radiation"**. It is a **coherent, unidirectional beam of perfectly monochromatic light** (therefore having greater energy than normal light) having a range of application like sensors, optical communication sources etc.

Applications of the discovery

- Water wave laser can be controlled better in terms of emissions and therefore it may be used in 'lab-on-a-chip' devices to study cell biology and test new drug therapies.
- It can be used to develop cheap nano-laser sensors having range of applications like security.

8.11.16. SUPERCONDUCTIVITY FOUND IN BISMUTH

Why in News?

- A team of researchers at the **Tata Institute of Fundamental Research** have discovered **superconductivity in bismuth** at a fraction of degree above absolute zero (-273.16° Celsius)
- The research has been published in the journal "**Science"**.

Bismuth is a high-density, silvery, pink-tinged metal. Bismuth metal is brittle and so it is usually mixed with other metals to make it useful. Its alloys with tin or cadmium have low melting points and are used in fire detectors and extinguishers, electric fuses and solders.

Background

- Scientists have been trying to discover superconductivity in bismuth for decades but in vain.
- Scientists in the past have found superconductivity in bismuth in amorphous or crystalline forms.
- The current theory of superconductivity says that superconducting material must be abundant in free flowing mobile electrons.
- However, Bismuth has only one mobile electron for every 100,000 atoms.
- As one electron is shared by 100,000 atoms, the carrier density of bismuth is very small.

Significance

- It invalidates the Bardeen-Cooper-Schrieffer Theory of Superconductivity. According to which, bismuth can only achieve superconductivity at a much lower temperature.
- With this discovery, bismuth has broken a 50 year old record of strontium titanate of being the lowest carrier density superconductor.
- This discovery will inspire more research and theoretical work on how low density superconductors work.

8.11.17. GRAPHENE FROM SOYBEAN

Why in news?

Scientists have used a soybean to make the world's strongest material graphene commercially more viable.

Properties of Graphene
- Stronger than the steel.
- Good conductor of heat and electricity.
- About 200 times stronger than steel
- Better conductor compared to Copper
- Nearly transparent.

About Graphene

Graphene form of carbon allotrope consisting of planar sheets (2D structure) which are one atom thick, with the atoms arranged in a honeycomb-shaped lattice. It is composed of carbon atoms linked in a hexagonal lattice.

Applications of Grpahene includes Paints and coatings, lubricants, oils and functional fluids, capacitors and batteries, thermal management applications, display materials and packaging, solar cells, inks and 3D-printers' materials and films.

9. MISCELLANEOUS

9.1. INDIA TO BECOME AN ASSOCIATE MEMBER OF CERN

Why in news?

- India recently became an associate member of the European Organisation for Nuclear Research (CERN), the world's largest nuclear and particle physics laboratory.
- India can choose to apply for full membership after two years or continue with this status for five years.

About

- India is set to become an associate member of CERN, the world's biggest laboratory of particle physics in the next few months.
- CERN (European Organisation for Nuclear Research) operates the Large Hadron Collider (LHC), the world's largest and most powerful particle accelerator and is associated with the discovery of the Higgs Boson (popularly known as the God particle).
- India currently holds "observer" status that allows non-member states to attend council meetings and to receive council documents without taking part in the decision-making procedures of the organisation.
- As an Associate Member, India would be entitled to attend open and restricted sessions of the organization.

CERN (European Organization for Nuclear Research)

- CERN is based in Geneva on the French-Swiss border.
- It was founded in 1954.
- It has 22 member states and four associate member states and other associate members transitioning to full member status.
- It is best known as operator of the Large Hadron Collider, which found the elusive Higgs boson in 2012.
- India was inducted as an 'Observer' at CERN in 2004.

Projects at CERN

- **Large Hadron Collider** - The Large Hadron Collider (LHC) is the world's largest and most powerful particle accelerator. It aims to study the fundamentals of universe.
- **Compact Muon Solenoid (CMS)** - It is a general-purpose detector at the LHC. Its studies the Standard Model (including the Higgs boson). It is also searching for extra dimensions and particles that make up dark matter.
- **ALICE** is the acronym for **A** **L**arge **I**on **C**ollider **E**xperiment. It researches in the physics of matter at an infinitely small scale. Eg. Research on quarks which make protons and neutrons.

Other facts about CERN membership

- India will also have to contribute 11.5 million Swiss francs every year to the capital or to the operating costs of CERN's programmes, which the country did not have to as an observer member.
- Being associate member status Indian industries, now, can bid for tenders and procurements.

India's contribution to CERN

- Many Indians have made contributed to the **construction of the LHC accelerator, ALICE and CMS** experiments at CERN.
- Indian scientist's role in LHC helped in the **discovery of Higgs Boson**.
- In the field of large-scale computing, India has designed, developed and deployed **software for the Worldwide Large Hadron Collider Grid (WLCG).**

9.2. INTERNATIONAL CONTINENTAL SCIENTIFIC DRILLING PROGRAM

- The Union Cabinet has given its approval for Indian membership of the International Continental Scientific Drilling Program (ICDP) consortium by signing an MoU (for a period of five years) with the Helmholtz Centre Potsdam GFZ German Research Centre for geosciences.
- It will enable India to engage with internationally renowned experts with profound expertise in different aspects of scientific drilling in order to accomplish deep drilling and associated investigations in Koyna region.

