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BY **PHYSICS WALLAH**



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FOR PRELIMS 2023

ONE STOP SOLUTION FOR CURRENT AFFAIRS



SCIENCE & TECHNOLOGY



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Website: www.pw.live

Youtube Channel: Physics Wallah - Alakh Pandey
UPSC Wallah
UPSC Wallah - Hindi Medium
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Email: support@pw.live

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PREFACE

A highly skilled professional team of PW ONLY IAS works arduously to ensure that the students receive the best content for the UPSC exam.

From the beginning, the whole content team comprising Content Creators, Reviewers, DTP operators, Proofreaders and others are involved in shaping the material to their best knowledge and experience to produce powerful content for the students.

Faculties have adopted a new style of presenting the content in easy-to-understand language and have provided the team with their guidance and supervision throughout the creation of this Study Material.

PW ONLY IAS strongly believes in conceptual and fun-based learning. PW ONLY IAS provides highly exam-oriented content to bring quality and clarity to the students.

A plethora of UPSC Study Material is available in the market but PW ONLY IAS professionals are continuously working to provide the supreme Study Material for our UPSC students.

This Study Material adopts a multi-faceted approach to master and understanding the concepts by having a rich diversity of questions asked in the examination and equip the students with the knowledge for the competitive exam.

The main objective of the study material is to provide short, crisp, concise and quality content to our students.

BOOK FEATURES

- One Stop Solution for Current Affairs Preparation
- Special Focus on PYQs, Data and Facts
- Most Comprehensive Current Affairs Compilation
- Comprehensive Coverage of Topics with Crisp Content

CONTENTS

1. Physics..... 1-4

- W Boson.....1
- Neutrino 1
- Large Hadron Collider 2
- Supercapacitors.....2
- Lux-Zeplin (LZ) Dark Matter Detector 3
- Anti-radiation pills.....4

2. Chemistry 5-6

- Single-Crystalline Scandium Nitride 5
- Detection of Barium in the Exoplanet Atmospheres.....5

3. Biology 7-11

- Colour Blindness.....7
- Retinoblastoma 8
- Anabolic Steroids.....9
- AlphaFold & Protein.....9
- Dunaliella Tertiolecta.....9
- Dark Genome.....10
- Ultrathin Hetero-protein Film.....10
- Athlete Biological Passport (ABP).....11
- Deoxyribonucleic Acid (DNA) 11

4. Biotechnology.....12-19

- Human Genome.....12
- M-RNA Technology 12
- Genetically Engineered Mosquitoes 14
- Genomics.....14
- Cervavac 14
- Cornea 14
- CRISPR Technology.....15
- Chimeric Antigen Receptor (CAR)- T Cell (T-Therapy).....15
- Endosulfan.....16
- Grey Matter 16
- Synthetic Biology.....17
- Lab-Grown Meat 17
- DMH-11.....18
- Indian Biological Data Center 18

- Incovacc 18
- Bio-Plastics.....19

5. Health and Diseases 20-45

- Mud Crab Reovirus 20
- First Pig Heart Transplant in Human.....20
- NEO COV 20
- Havana Syndrome 21
- Microplastics In Blood.....21
- Multiple Sclerosis (MS).....21
- Ischemic Stroke.....22
- Silicosis 22
- Mange Disease 23
- Dare2eraD TB program.....23
- Antimicrobial Resistance 24
- Common Antibiotic Manufacturing Framework (CAMF).....24
- Malaria Vaccine 24
- Conversion Therapy 25
- Bone Ossification Test 25
- Fusobacterium.....26
- Nipah Virus 26
- Rice Fortification 26
- XE Variant of Corona-virus.....27
- Polio.....27
- Bird Flu 28
- Hepatitis 28
- Adenoviruses.....29
- Shigella Bacteria.....29
- West Nile Virus 30
- Sudden Infant Death Syndrome 30
- Tomato Flu.....31
- Monkeypox.....31
- Epilepsy 31
- PK2 Molecule.....32
- Angiotensin Converting Enzyme 2 (ACE2) 32
- Lumpy Skin Disease.....33
- Ramsay Hunt Syndrome 33

○ Dostarlimab	33
○ Cholera	34
○ Epstein Barr Virus	34
○ Marburg virus disease	34
○ Oncolytic Virotherapy	35
○ Clofazimine	35
○ CSA6	36
○ Sickle Cell Disease	36
○ Lactose Intolerance	36
○ Chronic Fatigue Syndrome	37
○ Novel Langya Henipavirus	37
○ Vasculitis	38
○ African Swine Fever	38
○ Visceral Leishmaniasis/Kala Azar	38
○ Hand, Foot, and Mouth Disease (HFMD)	39
○ Ebola Virus Disease	39
○ Rabies Disease	39
○ Legionnaires Disease	40
○ Alzheimer Disease	40
○ Lassa Fever	40
○ Fairbank Disease	41
○ Immunosensor for Japanese Encephalitis Virus	41
○ Human Immuno-Deficiency Virus	42
○ Obstructive Sleep Apnoea	43
○ Aneurysm	43
○ First-ever Fungal Priority Pathogens List	44
○ Oral Rehydration Solution (ORS)	44
○ Assisted Reproductive Technology (ART) Act 2021	44
○ PEN-PLUS Strategy	45
○ Negative Ion Technology	45

6. Space Technology 46-76

○ Atmospheric Pressure of Pluto	46
○ Chemically Peculiar Stars	46
○ Solar Flare	46
○ NISAR (NASA-ISRO-SAR)	47
○ Indian Space Station (ISS)	47
○ Vikas (VIKram Ambalal Sarabhai) Rocket Engine	47
○ Small Satellite Launch Vehicle (SSLV)	48
○ Ultra-Long-Period Magnetar	48
○ Oscar 1 (Orbiting Satellites Carrying Amateur Radio)	49

○ Kalpana Chawla Centre for Research in Space Science & Technology	49
○ Anomaly Detection Method	49
○ Geomagnetic Storm	49
○ Overhauser Magnetometer	50
○ Parker Solar Probe	50
○ EOS-04	51
○ Muse and HelioSwarm Projects	51
○ Fast Radio Bursts	52
○ SARAS-3 Radio Telescope	53
○ Exomars	53
○ Perseverance Rover	53
○ Project Netra	53
○ Wright Mons	54
○ UVIT J2022	54
○ Jupiter Like Protoplanet	54
○ Solid Fuel Ducted Ramjet	55
○ Blue Straggler Stars	55
○ Europa	56
○ Episodic Accreting Young Stars	56
○ Bernardinelli-Bernstein Comet	56
○ Gagan	57
○ Axiom-1 Mission	57
○ Hayabusa-2 Probe	58
○ SOFIA Telescope	58
○ James Webb Space Telescope	58
○ Marsquake	59
○ Sagittarius A*(SgrA*)	59
○ HS200 Solid Rocket Booster	60
○ Amalthea	61
○ Chandrayaan 3 (C3)	61
○ Venus	61
○ International Liquid Mirror Telescope	61
○ Tiangong Space Station	62
○ Wentian Laboratory	63
○ IN-Space	63
○ GSAT-24	63
○ Neptune and Uranus appear in different colours	63
○ Plants in the Moon's Soil	64
○ Capstone	64
○ ISRO's POEM (PSLV Orbital Experimental Module) Platform	64
○ ARYABHATTA-1	65
○ Wormholes	65
○ Azaadi SAT	66
○ Novae and Supernova	66

○ STEVE Phenomenon.....	66	○ AlGaIn/GaN High Electron Mobility Transistors.....	81
○ India's First Observatory.....	67	○ Central Equipment Identity Register (CEIR)	81
○ Data Sonification.....	67	○ Altimeter	82
○ NASA's Artemis Programme.....	67	○ Web 3.0	82
○ Moxie.....	68	○ Param Pravega	82
○ Qimingxing 50.....	68	○ PARAM Ganga.....	83
○ Einstein Ring	69	○ Satellite Broadband Services.....	83
○ Inouye Solar Telescope.....	69	○ Quantum Key Distribution (QKD)	84
○ ISRO's heaviest rocket LVM3-M2	69	○ Param Ananta.....	84
○ Double Asteroid Redirection Test (DART).....	70	○ Quantum Computing.....	85
○ RH-200	70	○ 5G Vertical Engagement and Partnership Programme.....	85
○ Navic.....	71	○ Variable Refresh Rates (VRR).....	86
○ Enceladus Ocean	71	○ Near Field Communication (NFC) Technology	86
○ ISRO's Mangalyaan Mission.....	71	○ Splinternet.....	87
○ Next-Gen Launch Vehicle (NGLV)	72	○ Virtual Private Network (VPN).....	87
○ Sampurnanand Telescope (ST).....	72	○ Radio Access Network (RAN).....	88
○ Coronal Holes	72	○ Radio Frequency Identification (RFID) tags	89
○ Gaia BH1	73	○ 5G Testbed	89
○ ISRO's RISAT-2 Satellite	73	○ Param Porul Supercomputing Facility	90
○ Falcon Heavy Rocket	73	○ Hermit	90
○ Vikram-S.....	74	○ Language Model for Dialogue Applications	90
○ Beaver Blood Moon.....	74	○ Artpark and Gigamesh.....	91
○ CE20 Cryogenic Engine.....	75	○ Extended Reality (XR)	91
○ Loftid Mission	75	○ E-SIM Technology	91
○ Gamma Ray Burst (GRB).....	75	○ Everything App or A Super App	92
○ Tidal Disruption Events (TDES).....	75	○ Net Neutrality.....	92
○ Earth Records Shortest Day.....	76		
○ Exo-Moons	76		
7. Robotics	77-78	10. Basic science	93-93
○ Side-channel attacks	77	○ Quantum Entanglement (QE).....	93
○ Magnetically Impelled Arc Butt (MAIB) Welding Equipment.....	77	○ Phenol.....	93
○ Vyom Mitra	77		
○ Micro-Swimmers.....	77	11. Alternative Energy	94-97
○ Cyber-Knife	78	○ Perovskite Solar Cells	94
8. Nano Technology.....	79-80	○ Small Modular Reactors.....	94
○ Nanoalloys	79	○ Roshini	95
○ Cordy Gold Nanoparticles	79	○ Light-Emitting Diodes (LED).....	95
○ Liquid Nano Urea Fertilizer.....	80	○ Flex Fuel	95
9. Information and Communication Technology (ICT)	81-92	○ Hydrogen Fuel Cell	96
○ SOVA virus attack	81	○ Coal Based Hydrogen.....	96
		○ Lithium Cell Plant.....	96
		○ Nuclear Fusion.....	97

12. Emerging Technologies.....98-101

○ Artificial Neural Network (ANN)	98
○ AI Research Supercluster	98
○ Daylight Harvesting	98
○ Artificial Intelligence (AI) Chips.....	99
○ Blockchain Gaming	99
○ Proof-of-Stake Technology	100
○ Mitticool Refrigerator.....	100
○ Artificial Snow	100
○ Chat GPT.....	100

13. Defense Technology 102-123

○ Exercise Skylight.....	102
○ Facial Recognition Technology	102
○ BrahMos Missiles.....	102
○ C295 aircraft.....	103
○ AD-1 (Air Defence).....	103
○ Five make II Projects.....	103
○ Submersible Platform for Acoustic Characterization & Evaluation (SPACE)	104
○ Hwasong-17	104
○ Agni-IV	104
○ Agni-Prime Missile.....	104
○ Blue bugging.....	105
○ P-8I Patrol Aircraft.....	105
○ INS Vikrant.....	105
○ Light Combat Aircraft Programme.....	106
○ Cluster Bombs and Vacuum Bombs.....	106
○ Hermetic Wiper.....	107
○ HANSA-NG	107
○ White Phosphorus.....	107
○ Man-Portable Air-Defence Systems (MANPADS).....	108
○ Kamikaze Drones.....	108
○ Kinzhal Hypersonic Missile.....	108
○ INS Shivaji.....	109
○ INS Valsura	109
○ Medium Range Surface to Air Missile (MRSAM)	109
○ DRDO's Corner-Shot Weapon System	110
○ Weaponization of Space.....	110
○ DefConnect 2.0.....	111
○ INS Vagsheer.....	111

○ Sarmat Intercontinental Ballistic Missile.....	111
○ HELINA.....	112
○ Pinaka Mk-I (Enhanced) Rocket System (EPRS).....	112
○ Advanced Towed Artillery Gun System	112
○ Air Independent Propulsion Technology	112
○ INS Surat and INS Udaygiri.....	113
○ Y-3023 Dunagiri	113
○ INS Sindhudhvaj.....	113
○ Naval anti-ship missile	114
○ Project WARDEC	114
○ INS Gomati.....	114
○ Laser-Guided Anti-Tank Guided Missiles	114
○ Iskander-M Missile	115
○ VL-SRSAM	115
○ Prithvi-II Missile	115
○ HIMARS.....	116
○ Astra Mark-1	116
○ Unmanned Aerial Vehicle (UAV)	116
○ Fujian.....	117
○ INS Tarkash	117
○ MiG 21	117
○ Hellfire R9X Missile	118
○ Yuan Wang 5	118
○ Butterfly Mines	118
○ F-INSAS System	118
○ Zorawar.....	119
○ INS Sumedha	119
○ Pegasus Spyware	119
○ F/A-18 Super Hornet	120
○ Very Short-Range Air Defense System (VSHORADS).....	120
○ Carl-Gustaf M4	120
○ Taragiri.....	121
○ Quick Reaction Surface to Air Missile (QRSAM) System.....	121
○ Virtual Cyber Exercise on Ransomware Resilience	121
○ Inflatable Aerodynamic Decelerator	121
○ Chinook Helicopters.....	122
○ Scorched-Earth Tactics.....	122
○ Dirty Bomb	122

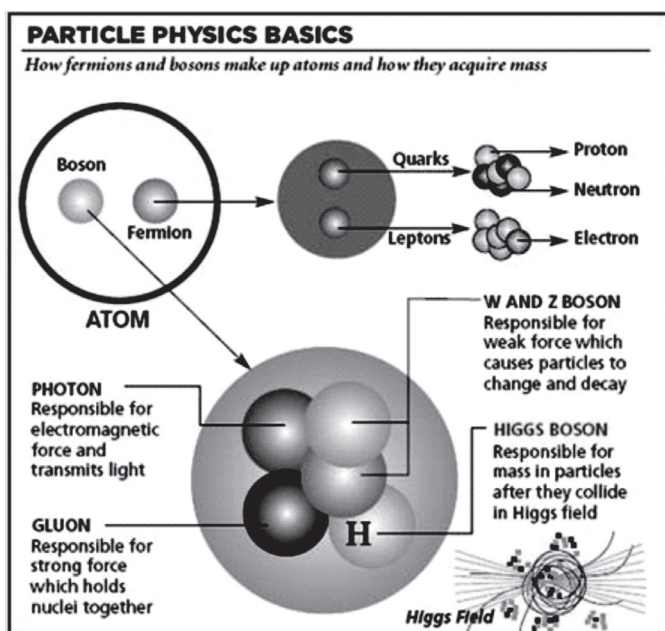
○ Hawk Air Defense Equipment.....	122	○ Women in Engineering, Science, and Technology (West) Initiative	130
○ Cluster Bombs and Thermobaric Weapons.....	123	○ Scientific Social Responsibility (SSR).....	131
14. Institutions and Organizations	124-125	○ Biological Research Regulatory Approval Portal (Bio Rrap).....	131
○ Council of Scientific & Industrial Research (CSIR).....	124	○ Ayurveda Aahara' Products.....	131
○ Cert-In	124	○ Data Empowerment Protection Architecture (Depa).....	132
○ Natgrid	124	○ Studentship Program for Ayurveda Research Ken (Spark) Program.....	132
○ Regional Standardization Forum.....	125		
○ The Global Lighthouse Network.....	125		
15. Government Policies and Initiatives	126-132	16. Awards and Prizes	133-134
○ Graphene Innovation Centre	126	○ WISER programme	133
○ Additive Manufacturing.....	126	○ Nobel Prize in Medicine or Physiology, 2022	133
○ Vigyan Jyoti Scheme	126	○ Nobel Prize in Physics	133
○ Vigyan Sarvatra Pujiyate.....	127	○ Nobel Prize in Chemistry	134
○ Draft India Data Accessibility & Use Policy, 2022	127	○ Ramanujan Prize for Young Mathematician	134
○ Gallium Nitride Ecosystem Enabling Centre And Incubator	127	17. Miscellaneous	135-138
○ Pacer Initiative.....	128	○ Dark Sky Reserve.....	135
○ Atal New India Challenge	128	○ Tihan Testbed for Autonomous Navigation.....	135
○ Aim-Prime Playbook.....	128	○ Avishkar Hyperloop.....	135
○ Telangana Spaceteck Framework.....	129	○ N-Treat technology.....	136
○ Evtol	129	○ MIST Submarine Cable System.....	136
○ Vritika	129	○ Yotta D1	136
○ Fiberisation.....	129	○ Super-Abrasive Tools	137
○ Battery Certification and Quality Control.....	130	○ Nixtamalization.....	137
○ Draft Guidelines on Anonymisation of Data (AOD)	130	○ Photonic Crystals.....	137
		○ Kavach	138

W BOSON

News: Researchers from Collider Detector at Fermilab (CDF) Collaboration, in the US, announced that they have made a precise measurement of the mass of the W boson.

About

- Discovered in 1983 at CERN, located on the Franco-Swiss border, the W boson is a fundamental particle.
- Together with the Z boson, it is responsible for the weak force, one of four fundamental forces that govern the behavior of matter in the universe.
- The W boson, which is electrically charged, changes the very make-up of particles.
- It switches protons into neutrons, and vice versa, through the weak force, triggering nuclear fusion and letting stars burn.



Standard Model of Elementary Particle Physics

- The standard model of elementary particles is a **theoretical construct in physics that describes particles of matter and their interaction.**
- It describes the elementary particles of the world as being connected by mathematical symmetry, just as two objects are connected by bilateral (left-right) symmetry.
- According to this model there are a finite number of fundamental particles which are represented by the characteristic “eigen” states of these groups.
- The particles predicted by the model, such as the Z boson, have been seen in experiments.
- The last to be discovered, in 2012, was the Higgs boson which gives mass to the heavy particles.

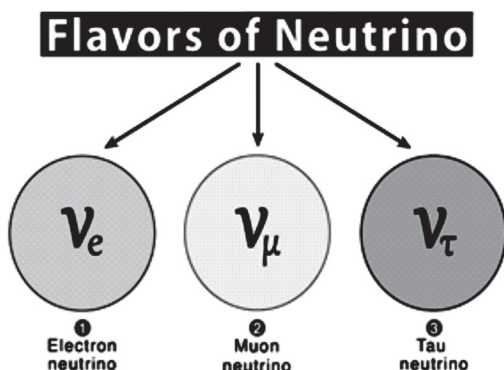
NEUTRINO

News: Tamil Nadu has said to the Supreme Court that it does not want the Indian Neutrino Observatory (INO) to be set up in a sensitive ecological zone in the Western Ghats at a great cost to wildlife and biodiversity.

About

- A neutrino is a subatomic particle with no electric charge.
- They are considered to be the second most abundant particle in the universe, after photons, or light particles.
- **History:** Predicted in 1931, neutrinos were detected for the first time in 1959 by Clyde Cowan and Fred Reines.
- They come in three types, and each type is associated with a light elementary particle.
- They are:
 - **Electron-neutrino** is associated with the electron;
 - **Muon-neutrino** with the muon and Tau-neutrino with the tau particle.

- **They are not easy to catch**, as they do not carry a charge, as a result of which they do not interact with matter.
- **They also might have unique properties that would help explain why the universe is made of matter instead of antimatter.**
- Subatomic particles that make up antimatter have properties that are opposite to the subatomic particles of normal matter.



- **Protons, neutrons and electrons (subatomic particles of normal matter) are among the 12 quarks and leptons have been discovered so far.**

India-Based Neutrino Observatory (INO)

- The India-based Neutrino Observatory (INO) is a proposed Pure-Science underground laboratory.
- Its primary goal is to study the properties and interactions of neutrinos.
- The observatory is **jointly supported by the Department of Atomic Energy (DAE) and Department of Science & Technology (DST)** with DAE acting as the nodal agency.
- The **proposed site of the observatory is in Bodi West Hills, in Theni district.** The site is spread across Kerala and Tamil Nadu.

LARGE HADRON COLLIDER

News: The world's most powerful particle collider, the Large Hadron Collider (LHC), will begin smashing protons into each other at unprecedented levels of energy beginning July 5.

About

- The Large Hadron Collider is a **giant, complex machine built to study particles that are the smallest known building blocks of all things.**
- It is a 27-km-long track-loop buried 100 meters underground on the **Swiss-French border.**

- **Agencies involved:** European Organization for Nuclear Research (CERN) between 1998 and 2008 in collaboration with over 10,000 scientists from hundreds of universities and laboratories.
- **Significance:** It is the world's largest and most powerful particle accelerator.
- **Experiments conducted at LHC:** ATLAS is the largest general-purpose particle detector experiment at the LHC.
- **The Compact Muon Solenoid (CMS) experiment** is one of the largest international scientific collaborations in history with the same goals as ATLAS, but which uses a different magnet-system design.

Achievements

- In 2012, scientists at CERN had announced to the world the discovery of the Higgs boson or the 'God Particle' during the LHC's first run.
- This led to Peter Higgs and his collaborator François Englert being awarded the **Nobel Prize for physics in 2013.**
- The Higgs boson is the fundamental particle associated with the Higgs field, a field that gives mass to other fundamental particles such as electrons and quarks.

Quarks, Pentakquark and Tetraquark

- **Quarks are elementary particles that come in six "flavours":** up, down, charm, strange, top, and bottom.
- **They usually combine together in groups of two and three to form hadrons such as the protons and neutrons** that make up atomic nuclei.
- However, they can also combine into **four-quark and five-quark particles called Tetraquarks and Pentaquarks.**
- **These exotic hadrons were predicted by theorists about six decades ago** — around the same time as conventional hadrons — but they have been observed by the Large Hadron Collider and other experiments only in the past 20 years.

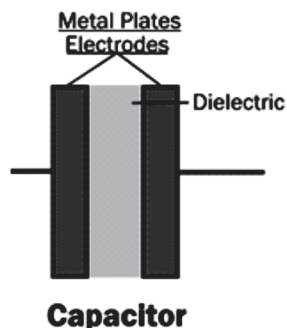
SUPERCAPACITORS

News: A team of Indian scientists have developed a new low-cost, pristine, conducting polymer-based electrode/redox-active electrolyte combination that can give enhanced electrochemical performance and cycling stability to supercapacitors.

About

- Supercapacitors are **electronic devices which are used to store extremely large amounts of electrical charge.**

- They are also known as double-layer capacitors or ultracapacitors.



- Supercapacitors combine the characteristics of conventional capacitors and batteries to give a sudden kick-start to devices by providing a large amount of power and sustained energy release.
- **Electrode materials of supercapacitors:** Conducting polymers like polyaniline and polypyrrole are excellent candidates for electrode materials owing to their flexibility, stability and tuneable electrical and electrochemical properties. They are also inexpensive, lightweight and can be synthesized easily.
- **The poor energy density of these devices is another issue that limits the use of these devices in practical applications.**

Difference Between Capacitor and Supercapacitor/Ultra-Capacitor

Capacitor	Supercapacitor/Ultra-Capacitor
• A Capacitor is a two-terminal passive electronic component that stores charge in the form of electric field between its metal plates. • It is made up of two metal plates (electrodes as anode and cathode) separated by an insulator known as the dielectric.	• Supercapacitor is also known as Super Cap, Double Layer Capacitor or Ultra-capacitor. ○ The electrodes of a supercapacitor are coated with active carbon as electrode material. ○ A separator is used between Anode and Cathode in Supercapacitor, whereas dielectric materials are used in conventional capacitors. • The supercapacitors store charge either using electrostatic double-layer capacitance (EDLC) or electrochemical pseudo-capacitance or both known as hybrid capacitance. • In Supercapacitor, activated carbon is used as a medium. When voltage applied, a double electric field is generated which acts like a dielectric medium.

LUX-ZEPLIN (LZ) DARK MATTER DETECTOR

News: A test run of the LZ detector in the U.S. has shown it to be the most sensitive dark matter detector yet created.

About	• Visible universe—including Earth, sun, other stars, and galaxies—is made of protons, neutrons, and electrons bundled together into atoms. ○ This ordinary, also called baryonic, matter makes up less than 5 percent of the mass of the universe. • Rest of the universe appears to be made of a mysterious, invisible substance called Dark Matter (25 percent) and a force that repels gravity known as Dark Energy (68 percent). • Unlike normal matter, dark matter does not interact with electromagnetic force. This means it does not absorb, reflect or emit light, making it extremely hard to spot.
Significance of study of Dark matter	• It may account for unexplained motions of stars within galaxies. • Critical to understanding the evolution of the universe and to the emergence of stars, planets etc. • Help to determine if the universe is open (continues to expand), closed (expands to a point and then collapses) or flat (expands and then stops when it reaches equilibrium).

LUX-ZEPLIN (LZ) detector

- It is **designed (underground)** to capture dark matter in the form of weakly interacting massive particles (WIMPs).
- It consists of a huge titanium tank filled with extremely pure liquid xenon.
- **Centre of LZ is one of the purest places on Earth (free of radiation and dust).**
- Collaboration of scientists/institutions from the U.S., U.K., Portugal, and Korea.

ANTI-RADIATION PILLS

News: Recently, with fears of a nuclear disaster at Ukraine's Zaporizhzhya power plant growing, the European Union has decided to pre-emptively supply 5.5 million anti-radiation pills to be distributed among residents in the vicinity.

About Radiation Emergency

- These are **unplanned or accidental events that create radio-nuclear hazard to humans and the environment.**
- Such situations **involve radiation exposure** from a radioactive source and require prompt intervention to mitigate the threat.
- Dealing with such an emergency also involves the use of anti-radiation tablets.

Anti-Radiation Pills

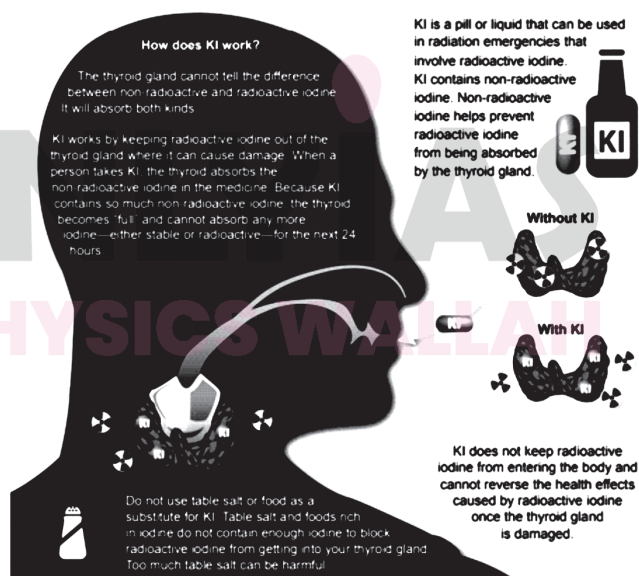
- **Potassium iodide (KI) tablets or Anti-Radiation Pills** are known to provide some protection in cases of radiation exposure.
- They **contain non-radioactive iodine** and can help block absorption and subsequent concentration of radioactive iodine in the thyroid gland.

Working of Pills

- **Potassium iodide (KI) is a type of iodine that is not radioactive** and can be used to help block one type of radioactive material, radioactive iodine (I-131), from being absorbed by the thyroid.
- **After a radiation leak, radioactive iodine floats through the air and then contaminates food, water and soil.**
- While radioactive iodine deposited during external exposure can be removed using warm water and soap, the bigger risk is inhaling it.
- The thyroid gland which uses iodine to produce hormones to regulate the body's metabolism has no way of differentiating radioactive from non-radioactive iodine.

- **Potassium iodide (KI) tablets rely on this to achieve 'thyroid blocking'.**
 - KI pills take a few hours before or soon after radiation exposure to ensure that non-radioactive iodine in the medicine is absorbed quickly to make the thyroid "full".
 - **When the thyroid absorbs high levels of radioactive iodine, it can increase the risk of thyroid cancer** in infants, children, and young adults many years after exposure.
- KI pills are **preventive only** and **cannot reverse any damage done by radiation** to the thyroid gland.

HOW POTASSIUM IODIDE (KI) WORKS



Zaporizhzhia Nuclear Power Plant

- It is located in south-eastern Ukraine and is the largest nuclear power plant in Europe and among the 10 largest in the world.
- It was built by the Soviet Union near the city of Enerhodar, on the southern shore of the Kakhovka Reservoir on the Dnieper River.

BRINGING INNOVATIVE DISRUPTION IN UPSC PREPARATION



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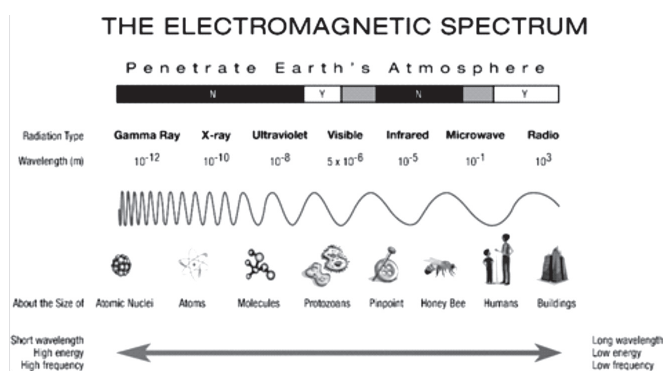
SINGLE-CRYSTALLINE SCANDIUM NITRIDE

News: Researchers at Bengaluru's Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) have discovered a new material called "single-crystalline scandium nitride (ScN)" that can convert infrared light into renewable energy.