The Koyna Dam located in Maharashtra, western India is the most outstanding example of Reservoir Triggered Seismicity (RTS), where triggered earthquakes have been occurring in a restricted area of 20x30 sq km since the impoundment of Shivajisagar Lake in 1962.

About ICDP

- It is an infrastructure for scientific drilling that facilitates outstanding science.
- It is the only international platform for scientific research drilling in terrestrial environments.
- It provides the means for conducting cutting edge research:
- It brings together scientists and stakeholders from 23 nations to work together at the highest scientific and technical level.

9.3. PAVA SHELLS

Why in news?

- **PAVA, a chilli based non-lethal munition** will replace **pellet guns** in **Jammu & Kashmir**, decided an expert panel of the **Home Ministry**.

What is it?

- PAVA stands for **Pelargonic Acid Vanillyl Amide.** It is also called **Nonivamide**.
- It is an **organic compound** characteristically found in natural chilli pepper.
- On the **Scoville scale** (the degree to measure the power of chilli), PAVA is categorised as "above peak".
- It has the **ability temporarily but severely irritate and paralyse humans**.

9.4. FOSSILS FOUND POINTS TO LIFE ON EARTH 3.7 BILLION YEARS AGO

Why in news?

- Scientists have found fossils of a tiny structure called stromatolites in ancient sedimentary rock along the Greenland's ice caps.

> Stromatolites are calcareous mound built up of layers of lime-secreting cyanobacteria and trapped sediment, found in Precambrian rocks as the earliest known fossils.

Significance

- The finding has push back the date of origin of life on earth by hundreds of millions years. (Note: In geological terms, earth was originated 4.5 bn years ago)
- The structure and geology of the rock in which the stromatolite fossils has been found points to a rapid emergence of life on earth.
- The finding will also through light on the kind of earliest form of life that existed on earth and how they evolved.
- The finding will have great implication on our understanding of life on Mars and other planets. Probably a very basic life might have existed of Mars.

9.5. ICGS SHIPS COMMISSIONED

Why in News?

- Two **Indian Coast Guard Ships: Aryaman and Atulya** have been commissioned into the service.

What is it?

- These coast guard ships are eighteenth and nineteenth in the series of twenty **fast Patrol Vehicles (FPVs).**
- Aryaman and Atulya have been built by Cochin Shipyard Limited.
- Atulya will be based at Kochi while Aryaman will be based at Vishakhapatnam.
- Special features include Integrated Bridge Management System (IBMS) and Integrated Machinery Control System (IMCS).
- Integrated bridge system (IBS) is a kind of navigation management system which links other systems to provide all the details pertaining to ship's navigation at one place. (in box)

9.6. FAST NEUTRON REACTOR

Why in News?

- Russia has invited India to join it in developing the next generation nuclear reactors and to participate in its fast-reactor research project.
- The multipurpose fast reactor project, known by the Russian acronym MBIR, is coming up at the International Research Centre in Dimitrovgrad located in the Ulyanovsk region in Russia.

What Are Fast Reactors?

- A fast neutron reactor/fast reactor is a type of reactor in which nuclear fission chain reaction is sustained by fast neutrons.
- Such a reactor does not need any neutron moderator such as water which serves such a purpose in thermal reactors.
- Fast reactors are beneficial in the sense that it can help in the reprocessing and deactivation of radioactive waste material and produce energy as well.
- MBIR, the fast reactor project follows the closed fuel cycle.
- Transitioning to closed fuel cycle which is based on fast neutron reactors can solve five essential problems: safety, competitiveness, shortage of fuel, reprocessing and refabricating the used nuclear fuel and radioactive waste.
- It also addresses the non-proliferation of fission materials and weapon technologies.

More on MBIR

- The main purpose of the MBIR is to conduct large no. of reactor studies of Generation-4 nuclear systems.
- MBIR's design includes three independent loops that can be used to test different coolants like gas, lead, molten salt and others.

Where Does India Stand?

- The country is currently developing breeder reactors which will be fuelled by the country's vast thorium deposits.
- The Advanced Heavy Water Reactor (AHWR) is the latest Indian design for a next-generation nuclear reactor.
- Russia has also offered India a new breed of reactor units – the VVER-Toi (typical optimised, enhanced information design) for the third and fourth units of Kundakulam project in Tamil Nadu.

9.7. MUSHROOM CULTIVATION

Why in news?

- The first Indian Mushroom Growers Association (IMGA) was launched recently in national mushroom industry interface meet made possible by the Indian Institute of Horticultural Research (IIHR), Bengaluru.

Reasons why is it well suited to India?

- Mushroom production is indoor activity using vertical space. Hence, does not compete with agricultural land and thus well suited to small farmers & landless labourers.
- Many of its agricultural wastes can be utilised to produce quality food and organic manure for field crops. Besides, mushroom has high bio-efficiency i.e. conversion of dry substrate into fresh mushroom.
- It can generate self-employment, alleviate poverty and improve socio-economic status of women, youth and unemployed in the rural areas.
- It can provide nutritional security particularly to poor people through incorporating mushrooms in their diets.

9.8. TOBACCO FAMING

Why in news?

COP7 meet for WHO's Framework Convention on Tobacco Control (FCTC) was held in New Delhi recently, health authorities and Governments across the Southeast Asia region — and the world — explored how best they can support tobacco farmers as demand-targeted initiatives make their mark.

Background

In the backdrop of declining demand for tobacco products among wealthier countries and measures to roll-back tobacco consumption in the developing world supporting the tobacco farmers and finding alternative livelihood has become necessary to secure their future.

Steps that can be taken by the government and local authorities-

- Providing training that gives the skills needed for tobacco farmers to diversify their crops and income, while also emphasising tobacco's harmful environmental and health outcomes for consumers and farmers.
- Industry strategies to promote tobacco farming must be identified and regulated and policies should be developed to protect tobacco growers and workers from industry practices that fix prices or create conditions that are disadvantageous.
- Raising awareness among tobacco farmers so that they can increase their autonomy, as well as creating a network of civil society organisations able to monitor industry malpractices.
- Appropriate research on market opportunities

About Tobacco Farming in India

- In India, Tobacco crop is grown in an area of 0.45 M ha (0.27% of the net cultivated area) producing ~ 750 M kg of tobacco leaf. India is the 2nd largest producer and exporter after China and Brazil respectively.
- In the global scenario, Indian tobacco accounts for 10% of the area and 9% of the total production.
- It is grown largely in semi-arid and rain-fed areas where the cultivation of alternative crops is economically unviable.
- The distinctive and positive features of Indian tobacco include the lower levels of heavy metals, very low levels of Tobacco Specific Nitrosamines (TSNAs) and pesticide residues compared to the other tobacco producing countries in the world.
- Further, endowed with varied agro-climatic conditions, India has the capacity to produce different styles of tobacco ranging from coloury neutral filler to flavourful leaf catering to the needs of a wide variety of customers globally.
- In addition, production and processing costs of tobacco are also quite low in India, thus making the Indian tobacco price-competitive and value for money.

9.9. AQUAPONIC FARM

Why in news?

In the backdrop of a huge demand for organic farming in the country and reports of high level of chemicals and toxic in the vegetables the concept of kitchen gardening has come up. One such initiative is Aquaponic in Gurugram Haryana.

What is it?

Aquaponics, a technique that marries horticulture and aquaculture, helps the farmer raise fishes while he also grows plants.

How does it work?

- In aquaponics fish and plants are grown together in a tank. The tank has fishes in it and on the sides of the tank there are beds for plants. The water from the fish tank which is rich in nutrients due to the fish waste goes into the plants.
- The beds for supporting the plants can be made using material such as thermocol sheets or gravel.

Significance

- The setup cost of aquaponic farm might be higher than conventional farms, but the operational cost is much less
- There is no need for fertilizers and the water requirement is 90% less than that required in conventional farming.
- Suits greatly to the demand of organic fruits and vegetables
- The yield from aquaponics is two times higher than that of conventional farming.
- However, there remains one restriction that fruits and vegetables which grow underground cannot be grown using aquaponics.

9.10. INTERNATIONAL CONFERENCE ON BRUCELLOSIS

The International Research Conference on Brucellosis held in New Delhi recently.

About Bercellosis

- Brucellosis is a dreadful zoonotic disease caused by the genus of the bacteria known as Brucella infecting various species of Brucella cows, buffalos, sheep, goats, deer, pigs, dogs and other animals as well as humans.
- People acquire the infection by consuming unpasteurized milk and other dairy products, and by coming in contact with the contaminated animal secretions and tissues.

India on Brucellosis

- India is a brucellosis endemic country with approximately 3 to 5% of cattle and buffaloes, and ~4% sheep and goats are infected with *Brucella abortus* and *Brucella melitensis* respectively.
- Infected animals abort in late stages of pregnancy, leading to loss of milk production, loss of calves and spread of infection from the infected discharges and aborted fetal tissues to other animals. Also, transfer the disease to the next generation animals in the herd.

9.11. PHOTOSYNTHESIS TO INCREASE CROP YIELD

Why in news?

- Recent trial on tobacco plant has shown that GM techniques can be used to increase efficiency of photosynthesis which could help meet the global demand for food.
- The scientists modified three genes with the aim of increasing the levels of three proteins that could help ramp up the efficiency of photosynthesis more quickly after exposure to bright sunlight.

What is the Natural process?

- Crop leaves exposed to full sunlight absorb more light than they can use. Chemical changes within the leaf allow the excess energy to be dissipated as heat, in a process called **nonphotochemical quenching (NPQ).**
- While plants switch on the quenching mechanism almost instantaneously – similar to the way in which the pupil in the human eye contracts in bright light – it takes much longer for it to switch off again.
- When a cloud crosses the sun, or a leaf goes into the shade of another, it can take up to half an hour for that NPQ process to relax. In the shade, the lack of light limits photosynthesis, and NPQ also wastes light as heat.
- The energy wasted after quenching reduces overall crop productivity drastically, by 7.5 to 30%, depending on the plant type and sunlight conditions.