About

- Electromagnetic waves are a **renewable energy source**. It is used for **electricity generation, telecommunication, defence and security technologies**, sensors and healthcare services.
- Scientists use high-tech methods to manipulate such waves precisely.
- However, **not all the wavelengths of light (electromagnetic waves) are easy to utilize**, especially infrared light, since it is **difficult to detect and modulate**.
- For infrared light applications, **intelligent and cutting-edge materials are required** which can enable excitation, modulation and detection at desired spectral range with high efficiencies.

- Only a few existing materials can serve as hosts for light-matter interactions in the infrared spectral range with very low efficiencies.
- The operational spectral range of such materials also does not cover the industrially **important short-wavelength infrared (SWIR) spectral range**.



DETECTION OF BARIUM IN THE EXOPLANET ATMOSPHERES

News: Recently, in a new study, scientists have detected barium in the upper atmosphere of two giant exoplanets for the first time.

Findings of the Study:	• The exoplanets are two ultra-hot Jupiters — WASP-76b and WASP-121b — which orbit their host stars WASP 76 and WASP 121. • The former is about 640 light-years away from the Earth and the latter around 900 light-years away. Both WASP-76b and WASP-121b complete one orbit in two days. • Surface temperatures in these bodies reach as high as 1,000 degrees Celsius. • The presence of hydrogen, lithium, sodium, magnesium, calcium, vanadium, chromium, manganese and iron in the atmosphere of the WASP-76 b has also been confirmed in addition to barium. • In WASP 121b, they confirmed the presence of lithium, sodium, magnesium, calcium, vanadium, chromium, manganese, iron and nickel. • Additionally, the scientists found elements such as cobalt and strontium. They also found indications of titanium in the exoplanet.
Barium:	• Barium, which is slightly harder than lead, has a silvery white luster when freshly cut. • It readily oxidizes when exposed to air and must be protected from oxygen during storage. • In nature it is always found combined with other elements. • It is very light and its density is half of that of iron.

**Applications
of Barium:**

- Barium is often **used for spark-plug electrodes and in vacuum tubes as a drying and oxygen-removing agent.**
- **As fluorescent lamps:** impure barium sulfide phosphorescence after exposure to light.
- Its compounds are **used by oil and gas industries to make drilling mud.** Drilling mud simplifies drilling through rocks by lubricating the drill.
- Barium compounds are also **used to make paint, bricks, tiles, glass, and rubber.**
- Barium nitrate and chlorate **give fireworks a green colour.**

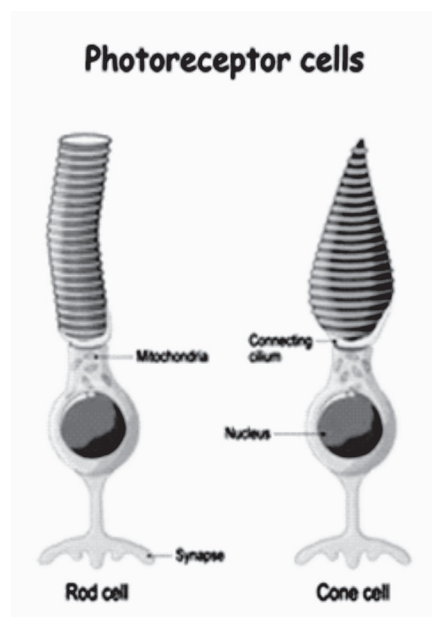


COLOUR BLINDNESS

News: Recently, the Supreme Court has directed the Film and Television Institute of India (FTII) not to exclude candidates suffering from colour blindness from its courses on film making and editing and asked it to make changes to its curriculum instead.

About Colour Blindness:

- Colour blindness is the **inability to see colours in the normal way.**



- Colour blind individuals often **cannot distinguish between certain colours**—usually greens and reds, and sometimes blues as well.
- It is also **known as colour deficiency.**
- **Anatomy: Two types of cells in the retina detect light-**
 - 1. Rods:** These help in distinguishing between light and dark.
 - 2. Cones:** These help in detecting colour.
- **There are three types of cones that see colour—red, green, and blue**—and our brains use the information from these cells to perceive colour.
- **Colour blindness can be the result of the absence of one or more of these cone cells,** or their failure to work properly.
- **Different Kinds:** Colour blindness may be of different kinds and degrees.
- In a situation where all three cone cells are present but one of them is malfunctioning, mild colour blindness may occur.
- **In the most severe kind of colour blindness,** vision is black-and-white, that is, everything appears as a shade of grey. This is not very common.

Causes of Colour Blindness:	• Congenital Colour Blindness: Most colour blind people are born with the condition (congenital colour blindness). Congenital colour vision deficiencies are usually passed on genetically. • This type of Colour blindness generally affects both eyes, and the condition remains roughly the same for as long as the individual is alive. • Medical Conditions: ○ A problem with colour vision that arises later in life could be the result of disease, trauma, or ingested toxins. ○ If colour blindness arises out of disease, one eye may be affected differently from the other, and the difficulty could worsen over time. • Medical conditions that may increase the risk of getting colour blindness include glaucoma, diabetes, Alzheimer's, Parkinson's, alcoholism, leukaemia, and sickle-cell anaemia.
Treatment:	• Colour blindness cannot as yet be treated or reversed. • However, it can be corrected to some extent by wearing special contact lenses or colour filter glasses. • There is some research that suggests gene replacement therapy can help modify the condition.

Film and Television Institute of India (FTII)

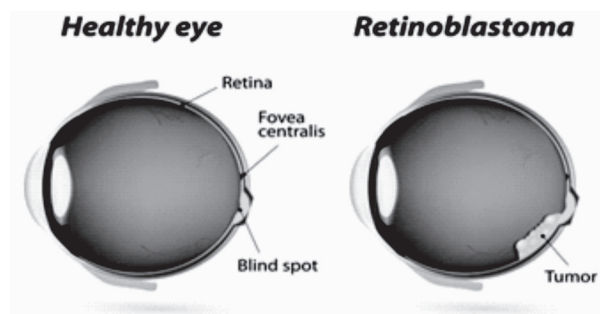
- It is an autonomous body under the **Union Ministry of Information and Broadcasting**.
- Set up by the **Government of India in 1960**, in the premises of the erstwhile Prabhat Studios in Pune.
- Prabhat Studio was a pioneer in the business of filmmaking and shifted to Pune from Kolhapur in 1933.

RETINOBLASTOMA

News: The World Retinoblastoma Awareness Week was observed from May 15 to 21.

About

- **Retinoblastoma is the most common eye cancer (malignant tumour)** occurring in young children.
- **It can occur in one or both eyes and may be hereditary or sporadic.**
- It can be **life-threatening** as well as take away vision if not treated timely and is detected by seeing White Reflex (WR).
- **Symptoms:**
 - **White Reflex in the eye:** Pupil that looks white or yellow instead of red when light hits it.



- **Squinting:** A crossed eye, looking either toward the nose or towards the ear.
- **Poor vision with or without WR:** The eye may be red or painful also.

- **Treatment:**
 - **Chemotherapy:** can be delivered intravenously or intra-arterial and is given by the paediatric oncologist.
 - This has to be followed up with local therapy, which is managed by the ophthalmologist using various modalities.

About Cancer

- The most common cancers are breast, lung, colon and rectum and prostate cancers.
- **Cancer is a generic term for a large group of diseases that can affect any part of the body.** Other terms used are malignant tumours and neoplasms.
- One defining feature of cancer is the **rapid creation of abnormal cells that grow beyond their usual boundaries**, and which can then invade adjoining parts of the body and spread to other organs; **the latter process is referred to as metastasis.**

ANABOLIC STEROIDS

News: From two Tokyo Olympians being banned to Noida Police seizing fake drugs and supplements worth Rs 2 crore, anabolic steroids have often been in news, although not for the right reasons.

About

- Anabolic steroids are essentially **lab-made versions of the male hormone testosterone** and have a similar effect of increasing muscle mass as the natural hormone does.
- It also increases male characteristics in a person, such as facial hair and a deeper voice.
- **Different from Corticosteroids:** Unlike corticosteroids, anabolic steroids have limited medical use.

Health Impacts	• Use of anabolic steroids in the short-term can cause acne and hair fall. • Extended misuse of the substance can also lead to gynaecomastia (growth of breasts in men) and erectile dysfunction. • In women, it can lead to growth of facial hair.
About Steroids	• Steroids are a man-made version of chemicals, known as hormones, that are made naturally in the human body. • Steroids are designed to act like these hormones to reduce inflammation. • They're also known as corticosteroids, and are different to anabolic steroids used by bodybuilders and athletes. • Steroids won't cure your condition, but they're very good at reducing inflammation and will ease symptoms such as swelling, pain and stiffness.

ALPHAFOLD & PROTEIN

News: DeepMind, a company based in London, announced that it had predicted the three-dimensional structures of more than 200 million proteins using AlphaFold.

About

- AlphaFold is an **AI-based protein structure prediction tool.**
- It is based on a computer system called **Deep Neural Network.**

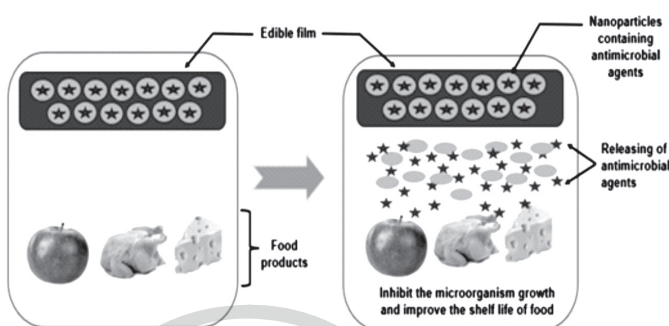
Working Mechanism:	• It uses processes based on "training, learning, retraining and relearning". • By using this method, AlphaFold has now predicted the structures of the entire 214 million unique protein sequences deposited in the Universal Protein Resource (UniProt) database.
Implications of this development	• Proteins carry out all the functions inside a living cell. • Therefore, knowing protein structure and function is essential to understanding human diseases. • Scientists predict protein structures using x-ray crystallography, nuclear magnetic resonance spectroscopy, or cryogenic electron microscopy. • These techniques are not just time-consuming, they often take years and are based mainly on trial-and-error methods. • Therefore, the development of AlphaFold changes all of that. It is a watershed movement in science and structural biology in particular.
Is AlphaFold the only tool for predicting protein structures?	• AlphaFold is neither flawless nor the only AI-based protein structure prediction tool. • RoseTTaFold, developed at the University of Washington in Seattle, U.S., is another tool.

DUNALIELLA TERTIOLECTA

News: Researchers from the Indian Institute of Technology (IIT) Guwahati have developed an edible material, using marine microalga Dunaliella tertiolecta, that can be coated on vegetables and fruits to extend their shelf life.

About

- **Dunaliella tertiolecta** is a marine microalga or the phytoplankton known for its **antioxidant properties** and has various **bioactive compounds** such as carotenoids and proteins.
- **Dunaliella** is also used to produce **algal oil**, which is a **non-animal source of omega-3 fatty acid**, and is a **good source of biofuel**. After the oil is extracted, the residue is usually discarded.
- However, the researchers have now used these extracts from the residue in formulating their edible film, in combination with chitosan.



- **Edible Film:**
 - It has **antimicrobial and anti-fungal properties**.
 - This material **displayed superior antioxidant activity**, thermal stability, mechanical strength, total **phenolic content** and **water vapour barrier property**.
 - It also had **excellent UV-Vis light-blocking properties**.
- **Coating Technique:** The material can be either directly coated on the vegetables and fruits or made into a vegetable storage pouch. In both cases, the shelf life of the vegetables can be extended.
- **Benefits:**
 - The new coatings can be mass-produced.
 - They are **very stable to light, heat, and temperature up to 40 C**, and can be safely eaten as part of the product formulation.
 - They retain texture, colour, appearance, flavour and nutritional value.
- **Safety:** To test the biosafety of these coatings, the coatings were tried on the BHK21 cell line, which is a laboratory standard for the study of various biological processes. The tests showed that the new coating materials were **nontoxic and could be safely used as edible food packaging materials**.

DARK GENOME

News: Scientists investigating the DNA outside our genes (dark genome) have discovered recently evolved regions that code for proteins associated with schizophrenia and bipolar disorder.

About

- Dark genome refers to '**DNA outside of the regions conventionally defined as genes**'.
- They are genes/proteins for which there is minimal knowledge on biological function and, allied to this, limited tools for their analysis (such as antibodies).
- Thus, it **adversely affects the precision medicine initiative**.

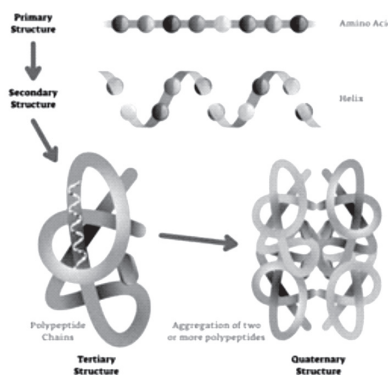
ULTRATHIN HETERO-PROTEIN FILM

News: Scientists have developed ultra-thin hetero-protein films that can revolutionize the food packaging and biomedical industries.

About

- A Thin Film is a layer of **material ranging from fractions of a nanometer (monolayer) to several micrometers in thickness**.
- Thin film deposition is the **process of creating and depositing thin film coatings onto a substrate material**.
- These coatings can be made of many different materials, **from metals to oxides to compounds**.
- **Thin-film deposition is an important manufacturing step in the production of many opto-electronic, medical devices and products** including consumer electronics, semiconductor lasers, LED displays, semiconductors, precision optics and medical implants.

PROTEIN STRUCTURE



What have The Scientists Developed?

- Scientists have **developed ultra-thin hetero-protein films with excellent thermal, mechanical and pH stability.**
- These films are **much thinner** as compared to the **other protein or plastic films.**
- They are **soft and thin** and **have the advantage of being more flexible than the other films.**

Proteins

- Proteins are **composed of amino acids, arranged into different groups.**
- These fundamental amino acid sequences are specific and their arrangements are controlled by the DNA.
- There are two types of protein molecules i.e. fibrous proteins and globular proteins:
 1. **Fibrous proteins** are insoluble and elongated.
 2. **Globular proteins** are soluble and compact.

ATHLETE BIOLOGICAL PASSPORT (ABP)

News: National Anti- Doping Agency (NADA) & NDTL are hosting the 3rd edition of World Anti-Doping Agency (WADA) ABP Symposium.

About

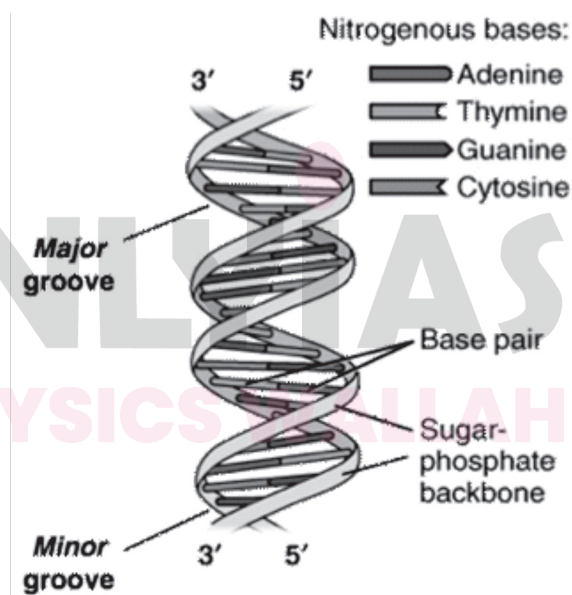
- ABP is an **Anti-doping tool that monitors selected biological variables over time to reveal effects of doping** rather than attempting to detect doping substance or method itself.
- It **works against doping** through enhanced target testing and analysis, investigations, deterrence, and as indirect evidence for use of prohibited methods or substances.

DEOXYRIBONUCLEIC ACID (DNA)

News: The Supreme Court has expressed concern about growing uses of Deoxyribonucleic Acid (DNA) Tests in court cases.

About

- Deoxyribonucleic acid (DNA) is an **organic molecule with a complex molecular structure.**
- DNA molecule's strands are **made up of a long chain of monomer nucleotides.**
- It is arranged in a **Double Helix structure.**
- **James Watson and Francis Crick** discovered that DNA is a double-helix polymer in 1953.
- It is **essential for the transfer of the genetic characteristic of the living being** from one generation to the other generation.
- The majority of DNA is found in the cell nucleus so it is called **nuclear DNA.**
- It **stores data in the form of a code made up of four Nitrogenous bases.**
 - **Purines:** Adenine (A), Guanine (G).
 - **Pyrimidines:** Cytosine (C), Thymine (T).



Use of DNA Testing

- DNA testing is **essential for identifying and bringing justice in cases involving abandoned mothers and children.**
- It is also a **highly effective technique in civil disputes** when the court needs to determine the issue of maintenance and identify the child's parents.



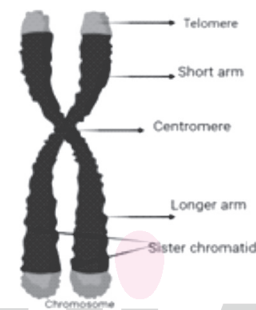
HUMAN GENOME

News: Nearly two decades ago, when scientists published the map of the human genome for the first time, about 8% of the human DNA was left sequenced. Now, this has been completed by a large global collaboration called the Telomere-2-Telomere (T2T).

About

- A genome refers to **all of the genetic material in an organism.**
- The Human genome is **mostly the same in all people, but a very small part of the DNA does vary between one individual and another.**

- By constructing a complete human genome, scientists can use it for reference while studying the genome of various individuals, which would help them understand which variations, if any, might be responsible for the disease.



Background	• Human Genome Sequencing was made available in 2003 by the Human Genome Project, an international collaboration between 1990 and 2003. • It contained information from a region of the human genome known as the euchromatin. • This chromosome is rich in genes, and the DNA encodes for protein. • The remaining 8% that was left out was in the area called heterochromatin. ○ This is a smaller portion of the genome and does not produce protein.
Why was heterochromatin not sequenced?	• There were two key reasons why heterochromatin was given lower priority: 1. This part of the genome was thought to be “junk DNA” because it had no clear function, 2. The euchromatin contained more genes that were simpler to sequence with the tools available at the time.
What has been done now?	• A global collaboration called the Telomere-2-Telomere (T2T) project has completed the reading of the remaining 8% of the genome. • They found a new reference genome called T2T-CHM13. • This genome includes highly repetitive DNA sequences found in and around the telomeres (structures at the ends of chromosomes) and the centromeres (at the middle section of each chromosome). • The sequence also reveals long stretches of DNA that are duplicated in the genome and are known to play important roles in evolution and disease.

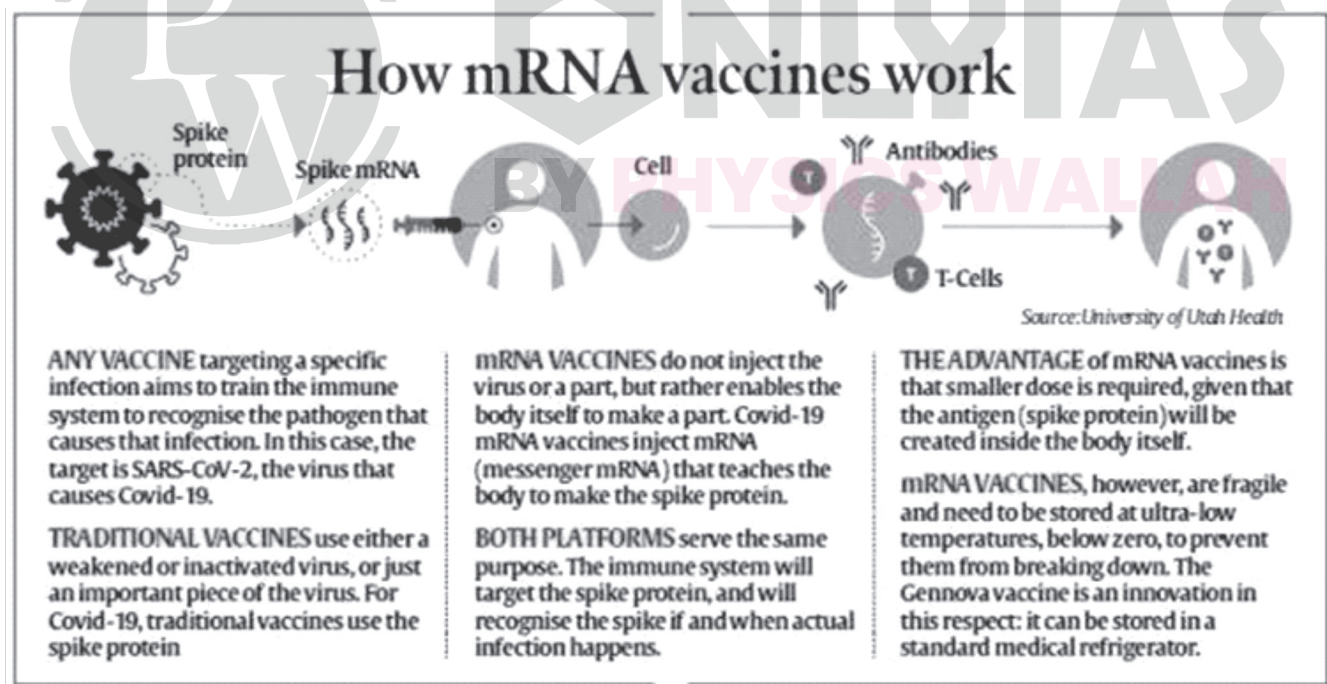
M-RNA TECHNOLOGY

News: Recently, Vaccine maker Biological E. has been selected to receive mRNA technology from the World Health Organization technology transfer hub.

About

- Messenger RNA or mRNA technology works by teaching our cells to recognize and protect us against infectious diseases.
- One of the challenges with this new technology is that it must be kept cold to maintain stability during transport and storage.

About mRNA	• Messenger RNA (abbreviated mRNA) is a type of single-stranded RNA involved in protein synthesis. • mRNA is made from a DNA template during the process of transcription. • The role of mRNA is to carry protein information from the DNA in a cell's nucleus to the cell's cytoplasm (watery interior), where the protein-making machinery reads the mRNA sequence and translates each three-base codon into its corresponding amino acid in a growing protein chain.
mRNA vaccines:	• mRNA vaccines trick the body into producing some of the viral proteins itself. • They work by using mRNA, or messenger RNA, which is the molecule that essentially puts DNA instructions into action. • Inside a cell, mRNA is used as a template to build a protein.
Working Mechanism:	• To produce an mRNA vaccine, scientists produce a synthetic version of the mRNA that a virus uses to build its infectious proteins. • This mRNA is delivered into the human body, whose cells read it as instructions to build that viral protein, and therefore create some of the virus's molecules themselves. • These proteins are solitary, so they do not assemble to form a virus. • The immune system then detects these viral proteins and starts to produce a defensive response to them.



WHO's Technology Transfer Hub

- Primarily **set up to address the Covid-19 emergency**, WHO's technology transfer hub has the potential to expand manufacturing capacity for other products as well, including treatments, and target other priorities such as malaria, HIV and cancer.

GENETICALLY ENGINEERED MOSQUITOES

News: A recent study of genetically modified mosquitoes in the United States has raised hopes of controlling disease-carrying mosquitoes.

About

- For this experiment, the scientists engineered a gene that will kill the female offspring.

- It was done to **reduce the population of wild *Aedes aegypti* mosquitoes**, which is a **vector for viruses like chikungunya, and dengue, zika, and yellow fever**.
- Genetically engineered mosquitoes are an **alternative to insecticides** to control insect populations.

GENOMICS

News: Recently, WHO' Science Council has released a report "Accelerating access to genomics for global health" advocating for passing on Genomic Technologies to developing countries.

Basics:	- Genomics is the study of the complete set of DNA (including all of its genes) in a person or other organism. - A genome is an organism's complete set of DNA.
Highlights WHO's Report:	The report calls for expanding access to genomic technologies, particularly in low- and middle-income countries (LMICs), by addressing shortfalls in the financing, laboratory infrastructure, materials, and highly trained personnel.
India's Steps:	Genome India (Department of Biotechnology): cataloguing the Genetic variation in Indians. IndiGen Program (CSIR): Collect whole genome sequences from different populations in India. INSACOG: Indian SARS-CoV-2 Genomics Consortium.

WHO Science Council

- Established in **April 2021** by WHO Director. It is composed of 9 leading scientists and public health experts from around the world.
- The **council advises the Director on high-priority issues and advances in science and technology** that could directly improve global health.
- It identified genomics as the focus of its first study, given the significant implications for public health.

CERVAVAC

News: Cervavac, a vaccine developed by the Serum Institute of India (SII), has recently acquired market authorization from the Drugs Controller General of India (DGCI).

About

- Cervical cancer is a **prevalent sexually transmitted infection**.
- It's a type of cancer that **occurs in the cells of the cervix**, the lower part of the uterus that connects to the vagina.
- It is mostly **caused by long-term infection with particular forms of HPV**.

- It is the second most prevalent cancer form and the second leading cause of cancer death in women of reproductive age (15-44).

Cervavac

- Cervavac is India's first quadrivalent Human Papillomavirus Vaccine (qHPV) vaccine.**
- It is intended to protect women against cervical cancer.
- The vaccine is based on VLP (virus-like particles), similar to the hepatitis B vaccine and provides protection by generating antibodies against the HPV virus's L1 protein.

CORNEA

News: Researchers in Sweden have developed a successful alternative — bioengineered cornea implants made of collagen derived from pig skin.

About

- The cornea is the **clear outer layer at the front of the eye**.
- The cornea **helps the eye to focus light so that one can see clearly**.

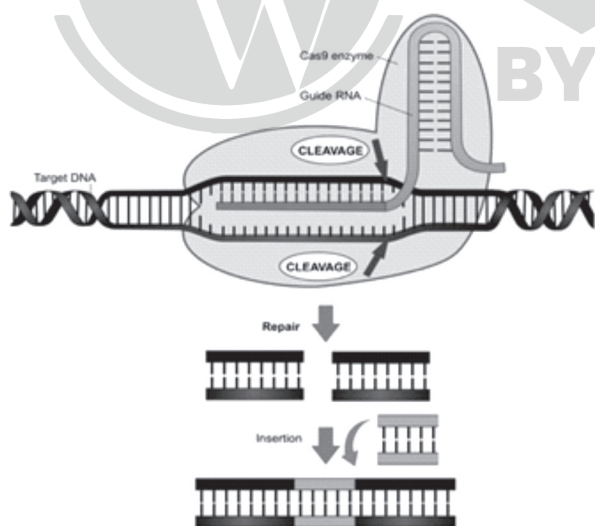
- Damage to the cornea is one of the **leading causes of blindness** across the world leaving approximately 12.7 million people blind.
- **Developments by researchers:**
 - As a substitute for human corneas, the **researchers have developed a successful alternative—bioengineered cornea implants made of collagen derived from pig skin.**
 - **Benefits:** This method is not only cheaper and easier to access than donated corneas but requires a less invasive procedure and can be stored for a significantly longer period—up to two years.

CRISPR TECHNOLOGY

News: In the 10 years since the CRISPR technology has been developed, it has begun to deliver on its unlimited potential which will help in improving the quality of human life.

About

- **CRISPR is short for Clustered Regularly Interspaced Short Palindromic Repeats.**
- It is a **powerful gene editing technology** which replicates **natural defense mechanisms in bacteria** to fight virus attacks using a special protein called Cas9.



Working

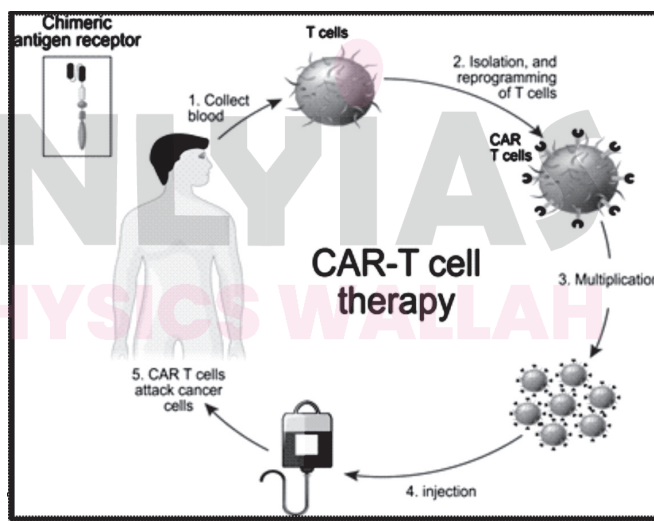
- **CRISPR-Cas9 technology behaves like a cut-and-paste mechanism on DNA strands** that contain genetic information.
- The specific location of the genetic codes that need to be changed, or edited, is identified on the DNA strand, and then, using the **Cas9 protein, which acts like**

a pair of scissors, that location is cut off from the strand.

- A DNA strand, when broken, has a **natural tendency to repair itself.**
- Scientists intervene during this auto-repair process, supplying the desired sequence of genetic codes that binds itself with the broken DNA strand.
- **Applications:** It has many potential applications, including correcting genetic defects, treating and preventing the spread of diseases, and improving the growth and resilience of crops.