9.12. INDIA-UK NEWTON FUND RESEARCH PROGRAMME

- India and the UK have announced a Newton Fund research programme worth up to USD 80 million to jointly address global societal challenges.
- An annual USD 1 million **Newton Prize** was also launched recently. The prize will recognize the Newton Fund's best science or innovation that promotes economic development and social welfare of partner countries.
- For 2017, the prize is open to entries from India, Malaysia, Thailand and Vietnam which focus on the grand societal challenge of public health and well-being, covering issues such as anti-microbial resistance, disease, healthcare, and nutrition.

9.13. DISANET-DISASTER COMMUNICATION NETWORK

Why in news?

- IIT Madras team is developing a low-cost communication system named **DISANET.**
- It will allow basic services such as voice, text and video communications to be exchanged within its network of rescue workers, Master Operation Centre and the NDMA.

Why the need?

- One of the first things to get affected during natural disasters and accidents is the communication network. In a country where over a billion use mobile phones, providing mobile connectivity during a disaster, at least for emergency usage, is a priority.
- The plan is also to enable citizens within the reach of this system to communicate essential messages, such as "I am safe" or basic information – name, age, gender, etc, of persons discovered.
- The whole system is compatible with basic model mobile phones, as most users in India do not own smart phones.
- At present, people who are involved in rescue operations, such as police personnel, use walkie/talkie handsets (VHF/UHF) but VHF/UHF handsets are expensive.

Components of the network

- The design has four subsystems - WiFi, a satellite link, single-carrier GSM and LTE (Long Term Evolution). Rescue workers with GSM handsets, WiFi cameras and WiFi nodes can spread out over an area of 12-25 square kilometre to form the **primary deployment area**. These workers supply communication between the affected area and the Master Operation Centre (MOC).

Benefits of the initiative

- The rescue team will be able to directly communicate with citizens about the arrangements using FM broadcast, which citizens receive on their mobiles.
- This enables the flow of authenticated information from the authorities to the citizens and prevents rumour-mongering during times of disaster.

9.14. JET STREAM IN EARTH'S CORE

Why in news?

- European Space Agency's Swarm satellites have found out an occurrence of Jet streams in the outer core of the Earth's interior. It is like an accelerating band of molten iron circling the North Pole, like the jet stream in the atmosphere.

Significance of the finding

- It will help the scientists to understand more about the interior mechanisms of the earth and also delve deeper into the phenomenon like earthquakes and volcanism.
- This proves a previous research that found out that iron in the outer core is moving faster in the northern hemisphere, mostly under Alaska and Siberia.

Swarm Satellites

- ESA's Swarm satellites measure and track the different magnetic fields caused by the Earth's core, crust, oceans, mantle, the ionosphere and the magnetosphere. By monitoring magnetic fields, the satellites give scientists a way to figure out how the core's layers move.

Jet Streams

Jet streams are fast-flowing air currents in the atmosphere (usually in upper troposphere) that meander too. Jets streams play a key role in determining the weather because they usually separate and push colder and warmer air. Jet streams that commonly occur in India are -

1. Subtropical westerly jet streams are most prominent in winter season
2. Easterly jet stream which are most dominant in monsoonal season.

9.15. DEAD ZONE IN BAY OF BENGAL

Why in News?

- The Bay of Bengal hosts a 'dead zone' of an estimated 60,000 square kilometres - Scientists have uncovered evidence that this area is showing signs of one of nature's most lethal marine features.

Dead Zones

- Dead Zones are areas inside the ocean that lack oxygen and cannot support the complex life systems that allow marine life to flourish - most marine life either dies, or, if they are mobile such as fish, leave the area - forming a biological desert.
- There are many physical, chemical, and biological factors that create dead zones, but nutrient pollution is the primary cause of those zones created by humans.
- Dead zones are well-known off the western coasts of North and South America, Namibia and India in the Arabian Sea.

Significance of the finding

- It can be a reminder of the rising artificial eutrophication and steps that needs to be taken to make the coastal communities eco-friendly.
- These hypoxic situations and formation of dead zones supports microbial processes that remove vast amount of nitrogen from the ocean.
- Bay of Bengal is close to large human populations that need food produced by nitrogen based fertilizers - there are fears of more oxygen depletion in the ocean waters which can cause removal of excess nitrogen hurting the food security.

9.16. LEAP SECOND TO BE ADDED TO FINAL MINUTE OF 2016

Why in news?

- This year will last a second longer as a "leap second" will be added to the world's clocks on New Year's Eve by timekeepers around the world.

Leap Second

- Leap Second is added to give Earth the opportunity to catch up with the atomic time.
- Earth's time is measured by Astronomical time/Universal time (T1) and the atomic time is measured by International Atomic Time (TAI)
- International Earth Rotation and Reference System Service (IERS) of Paris tells the world when to add leap seconds on the basis of difference between T1 and TAI.
- They're inserted at the end of the last day of either June or December.

Significance of the move

- Presently the world uses precision atomic clocks in many applications like satellites, where time is kept by measuring the movements of electrons in cesium atoms.
- Consequently, atomic time is constant, but the Earth's rotation slows by about two thousandths of a second per day. For example - At the time of the dinosaurs, Earth completed one rotation in 23 hours and it has gained 1 hour since then.
- So leap seconds are essential to ensuring atomic time does not move away from time based on the Earth's spin. If it isn't corrected, such a drift would result in clocks showing the middle of the day occurring at night.