CHIMERIC ANTIGEN RECEPTOR (CAR)- T CELL (T-THERAPY)

News: Recently, the researchers have said that India's first indigenously developed Chimeric Antigen Receptor (CAR)-T-Cell T-therapy for specific types of cancer patients has shown promising results and could be the safest therapy in this category so far.



About

- CAR-T cells are a **patient's own immune cells that are genetically engineered in the laboratory to fight cancer.**
- CAR-T cell is a **prospective therapy** that has ushered in a new era of **curing refractory and stubborn cancers.**
- **CAR-T cell therapy is used as third or second-line treatment for patients of specific types of cancers of blood and lymph nodes.**
- In India, those willing to undergo this treatment have to travel to other countries, mostly the US.
- T-cell receptor is widely used in developed nations for **immunotherapy** during cancer treatment.

Working Mechanism	- The therapy targets leukaemia and lymphoma. Leukaemia is cancer of blood-forming tissues, including bone marrow. Lymphoma is a cancer of the lymphatic system, which is part of the body's germ-fighting network. - It uses lentiviral technology. - In gene therapy, this is a method of inserting, modifying, or deleting genes in organisms using lentivirus, a family of viruses responsible for diseases such as AIDS. - As part of the treatment, a specific type of white blood cells called T cells are changed in the lab so they can find and destroy cancer cells. - It is also sometimes referred to as a type of cell-based gene therapy because it involves altering genes inside T cells to help them attack cancerous cells.
Base editing technology	- For the first time, Base editing technology used in CAR-T therapy defeated a seemingly incurable cancer. Base editing is a newer genome editing approach that allows scientists to zoom to a precise part of the genetic code and then alter the molecular structure of just one base. - Base editing makes point mutations in the DNA possible without generating Double Strand Breaks (DSBs).

ENDOSULFAN

News: The Supreme Court has slammed the Kerala government for doing "virtually nothing" for Endosulfan pesticide exposure victims.

About

- Endosulfan is an **organochlorine insecticide** and is commonly known by its trade name **Thiodan**.
- It is used to **control a wide range of pests** in agriculture, forestry, and other sectors.
- However, it has been **linked to a number of serious medical conditions**, such as neurotoxicity, physical deformities, and poisoning.

- Endosulfan is a **highly toxic chemical** that can **affect the nervous system, liver, and other organs**.
- In 2011, it was **included in the Stockholm Convention on Persistent Organic Pollutants**, a global treaty that aims to eliminate or restrict the use of certain hazardous chemicals.

GREY MATTER

News: Research supported under the SATYAM program by the Department of Science & Technology has found that daily **home-based meditation** can increase the amount of **grey matter in brains of patients with mild Alzheimer's disease**.

About Grey Matter:	- Grey matter refers to unmyelinated neurons and other cells of the Central Nervous System. - It is present in the brain, brainstem and cerebellum, and present throughout the spinal cord. - It is referred to as the grey matter due to its greyish appearance. The neuron cell bodies are concentrated here giving the colour.
Functions of Grey matter:	Grey matter in the brain is involved in muscle control, and sensory perception such as seeing and hearing, memory, emotions, speech, decision making, and self-control. - Also, the grey matter in the spinal cord is involved in muscle movement (motor neurons), and receiving and sending sensory information from the body (sensory neurons). White matter: White matter consists of fibres of the tracts covered with the myelin sheath, which gives an opaque white appearance to the layer.

About Science and Technology of Yoga and Meditation (SATYAM) Programme

- It was **conceptualized in 2015 by the DST under its Cognitive Science Research Initiative (CSRI)**.
- It aims to **foster scientific research** on the effects of **yoga and meditation on physical & mental health** and on cognitive functioning in healthy people as well as in patients with disorders.
- **Eligibility:**
 - Scientists/academicians with research background in Yoga and Meditation;
 - Practitioners involved in yoga and meditation can also apply in collaboration with research institutions.

SYNTHETIC BIOLOGY

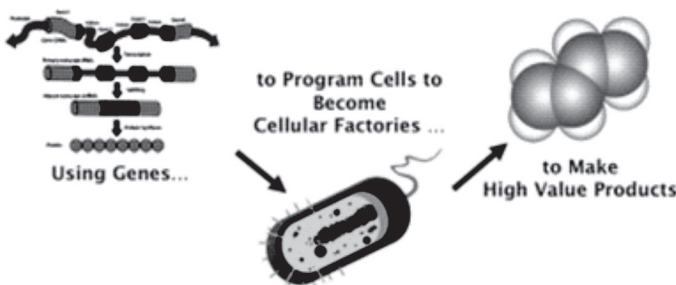
News: A draft foresight paper on synthetic biology released by the Department of Biotechnology.

About

- Synthetic biology **refers to the science of using genetic sequencing, editing, and modification to create unnatural organisms or organic molecules that can function in living systems.**
- Synthetic biology enables scientists to design and synthesize new sequences of DNA from scratch.

First usage:	• The term 'synthetic biology' was first used by Barbara Hobomin in 1980, to describe bacteria that had been genetically engineered using recombinant DNA technology. • In 2000, the term 'synthetic biology' was again introduced by Eric Kool and other speakers at the annual meeting of the American Chemical Society in San Francisco.
Applications of synthetic biology:	• It has applications in various fields. For instance, it can help in: (a) Developing synthetic organisms for vaccination, (b) Creating natural products in a lab such as vanillin, extracted from vanilla seeds, can be grown in yeasts with additional plant genomes. • Pharmaceutical industry: Synthetic biology can be used to make natural compounds such as artemisinin used for the treatment of malaria and Car T cell therapy for cancer treatment. • In the fashion industry: Some companies are exploring the possibility of dyeing jeans without producing hazardous waste using synthetic biology. • In Agriculture: Companies using synthetic biology to deliver fixed nitrogen to plants instead of using fertilisers, engineering microbes to create food additives or brew proteins.

Synthetic Biology



LAB-GROWN MEAT

News: The US Food and Drug Administration has given a safety clearance to lab-grown meat for the first time. Till now, Singapore was the only country to have approved the sale of cultivated meat products.

About

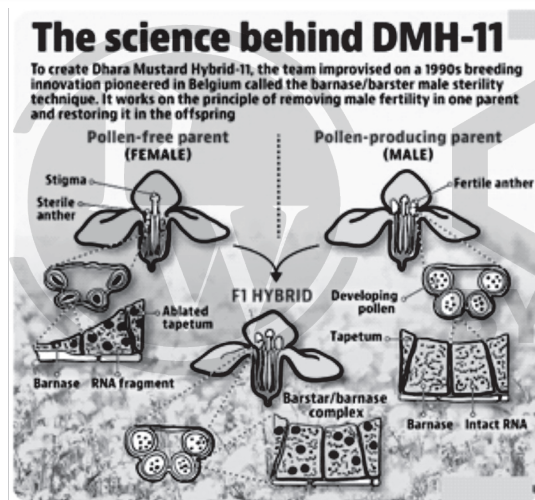
- Lab-grown meat, which can also be **referred to as cultivated or cultured meat**, is **real meat that's grown directly from animal cells.**
- This meat is **made without the need to raise and slaughter animals.**

How is Lab Grown Meat made?

- Lab-grown meat is made by using the more-than-100-year-old **technique of in-vitro muscle tissue growth**.
- **The process starts by taking a few cells from high-quality livestock animals** and then figuring out which of those cells have the ability to multiply and form delicious meat food products.
- In essence, we can recreate the conditions that naturally exist inside an animal's body so that the cells can continue growing.
- Lab-grown meat is **high in protein, vitamins, and minerals and can be lower in fat and cholesterol than conventional animal meat**.

DMH-11

News: The GEAC has endorsed releasing Dhara Mustard Hybrid-11, a transgenic hybrid mustard, into the ecosystem (DMH-11).



About

- The Centre for Genetic Manipulation of Crop Plants (CGMCP) at Delhi University created the DMH-11 gene, which consists of two foreign genes that were taken from the soil bacterium *Bacillus amyloliquefaciens*.
- **It was created by mating an East European mutant called "Early Heera-2" with the Indian mustard variety "Varuna" (of the barnase line) (barstar).**
- **The first gene in this produces a protein called "barnase" that reduces pollen production and makes the plant it is incorporated into male-sterile.**
- **The second is the "barstar" gene, which prevents the barnase gene from working.**
- The resulting F1 progeny has a high yield and can also produce grain or seed.

Genetic Engineering Appraisal Committee (GEAC)

- The **Ministry of Environment, Forests & Climate Change's GEAC (Statutory Body)** serves as India's **top biotech regulatory authority**.
- Established under the **Environmental Protection Act of 1986**.
- GEAC is chaired by the Special Secretary/ Additional Secretary of MoEF&CC and co-chaired by a representative from the Department of Biotechnology (DBT).
- The **GEAC is the agency in charge of evaluating requests for the "release" of GM organisms and products** (often regarded as harmful) into the environment.

INDIAN BIOLOGICAL DATA CENTER

News: The Indian Biological Data Center (IBDC) was officially opened in **Faridabad, Haryana**.

About

- Biological data **refers to all information about living organisms, such as nucleic acids, protein sequences, metabolites, and other molecular and functional properties.**
- IBDC is **India's first national repository for life science data.**
- **It is envisioned that it will become a major data repository for all life science data generated in India.**
- Furthermore, according to the **Biotech-PRIDE guidelines** issued last year, **IBDC is required to archive all life science data generated by publicly funded research in India.**
- It is being established in collaboration with the **National Informatics Centre at the Regional Centre of Biotechnology (RCB) in Faridabad.**
- The **digitised data** will be stored on '**Brahm**,' a **four-petabyte supercomputer.**
- It is backed by the **Department of Biotechnology (DBT).**
- In addition, the database contains the majority of the 2.6 lakh Sars-Cov-2 genomes sequenced by the Indian Sars-Cov-2 Genomic Consortium (INSACOG).

INCOVACC

News: In India, Bharat Biotech's iNCOVACC, the world's first intranasal vaccine for Covid-19, has been approved for emergency use.

About

- It is a **pre-fusion stabilized spike protein recombinant replication deficient adenovirus vectored vaccine**.
- It both produces antibodies and reduces the risk of transmission, whereas other vaccines only produce antibodies.
- Additional immune response in addition to blood immunity, it activates immunity in tissues lining the nose, mouth, and lungs.

BIO-PLASTICS

News: A British company recently claimed to have created the world's first bioplastic vinyl record, which it hopes will reduce the use of highly toxic Polyvinyl Chloride (PVC).

About

- **Bioplastics are derived from sugars and starches** rather than oil or gas, and their production produces no toxic waste.
- **These are 100% biodegradable, equally resistant, and versatile**, and are already used in agriculture, the textile industry, medicine, the container and packaging markets, and so on.



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MUD CRAB REOVIRUS

News: Andhra Pradesh recently found that 'Mud Crab Reovirus (MCRV)' has been the reason for mass mortality of wild crab (*Scylla serrata*).

Basics:	• Mud Crab Reovirus belongs to the Reoviridae family. It is responsible for the mass mortality of wild crabs. • It is also known as Sleeping Disease. • The virus mainly affects the connective tissue of hepatopancreas, intestine and gills.
Wild crab or mud crab	• Wild Crab are scientifically called Scylla serrata. • They are ecologically important species of crab and are found in the estuaries and mangroves of Africa, Asia and Australasia. • The shell colour varies from deep, mottled green to dark brown, In their most common form.

FIRST PIG HEART TRANSPLANT IN HUMAN

News: Recently, doctors transplanted a pig heart into a patient in a last effort to save his life, in Maryland hospital in the USA.

About

- This is the **first successful transplant of a pig's heart into a human being.**
- The earlier attempts of animal-to-human transplants — or **xenotransplantation** have failed largely because patients' bodies rapidly rejected the animal organ.
- In 1984, Baby Fae, a dying infant, lived 21 days with a baboon heart.

How was this animal to human transplantation different?	• This time, the surgeons used a heart from a pig that had undergone gene-editing to remove a sugar in its cells that's responsible for that hyper-fast organ rejection.
Reasons for choosing Pig for Transplantation:	• Pigs offered advantages over other animals for organ procurement — they are easier to raise, reach maturation faster and achieve adult human size in six months. • Pig heart valves are routinely transplanted into humans, and some patients with diabetes have received pig pancreas cells. • Pig skin has also been used as temporary grafts for burn patients.

NEO COV

News: NeoCov, a novel coronavirus, has been discovered in South African bats.

About

- NeoCoV, a **bat coronavirus**, was **discovered in 2011.** It was **discovered in the Neoromicia species of bats.**
- MERS-CoV is a virus that was **discovered in Saudi Arabia in 2012.**

- **SARS-CoV-2 is not NeoCov.**
- In terms of genome sequence, **NeoCov virus is 85% similar to Middle East Respiratory Syndrome Coronavirus (MERS-CoV)**, which enters cells via DPP4 receptors.
- NeoCoV **cannot interact with human receptors**, implying that in its current form the virus cannot infect humans.

Angiotensin-Converting Enzyme 2 (ACE2)

- ACE2 is an enzyme attached to the membrane of cells located in the intestines, kidney, testis, gallbladder, and heart.
- ACE2 lowers blood pressure by catalyzing the hydrolysis of angiotensin II (a vasoconstrictor peptide) into angiotensin.
- ACE2 also serves as the entry point into cells for some coronaviruses including SARS-Cov 2.

HAVANA SYNDROME

News: A new report on Havana syndrome (a mysterious illness that affected hundreds of US diplomats and intelligence officials around the world) has renewed interest in microwave weapons.

About

- It refers to a **group of mental health symptoms that typically include hearing certain sounds without any outside noise, nausea, vertigo, and headaches, memory loss, and balance issues.**
- It was **first reported in 2016** by officials at the **US Embassy in Cuba.**

MICROPLASTICS IN BLOOD

News: Microplastics have been discovered in human blood for the first time, raising concerns that the ubiquitous particles may be making their way into organs.

About

- The nearly invisible plastic fragments have already been discovered almost everywhere else on Earth, from the deepest oceans to the highest mountains, as well as in the air, soil, and food chain.
- It is unclear whether these microplastics can cross the bloodstream and deposit in organs, causing diseases.

About Microplastics

- Officially, they are defined as **plastics less than five millimetres (0.2 inches) in diameter.**
- There are two categories of microplastics: **primary and secondary.**
 1. **Primary microplastics:** tiny particles designed for commercial use, such as cosmetics, as well as microfibers shed from clothing and other textiles, such as fishing nets.
 2. **Secondary microplastics:** particles that result from the breakdown of larger plastic items, such as water bottles. This breakdown is caused by exposure to environmental factors, mainly the sun's radiation and ocean waves.

MULTIPLE SCLEROSIS (MS)

News: A new study suggests that most Multiple Sclerosis (MS) cases could be prevented by stopping Epstein-Barr virus (EBV) infection, and that targeting EBV could lead to the discovery of a cure for MS.

Basics:

- Multiple sclerosis (MS) is a **potentially disabling disease of the brain, spinal cord and optic nerves (Central Nervous System).**



- In MS, the **immune system attacks the protective sheath (myelin)** that covers nerve fibers and causes communication problems between your brain and the rest of your body.
- Eventually, the **disease can cause permanent damage or deterioration of the nerves.**

Symptoms:	• Numbness or weakness in one or more limbs that typically occurs on one side of your body at a time, or your legs and trunk. • Electric-shock sensations that occur with certain neck movements, especially bending the neck forward (Lhermitte sign) • Both males and females may lose interest in sex (Sexual dysfunction). • Some people with severe MS may lose the ability to walk independently or at all, while others may experience long periods of remission without any new symptoms.
Diagnosis:	• Can be diagnosed with blood tests and MRI. • There's no cure for multiple sclerosis. • However, treatments can help speed recovery from attacks, modify the course of the disease and manage symptoms.
National Registry of Multiple Sclerosis (MS):	• The Indian Council of Medical Research (ICMR) launched a national registry of multiple sclerosis (MS) and the Indian Multiple Sclerosis and Allied Demyelinating Disorders Registry and Research Network (IMSRN). • The registry will create an organized system for data collection, storage, retrieval, analysis, management and outcomes.

Indian Multiple Sclerosis and Allied Demyelinating Disorders Registry and Research Network (IMSRN)

- The **IMSRN was started in October 2021** with AIIMS New Delhi as the national coordinating center.
- It is the **first Indian nationwide dedicated database research network for Multiple Sclerosis (MS) and allied demyelinating disorders**.

ISCHEMIC STROKE

News: A 22-year-old student from Punjab who had suffered an ischemic stroke and was undergoing treatment for about a month died in Ukraine.

About

- It's also referred to as **brain ischemia and cerebral ischemia**.
- **Causes:**
 - It is usually **caused by a blood clot that blocks a blood vessel in the brain**. This interrupts or reduces blood from flowing to the brain.
 - This, in turn, will **prevent brain tissue from getting oxygen and nutrients**. Brain cells begin to die in minutes. Another cause is **stenosis, or narrowing of the artery**.
 - This can happen because of atherosclerosis, a disease in which plaque builds up inside your arteries.
 - **Transient Ischemic Attacks (TIAs) also known as a mini-stroke**, occur when the blood supply to the brain is interrupted briefly.

Symptoms:

- Trouble speaking and understanding what others are saying.
- Paralysis or numbness of the face, arm or leg.
- Problems seeing in one or both eyes.
- A sudden, severe headache, which may be accompanied by vomiting, dizziness or altered consciousness.

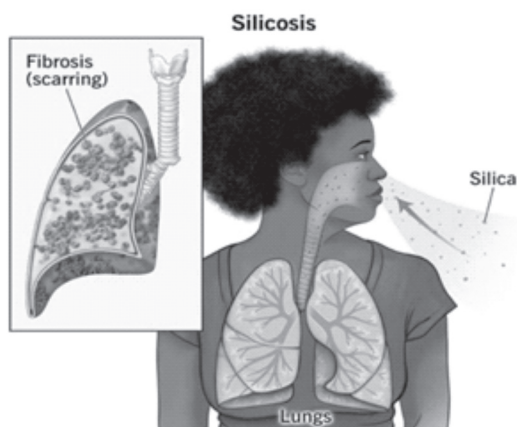
SILICOSIS

News: Silicosis is ravaging mine and factory workers in several villages of Jharkhand.

About

- Silicosis is a **type of pulmonary fibrosis**, a lung disease caused by breathing in tiny bits of silica, a common mineral found in sand, quartz and many other types of rock.
- It usually **happens in jobs where you breathe in dust that contains silica**.
- **High-risk jobs** are construction work, stone countertop fabrication, foundry work, ceramics manufacturing, mining and hydraulic fracturing (fracking).
- **Over time, exposure to silica particles causes scarring in the lungs, which can harm your ability to breathe**.
- **Symptoms:**
 - Usually appear after many years of exposure.
 - The first real signs of a problem may be an **abnormal chest X-ray and a slowly developing cough**.

- Complications from silicosis can include **tuberculosis, lung cancer, chronic bronchitis, auto-immune disorders and kidney disease.**



- **Treatment:** There is no cure for silicosis, but treatment is available, and employers and workers can take steps to prevent it.
- **Medications:** Inhaled steroids reduce lung mucus; Bronchodilators help relax your breathing passages;
 - Oxygen therapy;
 - Lung transplant surgery.
 - **Cigarette smoking adds to the lung damage caused by silicosis.** Quitting smoking is an important part of managing the disease.

MANGE DISEASE

News: Wildlife conservationists have expressed concern after locals spotted a few desert foxes, found in the scrub forests of Rajasthan's Jaisalmer district, suffering from a loss of fur due to the mange skin disease.

About

- Caused by **parasitic mites**.
- The disease is **characterized by inflammation, itching, thickening of the skin and hair loss.**
- **Caused by:** the **parasitic mite *Sarcoptes scabiei***, which also causes human scabies.
- **Transmission:** The disease is transmitted between animals by direct contact and by objects that have been in contact with infected animals.
- **Humans can also catch sarcoptic mange from dogs**, but the mites involved cannot complete their life cycle in human skin. As a result, the issue can cause some skin irritation in humans, but it does not last long.
- **Treatment:** The treatment of mange requires both oral medicines as well as the application of skin medicine.

DARE2ERAD TB PROGRAM

News: "Dare2eraD TB" initiative was launched by the Department of Biotechnology on the occasion of World TB Day.

About

- Dare2eraD TB stands for **Data-Driven Research to Eradicate TB**.
- **"Dare2eraD TB"** will be an **umbrella TB programme of DBT**.
- **Components:** The programme consists of key initiatives such as -
 - **InTGS-Indian Tuberculosis Genomic Surveillance Consortium:** It aims to monitor the genomic variations in *Mycobacterium tuberculosis* (Mtb) on a regular basis through a multi-laboratory network.
 - **InTBK Hub-Indian:** TB Knowledge Hub- Webinar Series.

Other initiatives related to Tuberculosis (TB):	• Regional Prospective Observational Research in Tuberculosis (RePORT) India initiative: It is a bilateral, multi-organizational, collaborative research effort established in 2013 under the Indo-US Vaccine Action Program (VAP). • It aims to advance tuberculosis (TB) research in India. • Department of Biotechnology has initiated a major network programme on "MDR-TB in Northeast India: A genomic driven approach" involving 22 North East Region (NER) institutes from 8 states and 14 other Institutes.
Global TB Report, 2022 by WHO:	• Between 2019 and 2021, the estimated number of TB deaths rose, reversing years of reduction between 2005 and 2019. (Ascribed to the epidemic of Covid-19.)
Pradhan Mantri TB Mukh Bharat Abhiyaan:	• The Abhiyan is aimed at eliminating TB from the country by 2025, five years ahead of the Sustainable Development Goals of 2030. • World Tuberculosis Day 2022 Observed On 24th March.

ANTIMICROBIAL RESISTANCE

News: According to a Lancet study, Antimicrobial Resistance (AMR) is now the leading cause of death worldwide.

About

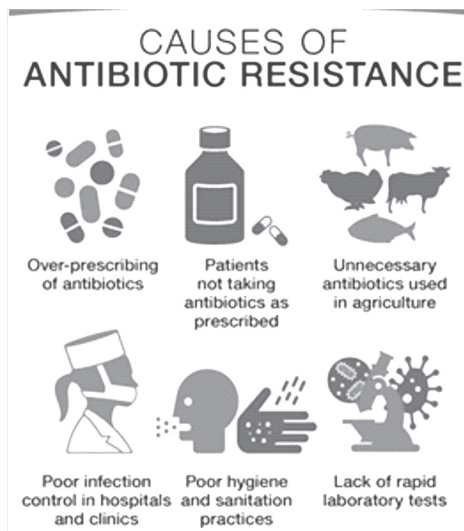
- **AMR was discovered to be especially harmful to young children.** In 2019, one in every five AMR-related deaths occurred in children under the age of five.
- **Antimicrobials, which include antibiotics, antiviral, antifungal, and antiparasitic medications,** are used to treat diseases in humans, animals, and plants.
- **Antimicrobial resistance (AMR) occurs when bacteria, viruses, fungi, and parasites evolve and no longer respond to medications,** making infections more difficult to treat and increasing the risk of disease spread, severe illness, and death.
- **Superbugs are microorganisms that develop AMR.**

Antibiotics

- Antibiotics are medicines that fight bacterial infections in people and animals.
- They work by killing the bacteria or by making it hard for the bacteria to grow and multiply.

Global Efforts Towards Controlling AMR

- **One Health Global Leaders Group on Antimicrobial Resistance:** Food and Agriculture Organization, World Organization for Animal Health, and World Health Organization launched the initiative.
- **Global Antimicrobial Resistance Surveillance System (GLASS) by WHO.**
- **AwaRE tool by WHO:** Its goal is to help policymakers and health professionals use antibiotics more safely and effectively. It divides antibiotics into three categories:
 1. Antibiotics used to treat the most common and serious infections are available.
 2. Antibiotics should be available in the healthcare system at all times.
 3. Reserve- antibiotics that should be used sparingly or only as a last resort.
- **The Global Action Plan on Antimicrobial Resistance:** aims to ensure the safe and effective treatment of infectious diseases.



COMMON ANTIBIOTIC MANUFACTURING FRAMEWORK (CAMF)

News: Recently, the third progress report of the Antimicrobial Resistance (AMR) Industry Alliance was released.

About

- AMR Industry Alliance is a **private-sector coalition working to tackle AMR.**
- In order to mitigate the environmental risks associated with antibiotic production, Alliance manufacturing members had developed CAMF in 2018.

About CAMF

- CAMF provides a methodology and set of minimum requirements needed to conduct a site risk evaluation of both macro and micro controls in our supply chains.
- It provides certain:
 - **Minimum expectations such as compliance with local laws and regulations,** environment permits, no untreated discharge of manufacturing waste containing antibiotics etc.
 - **Minimum requirements for environmental programs** to focus on environmental compliance and appropriate antibiotic discharge management.

MALARIA VACCINE

News: Gavi, the global vaccine alliance, announced \$160 million in international funding for the first malaria vaccine rollout in Africa from 2022 to 2025.

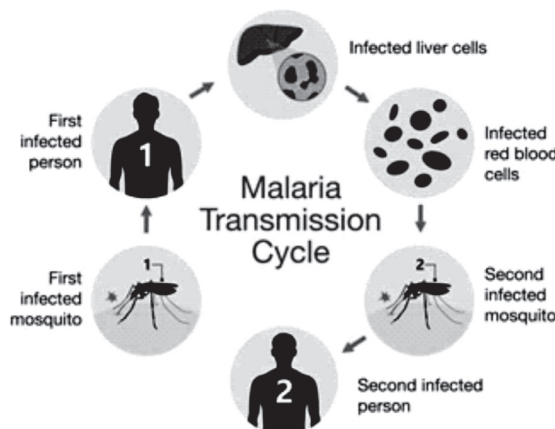
About

- The **first malaria vaccine in Africa will be introduced in Ghana, Kenya, and Malawi** (with a pilot programme beginning in 2019), and will then be expanded to other eligible endemic countries.

- Malaria is an **acute febrile illness caused by Plasmodium parasites** that are transmitted to humans via the bites of infected female *Anopheles* mosquitoes.

Malaria in India:

- In the WHO South-east Asia Region, **India accounted for 83% of estimated cases and approximately 82% of all malaria deaths** (WMR 2021).



- India launched the **National Framework for Malaria Elimination (NFME), 2016-2030**, with the goal of eliminating malaria in stages.
- Goal is to achieve **zero indigenous cases of Malaria by 2027 and sustain elimination by 2030**.

Causing agents of Malaria

- Malaria is an acute febrile illness caused by **Plasmodium parasites**, which are **spread to people through** the bites of infected **female Anopheles mosquitoes**.
- There are 5 parasite species that cause malaria in humans**, and 2 of these species – *P. falciparum* and *P. vivax* – pose the greatest threat.

CONVERSION THERAPY

News: The National Medical Commission held that conversion therapy is banned in India.

About

- Conversion therapy—sometimes called “Reparative Therapy” or “Gay Cure Therapy”—**tries to change someone’s sexual orientation or gender identity.
- Several countries (Brazil, Ecuador, Malta, Switzerland, Germany, Chile etc.) have introduced criminal bans for those found to be practicing conversion therapy.

BONE OSSIFICATION TEST

News: Recently, the Supreme Court has said the test can’t be said to be infallible and cannot be the sole basis to decide the age of an accused who claims to be a juvenile.

About

- The test is **required to determine the age in order to fix the criminal liabilities** based on which the law treats the persons differently based on their age.
- It is an age determination test of a person on the basis of assessment of his or her bony framework done through X-Rays/ CT-scans.

Bone and Cartilages

Bone	Cartilages
- Bone is a strong, flexible and semi-rigid supporting tissue. - It can withstand compression forces, and yet it can bend. - Cells - which in bone are called osteoblasts and osteocytes, (osteo - bone).	- Cartilage is a strong, flexible connective tissue that protects your joints and bones. - It acts as a shock absorber throughout your body. - Cartilage at the end of your bones reduces friction and prevents them from rubbing together when you use your joints.

FUSOBACTERIUM

News: Several groups have corroborated the finding that oral tumors among Indian patients are not driven by HPV infection but by the Fusobacterium.

About

- Fusobacterium species is a **genus of anaerobic, elongated, Gram-negative, non-spore forming bacteria, similar to Bacteroides**.
- They are **common obligately anaerobic bacteria of the oral cavity** that may act as a bridge between early and late colonizing bacteria in dental plaque and have a role in oral and extra-oral infections.
- There are multiple species of Fusobacterium, but the one most associated with human disease is *F. Necrophorum*.
 - F. Necrophorum* is a cause of periodontal disease**, tonsillitis, peritonsillar abscess, and thrombophlebitis of the jugular vein (Lemierre syndrome).
- Fusobacterium nucleatum* has a crucial **role in oral biofilm structure and ecology**, as revealed in experimental and clinical biofilm models.

Anaerobic Bacteria

- Bacteria can be classified by their need and tolerance for oxygen:**
 - Facultative:** Grow aerobically or anaerobically in the presence or absence of oxygen
 - Microaerophilic:** Require a low oxygen concentration (typically 2 to 10%) and, for many, a high carbon dioxide concentration (e.g., 10%); grow very poorly anaerobically
 - Obligate anaerobic:** Are incapable of aerobic metabolism but are variably tolerant of oxygen. Obligate anaerobes replicate at sites with low oxidation-reduction potential (e.g., necrotic, devascularized tissue). Oxygen is toxic to them.

NIPAH VIRUS

News: Scientists detected the presence of IgG antibodies against Nipah virus infection (NiV) in 51 bats that were captured from Karnataka, Kerala, Tamil Nadu and Puducherry.

About

- It is a zoonotic virus** (it is transmitted from animals to humans).

History:

- It first broke out in Malaysia and Singapore in 1998 and 1999.
- It first appeared in domestic pigs** and has been found among several species of domestic animals including dogs, cats, goats, horses and sheep.

Transmission:

- The virus is **transmitted to people from animals** and can also be passed on through contaminated food or directly from person-to-person.
- Fruit bats** are considered to be a **natural reservoir of the virus**.

Symptoms:

Acute Encephalitis and respiratory illnesses.

Prevention:

- Currently, there are **no vaccines for both humans and animals**.
- Intensive supportive care is given to humans infected by Nipah virus.

RICE FORTIFICATION

News: To maintain desired quality standards for the implementation of 'Rice Fortification,' the Department of Food and Public Distribution has issued Standard Operating Procedure (SOP).

WHAT IS FORTIFIED RICE?

Fortification is the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in food to improve its nutritional quality and provide a public health benefit with minimal risk to health

➤ The fortification factor does not last for more than **45 days**, so it isn't advisable to store fortified rice for long

➤ According to National Family Health Survey, **78.7%** children and **75%** in the district are anaemic and suffer from malnutrition

➤ In the first phase, fortified rice will be distributed in Badangi, Bobbili, Ramabhadrapuram and Terlam mandals

About

- To address **malnutrition, anaemia, and micronutrient deficiencies**, Standard Operating Procedures (SOP) for 'Rice Fortification' are issued.
- Rice fortification is the **process of supplementing rice with micronutrients such as iron, folic acid, and vitamin B12**.
- Fortified, rice **must contain mandatory micronutrients (Iron, Folic Acid, and Vitamin B12) or optional micronutrients (Zinc, Vitamin A, Thiamine, Riboflavin, Niacin, and Pyridoxine)** at levels specified in the Food Safety and Standards (Fortification of Foods) Regulations, 2018.

- According to FSSAI standards, **one kilogramme of fortified rice should contain iron (28mg-42.5mg), folic acid (75-125 micrograms), and vitamin B-12 (0.75-1.25 microgram).**

Recent Developments

- The government has approved the gradual introduction of fortified rice into government-run food schemes by 2024, with the goal of combating nutrition deficiency in all states and UTs.
- Fortified rice will be distributed through the Targeted Public Distribution System (TPDS)** in accordance with the National Food Security Act

(NFSA), 2013, the Integrated Child Development Services (ICDS), PM POSHAN, and other welfare programmes (OWS).

- The Centre would bear the entire cost of rice fortification.**

XE VARIANT OF CORONA-VIRUS

News: Brihanmumbai Municipal Corporation (BMC) has announced that a woman with a travel history to South Africa may have been infected with the newly-discovered 'XE' variant of the coronavirus.

Basics:	XE is a sub-variant of Omicron which caused the third wave of Covid-19. - XE was first discovered in the United Kingdom in January 2022 and so far, more than 600 samples of XE have been found in different countries.
Formation:	- The Omicron variant has two prominent sub-variants, called BA.1 and BA.2. There is also a BA.3 sub-variant as well, but that is less common. The XE variant is what is called a 'recombinant' variant. - This means it contains the mutations found in BA.1 as well as BA.2 varieties of Omicron.

Recombinant Variant

- Apart from the errors in the virus genome, another process through which the virus increases its genetic diversity is recombination.
- Recombination occurs in extremely rare situations.** In this, two different lineages of the virus co-infect the same cell in the host and exchange fragments of their individual genomes.
- This generates a descendent variant having mutations that occurred in both the original lineages of the virus.
- Recombination of lineages happens in a variety of other viruses**, including those that cause influenza, as well as other coronaviruses.

POLIO

News: With the possibility of a new Covid-19 variant triggering a fresh surge in cases, the Centre has told the states to send sewage samples to all sentinel sites that currently carry out surveillance of Poliovirus.

About

- Polio is a **crippling and potentially deadly viral infectious disease that affects the nervous system.**

- There are **three individual and immunologically distinct wild poliovirus strains:**
 - Wild Poliovirus type 1 (WPV1),
 - Wild Poliovirus type 2 (WPV2),
 - Wild Poliovirus type 3 (WPV3)
- Symptomatically, **all three strains are identical**, in that they **cause irreversible paralysis or even death.**
- However, **there are genetic and virological differences**, which make these three strains separate viruses which must each be eradicated individually.

Spread:	- The virus is transmitted by person-to-person mainly through the faecal-oral route or, less frequently, by a common vehicle (for example, through contaminated water or food). It largely affects children under 5 years of age. - The virus multiplies in the intestine, from where it can invade the nervous system and can cause paralysis.
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Symptoms:	• Most people with polio do not feel sick. Some people have only minor symptoms, such as fever, tiredness, nausea, headache, pain in the arms and legs, etc. • In rare cases, polio infection causes permanent loss of muscle function (paralysis). • Polio can be fatal if the muscles used for breathing are paralyzed or if there is an infection of the brain. • Prevention and Cure: There is no cure, but it can be prevented through Immunization.
Vaccines:	• Oral Polio Vaccine (OPV): It is given orally as a birth dose for institutional deliveries, then primary three doses at 6, 10 and 14 weeks and one booster dose at 16-24 months of age. • Injectable Polio Vaccine (IPV): It is introduced as an additional dose along with the 3rd dose of DPT (Diphtheria, Pertussis and Tetanus) under the Universal Immunization Programme (UIP).

BIRD FLU

News: China's National Health Commission (NHC) announced that a four-year-old boy was found to have been infected with the H3N8 variant of Bird Flu after developing several symptoms, including fever.

About

- H3N8 viruses **originated in horses and then transmitted to dogs.**
- The H3N8 bird flu virus was **first detected in North American waterfowl in 2002**, however, no cases of human transmission were reported until now.

Bird Flu:	• Avian influenza—known informally as avian flu or bird flu—refers to “influenza caused by viruses adapted to birds”. • Most avian influenza viruses do not infect humans, however, some, such as A(H5N1) and A(H7N9), have caused serious infections in people. • The Avian (H5N1) virus subtype, a highly pathogenic virus, first infected humans in 1997 during a poultry epidemic outbreak in Hong Kong SAR, China.
Types of Influenza Virus:	• There are four types of influenza viruses: Influenza A, B, C, and D. • Influenza A and B are the two types of influenza that cause epidemic seasonal infections nearly every year. • Avian influenza Type A viruses: ○ Type A viruses are classified based on two proteins on their surfaces – Hemagglutinin (HA) and Neuraminidase (NA). ○ There are about 18 HA subtypes and 11 NA subtypes. ○ Several combinations of these two proteins are possible e.g., H5N1, H7N2, H9N6, H17N10, H18N11 etc. • Influenza C mainly occurs in humans, but has been known to also occur in dogs and pigs. • Influenza D is found mainly in cattle. It's not known to infect or cause illness in humans yet.
Spread:	• Bird flu viruses do not normally infect humans. However, sporadic human infections with bird flu viruses have occurred.
Symptoms:	• Cough, fever, sore throat, muscle aches, headache, and shortness of breath.
Treatment:	• Antiviral treatment functions best if one receives it as soon as the symptoms emerge. However, it noted that antiviral drugs may not work as well against some A(H5N1) and A(H7N9) bird flu viruses.

HEPATITIS

News: World Hepatitis Day is observed each year on 28th July to enhance awareness of viral hepatitis. The theme for the year 2022 is “Bringing hepatitis care closer to you”.

About

- The word hepatitis **refers to any inflammation of the liver**—the irritation or swelling of the liver cells from any cause.
- It can be **acute (inflammation of the liver that presents with sickness—jaundice, fever, vomiting) or chronic** (inflammation of the liver that lasts more than six months, but essentially showing no symptoms).

Causes

- Usually caused by a group of viruses known as the “**hepatotropic**” (liver directed) viruses, including A, B, C, D and E.
- **Other viruses may also cause it**, such as the varicella virus that causes chicken pox.
- **SARS-CoV-2, the virus causing Covid-19 may injure the liver too.**
- Other causes include drugs and alcohol abuse, fat build-up in the liver (fatty liver hepatitis) or an autoimmune process in which a person’s body makes antibodies that attack the liver.
- **Hepatitis is the only communicable disease where mortality is showing an increasing trend.**

Treatment

- **Hepatitis A and E are self-limiting diseases** (i.e., go away on their own) and require no specific antiviral medications.
- **For Hepatitis B and C, effective medications are available.**

Hepatitis B

- Hepatitis B is an **infection in the liver**.
- The virus usually spreads through blood, semen or other body fluids.
- **Prevention:** It can be prevented or protected against through vaccination.

Global Target for Hepatitis

- The Global Target is **to eliminate viral hepatitis as a public health threat by 2030.**
- By 2025, we must reduce new infections of hepatitis B and C by 50%, reduce deaths from liver cancer by 40%, ensure that 60% of people living with hepatitis B and C are diagnosed and that half of those eligible receive appropriate treatment.
- An **Integrated Regional Action Plan** for viral hepatitis, HIV and Sexually Transmitted Infection STIs 2022–2026 is being developed by WHO.

ADENOVIRUSES

News: Recently, The World Health Organization (WHO) has said that 348 probable cases of hepatitis in children potentially linked to adenovirus have been reported from 20 countries across five global regions.

About

- Adenoviruses are a **group of common viruses that infect the lining of your eyes, airways and lungs, intestines, urinary tract, and nervous system.**
- **Symptoms:** The virus usually causes fever, respiratory illness (cough, cold, sore throat), gastroenteritis (stomach inflammation) and conjunctivitis (red eyes).
- **Vulnerable Group:** Adenovirus infections happen in children more often than in adults, but anyone can get them.
- **Types:**
 - There are many different types of adenoviruses, so people can get infected more than once.
 - These viruses also don’t have a “season” like other viruses (the flu, for example), so **infections can happen at any time of the year.**
- **Transmission:** Adenovirus infections spread from one person to another through surfaces, close contact and respiratory droplets.
- **Treatment:** Infections are mild, and they typically get better on their own.
- Scientists have used modified adenoviruses to build other vaccines such as those that protect against COVID-19.

SHIGELLA BACTERIA

News: An outbreak of shigella bacteria is believed to be the reason behind the recent incident of suspected food poisoning in Kasaragod district, Kerala.

About

- Shigella is a **genus of bacteria that causes an infection called shigellosis.** It is the **second leading cause of diarrhoea (after Rotavirus) worldwide** and the third leading cause of death in children less than 5 years old.
- **Symptoms:** Symptoms include diarrhoea, fever, stomach cramps which can last for seven days.
- **Transmission:**
 - Shigella is generally transmitted through contaminated food or water, or through person-to-person contact.
 - Shigellosis is primarily a disease of poor and crowded communities that do not have adequate sanitation or safe water.
- **Incubation Period:** The incubation period of shigellosis is typically 1–4 days.
- **Different Species:** The severity of the disease varies by the infecting species-

- **Shigella dysenteriae**: causes dysentery, which may also occur in infection with *Shigella flexneri*.
- **Shigella boydii** and **Shigella sonnei** often have self-limited watery diarrhoea.
- **Vaccines**: Currently, there are no vaccines available for shigellosis.

About Diarrhoea

- According to the WHO, Diarrhoea is **the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual.**
- It is usually a symptom of gastrointestinal infection, which **can be caused by a variety of bacterial, viral and parasitic organisms.**

WEST NILE VIRUS

News: A man who was undergoing treatment for West Nile fever in Kerala's Thrissur succumbed to it recently.

About

- It is a member of the **flavivirus** genus and belongs to the **Japanese encephalitis antigenic complex** of the family
- It is a **single-stranded RNA virus**.
- It was first isolated in a woman in the **West Nile district of Uganda in 1937**.
- **Commonly found**: in Africa, Europe, the Middle East, North America and West Asia.
- **Vector**: *Culex* species of mosquito.

Source of Transmission:

- By infected mosquitoes between and among humans and animals, including birds, which are the reservoir host of the virus.
- It can **also spread through blood transfusion**, from an infected mother to her child, or through exposure to the virus in laboratories.
- **Note**: To date, **no human-to-human transmission of WNV through casual contact has been documented.**

Symptoms:

- The disease is asymptomatic in 80% of the infected people. The rest develop what is called the **West Nile fever**.
- In these 20% cases, the **symptoms include fever, headache, fatigue, body aches, nausea, rash** and swollen glands.
- Severe infection can lead to encephalitis, meningitis, paralysis and even death.

Treatment:

- Treatment often involves hospitalization, intravenous fluids, respiratory support and prevention of secondary infections.
- **No vaccine is available** for humans.

SUDDEN INFANT DEATH SYNDROME

News: A team of researchers in Australia has identified a biochemical marker in the blood that could help identify new-born babies at risk for the sudden infant death syndrome (SIDS).

Basics:	● SIDS is the unexplained death, usually during sleep, of a seemingly healthy baby less than a year old. ● SIDS is known as crib death because the infants often die in their cribs. ● Butyrylcholinesterase (BchE) is an enzyme that plays a major role in the brain's arousal pathway. In the new study, the researchers have found that the babies who died of SIDS had lower levels of the BchE enzyme shortly after birth. So, the low levels of BchE would reduce a sleeping infant's ability to wake up or respond to its environment, leading to death in SIDS.
Other causes:	● Physical factors (Brain defects, low birth weight, respiratory infection); and environmental factors (sleeping on the stomach or side, sleeping on a soft surface, sharing a bed or overheating) ● Babies who live with smokers have a higher risk of SIDS (Second hand smoke). ● Premature babies and babies having a low-birth-weight result in SIDS. ● During pregnancy, the mother also affects her baby's risk of SIDS, especially if she is younger than 20, smokes cigarettes, uses drugs or alcohol, and/or has inadequate prenatal care.
Prevention:	● The actions are to be taken based on the above risks like placing your baby to sleep on his or her back, etc. ● Breast-feeding your baby for at least six months lowers the risk of SIDS.

TOMATO FLU

News: Tamil Nadu has ramped up surveillance at its borders in the wake of “tomato flu” cases being detected in Kerala.

About

- **Tomato flu or fever is a viral disease.** The flu gets its name because of the **red blister it causes**. The fever is **affecting children below the age of five**.
- **Symptoms:** The affected child can get blisters, high fever, body ache, joint swelling and fatigue.

- **Transmission:** Like other cases of flu, tomato fever is also contagious. If someone is infected with this flu, they need to be kept in isolation as this could spread rapidly from one person to another.
- **Treatment:** This flu is a self-limiting one and there is no specific drug for this. This means that the symptoms will resolve over time on their own if supportive care is given.

MONKEYPOX

News: Health authorities in the United Kingdom have confirmed a case of monkeypox, a rare viral infection similar to smallpox, in an individual who recently travelled to that country from Nigeria.

Basics:	• First discovered in 1958 following two outbreaks of a pox-like disease in colonies of monkeys kept for research—which led to the name ‘monkeypox’. • The monkeypox virus is an orthopoxvirus, which is a genus of viruses that also includes the variola virus, which causes smallpox, and vaccinia virus, which was used in the smallpox vaccine. • Monkeypox is a viral zoonotic disease that occurs primarily in tropical rainforest areas of Central and West Africa and is occasionally exported to other regions.
Symptoms:	• Monkeypox typically presents clinically with fever, rash and swollen lymph nodes. • It causes the lymph nodes to swell (lymphadenopathy), which smallpox does not.
Transmission:	• Monkeypox virus is mostly transmitted to people from wild animals such as rodents and primates, but human-to-human transmission also occurs. • Human to Human Transmission: The first human case was recorded in 1970 in the Democratic Republic of the Congo (DRC) during a period of intensified effort to eliminate smallpox. • Monkeypox virus is transmitted from one person to another by contact with lesions, body fluids, respiratory droplets and contaminated materials such as bedding.
Incubation Period:	• The incubation period (time from infection to symptoms) for monkeypox is usually 7-14 days but can range from 5-21 days.
Treatment:	• The clinical presentation of monkeypox resembles that of smallpox, a related orthopoxvirus infection which was declared eradicated worldwide in 1980. • The Vaccinia vaccine used during the smallpox eradication programme was also protective against monkeypox. • A new third generation vaccinia vaccine has now been approved for prevention of smallpox and monkeypox. Antiviral agents are also being developed.

EPILEPSY

News: Epilepsy in children is treatable.

About

- Epilepsy is a **chronic Non-Communicable Disease of the brain that affects people of all ages**.
- It is **characterized by recurrent seizures**, which are brief episodes of involuntary movement that may

involve a part of the body (partial) or the entire body (generalized) and are sometimes accompanied by loss of consciousness and control of bowel or bladder function.

- Seizure episodes are a result of **excessive electrical discharges in a group of brain cells**.
- **One seizure does not signify epilepsy.** Epilepsy is defined as **having two or more unprovoked seizures**.

- **Treatment:**
 - With medications or sometimes surgery can control seizures for the majority of people with epilepsy.
 - Some people require lifelong treatment to control seizures, but for others, the seizures eventually go away.
- Some children with epilepsy **may outgrow the condition with age.**

PK2 MOLECULE

News: Researchers at IIT Mandi have identified a drug molecule that can be used to treat diabetes.

About

- The molecule, called PK2, is able to trigger the release of insulin by the pancreas, and can potentially be used as an orally administered medicine for diabetes.
- The researchers found that PK2 was rapidly absorbed by the gastrointestinal tract, which means that it can be used as an oral medication rather than an injection.
- There was a small amount present in the brain, which shows that the molecule may be able to cross the blood-brain barrier. It was cleared from circulation in about 10 hours.
- Beyond increasing insulin release, PK2 was also able to prevent and even reverse beta cell loss, a cell essential for insulin production, making it effective for both Type 1 and Type 2 diabetes.

About Diabetes

- Diabetes is a chronic disease that occurs either **when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces.**
 - Insulin is a hormone that **regulates blood glucose.**
- **Hyperglycaemia, also called raised blood glucose or raised blood sugar,** is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the **nerves and blood vessels.**
- **Type 1 diabetes:**
 - Previously known as **insulin-dependent**, juvenile or childhood-onset.
 - Characterized by deficient insulin production and requires daily administration of insulin.
- **Type 2 diabetes:**
 - Formerly called **non-insulin-dependent**, or adult-onset

- Results from the body's ineffective use of insulin.
- More than 95% of people with diabetes have type 2 diabetes.
- This type of diabetes is largely the **result of excess body weight and physical inactivity.**

ANGIOTENSIN CONVERTING ENZYME 2 (ACE2)

News: ACE2 receptor involved in transmission of CoVID-19 disease.

About

- ACE2 is a “receptor,” protein that provides the entry point for the coronavirus into human cells.
- It is of two types:
 1. A **full-length** form that can bind to the cell membrane of healthy host cells,
 2. A **shorter**, soluble form that circulates in the blood in small amounts.



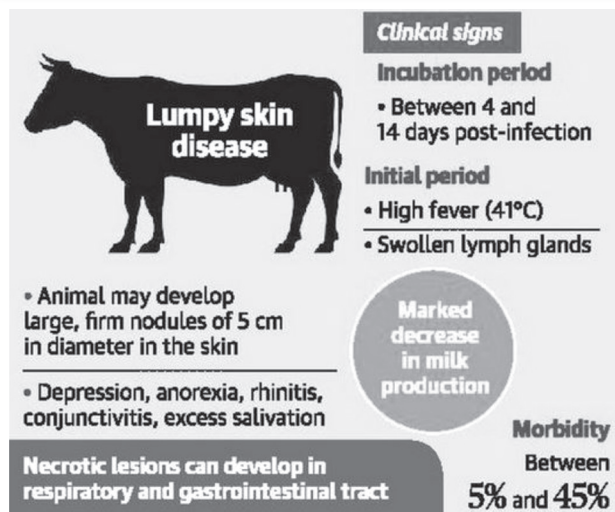
- According to a recent study the membrane-bound form of ACE2 is essential for enabling infection with SARS-CoV-2.
- Soluble ACE2 lacks the ability to anchor to the cell membrane.

About SARS-CoV-2

- The **virus that causes a respiratory disease** called coronavirus disease 19 (COVID-19).
- SARS-CoV-2 is a member of a large family of viruses called coronaviruses.
- These viruses can infect people and some animals.
- SARS-CoV-2 is a **positive-sense single-stranded RNA virus.**

LUMPY SKIN DISEASE

News: Around 1,229 cattle across five districts of Gujarat have been infected with Lumpy Skin Disease (LSD).



About

- Lumpy skin disease was **first seen as an epidemic in Zambia in 1929**. The mortality rate is less than 10%.
- Caused by infection of cattle or water buffalo with the **poxvirus Lumpy Skin Disease Virus (LSDV)**.
- **Transmission:** Lumpy skin disease is **primarily spread between animals by biting insects (vectors)**, such as mosquitoes and biting flies.
- **Symptoms:** It primarily consists of fever, fluid excretion from eyes and nose, dribbling of saliva from the mouth and blisters on the body.
- **Prevention and Treatment:** Vaccination against these diseases is covered under the Livestock Health and Disease Control Programme of India.
- There are no **specific antiviral drugs available for the treatment of lumpy skin disease**.
- **Anti-inflammatory painkillers can be used** to keep up the appetite of affected animals.

RAMSAY HUNT SYNDROME

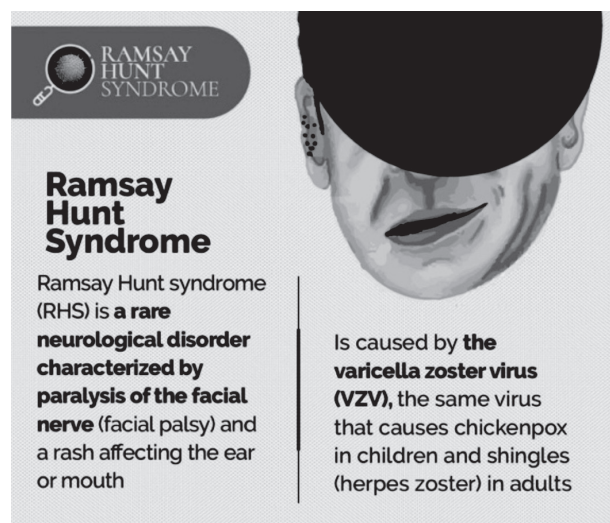
News: A famous Canadian pop singer is suffering from 'Ramsay Hunt Syndrome'.

Basics:

- Dostarlimab is a **type of monoclonal antibody**.
- It **blocks proteins called checkpoints** which are made up of immune system cells such as T cells, and some cancer cells. These checkpoints help keep immune responses from acting too strong and may prevent T cells from killing cancer cells.
- When these checkpoints are blocked, T cells are free to kill cancer cells more efficiently.
- Examples of checkpoint proteins found on T cells or cancer cells include PD-1, PD-L1, CTLA-4, and B7-1.

About

- Ramsay Hunt Syndrome (**herpes zoster oticus**) is a **rare neurological disorder** which usually **leads to paralysis of the facial nerve and a rash** that generally affects the ear or mouth or face.



Causes:

- **By reactivation of varicella zoster virus** that has previously caused chickenpox and shingles in the patient.
- This virus belongs to the **herpesvirus group** and can stay in the body as a **latent infection**. Varicella Zoster Virus can get reactivated due to **weakening of the immune system**.
- **The disease is not contagious** but can lead to chickenpox in those not vaccinated for the disease.
- **Symptoms:** It begins with a reddish patch which may inflame into a persistent rash.
- **Treatment:** Antiviral therapies and corticosteroids (anti-inflammatory drugs) are commonly used to treat the condition.

DOSTARLIMAB

News: Recently, 12 patients in the United States were completely cured of rectal cancer without requiring any surgery or chemotherapy. The trial used a monoclonal antibody called dostarlimab every three weeks for six months for the treatment.

Can Dostarlimab work against all cancers?

- According to experts, drugs like Dostarlimab **can be used only in patients with the genetic property of Mismatch Repair (MMR) Deficiency.**
- 'Mismatch Repair Deficient' cancer is most common among colorectal, gastrointestinal, and endometrial cancers. Patients suffering from this condition lack the genes to correct typos in the DNA that occur naturally while cells make copies.

Monoclonal Antibodies

- Monoclonal antibodies are **laboratory-produced molecules.**
- They **serve as substitute antibodies that can restore, enhance, modify or mimic the immune system's attack on unwanted cells.**
- Each monoclonal antibody is **designed in a way that it binds to only one antigen.**

CHOLERA

News: Researchers identified the decline of antimicrobial resistance in Cholera-Causing Bacteria.

About

- It is a **life-threatening infectious disease and a public health hazard.**
- **Cholera is an acute, diarrheal illness caused by infection of the intestine with the bacterium *Vibrio cholerae*.** The infection is often mild or without symptoms, but sometimes can be severe.
- **Symptoms:** Profuse watery diarrhoea, Vomiting, Leg cramps.
- **Transmission:**
 - A person may get **cholera by drinking water or eating food contaminated with the cholera bacterium.**
 - The disease can spread rapidly in areas with **inadequate treatment of sewage and drinking water.**
- **Vaccine:**
 - Currently there are three WHO pre-qualified Oral Cholera Vaccines (OCV), Dukoral, Shanchol, and Euvichol-Plus.
 - All three vaccines require two doses for full protection.

EPSTEIN BARR VIRUS

News: Scientists have found that cancer-causing virus Epstein Barr Virus (EBV) can infect the neuronal cells and drive various changes in biomolecules.

About

- The EBV virus has been **found to be widely present in the human population.**
- It **usually does not cause any harm**, but the virus gets reactivated inside the body in some unusual conditions like immunological stress or immunocompetence.
- This may further **lead to various complications like a type of blood cancer called Burkitt's lymphoma, stomach cancer, multiple sclerosis and so on.**
- Earlier studies provided links to EBV involvement in various neuro-degenerative diseases. However, how this virus can affect the cells of the brain and manipulate them is still unexplored.

Findings

- **Scientists have found that Epstein Barr Virus (EBV) can infect neuronal cells and drive various changes in biomolecules** such as fatty acids, carbohydrates and protein components leading to diseases of the central nervous system as well as brain cancer.
- **Significance of these findings:** This research work **aids in the understanding of EBV-mediated biomolecular changes** in the various compartments of the central nervous system leading to a better understanding of nervous system diseases.

MARBURG VIRUS DISEASE

News: The World Health Organisation (WHO) convened an urgent meeting after central African nation Equatorial Guinea confirmed its first outbreak of the highly infectious Marburg Virus Disease, or MVD. .

About

- Marburg Virus Disease (MVD) is a **severe disease in humans caused by Marburg Marburg Virus (MARV).**
- The virus belongs to the same family (**Filoviridae family**) as the Ebola virus.
- **The disease was first identified in 1967 in Germany's Marburg and Frankfurt and Serbia's Belgrade** following two large outbreaks.
- **Vector:**
 - **Fruit bats** are the key carriers of the disease.
 - It typically **infects humans following prolonged exposure** to mines or caves inhabited by Rousettus bat colonies.

- **Transmission:** Human-to-human transmission takes place through direct contact with the **blood**, secretions, organs or other bodily fluids of infected people.
- **Symptoms:** High fever, severe headache and severe malaise accompanied by muscle aches and pains are some common symptoms of the disease.
- **Fatality Rate:** Case fatality rates in past outbreaks have ranged from 24% to 88%.
- **Treatment:**
 - There are **no specific vaccines or antiviral treatments** to treat the disease.
 - However, chances of survival improve significantly with the help of rehydration with oral or intravenous fluids and targeted symptom treatment.

ONCOLYTIC VIROTHERAPY

News: Researchers in the US have developed a novel strategy in Oncolytic Virotherapy (OV) to improve a cancer therapy that can kill tumour cells while leaving nearby healthy tissues intact.

About

- **Oncolytic viruses can kill cancer cells** while leaving nearby healthy cells and tissues intact.
- In oncolytic virotherapy, the treatment also exerts its influence by activating an antitumor immune response made of immune cells such as **Natural Killer (NK) cells**.

Novel Approach:	• A region of the gene is deleted which shows to activate the immune pathway that enables the virus to replicate in normal cells. • It consists of a new oncolytic virus called FusOn-H2, based on the Herpes simplex 2 virus, (HSV-2), commonly known as genital herpes. • Arming FusOn-H2 with a chimeric NK engager that can engage the infiltrated natural killer cells with tumor cells can significantly enhance the effectiveness of this virotherapy.
Natural Killer (NK) Cells:	• NK cells were originally described as large granular lymphocytes with natural cytotoxicity against tumor cells. • Natural killer (NK) cells are effector lymphocytes of the innate immune system that control several types of tumors and microbial infections by limiting their spread and subsequent tissue damage. • NK cells were first noticed for their ability to kill tumour cells without any priming or prior activation (in contrast to cytotoxic T cells, which need priming by antigen presenting cells). • They are named for this 'natural' killing.

CLOFAZIMINE

News: Clofazimine, a key drug for treatment of leprosy, which had been in short supply in the Indian market for several months, is now "not available", with the situation turning into a crisis over the past three months.

About

- Clofazimine is **one of the three essential drugs in the Multi Drug Treatment of Multibacillary Leprosy (MBMDT) cases**, along with Rifampicin and Dapsone.
- It is needed not just for the therapy/cure of leprosy, but also **for controlling acute exacerbations of this disease**.
- Clofazimine has shown activity against **MultiDrug Resistance Tuberculosis** and has been recommended by the WHO to treat drug resistance.

- Under the NLEP (National Leprosy Eradication Programme), the government has been ensuring a steady supply of monthly blister packs for 12 months to all the multibacillary leprosy cases containing these three drugs.