9.17. FLOATING LIQUIFIED NATURAL GAS (LNG) PLANT

Why in news?

- Recently a Chinese company has developed its own version of system for floating LNG plant.
- Each plant, as single unit will have all features like loading and storage facilities for LNG, Regasification and Power generation.
- Smallest floating plant will have a capacity to generate 10 MW while largest will generate 800 MW of electricity.

Liquefied Natural Gas

- It is natural gas converted into a liquid by cooling it to -260°F (-162°C).
- LNG is 85 to 95% methane, along with few percent ethane, even less propane and butane, and trace nitrogen.
- It is odorless, colourless, non-corrosive and non-toxic liquid.
- The volume of gas is contracted by 600 times during liquefaction, making it easier and safer to store and ship.
- In liquid state, it does not ignite

Advantages

- It provides a **clean alternative** to coal based power plant with far less environment footprint because of less carbon emissions.

- **Investment friendly** and **cost effective** as it minimizes land acquisition process and also involves less civil works.

9.18. ASHALIM PROJECT

Why in news?

- Israel is building its largest solar power station in Negev desert called Ashalim Project.

HELIOSTAT: It is an apparatus containing a movable or driven mirror, used to reflect sunlight in a fixed direction. As the sun moves across the sky, a heliostat makes small adjustments to the position of a mirror in order to keep reflected light on a target. The larger the mirror, the more energy and light is delivered to the target.

Highlights of the Project

- Ashalim solar Tower will be encircled with 55000 projecting mirrors called **Heliostat**
- It will house world tallest solar tower standing at 250 m (820 feet).
- The project will generate 310 MW of power enough for 130,000 households.
- It will use **Solar-thermal method** where these mirrors will focus sun's rays to heat the boiler creating steam to spin turbine and generate electricity.

9.19. E-CIGARETTES

Why in News?

- A study by University of California says that E-cigarettes are attracting a new population of adolescents who might not otherwise have smoked tobacco products.

About E-cigarette

- It is a type of Electronic nicotine delivery systems (ENDS).
- It is a battery-powered device using electricity to vaporize a nicotine containing fluid.
- These do not have tar like conventional cigarettes.
- It resembles a cigarette by having a red LED to simulate the tip of a real cigarette.
- It also produces a bluish vapour that resembles cigarette smoke.
- It can be an **Electronic non-nicotine delivery system (ENNDS) too** where the liquid is not nicotine. The liquid here is dissolved into propylene glycol or/and glycerine to create an aerosol.
- WHO has termed both ENDS and ENNDS as **'vaping'** — a 'tobacco-free' version of the cigarette in which a liquid is inhaled through a vaporiser.

Who Framework Convention on Tobacco Control (FCTC) 2003

- WHO FCTC is the first global public health treaty in response to the globalization of the tobacco epidemic.
- It is **legally binding** to its members. **India has also ratified it.**
- Its recommends **demand side measures of tobacco control** like
  - **Price and tax measures** to reduce the demand for tobacco.
  - **Non-price measures** like Packaging and labelling of tobacco products; public awareness and Tobacco advertising etc.

9.20. CLOUD SEEDING

Why in news?

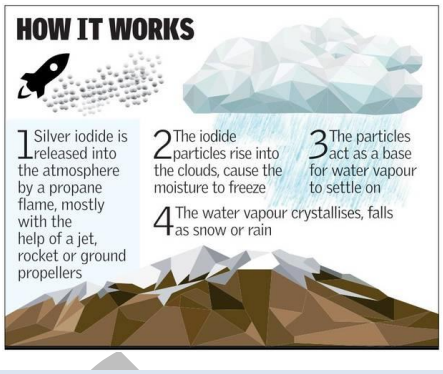
- Maharashtra government has decided to conduct **cloud seeding experiment** next three year to tackle the problem of frequent droughts in Vidarbha region.
- This programme will be coordinated by the **Indian Institute of Tropical Meteorology** and is part of larger experiment of **Earth Science Ministry** to understand how clouds and aerosols interact and influence climate.

Indian Institute of Tropical Meteorology, Pune

- It was formed in 1962 and is under administrative control of **Ministry of Earth Sciences.**
- It is a **premiere research Institute** to generate scientific knowledge in the field of meteorology and atmospheric sciences.
- It functions as a **national centre** for basic and applied research in monsoon meteorology.

Cloud seeding

- **Cloud seeding** also known as **weather modification**Technique, is an artificial way to induce moisture in the clouds so as to cause a rainfall. In this processeither **silver iodide, potassium iodide** or **dry ice (solid carbon dioxide)** is dumped onto the clouds causing rainfall.



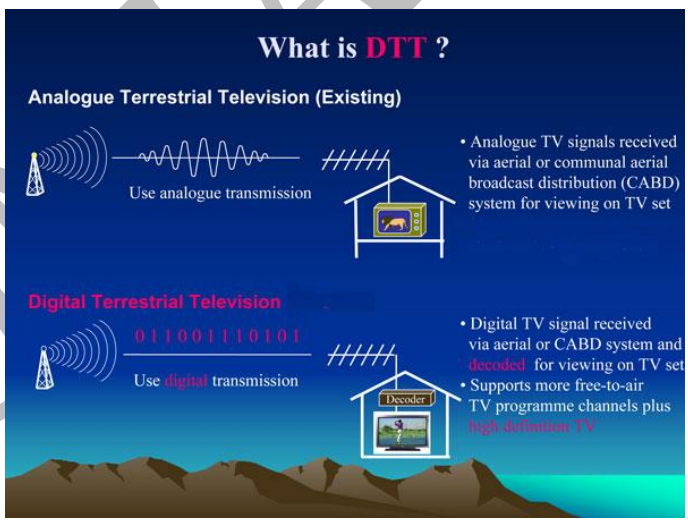
Application of cloud seeding

- This method can be used to cause significant amount of rainfall over a specified area especially in location where rain is badly needed.
- It can be developed as an effective tool to safeguard from the effect of vagaries of monsoon on agriculture as it is timely rain, rather than a lot of it, which is more important for crops.
- Timely and ambient rain results in maximum farm yield. Thus it helps in boosting local economy and feeding people.

9.21. SWITCH TO DIGITAL TERRESTRIAL TRANSMISSION BY 2023

Why in news?

- The broadcast regulator, Telecom Regulatory Authority of India (TRAI), has recommended introduction of **digital terrestrial transmission for broadcast services** in a **phased manner** and complete shutdown of analog transmission by end of 2023.
- TRAI has recommended that DTT should be deployed in **metros by December 2019 in phase 1**, cities having more than 10 lakh population as per Census 2011 should be covered by December 2021 and **rest of India by December 2023.**



Basic facts about DTT

- **Terrestrial transmission** is a type of broadcasting in which signals are transmitted by radio wave from a terrestrial transmitter. It is of two type:
- **Analog terrestrial transmission (ATT)**: In analogue terrestrial television broadcasting **only one signal** is transmitted on a given frequency channel.
- **Digital terrestrial transmission (DTT)** Digital Terrestrial Transmission (DTT) broadcasting allows the transmission of about **10 or more digital services in a single frequency channel**, depending on the technical parameters used and the quality of services desired.

9.22. WHY DOESN'T EARTH'S INNER CORE MELT?

- Spinning within Earth's molten core is a crystal ball, almost pure crystallized iron, nearly the size of the moon. Scientists have been trying to know the atomic structure of these crystals for years.
- The iron atoms are packed differently at room temperature and at high temperature.
- However, researchers have found that this packing of iron atoms remains the same at Earth's core.
- Due to high pressure, on the edge of the inner core, pieces of crystals' structure continuously melt and diffuse only to be reinserted in the original configuration like "shuffling deck of cards".
- This energy distribution cycle keeps the crystal stable and the core solid.

9.23. THOR EXPERIMENT

- The THOR experiment aims to investigate electrical activity from thunderstorms.
- The interaction between charged particles, at the height of 10 to 100 Kms in the atmosphere, produces a variety of dazzling electric phenomena from blue jets to red sprites.

- The Thor experiment will look at them with a thundercloud imaging system from the vantage point of the International Space Station.
- It will help to understand how these discharges influence water vapour levels, cloud formation, and eventually changes in climate.
- The experiment is called 'Thor' after the god of thunder, lightning and storms in Nordic mythology.

9.24. URANIUM RESERVES FOUND IN MEGHALAYA

- Uranium mineralization in Meghalaya has been found over a large area around Domiasiat, Wahkyn, Lostoin etc.
- Uranium Corporation of India Ltd. (UCIL) under Department of Atomic Energy (DAE) has already made a plan to develop the mineral resources at Domiasiat.
- The project has the potential to generate substantial nuclear fuel for the atomic power plants of the country.

9.25. VX NERVE AGENT

Why in news?

A preliminary report from Malaysian authorities has found that Kim Jong-nam, the half-brother of North Korean dictator Kim Jong-un, was killed by the banned nerve agent VX.

- The Chemical Weapons Convention (CWC) is an arms control treaty which outlaws the production, stockpiling, and use of chemical weapons and their precursors.
- It is administered by the Organisation for the Prohibition of Chemical Weapons (OPCW), an intergovernmental organization based in The Hague, Netherlands. The treaty entered into force in 1997.
- India ratified the Chemical Weapons Convention (CWC) in 1996.

About VX nerve agent

- It acts on the nervous system (hence the name nerve agents), typically the nerves that control breathing.
- It inhibits the enzyme acetylcholinesterase, which breaks down the neurotransmitter acetylcholine secreted by the cholinergic nerves. This results in more acetylcholine, which overstimulates the tissues, resulting in respiratory paralysis and death.
- The VX nerve agent is banned under international law because it's a chemical weapon as defined in the Chemical Weapons Conventions.

9.26. FIRST ZERO EMISSION TRAIN

- The Coradia iLint is the world's only fuel cell passenger train that can be used for mass transit system.
- It has been made by a French company Alstom.
- It is considered to be an environmentally-friendly rail solution. It is a significant milestone in environmental protection and technical innovation.
- The Coradia iLint is silent and can reach speeds of up to 140 km/h.
- It is powered **by a hydrogen fuel cell**, which produces electrical power for the traction.