About Leprosy

- Leprosy is also known as **Hansen's Disease**.
- Leprosy is a **chronic, progressive bacterial infection caused by a bacterium called Mycobacterium Leprae**, which is an **acid-fast rod-shaped bacillus**.
- **Areas of Infection:** Skin, Peripheral nerves, Upper respiratory tract and Lining of the nose.
- **Mode of Transmission:** Mainly by breathing airborne droplets from the affected individuals. It can be contacted at any age.

CSA6

News: Scientists have identified a gene called CSA6. This gene can hold the key to prevent fungal infection Candidiasis.

About

- CSA6 is a gene identified in *Candida albicans*, a **fungal species infamous for causing high rates of morbidity and mortality under certain immune-compromised conditions such as AIDS or during cancer treatment.**
- This gene can hold the key to prevent the fungal infection Candidiasis which often affects Intensive-Care Unit (ICU) patients, cancer patients and patients receiving immune-suppressive therapy.

About Candidiasis

- **White Fungus is also known as Candidiasis.** It is a type of fungal infection caused by a yeast called *Candida*.
- **Candida normally lives on the skin and inside the body** in places such as the mouth, throat, gut without causing any problems.
- However, candida can cause infections if it grows out of control or if it enters deep into the body.
- **Symptoms of white fungus vary depending on the area affected.** Most infections result in minimal complications such as redness, itching, and discomfort.
- **Treatment:** It is not life-threatening. The treatment of White Fungus disease is mainly done through antifungal medicines. However, this changes if a person contracts severe disease and lungs are infected.

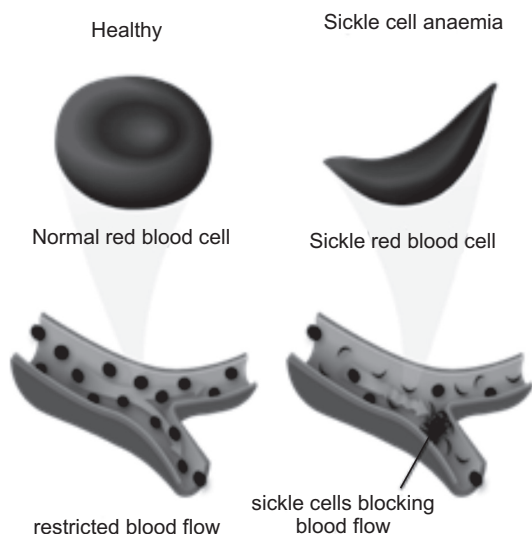
SICKLE CELL DISEASE

News: African health ministers launched a campaign to ramp up awareness, bolster prevention and care to curb the toll of sickle cell disease.

About

- It is a group of **inherited red blood cell disorders.** Red blood carries oxygen to all parts of the body.
- Healthy red blood cells are round, and they move through small blood vessels to carry oxygen to all parts of the body.

- In someone who has SCD, the **haemoglobin is abnormal**, which causes the Red Blood Cells to become hard and sticky and look like a **C-shaped farm tool called a “sickle.”**
- The **sickle cells die early**, which **causes a constant shortage of Red Blood Cells.**



- **Types:**
 - There are several types of SCD.
 - The specific type of SCD a person has depends on the genes they inherited from their parents.
- People with SCD **inherit genes that contain instructions, or code, for abnormal haemoglobin.**
- **Cause:**
 - SCD is a genetic condition that is **present at birth.**
 - It is **inherited when a child receives two genes**—one from each parent—that code for abnormal haemoglobin.
- **Prevention:** Prevention strategies include lifestyle behaviours as well as medical screening and interventions to prevent SCD complications.

Recent Initiatives

- **The Unmukt Project is being implemented by the Central Government** to strengthen screening and timely management of Sickle Cell Anaemia.
- **The Tribal Affairs Ministry established the National Council on Sickle Cell Disease and Tribal Health Cell**, which would coordinate with the Ministry of Health and State Governments.

LACTOSE INTOLERANCE

News: Studies on the global level suggest that 65% of humanity is lactose-intolerant.

About

- Lactose intolerance means the **individual lacks the gene to break down lactose into adulthood**.
- Beyond the age of five, lactose, a sugar present in milk, cannot be naturally broken down in the stomach and this remains in the gut **causing flatulence, acidity and diarrhoea**.
- However, in the last 5,000 years, a genetic mutation enabled European pastoralists to produce lactase.
- **Drinking milk is actually harmful in those who lacked the gene-variant but only in periods of famine and adverse environmental conditions.**

Lactose Persistence

- Lactase, **an enzyme that breaks down lactose into a digestible form, well into adulthood**, a trait called lactose persistence.
- The lactase persistence trait is **more common in populations that practice cattle herding and dairy farming**, and it is related to genetic selection of individuals with the ability to digest lactose.

CHRONIC FATIGUE SYNDROME

News: A woman from Bengaluru has filed a petition in the Delhi High Court to stop her friend who has been suffering from chronic fatigue syndrome since 2014 from travelling to Europe to undergo physician-assisted euthanasia.

About

- Chronic Fatigue Syndrome is also known as **Myalgic Encephalomyelitis (ME/CFS)**.
- It is a **serious and debilitating disease that affects the nervous system, the immune system and the body's production of energy**.
- **Its causes are still unknown.** However, the potential triggers would include viral or bacterial infection, hormonal imbalances and genetic predispositions.
- There is **no specific test for the disease** and doctors have to rely on medical examinations, and blood and urine tests.
- **Vulnerable Groups:** ME/CFS can affect anyone from children to adults of all ages. But it is more common in women and people between 40 and 60 years old.
- **Symptoms:**
 - The biggest symptom is significantly lowered ability to do activities that were performed before the illness.
 - **The most recognizable symptom is post-exertional malaise (PEM).** Patients often describe

it as a “crash” in physical/mental energy following even minor activities like grocery shopping or brushing teeth.

- **Treatment:** As of yet, there is no specific cure or approved treatment.

NOVEL LANGYA HENIPAVIRUS

News: Almost three years after the novel coronavirus was detected in China, the novel Langya virus (LayV) has been discovered in the two eastern provinces of China.

About

- Langya Henipavirus (LayV) was **discovered in eastern China** during surveillance testing of patients who had fever along with a recent history of animal exposure. It is a **type of Henipavirus, a category of zoonotic viruses** that can jump from animals to humans.
- **It is closely related to the Mojiang Henipavirus**, which was discovered in southern China.
- **Symptoms:** Fever, fatigue, cough, nausea, headache are the common symptoms of LayV disease.
- **Transmission:**
 - In all likelihood, the new virus has jumped from an animal to humans. The LayV virus RNA has been predominantly found in shrews, which may be its natural hosts.
 - **So far, there have been no cases of human-to-human transmission** of the virus. However, the possibility of spread cannot be ignored.
- **Detection:** A standardized nucleic acid testing method is required to identify the Langya virus.
- **Treatment:** There is currently no vaccine or treatment for Henipavirus and the only treatment is supportive care to manage complications.

About Henipa Viruses

- Henipaviruses are **classified as Biosafety Level 4 (BSL4) pathogens**.
- **They can cause severe illness in animals and humans**, and as of now there are no licensed drugs or vaccines meant for humans.
- The types of Henipaviruses that had been identified prior to this included Hendra, Nipah, Cedar, Mojiang and the Ghanaian bat virus.
- According to the US CDC, the Cedar virus, Ghanaian bat virus, and Mojiang virus are not known to cause human disease. **But Hendra and Nipah infect humans and can cause fatal illness.**

VASCULITIS

News: Actor Ashton Kutcher had a “weird, super rare form of vasculitis” two years ago that “knocked out” his vision, hearing, and “equilibrium”. He mentioned about it in a recent tweet.

About

- Vasculitis is a **general term for several conditions that cause inflammation of blood vessels**.
- It is also called **angiitis** (“inflammation within blood vessels”) or **arteritis** (“inflammation in arteries”).
- **It is an auto-immune disease** in which the body’s immune system turns on healthy blood vessels, causing them to swell up, narrow down, stretch, or become weak.
- **The trigger for vasculitis may be an infection or a drug or blood cancers or immune system diseases**, although the precise reason is often uncertain or unknown.
- **Vasculitis can be only a minor problem affecting the skin**, or it can be a serious condition that impacts the heart, kidneys or other vital organs.
- **Types of Vasculitis:**
 - There are around 20 different disorders that are classified as vasculitis.
 - Although the diseases are similar in some ways, they often differ with respect to which organs are affected, which medications are used to treat them, and other characteristics.
- **Treatment:** Different types of inflammation cause different diseases, which have their own symptoms and treatment protocols.
- **Steroids are frequently prescribed**, as are some other medicines that reduce the activity of the immune system.

AFRICAN SWINE FEVER

News: African Swine Fever has been confirmed for the first time, at a private pig farm in Kerala, after more than 15 pigs on the farm had died due to the disease in the last ten days.

About

- African Swine Fever (ASF) is a **highly contagious hemorrhagic viral disease of domestic and wild pigs** which is responsible for serious economic and production losses.

- **It is caused by a large DNA virus of the Asfarviridae family**, which also infects ticks of the genus *Ornithodoros*.
- It was **first detected in Africa in the 1920s**.
- **The mortality is close to 95% - 100%** and since the fever has no cure, the only way to stop its spread is by culling the animals.
- **ASF is not a threat to human beings** since it only spreads from animals to other animals.
- ASF is a disease **listed in the World Organisation for Animal Health (OIE)’s Terrestrial Animal Health Code**.

Transmission

- Direct contact with infected pigs, faeces or body fluids.
- Indirect contact via fomites such as equipment, vehicles or people who work with pigs between pig farms with ineffective biosecurity.
- Pigs eating infected pig meat or meat products.
- Biological vectors—**ticks of the species *Ornithodoros***.

World Organisation for Animal Health

- WOAHA was formerly called the “**Office International des Epizooties**”.
- OIE is an intergovernmental organisation responsible for improving animal health worldwide.
- It has **182 Member Countries**.
- **India is one of the member countries**.
- It is headquartered in **Paris, France**.

VISCERAL LEISHMANIASIS/KALA AZAR

News: The Government has set the target to eliminate Kala Azar by next year from the country.

About

- Out of 633 Kala-azar endemic blocks, 625 blocks have achieved the elimination target last year.
- **It is a Non-Tropical Disease caused by a protozoan parasite of genus *Leishmania* and spread by sandfly bites is the second deadliest parasitic disease in the world after malaria**.
- It affects the **spleen, liver and bone marrow**.
- In India, it is **endemic to Bihar, Jharkhand, Uttar Pradesh and West Bengal**.

HAND, FOOT, AND MOUTH DISEASE (HFMD)

News: There has been a spike in cases of Hand, Foot, and Mouth Disease (HFMD) in Mumbai. As per data provided by the state's public health department, Maharashtra has reported 250 cases of hand-foot-and-mouth disease.

About

- Hand, Foot, and Mouth Disease (HFMD) is a **highly contagious infection**. It is common in children under the age of 5, but anyone can get it.
- **Caused by:** It is most **commonly caused by a coxsackievirus**, which belongs to a group of **viruses called non polio enteroviruses**.
- **Transmission:**
 - These viruses can spread from person to person through direct contact with unwashed hands or surfaces contaminated with faeces.
 - It can also be transmitted through contact with a person's saliva, stool, or respiratory secretions.
- **Symptoms:** usually include fever, mouth sores, and skin rash. The rash is commonly found on the hands and feet.

- **Treatment:** The illness is usually not serious. Children are mostly treated with anti-allergic medicines and ointments. The lesions usually disappear in five to six days.
- **Prevention:** Frequent hand-washing and avoiding close contact with people who have hand foot and mouth disease may help lower a child's risk of infection.

EBOLA VIRUS DISEASE

News: Recently, an outbreak of Ebola Virus Disease (EVD) has been declared in Uganda following the confirmation of a relatively rare Sudan strain case.

About

- **Formerly known as Ebola Hemorrhagic Fever.** The first cases were recorded in Guinea in December 2013. Later, the disease spread to neighbouring Liberia and Sierra Leone.
- Three of its six strains—Bundibugyo, Sudan and Zaire—have historically been responsible for major outbreaks.

Spread:	• It is thought that fruit bats of the Pteropodidae family are natural Ebola virus hosts. • The virus is transmitted to people from wild animals and spreads through human-to-human transmission.
Symptoms:	• Symptoms of EVD can be sudden and include: Fever, Fatigue, Muscle pain, Headache, Sore throat • This is followed by: Vomiting, Diarrhoea, Rash.
Diagnosis:	• It can be difficult to clinically distinguish EVD from other infectious diseases such as malaria, typhoid fever and meningitis. • Many symptoms of pregnancy and Ebola disease are also quite similar. Confirmation that symptoms are caused by Ebola virus infection are made using the following diagnostic methods: ○ Antibody-capture enzyme-linked immunosorbent assay (ELISA) ○ Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) Assay
Treatment:	• The Ervebo vaccine has been shown to be effective in protecting people from the species Zaire ebolavirus. • Two monoclonal antibodies (Inmazeb and Ebanga) were approved for the treatment of Zaire ebolavirus (Ebola virus) infection in adults. • Remdesivir was also tested as an Ebola treatment.

RABIES DISEASE

News: The Supreme Court observed that those who feed the street dogs could be made responsible for vaccinating them.

About

- It is a **viral zoonotic disease** that causes progressive and fatal inflammation of the brain and spinal cord.
- It is a **fatal but preventable** viral disease.
- **Clinically, it has two forms:**
 1. **Furious rabies** – characterized by hyperactivity and hallucinations.

2. Paralytic rabies – characterized by paralysis and coma.

- **It is present on all continents, except Antarctica**, with over 95% of human deaths occurring in the Asia and Africa regions.
- **Rabies is one of the Neglected Tropical Diseases (NTD)** that predominantly affects poor and vulnerable populations who live in remote rural locations.
- **Transmission:** It can spread to people and pets if they are bitten or scratched by a rabid animal.
- **Impact:** The rabies virus infects the central nervous system, ultimately resulting in death.
- **Treatment and Prevention:** Rabies can be prevented by vaccinating pets, staying away from wildlife, and seeking medical care after potential exposures before symptoms start.

LEGIONNAIRES DISEASE

News: Recently, a cluster of pneumonia cases in Tucumán, Argentina was caused by legionella which is the bacteria that causes Legionnaires' disease.

About

- Legionella was **discovered after an outbreak in 1976 among people who went to a Philadelphia convention of the American Legion.**
- Legionnaires disease is a **serious type of pneumonia (lung infection) caused by Legionella bacteria.**
- People can get sick when they breathe in small droplets of water or accidentally swallow water containing Legionella into the lungs.
- **Legionella can cause Legionnaires' disease and Pontiac fever**, collectively known as legionellosis.
- In general, people do not spread Legionnaires' disease to other people.

Causes and Common Sources of Infection

- Legionella bacteria are **found naturally in freshwater environments, like lakes and streams.**
- The bacteria can become a health concern when they grow and spread in human-made building water systems like Showerheads and sink faucets, Cooling towers, Hot tubs, Decorative fountains and water features, Hot water tanks and heaters, Large, complex plumbing systems.
- **Signs and Symptoms:** Cough, Shortness of breath, Fever, Muscle aches, Headaches,
- **Treatment:**
 - There are **no vaccines** that can prevent Legionnaires' disease.

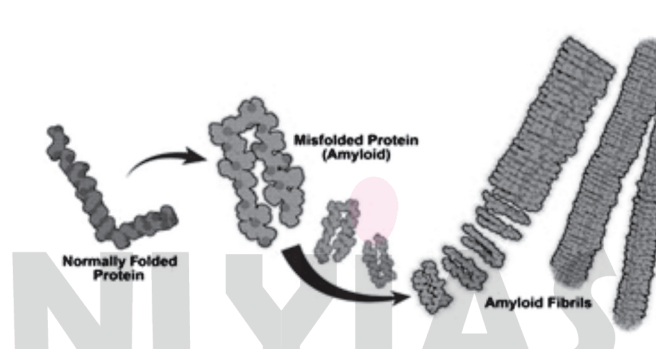
- Legionnaires' disease requires treatment with antibiotics and most cases of this illness can be treated successfully.

ALZHEIMER DISEASE

News: Researchers have discovered a drug named Lecanemab that reduces cognitive decline in patients with early Alzheimer's, making it one of the first neuroprotective treatments for the disease.

About

- **It is a neurological disorder which causes brain cells to degenerate and die.** This leads to **loss of memory**, problems with words in speaking or writing, poor judgment, **changes in mood and personality**, confusion with time or place, etc.



- Alzheimer's is the **most common cause of dementia** among older adults.
- Caused by the **abnormal build-up of proteins in and around brain cells.**
- **One of the proteins involved is called "amyloid", deposits of which form plaques around brain cells and the other protein is called "tau".**
- **Tau is a protein that when it occurs in tangled formations** in the brain of Alzheimer patients, disrupts the ability of neurons to communicate with one another in the brain.
- **Alzheimer's is an incurable disease**, as the death of brain cells cannot be reversed.
- Women have a higher risk **of having Alzheimer's disease than men.**
- **Treatment:** There is currently no known cure for Alzheimer's disease.

LASSA FEVER

News: Recently published study has found that climate change will aid the spread of Lassa fever to the central and eastern parts of the continent in the next 50 years.

About

- It is a **zoonotic disease endemic to parts of west Africa**.
- **Causes:** It is caused by the Lassa virus, a member of the **Arenaviridae family**.
- **Transmission:**
 - It's transmitted through the urine and droppings of infected multimammate rats found in most tropical and subtropical countries in Africa.
 - They are able to contaminate anything they come in contact with.
 - The Lassa virus spreads through **human-to-human contact** with tissue, blood, body fluids, secretions or excretions.
- **Fatality rate:** The fatality rate for hospitalized patients is generally high and can reach 80 per cent at times.
- **Vaccines and Treatment:** There is currently no vaccine approved to prevent the disease.
- **Antiviral drug ribavirin is often used** to treat Lassa fever although the usage is not a licensed treatment.
- **Other procedures used are supportive care** including hydration, oxygenation, and treatment of specific complications arising due to the disease.

FAIRBANK DISEASE

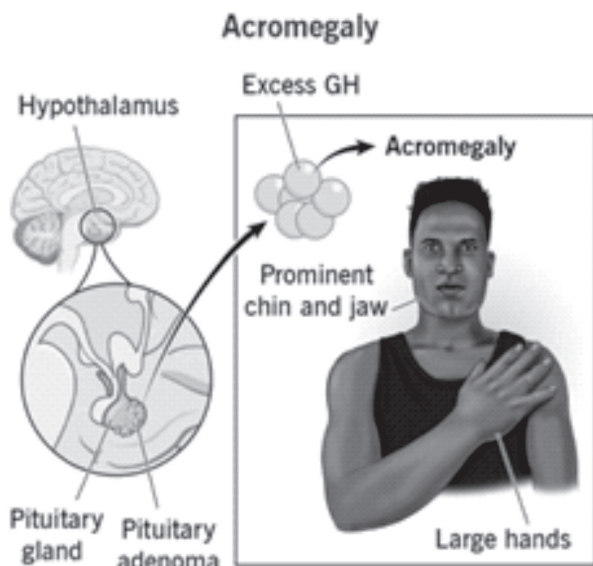
News: Recently, the Union Minister of State for Health and Family Welfare has informed the Rajya Sabha that Fairbanks Disease and Acromegaly Disorder's patients are getting treatment at various tertiary health facilities like Medical Colleges, Central Institutes like AIIMS at free or subsidized rates besides in tertiary care private hospitals.

About

- **Fairbanks disease or multiple epiphyseal dysplasia (MED)** is a rare genetic disorder (dominant form—1 in 10,000 births) which affects the growing ends of bones.
- **Bones usually elongate by a process that involves the depositing of cartilage at the ends of the bones**, called ossification.
- **This cartilage then mineralizes and hardens to become bone.** In MED, this process is defective.
- **The Fairbank's disease (Multiple epiphyseal dysplasia)** patient usually requires management of pain and orthopaedic procedures, for which facilities are available at tertiary care institutions in India.

About Acromegaly Disorder

- Acromegaly is a **hormonal disorder that develops when the pituitary gland produces too much growth hormone in the body**.
- In childhood, this leads to **increased height and is called "gigantism"**. But in adulthood, a change in height doesn't occur.
- Instead, the increase in bone size is limited to the bones of the hands, feet and face and is called **Acromegaly**.
- This disorder is **not inherited from a person's parents**.
- **Symptoms include:** Enlargement of the face, hands and feet. Other symptoms may include joint pain, thicker skin.
- Complications of the disease may include type 2 diabetes, sleep apnoea, and high blood pressure.



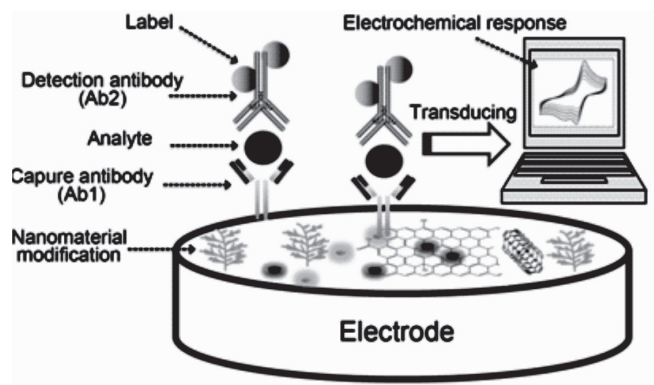
IMMUNOSENSOR FOR JAPANESE ENCEPHALITIS VIRUS

News: Hyderabad-based National Institute of Animal Biotechnology has developed an electrochemical based immunosensor for detecting the Non-Structural 1 (NS1) secretory protein, a biomarker for Japanese Encephalitis Virus (JEV).

About

- This immunosensor was developed by fabricating **fluorine-doped Tin Oxide electrodes with reduced Graphene Oxide** for the rapid, sensitive and specific detection of the NS1 secretory protein.

- The synthesized NS1 Antibodies were used as the bioreceptor to fabricate the electrode with reduced graphene oxide as a conductivity enhancing nanomaterial for the detection of JEV NS1 antigen (Ag).



Significance

- Detection of the NS1 instead of antibody has an added advantage since the antigen is present from day 1 of the infection and hence facilitates early detection.
- Since there is no cure available for JEV, early detection is essential to mitigate a breakout.
- This immunosensor was also specific towards JEV NS1Ag as compared to other flavivirus NS1Ag.

Japanese Encephalitis Virus

- Japanese encephalitis is a disease caused by a flavivirus that affects the membranes around the brain.
- It is the major cause of Acute Encephalitis Syndrome (AES) in India.
- The disease is transmitted to humans through bites from infected mosquitoes of the Culex species.
- Migratory birds along with pigs in the community also play an important role in the transmission of JE from one area to another area.
- A small percentage of infected people develop inflammation of the brain (encephalitis), with symptoms including sudden onset of headache, high fever, disorientation, coma, tremors, and convulsions.
- There is no antiviral treatment for patients with JE. Treatment, available, is supportive to relieve symptoms and stabilize the patient.

HUMAN IMMUNO-DEFICIENCY VIRUS

News: Recently, a US patient has become the third person in the world, and the first woman, to be cured of HIV, the deadly virus that causes AIDS.

Basics:	• Human immune-deficiency virus or HIV is an infection that attacks the immune system by destroying the body's immune cells called CD4, which help it respond to infection. • Once HIV attacks the CD4 cells, it starts replicating and destroying the cells, weakening the body's immune system and making it more prone to certain "opportunistic infections" that take advantage of the weak immune system.
Transmission of HIV	• Bodily fluids such as blood, semen, vaginal fluids, rectal fluids and breastmilk can be carriers for HIV. • It can also be transmitted through unprotected sex, transfusion of contaminated blood, sharing needles and syringes, and from a mother with HIV to her infant during pregnancy.
How was the woman cured of HIV?	• In 2013, a woman from the US was diagnosed with HIV. She began to receive antiretroviral drugs to keep her virus levels low. • Four years later, she was diagnosed with leukaemia. As part of her cancer treatment, she received a transplant of umbilical cord blood from someone who had a natural resistance to HIV. • Since then, she has not required antiretroviral therapy.
Significance:	• This was the first time an umbilical cord blood transplant was successfully carried out on an HIV patient.
Leukaemia:	• Leukemia is cancer of the body's blood-forming tissues, including the bone marrow and the lymphatic system.
Umbilical Cord Blood:	• Cord blood is the blood left in the umbilical cord after birth. • It contains stem cells. • These cells have the amazing ability to grow into many different kinds of cells, like bone marrow cells, blood cells, or brain cells. • This can make them valuable for treating some diseases.

OBSTRUCTIVE SLEEP APNOEA

News: Singer and music composer Bappi Lahiri (69) passed away following complications from Obstructive Sleep Apnoea (OSA).

About

- OSA is a **widely prevalent but under-diagnosed medical condition**.
- OSA occurs when muscles in the throat and upper airway relax intermittently during sleep and block the airway.
- When a person is obese, they develop extra fat on their larynx and pharynx** (muscles in the throat) **that can close off their airway in sleep**.
- The muscles start relaxing in sleep and it is a garden hose like situation** (when there is no water, it flattens out and no air can go through).
- Cycle:**
 - When no air enters the lungs, the oxygen saturation starts falling. When it is critical, the brain wakes the person up.
 - They wake up subconsciously, the breathing restarts.
 - This cycle keeps repeating through the night.
- Impacts:**
 - Although the condition doesn't kill by itself, it can lead to heart attacks and strokes due to the low oxygen level.
 - In the long run, it can also result in increasing blood pressure, abnormal heart rhythms, and other metabolic disorders.
 - It further leads to an increase in obesity, compounding the problem.
 - It may also lead to depression.

- Prevalence:** The prevalence of OSA is 4% among women and 13.4% among men.
- Check-up time:** Snoring and choking are the most common symptoms of OSA.
- Prevention:** Studies have shown that a 10% increase in body weight increases the incidence of OSA six-fold. However, if the patients shed 10% weight, the incidence goes down by 20%. So, the best way to reduce the symptoms of OSA is to lose weight.
- Treatment:** The best method to treat is to use a Continuous Positive Airway Pressure (CPAP) therapy. In addition, some surgeries may be offered if there are structural anomalies in the mouth.

ANEURYSM

News: Actor Emilia Clarke, who appeared in Game of Thrones, has revealed her struggle with a brain aneurysm that caused the loss of "quite a bit" of the organ.

About

- It is a swelling of the arteries and veins in any part of the body** and is caused by weakening of the walls. It occurs most commonly in the aorta, back of the knees, brain or intestines.
- If the aneurysm gets ruptured, it can even cause internal bleeding and stroke.**
- Blood vessels of the brain and the heart are the most common locations to get seriously affected.
- The swelling can be of two types. Either the complete blood vessel is swollen or a specific side of the blood vessel can bulge out from the sides.

Causes:	- Potential risk factors for aneurysm include smoking, age, high cholesterol, obesity, hypertension or tissue disorders. - Pregnancy can also increase risk of aneurysm of the spleen.
Treatment:	- A device called flow diversion stent is a new innovative intervention for treatment of aneurysm for the initial stages, when it has not ruptured. - A cylindrical, metallic mesh stent is placed inside the sac of the parent blood vessel to divert the blood flow from the aneurysm. The diversion is aimed at preventing rupture. - Flow diversion can be used to treat large or giant wide-necked brain aneurysms.
Risk reduction:	- Most cases being congenital, it is not always possible to prevent aneurysm, but certain lifestyle changes can help reduce risk. - These include quitting smoking; maintaining a healthy blood pressure by sticking to a balanced diet; maintaining a healthy body weight; and avoiding a high cholesterol diet.

FIRST-EVER FUNGAL PRIORITY PATHOGENS LIST

News: The World Health Organisation (WHO) has released the first-ever Fungal Priority Pathogens List (FPPL).

About

- The FPPL which includes 19 fungi categorised as critical, high, and medium priority will help identify fungi which pose the greatest threat to public health.

Critical groups	Include <i>Cryptococcus neoformans</i> , <i>Candida auris</i> , <i>Aspergillus fumigatus</i> and <i>Candida albicans</i> .
High groups	Include <i>Nakaseomyces glabrata</i> (<i>Candida glabrata</i>), Histoplasma spp., eumycetoma causative agents, <i>Mucorales</i> , <i>Fusarium</i> spp., <i>Candida tropicalis</i> and <i>Candida parapsilosis</i> .
Medium group	Scedosporium spp., Lomentospora prolificans , Coccidioides spp., <i>Pichia kudriavzevii</i> (<i>Candida krusei</i>), <i>Cryptococcus gattii</i> , <i>Talaromyces marneffeii</i> , <i>Pneumocystis jirovecii</i> and <i>Paracoccidioides</i> spp.

Fungal Pathogens are A Major Threat to Public Health as

- Most fungal pathogens lack rapid, sensitive and affordable diagnostics and only four classes of antifungal medicines (azoles, echinocandins, pyrimidines and polyenes) are currently available.
- The incidence and geographic range of fungal diseases are expanding worldwide due to global warming and the increase of international travel and trade.
- During the COVID-19 pandemic, the reported incidence of invasive fungal infections increased significantly among hospitalized patients.
- Fungi that cause common infections become increasingly resistant to treatment.
- Resistance to antifungal medicines is partly driven by inappropriate antifungal use.

ORAL REHYDRATION SOLUTION (ORS)

News: Recently, Dr. Dilip Mahalanabis died. He was a pioneer in the correct, emergency use of oral rehydration solution, also known as ORS, for diarrheal disorders.

About

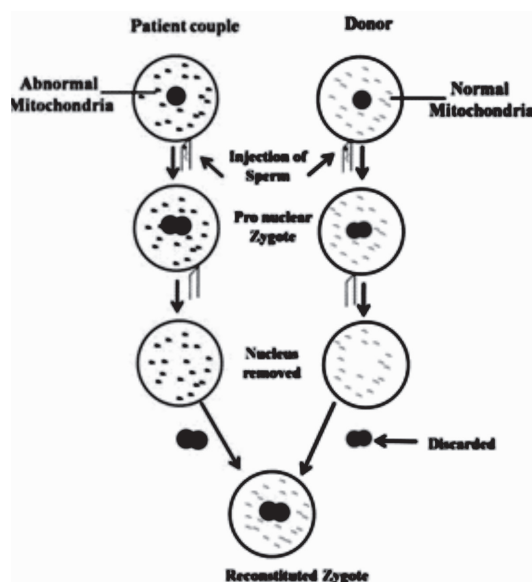
- According to the Lancet, ORS is the most important medical discovery of the twentieth century.
- Oral Rehydration Salts (ORS) are a **water-soluble mixture of electrolytes (salts) and carbohydrates (in the form of sugar)**.
- They are **used to replenish salts and water lost by the body as a result of dehydration** caused by gastroenteritis, diarrhea, or vomiting. Potassium and sodium are electrolytes.
- These components **improve gastrointestinal fluid absorption**.
- Sodium-glucose cotransporters (SGLTs)**, which are **carrier proteins in intestinal cells**, are essential in the gastrointestinal tract. **Cotransporters aid in the movement of substances across membranes**.
- SGLTs, in particular, link sodium and glucose transport in the small intestine. This allows glucose to increase fluid absorption.
- Furthermore, sodium requires glucose to be properly absorbed.** ORS thus contains both glucose and sodium.

ASSISTED REPRODUCTIVE TECHNOLOGY (ART) ACT 2021

News: Parliament recently passed the ART Act 2021.

About ART Act 2021

- The act defines ART to include all techniques that seek to obtain a pregnancy by handling the sperm or the oocyte (immature egg cell) outside the human body and transferring the gamete or the embryo into the reproductive system of a woman.



Important Provisions

- The ART Act proposes the **establishment of a National Registry and Registration Authority for all clinics and medical professionals** serving in the field.
- Child born through ART will be deemed to be a **biological child of the commissioning couple** and will be **entitled to rights and privileges available to a natural child** of the commissioning couple.
- Act introduced **stringent punishment** for those practicing sex selection, sale of human embryos or gametes, running agencies, rackets, and organizations violating the law.

Type of Assisted Reproductive Technology (ART)

- **In Vitro Fertilisation (IVF):** It is the **most common form** of ART that is used by maximum patients. In this, **a woman's eggs are combined with a man's sperm in a laboratory**. The fertilised egg is then placed inside the woman's uterus in a procedure called **embryo transfer**.
- **Gamete Intrafallopian Transfer (GIFT):** The man's sperm and a woman's egg are made to combine in a lab. Then the **eggs are implanted into the fallopian tubes and the fertilisation occurs** inside a woman's body.
- **Mitochondrial Replacement Therapy (MRT):** With a concept of a **three parent baby** is a form of IVF.
- **Intrauterine Insemination (IUI):** Also known as **artificial insemination**, it involves insertion of the male partner's (or a donor's) sperm into a woman's uterus at or just before the time of ovulation by long narrow tube.
- **Gestational Surrogacy:** In this, **the embryo is created via IVF, using the eggs and sperm of the intended parents or donors, and is then transferred to the surrogate**. The child is, thus, **not biologically related** to the surrogate mother, who is often referred to as a **gestational carrier**.

PEN-PLUS STRATEGY

News: Africa has adopted a **new strategy** to boost access to the **diagnosis, treatment and care** of severe **Non-Communicable Diseases (NCD)**.

About

- Pen Plus is a **Regional Strategy** to address **Severe Non-communicable Diseases at First-Level Referral Health Facilities**.
- It is **aimed at bridging the access gap** in the treatment and care of patients with chronic and severe NCDs.
- It **urges countries to put in place standardised programmes** to tackle **chronic and serious non-communicable diseases** by ensuring that essential medicines and diagnostics are available and accessible in district hospitals.

About Non-Communicable Diseases

- Also known as **chronic diseases**, are a **group of conditions** that are **not caused by infectious agents**, and are **not transmitted from person to person**.
- They include a **wide range of diseases** such as cancer, diabetes, heart disease, stroke, chronic respiratory disease and mental health disorders.
- In India, **nearly 5.8 million people (WHO report, 2015)** die from NCDs (heart and lung diseases, stroke, cancer and diabetes) every year before they reach the age of 70.

NEGATIVE ION TECHNOLOGY

News: The Authority for Nuclear Safety and Radiation Protection (ANVS), Netherlands issued a statement identifying various negative ion wearable products containing more Radioactivity than legally permitted.

About

- Negative ion technology is a **marketing term** used to **describe the process of embedding negative ions in personal products** such as **wristbands, pendants, and tape**.
- The claims made about the benefits of these products, such as maintaining health, balancing energy, and improving well-being, are **not scientifically proven**.
- The use of negative ion technology in some personal products may result in the **emission of ionizing radiation** which can be **harmful to human health** if exposure is excessive.



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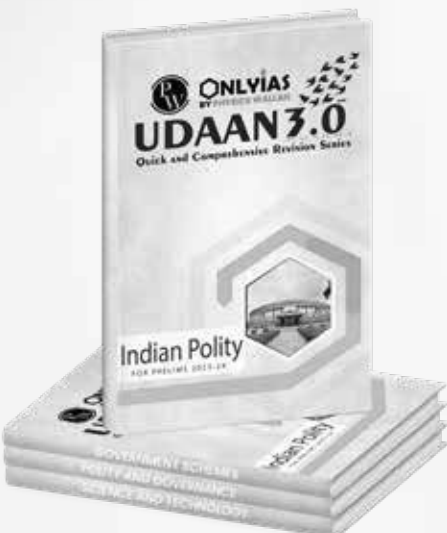
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ATMOSPHERIC PRESSURE OF PLUTO

News: A team of scientists determined that Pluto's atmospheric pressure is 80,000 times lower than the atmospheric pressure at mean sea level on Earth.

About

- It was calculated using data obtained from Pluto's observation of stellar occultation.
- Occultation occurs when a celestial object is obscured from the observer's view due to another celestial object passing between them.

More About Pluto

- Pluto is the **largest known dwarf planet** in the solar system.
- **Located in the Kuiper Belt**, a zone beyond the orbit of Neptune.
- **NASA's New Horizons space probe made a close flyby of Pluto.**
- New Horizons showed that Pluto has a diameter of 1,473 miles (2,370 km), less than one-fifth the diameter of Earth, and only about two-thirds as wide as Earth's moon.

CHEMICALLY PECULIAR STARS

News: Recently, a group of Indian and international scientists have spotted a binary chemically peculiar star (HD73619) in Cancer constellation, that shows heartbeat but no pulsations contrary to the norm of binary stars sporting both heartbeats as well as pulsations.

About

- The name 'heartbeat' was coined from the **similarity of the light curve of the star system**, if their brightness was mapped over time.
- When the stars are at closest passage of binary systems, a sudden increase in integrated brightness with amplitude of the order of several parts-per-thousand is observed.

- As the components move apart, the light variation falls and finally becomes flat, indicating that combined flux is reduced, resulting in alternating peaks and troughs in their light curves.
- **A total of about 180 heartbeat stars are known to date.**
- The pulsation activity of the stars is due to oscillations in the component stars when they are the closest.

Findings by the Scientists

- A team of 33 scientists from Aryabhata Research Institute Of Observational Sciences (ARIES) **carried out photometric and high-resolution spectroscopic observations of HD73619.**
- **It was found that HD73619 is the first member of heartbeat systems in binary chemical peculiar stars** that do not show any positional activity at the closest approach.
- Chemically peculiar stars are the **ones that have an abundance of elements heavier than hydrogen and helium on the surface.**
- The study also revealed an **absence of a weak magnetic field**, which reflects the unknown origins of the system.
- **Importance of the discovery:** It is important for the study of inhomogeneities due to spots in non-magnetic stars. It will help in the investigation of the origins of pulsation variability.

SOLAR FLARE

News: Recently, the sun emitted a large solar flare that was observed by NASA's Solar Dynamics Observatory (SDO).

About

- Solar flares are a **burst of energy caused by the reorganization of magnetic field lines near sunspots.**
- The solar magnetic cycle, which operates in the deep interior of the Sun, produces regions that rise to the surface and appear as dark spots. Sunspots are what they're called.

- Because they are cooler than the rest of the Sun's surface, they appear dark.
- Energy stored in the sun's magnetic structures is converted into light and heat energy during a solar flare. This causes the sun's surface to emit high-energy x-ray radiation and highly accelerated charged particles.
- Coronal Mass Ejection occurs when solar flares cause hot plasma to be ejected from the Sun, resulting in a solar storm (CME).
- Solar flares emit energy, radiation, and high energy particles, which can cause intense lights in the sky known as Auroras.
- Recently, Solar flare causes radio blackout over Indian Ocean.

NISAR (NASA-ISRO-SAR)

News: The NISAR mission is scheduled for launch in 2023.

About

- The Name 'NISAR' is short for NASA-ISRO-SAR.
- NISAR is a joint Earth-observing mission between NASA and the Indian Space Research Organization (ISRO).
- This satellite will be able to detect the earth's surface movement as small as 0.4 inches over an area.
- SAR here refers to the Synthetic Aperture Radar that NASA will use to measure changes in the surface of the Earth.
- It refers to a technique for producing high-resolution images. Because of the precision, the radar can penetrate clouds and darkness, which means that it can collect data day and night in any weather.
- It will scan the globe every 12 days over the course of its three-year mission of imaging the Earth's land, ice sheets and sea ice to give an unprecedented view of the planet.

Role of NASA	Role of ISRO
• The National Aeronautics and Space Administration will provide one of the radars for the satellite, a high-rate communication subsystem for science data, GPS receivers and a payload data subsystem.	• Provide the spacecraft bus, the second type of radar (called the S-band radar), the launch vehicle and associated launch services.

INDIAN SPACE STATION (ISS)

News: Recently, the Union Minister for Space Jitendra Singh announced in Parliament that India's first space station would be set up by 2030.

About

- The Indian space station will be **much smaller (mass of 20 tonnes) than the International Space Station (ISS)** and will be used for **carrying out microgravity experiments (not for space tourism)**.
- Preliminary plan for the space station is to accommodate astronauts for up to 20 days in space, and the **project will be an extension of the Gaganyaan mission**.
- It will orbit Earth at an **altitude of around 400 km**.
- **ISRO is working on a Space Docking Experiment (Spadex)**, a technology that is crucial for making the space station functional.

Other Space Stations

- The only space station currently in orbit is **the International Space Station (ISS)**.
- The ISS is backed by the **United States, Russia, Europe, Japan and Canada**.
- So far, **China has sent two previous space stations into orbit** - the Tiangong-1 and Tiangong-2 were trial stations.

VIKAS (VIKRAM AMBALAL SARABHAI) ROCKET ENGINE

News: Indian Space Research Organisation (ISRO) successfully conducted a 25-second qualification test for its liquid propellant-based Vikas engine to be used under the Gaganyaan mission.

About

- The Vikas (VIKram Ambalal Sarabhai) is a family of **liquid fuelled rocket engines** conceptualized and designed by the Liquid Propulsion Systems Centre in the 1970s.
- The design was based on the **licensed version of the Viking engine with the chemical pressurization system**.
- The primary difference being that the Vikas is rated for a longer burn time.
- The Vikas Engine is the **workhorse liquid rocket engine powering**.
 - The second stage of India's Polar Satellite Launch Vehicle (PSLV),

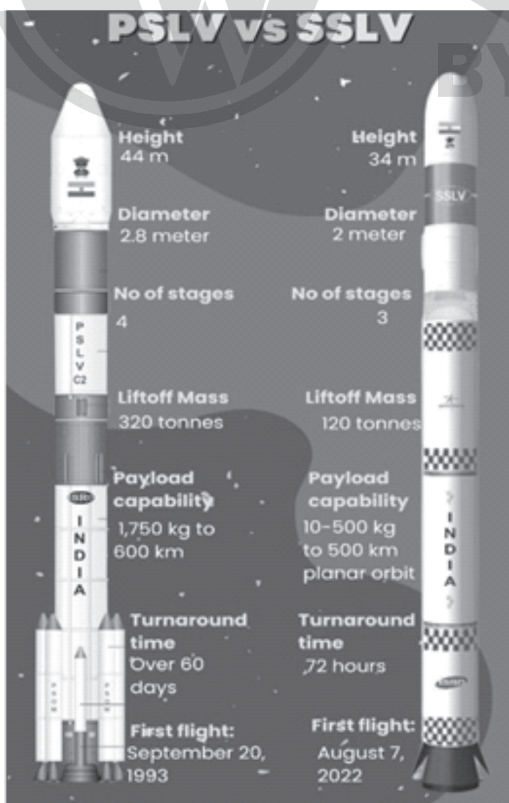
- The second stage and the four strap on stages of Geosynchronous Launch Vehicle (GSLV),
- The twin engine core liquid stage (L110) of GSLV Mk-III.
- The engine uses up about 40 metric tons of Unsymmetrical dimethylhydrazine (UDMH) as fuel and Nitrogen tetroxide (N₂O₄) as oxidizer with a maximum thrust of 725 kN.

SMALL SATELLITE LAUNCH VEHICLE (SSLV)

News: ISRO Chairman has said that the Small Satellite Launch Vehicle (SSLV) named "SLV-D1 Micro SAT" will be launched in April 2022.

About

- SSLV is an **all-solid three-stage vehicle with the capability to launch up to 500 kg satellite mass into 500 km Low Earth Orbit (LEO).**
- The SSLV is **intended to cater to a market for the launch of small satellites into low earth orbits.**
- The SSLV is the **smallest vehicle at 110-ton mass at ISRO.**
- It will **take only 72 hours to integrate.** Only six people will be required to do the job.
- It is best suited for launching multiple microsattellites at a time and supports multiple orbital drop-offs.



About PSLV

- PSLV can **launch satellites weighing in the range of 1000 kg.** But it takes 70 days to integrate this launch vehicle.
- It is the **third generation launch vehicle of India.**
- It is the **first Indian launch vehicle to be equipped with liquid stages.**

Difference between PSLV and GSLV

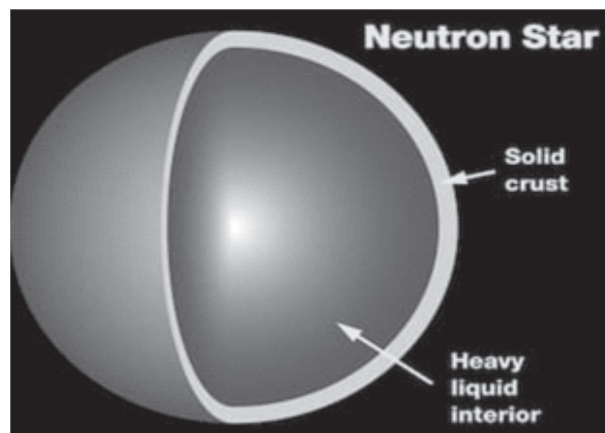
- **India has two operational launchers:**
 1. Polar Satellite Launch Vehicle (PSLV) and
 2. Geosynchronous Satellite Launch Vehicle (GSLV).
- **PSLV was developed to launch low-Earth Orbit satellites into polar and sun synchronous orbits.**
- PSLVs launch the satellites **useful for Earth resources monitoring** whereas GSLVs are designed mainly to launch **communication satellites.**
- **GSLV was developed to launch the heavier INSAT class of geosynchronous satellites into orbit.** In its third and final stage, GSLV uses the indigenously developed cryogenic upper stage.

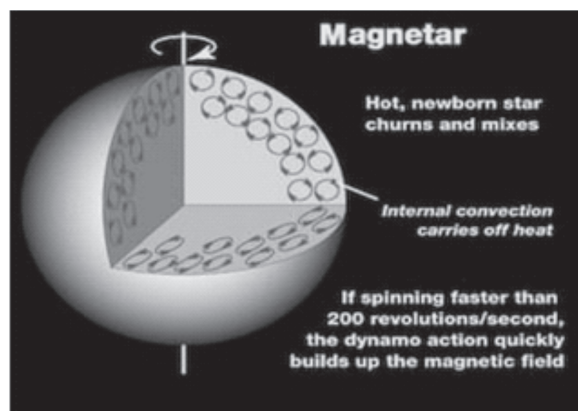
ULTRA-LONG-PERIOD MAGNETAR

News: Recently, Scientists have detected what appears to be an incredibly dense star behaving unlike anything else ever seen - and suspect it might be a type of exotic astrophysical object whose existence has been only hypothesized until now.

About

- The object, spotted using the Murchison Widefield Array telescope in outback Western Australia, unleashed huge bursts of energy roughly three times per hour when viewed from Earth during two months in 2018. **It may be the first known example of what is called an "Ultra-Long Period Magnetar."**





- This is a variety of neutron star - the compact collapsed core of a massive star that exploded as a supernova - that is highly magnetized and rotates relatively slowly, as opposed to fast-spinning neutron star objects called pulsars that appear from Earth to be blinking on and off within milliseconds or seconds.
- It is located relatively close to Earth in cosmic terms, roughly 4,200 light years away. A light year is the distance light travels in a year, 9.5 trillion km.
- Neutron stars including pulsars are among the universe's densest objects. They are roughly 12 km in diameter - akin to the size of a city - but with more mass than our Sun.

OSCAR 1 (ORBITING SATELLITES CARRYING AMATEUR RADIO)

News: It was launched successfully in December, 1961, (60 years ago) and the first non-governmental satellite that was built by private citizens.

About

- It was the first satellite to reach its own orbit after being ejected as a secondary payload of another primary mission.
- It was deployed in low-Earth orbit, just above the atmosphere and its function post deployment was to transmit the letters "HI" in Morse code.
- Ever since the launch of OSCAR I in 1961, it has been traditional for amateur radio satellites to carry the name OSCAR, and 111 satellites have received the OSCAR designations so far.

KALPANA CHAWLA CENTRE FOR RESEARCH IN SPACE SCIENCE AND TECHNOLOGY

News: Raksha Mantri Rajnath Singh inaugurated Kalpana Chawla Centre for Research in Space Science & Technology (KCCRSST) at Chandigarh University on January 03, 2022.

About

- It is established to train students in space science, satellite development and meet future challenges in space research.
- Kalpana Chawla, lost her life in the 2003 Columbia shuttle disaster.
- The centre will also be the ground control station for Chandigarh University's Student Satellite (CUSat) along with a Geo-Spatial Centre for research.

CUSat

- CUSat is a Nano-satellite being designed by the students of the Chandigarh University.
- The satellite will collect data related to border intrusion detection, agriculture, weather forecasting, natural disaster forecasting.
- The satellite will be among the 75 student-built satellites to be launched into space on the eve of the 75th Independence Day in 2022.
- Moreover, with the launch of CUSat, Punjab will become the first border state in India to have its own satellite in space.

ANOMALY DETECTION METHOD

News: Astronomers from the Indian Institute of Astrophysics have developed a new way to identify potentially habitable planets, with a high probability.

About

- They used an Artificial Intelligence (AI)- based algorithm for this, where 60 potentially habitable planets have been found out of 5,000 known planets.
- This method is based on the postulate that Earth is an anomaly with the possibility of the existence of a few other anomalies among thousands of data points. The method is named as Anomaly Detection Method.
- This method explored whether similar 'anomaly' candidates can be found.

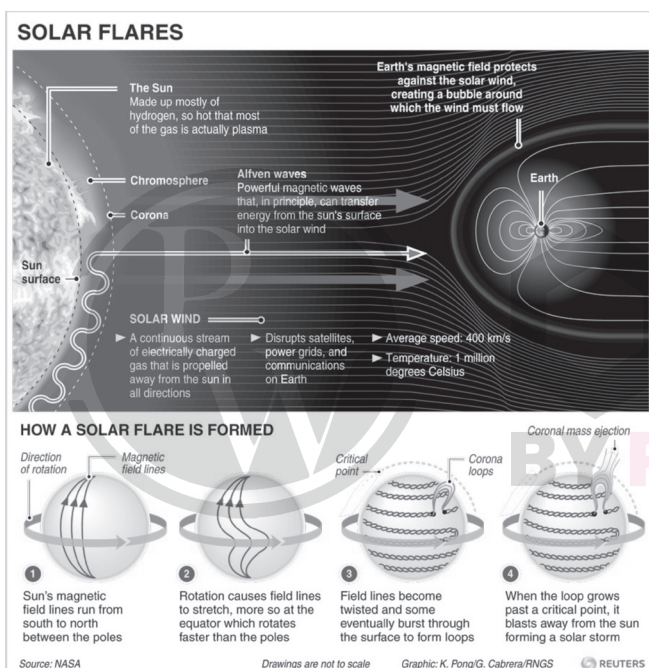
GEOMAGNETIC STORM

News: Recently, Elon Musk's Starlink lost 40 satellites that were caught in a geomagnetic storm a day after they were launched.

About

- These satellites have not created any space debris as the satellites were designed to burn up on re-entry into the Earth's atmosphere.

- **Geomagnetic storms are caused when events such as solar flares can send higher than normal levels of radiation towards Earth.** This radiation interacts with the Earth's magnetic field causing a geomagnetic storm.
- **Causes:** The disturbance that drives the magnetic storm may be a solar Coronal Mass Ejection (CME) or a Co-Rotating Interaction Region (CIR), a high-speed stream of solar wind originating from a coronal hole.
- **Effects of Geomagnetic storms:**
 - Effects from the geomagnetic storm can range from the appearance of auroras or the northern and southern lights to disruptions in communications systems due to high radiation.
 - This would make it difficult to communicate with others on Earth.



- **Classification of Geomagnetic storms:** Geomagnetic storms are classified according to a scale that measures the effect that storms will have.
 - **At its safest level, a G1 storm affects power grids** by causing weak fluctuations, minor impacts on satellite operations, and causes the northern and southern lights to occur.
 - **At its most extreme, G5,** there would be voltage control problems with some grid system collapses or blackouts, radio waves wouldn't be able to travel for one to two days, low-frequency radio would be out for hours, and the auroras would be able to be seen at lower latitudes than usual.

About Starlink

- **SpaceX runs the Starlink satellite constellation,** which covers 48 nations with satellite Internet service.
- After 2023, it also wants to provide international mobile phone service.
- Starlink satellite launches by SpaceX **began in 2019.**

OVERHAUSER MAGNETOMETER

News: Indian scientists have recently developed an Overhauser Magnetometer.

About

- Overhauser (OVH) Magnetometers are **used for performing geomagnetic field measurements.**
- They are known for their higher accuracy, higher sensitivity, and efficient power consumption and hence find applications in all magnetic observatories worldwide as well as in international space programs.

Present Developments

- Indian Institute of Geomagnetism (IG) has developed **India's first indigenous Overhauser (OVH) Magnetometer.**
- It has been **installed at Alibag Magnetic Observatory (MO), Maharashtra.**
- **Significance:** This will help in reducing the cost of sampling and sensing experiments essential for geomagnetic sampling.

PARKER SOLAR PROBE

News: The Wide-field Imager for Parker Solar Probe (WISPR) by the American space agency has managed to take pictures of the surface of Venus revealing stunning continents, plains, plateaus and even a layer of Oxygen.

About

- **For the first time in history, we can see the planet Venus in Color,** because of NASA Parker Solar Probe.
- Recently, the **Parker Solar Probe, became the first spacecraft to fly through the outer atmosphere of the Sun- Corona.**
- The spacecraft flew through Corona and sampled magnetic fields and particles there.
- The achievement would **help scientists discover critical information about the sun and its influence on our solar system.**

About the Mission

- **Launched in 2018, Parker Solar Probe will travel through the sun's atmosphere**, closer to the surface than any spacecraft before it, facing brutal heat and radiation conditions—and ultimately providing humanity with the closest-ever observations of a star.
- **Parker Solar Probe will use Venus' gravity during seven flybys over nearly seven years** to gradually bring its orbit closer to the sun.
- The spacecraft will fly through the sun's atmosphere as close as 3.9 million miles to our star's surface, well within the orbit of Mercury and more than seven times closer than any spacecraft has come before the sun.
- **Objectives of the Parker Solar Probe:**
 - **Trace the flow of energy** that heats and accelerates the solar corona and solar wind.
 - **Determine the structure and dynamics of the plasma and magnetic fields** at the sources of the solar wind.
 - Explore mechanisms that accelerate and transport energetic particles.

Importance of Studying Corona

- **The corona is hotter than the surface of the sun.** The corona gives rise to the solar wind, a continuous flow of charged particles that permeates the solar system.
- **Unpredictable solar winds cause disturbances in our planet's magnetic field** and can play havoc with communications technology on Earth.
- NASA hopes the findings will enable scientists to forecast changes in Earth's space environment.

EOS-04

News: India's Polar Satellite Launch Vehicle PSLV-C52 successfully injected Earth Observation Satellite (EOS)-04, into an intended sun synchronous polar orbit of 529 km altitude.

Earth Observation Satellite (EOS)-04	• EOS-04 is the fourth in the series of earth observation satellites. It is a Radar Imaging Satellite. • Weighing about 1710 kg, it generates 2280 W power and has a mission life of 10 years and will be placed in a sun synchronous polar orbit. • The satellite is designed to provide high-quality images under all weather conditions for applications such as agriculture, forestry and plantations, soil moisture & hydrology, and flood mapping. • The satellite will complement the data from Resourcesat, Cartosat and RISAT-2B series of satellites that are already in orbit.
Earlier EOS Satellites:	• EOS-01: It was launched in 2020. It is in orbit right now. • EOS-02: It is yet to be launched. It is a microsatellite to be flown on a new launch vehicle called SSLV. • EOS-03: It ended in a failure in August 2021. • EOS-05: Earth Observation Satellite in the Geostationary Orbit. • EOS-06: Earth Observation satellite meant for applications, which include ocean-related services and advisories towards potential fishing zone forecast, and ocean state forecast.
Other satellites launched with EOS-04:	• INSPIRESat-1: It is a student satellite developed by the Thiruvananthapuram based Indian Institute of Space Science and Technology in collaboration with the University of Colorado in the United States. This satellite will study the dynamics of the upper atmosphere and carries an X-ray spectrometer for studying solar flares. • INS-2TD: It is a technology demonstrator for the first India-Bhutan joint satellite that is scheduled to be launched in March 2022. • The INS-2TD has a thermal imaging camera meant for earth observation purposes, like the assessment of land and water surface temperature and identification of forest and tree cover.

MUSE AND HELIOSWARM PROJECTS

News: NASA has selected two science missions – the Multi-slit Solar Explorer (MUSE) and HelioSwarm – to help improve our understanding of the dynamics of the Sun, the Sun-Earth connection, and the constantly changing space environment.

MUSE Mission:	- The MUSE Mission will help the scientists in understanding driving forces of Sun's coronal heating. - It will also help in understanding the eruptions in the outermost region which are at the foundation of space. - It will offer deeper insight on the physics of the solar atmosphere by using an instrument called a multi-slit spectrometer, which will observe extreme ultraviolet radiation of the Sun and obtain highest resolution images of the Solar transition region and the corona.
Helio-Swarm mission:	- This mission is a constellation or "swarm" of nine spacecraft. - It will be launched to capture first multiscale in-space measurements of fluctuations in magnetic field as well as motions of solar wind, called as solar wind turbulence. - The outermost atmospheric layer of the Sun, called the heliosphere, encloses an enormous region of the solar system. - Solar Winds spread through the heliosphere. Their interactions with planetary magnetospheres and disruptions like coronal mass ejections affect the turbulence. - This mission will provide a unique ability to investigate turbulence.

FAST RADIO BURSTS

News: Recently, Astronomers of the National Center of Radio Astrophysics (NCRA-TIFR) in Pune and the University of California in the US have used the Giant Metrewave Radio Telescope (GMRT) to map the distribution of atomic hydrogen gas from the host galaxy of a Fast Radio Burst (FRB) for the first time.

About

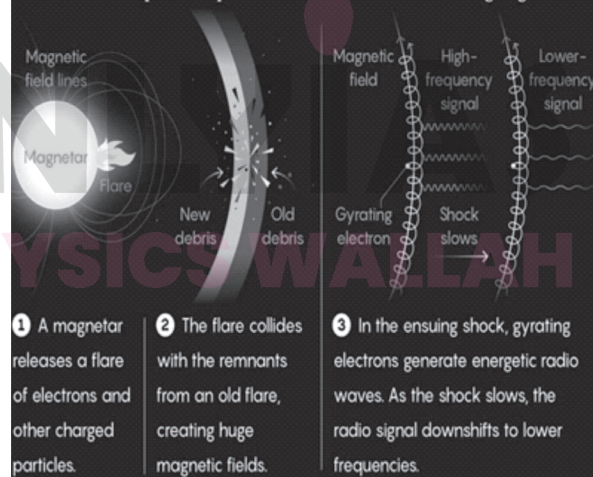
- FRBs are bright bursts of radio waves** whose durations lie in the millisecond scale, because of which it is difficult to detect them and determine their position in the sky.
- The first FRB was discovered in 2007**, since then scientists have been working towards finding the source of their origin.

What Did The Astronomers Find Out?