9.27. PROJECT 22220

- It is a project of the Russian government to build nuclear powered icebreaker ships to explore the Arctic region.
- NS Arktika, NS Sibir and NS Ural are ships in this project.
- NS Arktika has been launched recently and will be commissioned in 2019 while the two others are building. NS Arktika is the world's biggest and most powerful icebreaker.
- Russia is improving its icebreaker fleet as part of its strategy to militarize the Arctic Circle and deny it to NATO.

9.28. WORLD'S FIRST ELECTRIC ROAD

- The world´s first electric road will be inaugurated in Gävle city in central Sweden.
- It was a partnership between the Swedish Government and the private sector.

- It will permit the trucks to operate as electric vehicles when on the electrified road and as regular hybrid vehicles at other times.
- Trucks would receive electrical power from a pantograph – it is a metallic structure that collects power from overhead lines. Trucks can freely connect and disconnect from the overhead wires while in motion.
- When the truck goes outside the electrically-powered lane, the pantograph will be disconnected and the truck will then be powered by the combustion engine or the battery- operated electric motor.
- Sweden's ambition of an energy-efficient and fossil-free vehicle fleet by 2030.

9.29. BROWN CARBON

- Brown Carbon (BrC), emitted mainly by biomass combustion whereas the Black Carbon (BC) is emitted mainly by high-temperature combustion processes (diesel engines, etc.).
- These are the two most important light absorbing substances in the atmospheric aerosol.
- Recently IIT Kanpur has produced study which says that although brown carbon is 10 times more than black **carbon in terms of mass, the absorption capacity of black carbon is 50 times more than brown carbon.**

9.30. THUBBER

- Carnegie Melon University has developed a thermally conductive rubber nicknamed "thubber". (Rubber is usually an insulator)
- It exhibits a combination of metal-like thermal conductivity and elasticity similar to soft, biological tissue that can stretch over six times its initial length.
- Applications could extend to industries like athletic wear and sports medicine. It is an area of research in flexible electronics too. (Flexible electronics is also a part of Make in India).
- The key ingredient in "thubber" is a suspension of **non-toxic, liquid metal micro droplets**. The **liquid state allows the metal to deform** with the surrounding rubber at room temperature.

9.31. INDIA INTERNATIONAL SCIENCE FESTIVAL (IISF)

- IISF-2016 is was held at CSIR-National Physical Laboratory (NPL), Delhi.
- This is the second edition after the 2015 success.
- IISF-2016 **showcases India's S&T prowess, technological developments, history of Indian Science** and science education involving more than 10000 young researchers, school students, academicians and top level Indian scientists.

9.32. DYNAMIC MONSOON MODEL

- From 2017, India Meteorological Department (IMD) would use a **supercomputer running a dynamical model** (**Coupled Forecast System version 2**) that is being tested at the Indian Institute of Tropical Meteorology, (IITM) Pune.
- A **dynamical monsoon model** works by **simulating the weather on powerful computers** and extrapolating it over particular timeframes.
    - This method is normally effective in forecasting weather over a few days.
    - Dynamic models have been used for research purposes but not for weather forecast.
    - It can also be more easily tuned to account for rapidly changing global weather conditions.
- The **IMD relies on an ensemble model**, a statistical technique that uses an average of six meteorological values correlated to the monsoon such as sea surface temperatures in the Pacific, and North Atlantic sea level pressure.
    - These values are derived from **old meteorological data linked to the historical performance of the monsoon**.
- It will be a precursor **to giving monsoon predictions over India's 36 sub-divisions** rather than only four broad geographic regions that encompass them.

9.33. DECEPTION DETECTION TESTS

Deception Detection Tests (DDT) are used by investigating agencies to solve crimes. They help investigators to deduce if a person is lying or not. They are preferred to 'third degree methods' because of their non-invasive character.

Types

- **Lie Detector test**:
  - ✓ It is also called polygraph test which records physiological changes of a person under test.
  - ✓ Sensors are placed at various points to record parameters like blood pressure, breathing rate, heart rate, sweating palms etc.
  - ✓ It is still not fool proof because the physiological responses of general fear, underlying mental disorders etc. can give false readings. Also a trained person can bypass the test easily.
- **Narco Analysis**:
  - ✓ It is also called truth serum test which involves the use of chemical compounds to get information from a subject.
  - ✓ A range of psychoactive drugs are given to the person under test like Thiopental and Sodium amytal etc. These make the person goes under semi-conscious test.
  - ✓ Under drugs, the imagination power is reduced and lie fabrication is difficult.
- **Brain Mapping**:
  - ✓ It is also called Neuro-imaging technique.
  - ✓ Functional Magnetic Resonance Imaging (fMRI) helps map the centres of the brain that get activated while a person fabricates a lie.
  - ✓ It also notes the time lapse that is present between a truth and a lie.

9.34. MITOCHONDRIAL DNA AND NUCLEAR DNA

- While the bulk of DNA is in the nucleus in the form of 23 pairs of chromosomes, the mitochondrial DNA is contained in only one circular chromosome that code for the energy production.
- While the nuclear DNA exists only as one copy, a mitochondrial DNA contains 2-10 copies of its DNA (each cell contains hundreds of mitochondria).
- While one copy of nuclear genes are inherited from both the mother and father, both male and female offspring almost always inherit mitochondrial DNA only from the mother. The reason for this is that nuclear DNA is delivered to the egg but not the mitochondrial DNA.
- Both nuclear and the mitochondrial DNA can undergo mutations.
- Generally, mutation rates are higher in mitochondrial DNA than in nuclear DNA. This is because the nuclear DNA have a more efficient DNA replication error checking ability, thus removing mutation possibilities.
- During each cell division, the **number of mitochondria doubles**.