- Astronomers found that the FRB host galaxy has undergone a recent 'merger', and the FRB 'progenitor' is most likely a massive star formed due to this merger event.
- This is the first case of direct evidence for a recent merger in an FRB host**, a major step towards understanding the origins of the FRBs.
- The first surprise during this observation was the amount of atomic hydrogen in the FRB galaxy, which was around 10 times more than that found in similar nearby galaxies.

How Fast Radio Bursts Work

Fast radio bursts are brief, energetic blips of radio waves that originate far across the universe. At least one repeats, which has added to the challenge of explaining what might be creating them. A new model accounts for past observations and predicts specific features that should be seen going forward.



About Giant Metrewave Radio Telescope (GMRT)

- GMRT is an array of **thirty fully steerable parabolic radio telescopes of 45-meter diameter**, observing at a meter wavelength.
- It is a very versatile instrument for investigating a variety of radio astrophysical problems ranging from the nearby Solar system to the edge of the observable Universe.
- It is operated by the National Center for Radio Astrophysics (NCRA), a part of the Tata Institute of Fundamental Research, Mumbai.

SARAS-3 RADIO TELESCOPE

News: SARAS-3 radio telescope refutes the recent claim of the discovery of a radio wave signal from cosmic dawn.

About

- It was invented and built by the astronomers at **Raman Research Institute (RRI)**.
- **SARAS is a precision radio telescope that is used to detect extremely faint radio wave signals** from the depths of time, from our “Cosmic Dawn” when the first stars and galaxies formed in the early Universe.
- **Cosmic dawn: Cosmic dawn is the time in the infancy of our Universe** when the first stars and galaxies came into existence.
- **The signal from Cosmic Dawn is expected to arrive on Earth stretched in wavelength to metres and lowered in frequency by the expansion of the Universe** to lie in the radio frequency band 50-200 MHz.
- In 2018 a team of researchers from Arizona State University (ASU) and MIT in the US detected a signal from stars emerging in the early universe using data from the EDGES radio telescope.
- **The ASU/MIT team had claimed the discovery of a radio wave signalling the birth of the First Stars**, which was also hailed by Harvard astrophysicist Avi Loeb as worthy of two Nobel prizes.

EXOMARS

News: The European Space Agency's ExoMars 2022 mission has been delayed after the agency suspended all cooperation with Russia's space program Roscosmos.

About

- It was a **joint endeavour between ESA and the Russian space agency, Roscosmos**.
- **Aim:** To check if there has ever been life on Mars and also understand the history of water on the planet.
- **Stages:** It is a two-stage mission-
 1. **First Stage:** Its first mission launched atop a Proton-M rocket in 2016 and consisted of the European Trace Gas Orbiter and test lander called Schiaparelli. The orbiter was successful, while the test lander failed during its descent to Mars.
 2. **Second Stage:** It comprises a rover and surface platform.

PERSEVERANCE ROVER

News: NASA's Perseverance Rover has captured a solar eclipse on Mars.

About

- **Launched by NASA on 30th July 2020 and Land on 18th February 2021.**
- It is the **centrepiece of NASA's Mars 2020 mission** which also included the small robotic and coaxial helicopter **Ingenuity**.
- **Objectives:**
 - Perseverance's primary objective is looking for signs of ancient microbial life.
 - The rover is studying and analyzing the Red Planet's regolith, rock and dust, and is the first rover to collect and cache samples.
- It is the **most advanced, most expensive and most sophisticated mobile laboratory** sent to Mars.
- It is different from previous missions because it is **capable of drilling and collecting core samples of the most promising rocks and soils and setting them aside in a “cache” on the surface of Mars**.
- **Power Source:** A Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) which converts heat from the natural radioactive decay of plutonium (Plutonium Dioxide) into electricity.

Other Mars Missions

- **ExoMars rover (2021):** European Space Agency and Russian Space Agency
- **Tianwen-1:** China's Mars Mission (2021)
- **UAE's Hope Mars Mission** (UAE's first-ever interplanetary mission) (2021)
- **India's Mars Orbiter Mission (MOM)** or Mangalyaan (2013).

PROJECT NETRA

News: The ISRO is building up its orbital debris tracking capability by deploying new radars and optical telescopes under the Network for Space Objects Tracking and Analysis (NETRA) project.

About

- Project NETRA is an **early warning system in space to detect debris and other hazards to Indian satellites in low-earth orbits**.

Initiative of ISRO	• NETRA stands for Network for Space Object Tracking and Analysis. • Facilities under this Project: Under NETRA, ISRO plans to put up many observational facilities such as: ○ Space debris tracking radar: It will be capable of detecting and tracking objects 10 cm and above in size. It will have a range of 1,500 km. ○ Optical telescopes: These will be inducted as part of establishing an effective surveillance and tracking network. ○ Data processing units. ○ Space Situational Awareness Control Centre.
Space Debris:	• Space Debris consists of rocket bodies that are used to launch satellites, defunct satellites, materials released during mission operations, fragments from on-orbit breakups of space objects, and fragments from Anti-Satellite (ASAT) tests. • These space objects move with an average speed of 27,000 km per hour in Low Earth Orbits, therefore, a collision with even a centimeter sized tiny fragment can be catastrophic to an operational space asset. • According to ISRO, the volume of space debris is likely to go up in the coming years with the increase in space missions globally. • Globally, 2021 saw the highest space object-to-launch ratio. In other words, more space objects are placed in orbit per launch.

WRIGHT MONS

News: NASA's New Horizons probe has reported new findings of Pluto.

About

- The **only spacecraft to visit Pluto is NASA's New Horizons**, which passed close by in July 2015.
- **Wright Mons is a mountainous feature found on Pluto.** It was informally named by the New Horizons team in honour of the Wright brothers.
- **Scientists claim that Wright Mons is a volcano** and cite the lack of impact craters as evidence that it is not likely to be older than 1-2 billion years.
- Hummocks were likely created by some sort of ice volcanism, known by the technical term "cryovolcanism" – **erupting icy water rather than molten rock.**

UVIT J2022

News: Indian astronomers have discovered a Faint Galaxy named UVIT J2022 that remained hidden until now.

About

- It is a **faint galaxy**. It was discovered while studying a known galaxy, NGC6902A.
- Faint Galaxies are **called low surface brightness galaxies or ultra-diffuse galaxies** and have a surface

brightness that is at least ten times fainter than the surrounding night sky.

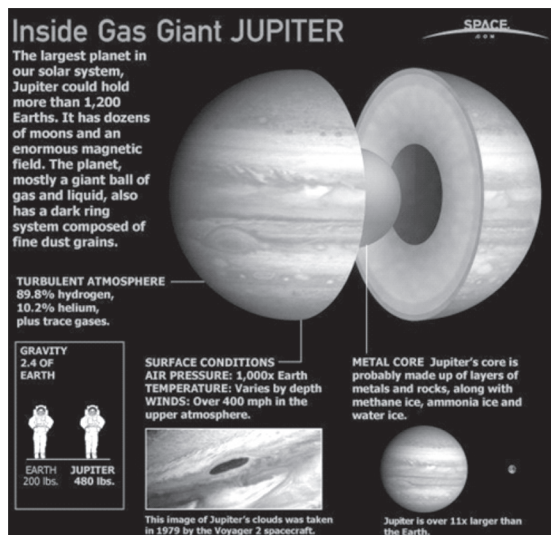
- Such faint galaxies **may account for up to 15 % of the mass of the universe**. However, they are **difficult to detect because of their inherent low luminosities**.

JUPITER LIKE PROTOPLANET

News: Recently, the Hubble Space Telescope has photographed a Jupiter-like protoplanet forming through a process that researchers have described as intense and violent.

About

- The **newly forming planet captured by the Hubble Space Telescope is called AB Aurigae b.**
- It is **embedded in a protoplanetary disk with distinct spiral structures** swirling around and surrounding a young star that is estimated to be about 2 million years old.
- That is also **about the same age our solar system** was when planet formation was underway.
- **This protoplanet is probably around nine times the size of Jupiter and orbits its host star** at a distance of 8.6 billion miles, over two times the distance between our Sun and Pluto.
- **Significance of this discovery:** According to NASA, this discovery supports a long-debated theory called "disk instability," which tries to explain how planets similar to Jupiter are formed.



- **Note:** The Hubble Space Telescope is a project of international cooperation between NASA and ESA (European Space Agency).

About Protoplanets

- Protoplanets are **small celestial objects that are the size of a moon or a bit bigger**. They are small planets, like an even smaller version of a dwarf planet.
- Astronomers believe that these objects form during the creation of a solar system.

Disk Instability Theory

- According to this theory, matter slowly moves inwards in this disc as dust particles grow into centimeter-sized pebbles.
- This is seen as the first step towards the formation of kilometer-sized planetesimals that eventually come together to form planets.

About Jupiter

- Jupiter is **the fifth planet from the Sun and the largest in the Solar System**.
- It is a gas giant with a mass more than two and a half times that of all the other planets in the Solar System combined.

SOLID FUEL DUCTED RAMJET

News: India successfully flight-tested Solid Fuel Ducted Ramjet (SFDR) Booster, a missile system, at the Integrated Test Range (ITR) in Chandipur off the Odisha coast.

About SFDR:

- SFDR is a **missile propulsion system** being developed by the DRDO.
- **Aim:** To develop critical technologies required in the propulsion systems of future long-range air-to-air missiles.
- **Technology:** The system is based on a solid fueled air-breathing ramjet engine. Unlike the other solid-propellant rockets, the Ramjet takes up oxygen from the atmosphere during flight without the need for cylinders.
- Due to this, it is light in weight and can carry more fuel, making it more efficient.

Significance:

- It **enables the missile to intercept aerial threats at very long range** at supersonic speeds.
- Air-to-air missiles which use SFDR technology can achieve longer ranges as they do not require oxidizers (take oxygen from the atmosphere).
- The missile based on SFDR fly at supersonic speeds and high manoeuvrability ensures the target aircraft cannot get away.

BLUE STRAGGLER STARS

News: Blue stragglers, is a particular type of star seen in clusters and also, sometimes, alone. Indian Institute of Astrophysics, Bengaluru conducted a study on their aberrant behavior.

About

- For this, the researchers also made use of the observations by the UVIT instrument (Ultraviolet

Imaging Telescope) of ASTROSAT, India's first science observatory in space.

- A **blue straggler is a main-sequence star in an open or globular cluster** that is more luminous and bluer than stars at the main sequence turnoff point for the cluster.
- **Blue stragglers were first discovered by Allan Sandage in 1953** while performing photometry of the stars in the globular cluster M3.
- The puzzle of why a blue straggler is more massive, and energetic, than expected may be resolved in several ways.

- One, that these do not belong to the family of stars in the cluster; and hence are not expected to have the group properties.
- But if they actually belong, the evasive behavior is due to these stars gaining mass from a binary companion.
- Second, the straggler draws matter from the giant companion and grows more massive, hot and blue, and the red giant ends up as a normal or smaller white dwarf.
- The third possibility is that the straggler draws matter from a companion star, but that there is a third star that facilitates this process.
- The IAP researchers have shown evidence that supports the second of the hypotheses listed above.

EUROPA

News: Researchers have said that there might be an abundance of water pockets beneath formations called double ridges on Jupiter's moons Europa.

About

- Europa is **slightly smaller than Earth's moon and its diameter is about one-quarter that of the Earth.**
- Europa has a **very thin oxygen atmosphere.**
- Interestingly, while its diameter is less than the Earth's, **Europa probably contains twice the amount of the water in all of the Earth's oceans.**
- **NASA is expected to launch its Europa Clipper in 2024.** The module will orbit Jupiter and conduct multiple close flybys to Europa to gather data on the moon's atmosphere, surface and its interior.

EPISODIC ACCRETING YOUNG STARS

News: Indian astronomers from the Aryabhata Research Institute of Observational Sciences (ARIES) have discovered Gaia 20eae belonging to the extremely rare group of young stars that exhibit episodic accretion.

About

- **Episodically accreting young stars are young, low-mass stars that have not initiated hydrogen fusion in their core.**
- They are fueled by gravitational contraction and deuterium fusion (pre-main-sequence phase of the star).
- **These pre-main-sequence stars are surrounded by a disc from which it steadily feeds** on the matter from the disc-shaped region of gas and dust surrounding the star to gain mass.
- This process is known as mass accretion from the circumstellar disc of the star.
- **On occasions their feeding rate increases.** This is known as the periods of enhanced mass accretion from their circumstellar disc.
- During such episodes, the brightness of the star increases by 4-6 magnitudes in the optical bands.
- **So far 25 such rare groups of stars have been discovered.**

Episodic Accretion:

- Episodic accretion is a **process where stars accrete (grow by accumulation) via a disk from a more spherically distributed envelope which adds mass to the disk and makes it unstable on an irregular basis.**
- Such instability dumps extra material onto the star and the accretion rate and luminosity increase.

BERNARDINELLI-BERNSTEIN COMET

News: Recently, NASA's Hubble Space Telescope has confirmed that the huge Bernardinelli-Bernstein comet is indeed the largest icy comet nucleus ever seen by astronomers.

About

- The nucleus is around 50 times larger than that of most known comets, and its mass is estimated to be around 500 trillion tonnes.

Bernardinelli-Bernstein Comet

- The comet was discovered by astronomers **Pedro Bernardinelli and Gary Bernstein** in archival images from the **Dark Energy Survey at an astronomical observatory in Chile.**
- It was discovered in **November 2010** and has been intensively studied since.
- The comet has been travelling towards the sun for **over a million years** and it is believed to have originated in the Oort Cloud.
- **Oort Cloud is a distant region of the solar system that is predicted to be the source of most comets.**

- The Oort Cloud is still only a theoretical concept as the comets that constitute it are too faint and distant to be directly observed.
- It was **first hypothesized by Dutch astronomer Jan Oort in 1950.**

About Comet:	• Comets are large objects made of dust and ice that orbit the Sun. • The word comet comes from the Latin word 'Cometa' which means 'long-haired'. • Comets or 'dirty snowballs' are mostly made of dust, rocks and ice and can range in their width from a few miles to tens of miles wide. • When they orbit closer to the sun, they heat up and release debris of dust and gases.	
Where do Comets Come From?		• According to NASA, while there are millions of comets orbiting the sun, there are more than 3,650 known comets as of now.
	Predictable Comets:	• The predictable comets are the short-period comets which take less than 200 years to orbit around the sun. ○ These can be found in the Kuiper belt, where many comets orbit the sun in the realm of Pluto. ○ One of the most famous short-period comets is called Halley's Comet that reappears every 76 years. Halley's will be sighted next in 2062.
	Less Predictable Comets:	• The less-predictable comets can be found in the Oort cloud that is about 100,000 AU (Astronomical Unit which is the distance between the Earth and the Sun and is roughly 150 million km) from the sun or 100,000 times the distance between the Earth and the sun. • Comets in this cloud can take as long as 30 million years to complete one rotation around the sun.

GAGAN

News: An IndiGo-operated ATR 72-600 aircraft landed at Kishangarh airport using an approach process guided by GAGAN or GPS-aided GEO Augmented Navigation.

About

- It is a **Satellite-Based Augmentation System (SBAS)** developed to provide the best possible navigational services over **Indian FIR (Flight Information Region)** with the capability of expanding to neighbouring FIRs.
- **Developed by:** The Airport Authority of India (AAI) and Indian Space Research Organization (ISRO).
- **Note:** While GAGAN is primarily meant for aviation, it can provide benefits to several other segments such as intelligent transportation, maritime, highways, railways, security agencies, and telecom among others.
- **Working of GAGAN:** GAGAN uses a system of ground stations – in Delhi, Guwahati, Kolkata, Ahmedabad, Thiruvananthapuram, Bengaluru, Jammu and Port Blair – to provide necessary augmentation to the GPS navigation signal.

- **A network of precisely surveyed ground reference stations is strategically positioned across the country to collect GPS satellite data.**
- Using this information, the master control center in Bengaluru generates messages to correct any signal errors.
- These correction messages are then uplinked and broadcast through geostationary communication satellites to receivers' onboard aircraft using the same frequency as GPS.
- **Coverage Area:** GAGAN covers the area from Africa to Australia and has the capability to cater to 45 reference stations for expansion to neighboring countries.
- **The system is also interoperable with other international SBAS systems** such as the U.S. Wide Area Augmentation System (WAAS), the European Geostationary Navigation Overlay Service (EGNOS) and the Japanese MTSAT Satellite Augmentation System (MSAS).

AXIOM-1 MISSION

News: The first-ever private mission to the International Space Station (ISS) named Axiom-1 has reached the ISS.

About

- It is the **first all-private astronaut mission to the International Space Station.**
- **Organized by:** US Based company Axiom Space.
- **Launched from:** The mission was launched from NASA's Kennedy Space Center in Florida and is flying on the SpaceX Crew Dragon Endeavour.
- **Purpose:** Under the mission, the astronauts will spend more than a week conducting scientific research, outreach and commercial activities on the space station.

Axiom Space

- Axiom Space is a **company that is focusing on making space travel more commercially available.**
- Besides this, it also aims to improve the understanding of space and the human body by bringing researchers into space.

HAYABUSA-2 PROBE

News: The Hayabusa-2 probe has brought 5.4 grams of rocks and dust from the asteroid Ryugu.

About

- The Hayabusa-2 mission was **launched in December 2014.**
- It is a **six-year voyage** to study the asteroid Ryugu.
- In 2018 the spacecraft reached the asteroid and deployed two rovers and a small lander onto the surface.
- In 2019, the spacecraft fired an impactor to create an artificial crater to collect the samples.
- A small capsule containing the rock and dust samples landed safely in the South Australian outback in 2020.

Findings of the Study

- In an article published in the journal Nature Astronomy on August 15, scientists from Japan suggest that water and organic materials might have been brought to our planet from the outer edges of the solar system.

About Asteroid

- Asteroids are **rocky objects that orbit the Sun, much smaller than planets.** They are also called **minor planets.**
- It is divided into 3 classes:
 1. **Asteroid:** between Mars and Jupiter.
 2. **Trojans:** which are asteroids that share an orbit with a larger planet.
 3. **Near-Earth Asteroids (NEA):** the orbits of the asteroids pass close to the Earth.

- More than 10,000 such asteroids are known, out of which over 1,400 are classified as potentially hazardous asteroids (PHAs).

SOFIA TELESCOPE

News: The United States National Aeronautics and Space Administration (NASA) has decided to shut down the SOFIA Telescope that confirmed the presence of water on the Moon.

About

- It is a 2.7-meter infrared telescope sitting inside a Boeing 747SP airplane flying at an altitude of 38,000-45,000 feet above the surface.
- SOFIA stands for **Stratospheric Observatory for Infrared Astronomy.**
- **Collaboration between:** NASA and the German Space Agency (DLR).
- **Purpose:** To observe cosmic objects in far-infrared wavelengths. This allows researchers to watch star formation by looking through huge, cold clouds of gas.
- **Significance:** It is the world's largest flying telescope. It is also the second-most expensive astrophysics mission.

Important Discoveries Made by SOFIA Telescope

- **Water on the Moon:** In 2020, NASA announced that SOFIA discovered water molecules (H₂O) on the sun-facing side of the Moon. The site is the Clavius Crater located in the Moon's Southern Hemisphere.
- **Helium Hydride in the Universe:** In 2019, SOFIA discovered helium hydride—the first molecule formed in the Universe almost 14 billion years ago.
- SOFIA also **identified atmospheric circulation patterns in Jupiter.**

JAMES WEBB SPACE TELESCOPE

News: NASA has unveiled images from the James Webb Space Telescope, the largest and most powerful orbital observatory ever launched.

About

- NASA released a deep field photo of a distant galaxy cluster, SMACS 0723, revealing the most detailed glimpse of the early universe recorded to date.
- The collection also included fresh images of another galaxy cluster known as Stephan's Quintet, first discovered in 1877.

James Webb Space Telescope:	- JWST is a joint NASA-ESA-CSA space telescope that is planned to succeed the Hubble Space Telescope as NASA's flagship astrophysics mission - It is the most powerful space telescope ever built. - It will enable a broad range of investigations across the fields of astronomy and cosmology, including observing some of the most distant events and objects in the universe, - It would help understand events such as the formation of the first galaxies, and detailed atmospheric characterization of potentially habitable exoplanets.
Significance:	- Some have called JSWT the "telescope that ate astronomy." - It is said to look back in time to the Dark Ages of the universe.
'Dark Ages' of the universe:	- Evidence shows that the universe started with an event called the Big Bang 13.8 billion years ago, which left it in an ultra-hot, ultra-dense state. - The universe immediately began expanding and cooling after the Big Bang. One second after the Big Bang, the universe was a hundred trillion miles across with an average temperature of an incredible 18 billion F (10 billion C). - Around 400,000 years after the Big Bang, the universe was 10 million light-years across and the temperature had cooled to 5,500 F (3,000 C). Throughout this time, space was filled with a smooth soup of high-energy particles, radiation, hydrogen and helium. There was no structure. As the expanding universe became bigger and colder, the soup thinned out and everything faded to black. - This was the start of what astronomers call the Dark Ages of the universe.

MARSQUAKE

News: NASA has reported that its InSight Mars lander detected the largest quake ever observed on another planet.

- However, Mars doesn't have tectonic plates, and its crust is a giant plate.
- Therefore, 'marsquakes' are **caused due to stresses that cause rock fractures or faults in its crust**.
- The recent Marsquake has been the largest ever recorded tremor on a planet other than earth, hence earning it the name of 'Monster Quake'.

About

- On Earth, quakes are caused by shifts in tectonic plates.

InSight Mission:	InSight is part of NASA's Discovery Program. - It will be the first mission to peer deep beneath the Martian surface, studying the planet's interior by measuring its heat output and listening for marsquakes, which are seismic events similar to earthquakes on Earth. It will use the seismic waves generated by marsquakes to develop a map of the planet's deep interior.
Significance of the mission:	- The findings of Mars' formation will help better understand how other rocky planets, including Earth, were and are created. - InSight would delve deep beneath the surface of Mars, detecting the fingerprints of the processes of terrestrial planet formation, as well as measuring the planet's "vital signs": Its "pulse" (seismology), "temperature" (heat flow probe), and "reflexes" (precision tracking).

SAGITTARIUS A*(SGRA*)

News: Scientists from the Event Horizon Telescope (EHT) facility revealed the first image of the black hole named Sagittarius A* at the centre of our galaxy - the Milky Way.

About

- Sagittarius A* is a supermassive black hole** at the center of our galaxy i.e., the Milky Way.
- It is located near the border of the constellations Sagittarius and Scorpius.

- **SgrA*** possesses 4 million times the mass of our sun and is located about 26,000 light-years and 5.9 trillion miles (9.5 trillion km)—from Earth.
- The diameter of Sagittarius A* is about 17 times that of the sun, meaning it would sit within the innermost planet Mercury's solar orbit.
- In 2019, the Event Horizon Telescope released the first-ever image of a black hole M87* – the black hole at the centre of another galaxy Messier 87 which is a supergiant elliptical galaxy.

Black Hole

- A black hole is a **place in space where gravitational force is so high that even light cannot get out**.
- The gravity is so strong because the matter has been squeezed into a tiny space. This can happen when a star is dying.
- **Because no light can get out, one can't see black holes. They are invisible.** High configuration space telescopes can help find black holes.
- **Black holes in the modern sense were first predicted as a consequence of Albert Einstein's general Theory of relativity in 1915.**
- **Types of Black Hole:** Black holes are mainly of two types,
 1. Stellar-mass black hole,
 2. Supermassive black hole.
- **Inside of Black Hole:** At the core of a black hole, all the black hole's mass is concentrated into a tiny point of infinite density. This point is known as a singularity.

Event Horizon

- There is a **region of space beyond the black hole called the event horizon**.
- This is a **"point of no return"**, beyond which it is impossible to escape the gravitational effects of the black hole.
- **Event Horizon Telescope Project:** EHT is a group of 8 radio telescopes (used to detect radio waves from space) located in different parts of the world.

HS200 SOLID ROCKET BOOSTER

News: Recently, ISRO successfully tested the HS200 solid rocket booster for the Gaganyaan programme.

About

- It is a 20-metre-long booster with a diameter of 3.2 metres and is the **world's second largest operational booster using solid propellants**.
- The control system used in the HS200 booster

employs **one of the world's most powerful electro-mechanical actuators with multiple redundancies and safety features**.

- **Designed and developed by:** Vikram Sarabhai Space Centre (VSSC) in Thiruvananthapuram over two years.



Applications

- The **GSLV Mk-III rocket** which will be used for the **Gaganyaan mission** will have two HS200 boosters which will supply the thrust for lift-off.
- Since **Gaganyaan is a crewed mission**, the **GSLV Mk-III will have improvements to increase reliability and safety to meet the requirements of 'human rating'**.
- **Significance:** The successful completion of this test marks a major milestone for the prestigious human space flight mission of ISRO, the Gaganyaan.

Gaganyaan Mission

- **Aim:** Gaganyaan is an Indian crewed orbital spacecraft that is intended to send 3 astronauts to space for a minimum of seven days by 2022 (delayed due to COVID-19).
- **Launched by:** ISRO's Geosynchronous Satellite Launch Vehicle GSLV Mk III (3 stages heavy-lift vehicle)
- **Components:** Consists of a service module and a crew module, collectively known as an Orbital Module (Crew Module carries astronauts & Service Modules carries propellants.)
- It will circle Earth at a low-earth-orbit at an altitude of 300-400 km from the earth for 5-7 days.
- **Vyom Mitra:** ISRO to send **humanoid Vyommitra in unmanned Gaganyaan spacecraft** ahead of human spaceflight (Monitoring module parameters).

AMALTHEA

News: According to recent findings, Amalthea appears to radiate out more heat than it receives from the sun, which NASA suggests may be due to Jupiter's magnetic field or from tidal stresses.

About

- The **moon Amalthea is one of Jupiter's 53 named satellites**; it was the first to be discovered after the four Galilean moons, and it is the fifth-largest overall.
- In terms of proximity to Jupiter, **Amalthea is the planet's third moon** — it takes just 12 hours to make a full orbit.
- **Amalthea also contributes to one of the Gossamer Rings of Jupiter** — the Amalthea Gossamer Ring — which is the faint innermost Gossamer ring of the planet. The Gossamer Rings are outside the main Jovian ring.
- **Only two missions have visited Amalthea:** Voyager and Galileo.
- Both the Voyager 1 and Voyager 2 spacecraft photographed the Jovian moon during their flybys in 1979.

CHANDRAYAAN 3 (C3)

News: The Chandrayaan-3 mission is expected to be launched in August 2023 by ISRO.

About

- Chandrayaan 3 spacecraft is the **3rd lunar exploration expedition, outlined by the Indian Space Research Organisation (ISRO)**.
- It will only consist of a rover and lander and will communicate to the earth via an orbiter from Chandrayaan 2.
- **India aims to examine the Moon's surface**, especially areas that have not been receiving sunlight in some billion years.
- Scientists and astronomers are **suspecting the presence of ice and abundant mineral stocks in these darker parts of the lunar surface**.
- In addition, **this exploration will not limit to the surface but aim to study the sub-surface and exosphere**.
- The rover will study the surface by taking images at a distance of 100km from the lunar orbit.
- The lander of ISRO's Chandrayaan-3 will be powered by 4 throttle-able engines.
- In addition, it will be endowed with a **Laser Doppler Velocimeter (LDV)**.

VENUS

News: After sending missions to the Moon and Mars, the ISRO is now readying a spacecraft to orbit Venus to study what lies below the surface of the solar system's hottest planet, and also unravel the mysteries under the Sulfuric Acid clouds enveloping it.

About

- It is **named after the Roman goddess of love and beauty**.
 - It is the **second planet from the Sun** and **sixth in the solar system in size and mass**.
 - **It is the hottest planet in the solar system** because of the high concentration of carbon dioxide which works to produce an intense greenhouse effect.
- **It is the second brightest natural object in the night sky after the Moon**, probably that is the reason why it was the first planet to have its motions plotted across the sky, as early as the second millennium BC.
- Unlike the other planets in our solar system, **Venus and Uranus spin clockwise on their axis**.
- **A day on Venus is longer than a year**. It takes Venus longer to rotate once on its axis than to complete one orbit of the Sun.
- **That's 243 Earth days to rotate once** - the longest rotation of any planet in the Solar System - and only 224.7 Earth days to complete one orbit of the Sun.

Missions to Venus

- **USA:** Mariner series 1962-1974, Pioneer Venus 1 and Pioneer Venus 2 in 1978, Magellan in 1989.
- **NASA's two new missions to Venus:** The Davinci+ (Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging) mission; Veritas (Venus Emissivity, Radio Science, InSAR, Topography, and Spectroscopy).
- **Russia:** Venera series of space craft's 1967-1983, Vegas 1 and 2 in 1985.
- **Japan:** Akatsuki in 2015.
- **Europe:** Venus Express in 2005.
- **Indian Initiative:** India plans to launch a new orbiter named **Shukrayaan** to Venus in 2024.

INTERNATIONAL LIQUID MIRROR TELESCOPE

News: India's first liquid-mirror telescope- International Liquid Mirror Telescope (ILMT) has now entered the commissioning phase and will start scientific observations in October this year.