9.35. VERTICAL FARMING

- It means growing crops in racks placed vertically in multi-storeyed apartments.
- It is the need of the hour with increased demands of food due to rising urbanization and also to feed the global population which goes hungry.
- In case of Vertical Farming, the plants get their nutrition either 'Hydroponically' (through nutrient enriched water) or 'Aeroponically' (through nutrient enriched air). The source of sunlight is Blue and Red LEDs which is the optimal light for photosynthesis.

9.36. SAFE DRINKING WATER TECHNOLOGIES BY CSIR

TERAFIL

- It has been developed by the CSIR lab - Institute of Mineral and Material Technology (Bhubneshwar).
- It is a low cost burnt red clay porous candle for filtration and treatment of turbid raw water in domestic applications.

- It can separate raw water from suspended particles, sediment, iron, micro-organisms, colour and bad odour.

'O' NEER

- It has been developed by the CSIR lab - Indian Institute of Toxicology Research (Lucknow).
- It is solar operated water purifier eliminating the need of changing filters.

Electrolytic De-flouridation Technology

- It has been developed by the CSIR lab - National Environmental Engineering Institute (Nagpur).
- It is a solar powered technology which removes fluoride from water.

9.37. THOR 3D AIRCRAFT

- Airbus has manufactured the **world's first 3D printed aircraft** called **Test of High-tech Objectives in Reality – THOR**.
- The aircraft is **completely 3D-printed, except the electrical elements**, which are built from a substance called polyamide.
- It is like a **windowless drone** of the size of a small aircraft.
- It is light and can reduce the costs of air travel in future years.

9.38. DECISION REVIEW SYSTEM (DRS)

- BCCI agreed to use DRS on trial basis in the home test series of India v/s England. Some changes in the DRS have been approved by the Massachusetts Institute of Technology.
- It would include the **introduction of ultramotion cameras** to calculate the predictive path of the ball so that its tracking becomes more accurate.
- **Ultra-edge has also been introduced** to determine the frame of impact.
    - It is upgraded version of the Snickometer for edge detection.
    - Structurally, it is similar to the Snickometer which works with sound feed from the stump mic and visual evidence however it uses live sound feed and its ultra-motion cameras.
- **Hawkeye has developed to record and save all images** so that the images can be rewound and replayed.
- **Additional cameras have been installed** so that there is redundancy and also provide 100 per cent reliable spin vision for DRS.
- Some of the other components of the DRS includes:
    - **Snickometer**- It includes the **stump microphone which** picks up the live sound, filters it and relays it to trace the relevant sound waves. In the meantime, cameras record the visual and replay it in slow motion.
    - **Hotspot**-
        - ✓ It is a more accurate solution to detect edges than the Snickometer as it is not a sound-based edge detection system.
        - ✓ The principle behind it is that contact between bat and ball creates friction and in turn temperature is increased appearing as a bright spot in the infra-red image.

9.39. AG600 AMPHIBIOUS AIRCRAFT

- It is the world's largest amphibious aircraft.
- It is amphibious because it can run on both land and water.
- It will mostly be used in forest fires and marine patrols.
- It is a part of Chinese military modernization programme. It can be used in maritime patrolling and is considered strategic due to the dispute on the South China Sea.

9.40. BLUE LIGHT EMITTED BY LED IS HARMFUL

- According to a report recently released by the American Medical Association (AMA) Council on Science and Public Health, excessive blue light emitted by light emitting diodes (LED) can adversely impact human health.

- Blue light directly affects sleep by suppressing the production of the hormone melatonin, which mediates the sleep-wake cycle in humans.
- The excessive blue wavelength contributes to glare effects as a result of larger scattering in the human eye.
- Glare forms a veil of luminance that reduces the contrast, thus in turn reducing the visibility of a target.
- The report also notes that unshielded LED lighting causes papillary constriction, leading to "worse night-time vision between lighting fixtures." Intense blue spectrum can even damage the retina.
- As per the report, contrary to the popular notion that bright LED lighting increases road safety, discomfort and disability glare caused by unshielded, bright LED lighting negatively impacts visual acuity, thus "decreasing safety and creating road hazards".

9.41. NEW ELEMENTS ON THE PERIODIC TABLE

- The IUPAC has announced the proposed names for elements 113, 115, 117 and 118: nihonium, moscovium, tennessine and oganesson. The names are on five-month probation before things are made official.
- All four elements are not found in nature, and were synthetically created in laboratories.
- Until now, these elements had temporary names and symbols on the periodic table as their existence was hard to prove. Because they decay extremely quickly, scientists found it difficult to reproduce them.

About IUPAC

- The International Union of Pure and Applied Chemistry (IUPAC) is the world authority on chemical nomenclature and terminology, including the naming of new elements in the periodic table; on standardized methods for measurement; and on atomic weights, and many other critically-evaluated data.