About

- It is located at an altitude of 2,450 metres on the **Devasthal Observatory campus of the Aryabhata Research Institute of Observational Sciences (ARIES) in Nainital district**, an autonomous institute under the Department of Science and Technology.
- **Built by:** Astronomers from India, Belgium and Canada.
- **Features:**
 - The telescope will help in surveying the sky, making it possible to observe several galaxies and other astronomical sources just by staring at the strip of sky that passes overhead.
 - For this, the telescope employs a 4-meter-diameter rotating mirror made up of a thin film of liquid mercury to collect and focus light.
- **Duration:** The ILMT will operate every night for five years and carry out daily imaging except between June and August monsoon months, as a precaution to protect the instruments from humid conditions.
- **Significance:** It is the first liquid mirror telescope in the country and the largest in Asia.
- **Remember:** ILMT will be the third telescope to be operating from Devasthal after the 3.6-metre Devasthal Optical Telescope (DOT) — the largest in India commissioned in 2016 — and the 1.3-metre Devasthal Fast Optical Telescope (DFOT) inaugurated in 2010.

TIANGONG SPACE STATION

News: Three Chinese astronauts docked at the country's space station on Sunday.

About

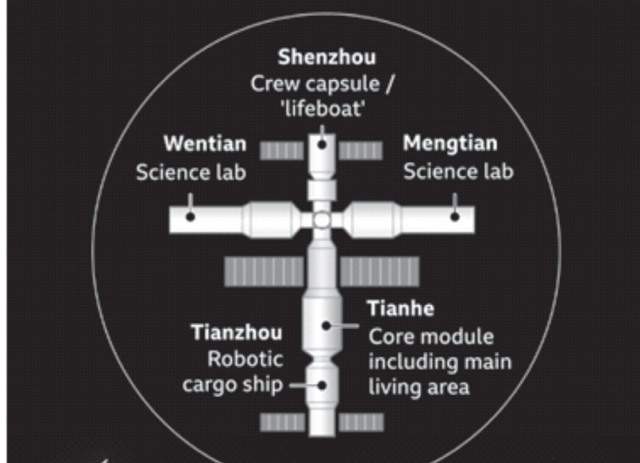
- Tiangong means “**Heavenly Palace**”.
- It was 10.4 metres long and 3.35 metres wide at its widest point, and weighed 8.6 metric tonnes.
- The space station **will operate in low-Earth orbit** at an altitude of 340-450 km above Earth's surface.

Significance of The Space Station

- **The low orbit space station would be the country's eye from the sky**, providing round the clock bird's-eye view for its astronauts on the rest of the world.
- **It shall aid China's aim to become a major space power by 2030.**
- It replicates the International Space Station (ISS), from which **China was excluded**.

China's space station

How it will look when fully assembled



Tiangong Space Station

- It is a **planned Chinese Permanent space station to be placed in Low Earth orbit**.
- The Space Station roughly will have **one-fifth the mass of the International Space Station**.
- The space station consists of three modules — the core module, Tianhe and two lab modules, Wentian and Mengtian.
- The Tianhe module was launched in 2021 and the Mengtian module is set to be launched in October 2022.

Others Planned Space Stations

- **Lunar Gateway:** involving four of the ISS partner agencies: NASA, European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA), and Canadian Space Agency (CSA). It is **planned to be both the first space station beyond low Earth orbit and the first space station to orbit the Moon**.
- The **Russian Orbital Service Station** is scheduled to begin construction in 2025.
- **Starlab** is the name given to the planned **LEO space station** designed by Nanoracks for commercial space activities.
- **Indian Human Spaceflight Programme:** India plans to deploy a 20-tonne space station as a follow-up programme of the **Gaganyaan mission**, it will be deployed in 5–7 years after the completion of the Gaganyaan project.

WENTIAN LABORATORY

News: China launched the second of 3 modules to its permanent space station, in one of the final missions needed to complete the orbiting outpost by year's end.

About

- **The 23-tonne Wentian ("Quest for the Heavens")** laboratory module was launched on China's most powerful rocket, Long March 5B.
- **The 17.9-metre long Wentian lab module will be where astronauts can carry out scientific experiments** along with the third module Mengtian ("Dreaming of the heavens") module that hasn't yet been launched.
- The Wentian module comes with an airlock cabin that is designed to be the main exit and entry point for activities when the space station is complete.
- It will also be **used as short-term living quarters for astronauts during crew rotations on the station.**
- It is designed for long-term accommodation of just three astronauts.
- Mengtian is launched in October 2022 and, like Wentian, is to dock with Tianhe, forming a T-shaped structure.

IN-SPACE

News: The Prime Minister inaugurated the headquarters of the Indian National Space Promotion and Authorization Centre (IN-SPACe) in Ahmedabad, Gujarat.

About

- IN-SPACe is an **independent nodal agency under the Department of Space.**
- **Mandate:** To encourage, promote and handhold the private sector for their participation in the Space Sector.
- **Headquarters:** Ahmedabad, Gujarat.
- **Members:** IN-SPACe will have a chairman, technical experts for space activities, Safety experts, experts from Academia and Industries, Legal and Strategic experts from other departments, members from PMO and MEA of Government of India.
- **Function:** It assesses the needs and demands of private players, including educational and research institutions, and explores ways to accommodate these requirements in consultation with ISRO.
- **IN-SPACe has been established as a single window nodal agency, with its own cadre,** which permits and oversees the **following activities:**
 - Space activities including building of launch vehicles and satellites and

- providing space-based services as per the definition of space activities.
- Sharing of space infrastructure and premises under the control of ISRO with due considerations to on-going activities.
- Establishment of temporary facilities within premises under ISRO control based on safety norms and feasibility assessment.

GSAT-24

News: India's GSAT-24 satellite was successfully placed into the geostationary orbit by French company Ariane space on its Ariane 5 space launch vehicle from Kourou in French Guiana in South America.

About

- GSAT-24 is a 24-Ku band **communication satellite.**
- **Built by:** Indian Space Research Organization (ISRO) for New Space India Limited (NSIL).
- **Purpose:** The satellite will provide high-quality television, telecommunications, and broadcasting services and will meet the DTH needs of Indian customers.
- **Weight:** 4180 kg
- **Significance:** It is the first "demand-driven" communication satellite mission undertaken by NSIL post space sector reforms.
- NSIL has leased the entire satellite capacity to Tata Play.
- **Note:** 'Demand-driven' mode basically means when a satellite is launched, one will know who the end customers are going to be and what's the kind of utilization and commitment so that one can have very effective utilization of this satellite capacity once it goes into orbit.

Why was GSAT-24 Launched on a French Rocket?

- At present, **India does not have a space-launch rocket capable of lifting a satellite that weighs more than 4 tons into geostationary orbit.**
- Currently, **India's most powerful rocket, the GSLV Mk3, can lift a maximum of 4 tons into geostationary orbit.**

NEPTUNE AND URANUS APPEAR IN DIFFERENT COLOURS

News: Neptune and Uranus have a lot in common, such as similar masses, sizes, and atmospheric components, but their colours are very different. Neptune is a rich, deep azure colour at visible wavelengths, while Uranus is a notably light shade of blue.

About

- The **haze around Uranus is thicker than that around Neptune**. Due to this, **Uranus's atmosphere has a lighter appearance than Neptune's**.
- Without this haze in either planetary atmosphere, astronomers believe both planets would be almost identically blue.

Why is The Haze Thicker on Uranus?

- There are **three aerosol layers in the atmospheres of Neptune and Uranus**.
- The key layer that affects the colours is the middle layer. The middle layer is a layer of haze particles that is thicker on Uranus than on Neptune.
- On both planets, **methane ice condenses onto the particles in this middle layer pulling the particles deeper into the atmosphere**.
- **But, because Neptune has a more active, turbulent atmosphere than Uranus does, the researcher believes Neptune's atmosphere is more efficient at churning up methane particles into the haze layer**.
- This removes more of the haze and keeps Neptune's haze layer thinner than it is on Uranus with the result that the blue colour of Neptune looks stronger.

PLANTS IN THE MOON'S SOIL

News: Scientists have for the first time successfully grown plants in the Moon's soil.

About

- This lunar soil, also called **regolith**, was brought to Earth from the Moon by the Apollo-era astronauts.
- **Researchers have grown the hardy and well-studied Arabidopsis thaliana in the nutrient-poor lunar regolith**.
- **Arabidopsis thaliana**, native to Eurasia and Africa, is a relative of mustard greens and other cruciferous vegetables like broccoli, cauliflower, and Brussels sprouts.
- **The breakthrough will open the doors to harvest crops on the Moon** in the future which will help in the extended stay of humans on the moon.

CAPSTONE

News: NASA has launched CAPSTONE, a microwave oven-sized CubeSat weighing just 55 pounds (25 kg).

About

- CAPSTONE is a microwave oven-sized CubeSat weighing just 55 pounds (25 kg).
- **Full Form:** Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE).
- **Aim:** To help reduce risk for future spacecraft by validating innovative navigation technologies and by verifying the dynamics of the halo-shaped orbit.

Which orbit will CAPSTONE study?	• For the Artemis Mission, NASA has decided to include Gateway, a small space station around the moon. That would make it easier for astronauts to reach more parts of the moon. • This outpost is to be placed in the Near-Rectilinear Halo Orbit (NRHO). • Halo orbits are those influenced by the gravity of two bodies — in this case, the Earth and the moon. • The influence of these two bodies helps make the orbit highly stable, minimizing the amount of propellant needed to keep a spacecraft circling the moon.
How will the CAPSTONE spacecraft work?	• At the Moon, CAPSTONE will enter NRHO, where it will fly within 1,600 km of the Moon's North Pole on its near pass and 70,000 km from the South Pole at its farthest. • The spacecraft will repeat the cycle every six-and-a-half days and maintain this orbit for at least six months to study dynamics.

ISRO'S POEM (PSLV ORBITAL EXPERIMENTAL MODULE) PLATFORM

News: Besides placing three Singaporean satellites in precise orbit, the Indian Space Research Organisation (ISRO) has also successfully launched the PSLV Orbital Experimental Module (POEM) of the PSLV-C53 Mission.

About

- The PSLV Orbital Experimental Module is a platform that will help perform in-orbit experiments using the final and otherwise discarded stage of ISRO's workhorse rocket, the Polar Satellite Launch Vehicle (PSLV).

What is PSLV and how was it Used in PSLV-C53?

- The PSLV is a four-stage rocket where the first three spent stages fall back into the ocean, and the final stage (PS4)—after launching the satellite into orbit—ends up as space junk.
- However, in the PSLV-C53 mission, the spent final stage was utilized as a “stabilized platform” to perform experiments.
- **Note:** This is the **first time** that the PS4 stage would orbit the earth as a stabilized platform.

How Will ISRO Keep POEM ‘Alive and Stable’ in Orbit?

- POEM has a dedicated Navigation Guidance and Control (NGC) system for attitude stabilization, which stands for controlling the orientation of any aerospace vehicle within permitted limits. The NGC will act as the platform’s brain to stabilize it with specified accuracy.
- POEM will also derive its power from solar panels mounted around the PS4 tank and a Li-Ion battery.
- It will navigate using four sun sensors, a magnetometer, gyros & NavIC.

Purpose:	• It is an analog chipset that will allow Artificial Intelligence and Machine Learning apps to perform much better and faster.
Uses:	• This chipset is especially helpful for AI-based applications which deal with object or speech recognition systems, like Alexa or Siri. • They are also very useful in operations that require massive parallel computing at high speeds.
Benefits:	• Most computing devices, be it cellphones, laptops or desktop computers use digital chips because the design process is simple and easily scalable. • However, the advantage of analogue is huge. • For instance, in applications that don’t require precise calculations, analogue computing has the potential to outperform digital computing as the former is more energy-efficient.

WORMHOLES

News: The wormhole theory postulates that a theoretical passage through space-time could create shortcuts for long journeys across the universe.

About

- Wormholes were **first theorized in 1916**.
- Just like black holes were predicted by **Einstein’s theory of relativity** long before they were experimentally observed, the existence of wormholes, too, has been predicted.
- **Ludwig Flamm, in 1916, first discovered that they could exist.**
- He described a “**white hole**,” a theoretical time reversal of a black hole.

Has ISRO Repurposed and Used PS4 Rocket Junk Earlier?

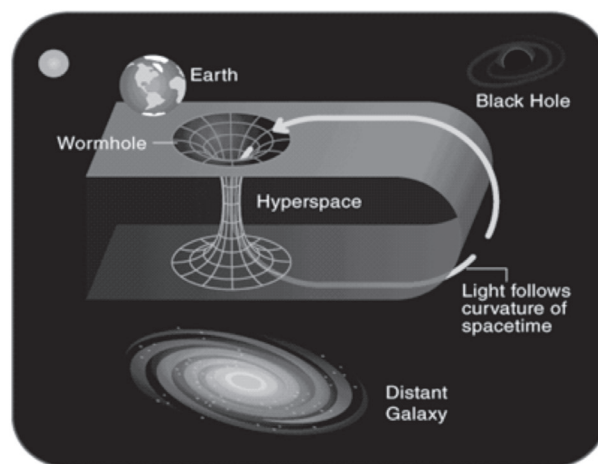
- ISRO first demonstrated the capability of using PS4 as an orbital platform in 2019 with the PSLV-C44 mission that **injected Microsat-R and Kalamsat-V2** satellites into their designated orbits.
- The fourth stage in that mission was kept alive as an orbital platform for space-based experiments.

ARYABHATTA-1

News: Recently, Researchers at the Indian Institute of Science or IISc have developed an analogue chipset called ARYABHATTA-1.

About

- ARYABHAT-1 stands for **Analog Reconfigurable Technology and Bias-scalable Hardware for AI Tasks**.



- Entrances to both black and white holes could be connected by a **space-time conduit**.

- In 1935, Einstein and physicist Nathan Rosen used the theory of general relativity to elaborate on the idea, proposing the existence of “bridges” through space-time.
- These bridges connect two different points in space-time, theoretically creating a shortcut that could reduce travel time and distance.
- The shortcuts came to be called **Einstein-Rosen bridges, or wormholes**.
- However, the presence of wormholes has not yet been established through observation or inference by astronomers.

AZAADI SAT

News: The Indian Space Research Organization (ISRO) is all set to launch a Small Satellite Launch Vehicle (SSLV) from Sriharikota. The vehicle will carry an Earth Observation Satellite named EOS-02 and a co-passenger satellite, ‘Azaadi SAT’ into low earth orbit.

About

- **Azaadi satellite** has been designed by 750 girl students of government schools in rural areas from Kashmir to Kanyakumari.
- **Purpose:** The satellite weighs around 8 kg and has 75 Femto experiments (selfie cameras to click pictures of its own solar panels and long-range communication transponders).
- It also contains a long-range transponder and a solid-state PIN diode-based radiation counter to measure the ionizing radiation in its orbit.
- **The satellite will also carry a recorded version of the national anthem sung by Rabindranath Tagore**, which will be played in space as a tribute to the country.
- **Significance:** The satellite is the result of ISRO pushing for girls to take up Science, Technology, Engineering, and Mathematics (STEM).
- **Small Satellite Launch Vehicle (SSLV):** It is an all-solid three-stage vehicle with the capability to launch up to 500 kg satellite mass into 500 km Low Earth Orbit (LEO).

NOVAE AND SUPERNOVA

News: Scientists from SN Bose Centre for Basic Science (SNBCBS) studied the thick dust formed around the novae called Nova V1280 Scorpii. The study of this cosmic dust could unravel the mysteries behind the start of life.

About

- A nova is an **explosion from the surface of a white dwarf star in a binary star system**.
- A nova occurs when the white dwarf, which is the dense core of a once-normal star, steals gas from its nearby companion star. When enough gas builds up on the surface of the white dwarf it triggers an explosion.
- **A supernova is a violent stellar explosion that can shine as brightly as an entire galaxy of billions of normal stars.**

Cosmic Dust

- **Cosmic dust is also called extra-terrestrial dust or space dust.** It is dust which exists in outer space or has fallen on Earth.
- **Cosmic dust was once solely an annoyance to astronomers**, as it obscures objects they wished to observe.
- When infrared astronomy began, the dust particles were observed to be significant and vital components of astrophysical processes.
- **Their analysis can reveal information about phenomena** like the formation of the Solar System.
- **For example**, cosmic dust can drive the mass loss when a star is nearing the end of its life, play a part in the early stages of star formation, and form planets.

STEVE PHENOMENON

News: The cosmic phenomenon known as “**Strong Thermal Emission Velocity Enhancement (STEVE)**” made a surprise appearance after a huge solar storm hit Earth.

About

- **STEVE first appeared in the sky in 2017** and has been appearing often since.
- There is evidence to support the claim that the phenomenon has been visible in the sky since 1705
- It is a **rare, mysterious, glowing purple arc** that runs east to west and occurs closer to the equator.

How does It Occur?

- The phenomenon is believed to be caused by a 25 km wide ribbon of hot plasma moving at a speed of 6 km/s (compared to 10 m/s outside the ribbon) at an altitude of 450 km
- **It has been observed in New Zealand, Canada, Alaska and the United Kingdom during a specific time of the year** - between October to February which

led NASA scientists to believe that its occurrence is related to seasons.

How is it Different from Aurora Borealis?

- **Disturbances in the Earth's magnetosphere due to solar wind** cause Auroras.
- These disturbances occur because of **enhancements in the speed of the solar wind from coronal holes and coronal mass ejections**.
- While the skylights, STEVE and the Auroras might seem similar, they are **nothing alike**.
- To begin with, the **STEVE phenomenon is closer to the equator than the Auroras**.
- STEVE is different from the usual aurora, but it is made of light and it is driven by the auroral system.

INDIA'S FIRST OBSERVATORY

News: India's first situational awareness observatory to monitor space activity is going to be **set up in Uttarakhand by Digantara**.

About

- The Space Situational Awareness (SSA) observatory **will assist in tracking any activity in space including that of space debris and military satellites hovering over the region**.
- **Aim:** to track objects as small as 10 cm in size orbiting the earth.
- **Significance:** It will fill the crucial gap in SSA observations in the region as there is a lack of such facilities between Australia and southern Africa.
- **The observatory will help to monitor events occurring in deep space**, especially in the geostationary, medium-Earth, and high-Earth orbits.
- The observatory **will give India indigenous capabilities to monitor space activity over the subcontinent providing a strategic advantage**.
- **Global Scenario:** At present, the **United States** is a dominant player in monitoring space debris. It has observatories in multiple locations with commercial companies providing additional inputs from across the world.

DATA SONIFICATION

News: NASA has created a 'sonification' of the sound emerging from the black hole at the centre of the Perseus galaxy cluster.

About

- Data Sonification is the **translation of astronomical data into sounds**.

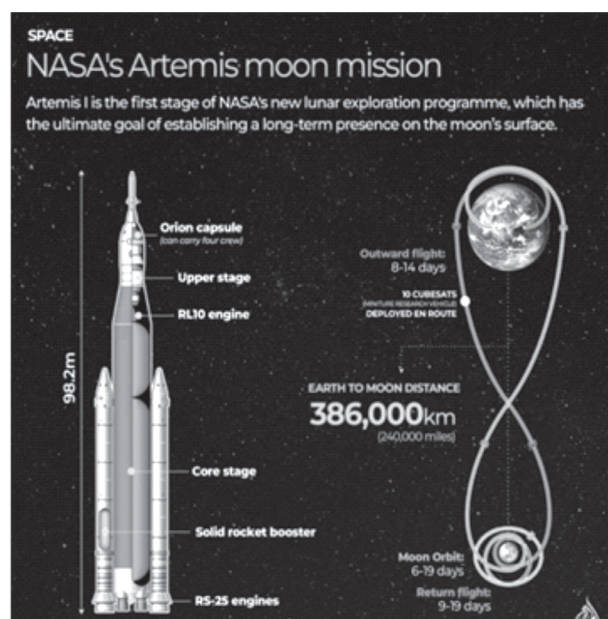
- This sonification **translates the actual sound waves discovered in data from various NASA missions** - such as the Chandra X-ray Observatory, Hubble Space Telescope, and Spitzer Space Telescope.
- There is a misconception that there is no sound in space because most of the space is a vacuum, with no medium for sound waves to travel.
- However, **galaxy clusters enveloping thousands of galaxies within it often have large amounts of sound, providing a medium for the sound waves to travel**.
- In the sonification of Perseus, the sound waves previously identified by astronomers were extracted in radial directions (outwards from centre).
- After extraction, the signals were synthesised into the range of human hearing by scaling them up to 58 octaves above their actual pitch.

NASA'S ARTEMIS PROGRAMME

News: Recently, NASA's Moon mission was named after the ancient lunar goddess Artemis.

About

- **Artemis I will send a rocket without a crew on a month-long journey around the Moon.**
- **Artemis I mission will carry two mannequins designed to study the effects of radiation on women's bodies so that NASA can learn how to protect female astronauts better.**
- The spacecraft will launch on SLS, the most powerful rocket in the world.
- It will travel 2, 80,000 miles from the earth for over four to six weeks during the course of the mission.



Aim:	- To land humans on the moon by 2024 and it also plans to land the first woman and first person of colour on the moon. - To contribute to scientific discovery and economic benefits and inspire a new generation of explorers.
Spacecraft:	The Orion spacecraft is going to remain in space without docking to a space station, longer than any ship for astronauts has ever done before.
SLS Rocket:	- The SLS rocket has been designed for space missions beyond low-earth orbit. - It can carry crew or cargo to the moon and beyond.
Artemis Base Camp:	- Base camp will be established on the surface and a gateway in lunar orbit to aid exploration by robots and astronauts. - It will give astronauts a place to live and work on the moon. - It includes a modern lunar cabin, a rover, and a mobile home.
Gateway:	- The gateway is a critical component of NASA's sustainable lunar operations and will serve as a multi-purpose outpost orbiting the moon. - It is a spaceship in lunar orbit where astronauts will transfer between Orion and the lander on regular Artemis missions. - Gateway will remain in orbit for more than a decade, providing a place to live and work, and supporting long-term science and human exploration on and around the Moon.
Space agencies involved:	- The Canadian Space Agency has committed to providing advanced robotics for the gateway, - The European Space Agency will provide the International Habitat and the ESPRIT module, which will deliver additional communications capabilities among other things. - The Japan Aerospace Exploration Agency plans to contribute habitation components and logistics resupply.

MOXIE

News: Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) has produced oxygen on Mars with components from the planet's atmosphere.

About

- MOXIE is a **small box sent by the Massachusetts Institute of Technology (MIT) with NASA's Perseverance rover.**
- It has produced oxygen on Mars** with components from the planet's atmosphere.
- MOXIE **makes oxygen like a tree does.** It inhales carbon dioxide and exhales oxygen.
- Significance:** MOXIE will help demonstrate a way that future explorers might produce oxygen from the Martian atmosphere for propellant and for breathing.
- Note:**
 - A substantial amount of oxygen supply on Mars is essential for crewed missions that plan to go there– not just for astronauts to breathe but for rockets to use as fuel while coming back to Earth.
 - Carbon dioxide makes up ~96% of the gas in Mars' atmosphere (Oxygen is only 0.13%).

QIMINGXING 50

News: China's first fully solar-powered unmanned aerial vehicle named "QIMINGXING 50" has successfully completed its maiden test flight with all onboard systems functioning optimally.

About

- QIMINGXING 50 or Morning Star-50 is **China's fully solar-powered, semi-satellite drone.**
- Purpose:** It is capable of conducting high-altitude reconnaissance, apart from monitoring forest fires, and providing communication and environment relay.
- Features:** This drone is powered entirely by solar panels. It can stay airborne for long durations.
- It flies above 20-km altitude where there is stable airflow with no clouds.** This helps these drones to make maximum use of solar equipment to stay functional for extended durations.
- Significance of this drone:**
 - Firstly**, this drone can operate in near-space – 20 km to 100 km above the Earth's surface. This makes it capable of carrying out satellite-like functions.
 - Secondly**, it is cost-effective to build and is also easy to launch and operate.

- **Thirdly**, being entirely powered by clean energy from the Sun, it can help boost China's capabilities to operate in near-space and over the ocean.

EINSTEIN RING

News: The Mid-Infrared Instrument (MIRI) of the James Webb Space Telescope has captured an image of an almost perfect "Einstein ring".

About

- An Einstein ring is a **ring of light created when light from a galaxy, star or other light-emitting cosmic objects passes near a massive object before it reaches the Earth, or in this case, the Webb telescope.**
- **When this happens, gravitational lensing causes the light to get diverted** and if the source, lens and the observing element are all in perfect alignment, this light appears as a ring.
- So, the ring itself is not a real physical structure in space, but just a play of light and gravity, a result of the gravitational lensing effect.
- The Einstein ring is also known as the **Chwolson ring**.

Recent Finding

- **"Einstein ring" that was captured recently** was formed from the light of a distant galaxy SPT-S J041839-4751.8, which is around 12 billion light-years away from Earth.
- From Webb's point of view, this galaxy is positioned directly behind another galaxy that is so massive that its gravitational pull warps space and time.
- As the light from the background galaxy travels to the Webb telescope, it has to cross the warped space-time near the foreground galaxy.
- This is what makes the light appear like a **curved ring**.

INOUE SOLAR TELESCOPE

News: The Inouye Solar Telescope has captured an image of the Sun's chromosphere at a resolution of 18 kilometres.

About

- The Daniel K Inouye Solar Telescope (DKIST) is located at the **Haleakala Observatory on the Hawaiian island of Maui.**
- The DKIST was **set up by the US National Science Foundation (NSF).**
- According to the NSF, the **Inouye Solar Telescope is the most powerful solar telescope in the world.**

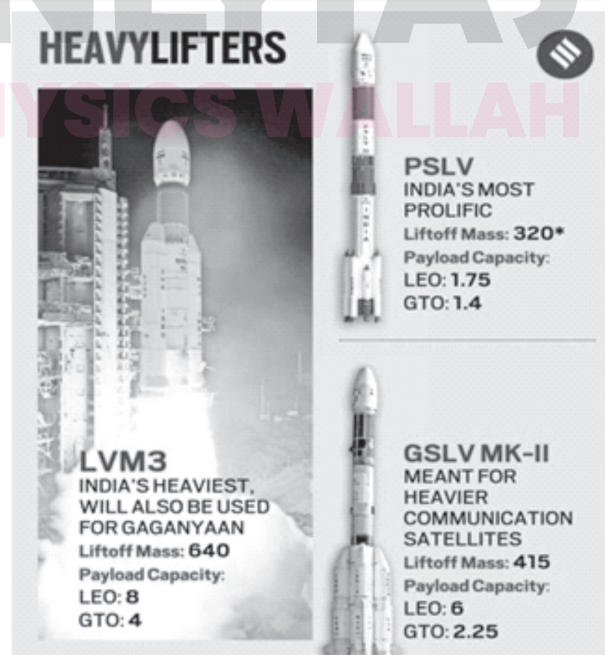
- Its insights will transform how we predict and prepare for events like solar storms.
- The chromosphere is the second of the three main layers in the Sun's atmosphere. It is located above the photosphere and below the solar transition region and corona.

Haleakalā

- Soaring nearly three kilometers, above the Pacific Ocean, **Haleakalā is Maui Island's largest volcanic mountain.**
- Haleakalā is a **high-elevation, shield volcano surrounded by ocean.**
- This unique geography offers a site 10,023 feet above the clouds, with a clear blue sky and a stable atmosphere that is relatively free of dust.
- It is a **near perfect place for solar astronomy.**

ISRO'S HEAVIEST ROCKET LVM3-M2

News: Indian Space Research Organisation (ISRO)'s heaviest rocket LVM3-M2 lifted-off from a launch pad at the Satish Dhawan Space Centre, in Sriharikota, recently. The rocket successfully placed 36 broadband communication satellites of OneWeb, on ISRO's maiden commercial mission.



About

- This mission is being undertaken as part of the commercial arrangement between New Space India Limited (NSIL) and m/s Network Access Associates Limited (m/s OneWeb Ltd), a U.K. based company.

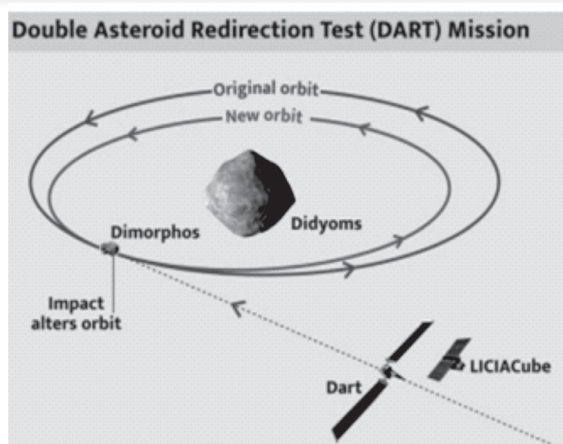
- OneWeb is a joint venture between India's Bharti Enterprises and the U.K. government.
- This is OneWeb's 14th launch, bringing the constellation to 462 satellites. This launch represents more than 70% of its planned 648 Low Earth Orbit (LEO) satellite fleet that will deliver high-speed, low-latency connectivity worldwide.
- The 43.5 metre LVM3 weighing around 644 tonnes carried 36 satellites weighing 5,796 kg or about 5.7 tonnes.

Launch Vehicle Mark III (LVM3)- M2

- The ISRO has renamed the **Geosynchronous Satellite Launch Vehicle (GSLV) Mark -III as Launch Vehicle Mark-III**, mainly to identify its task of placing satellites into a variety of orbits.
- **Launch Vehicle Mark III (LVM3)- M2 is the dedicated commercial satellite mission of New Space India Limited (NSIL)**, a Central Public Sector Enterprise (CPSE) under the Department of Space, Government of India.
- The **LVM3 rocket (earlier called the Geosynchronous Launch Vehicle Mark III or GSLV-MK3) can carry up to 8 tonnes into Low Earth Orbit (LEO-up to 1,200 km above the Earth).**
- The rocket is a three-stage launch vehicle consisting of two solid propellant S200 strap-ons on its sides and core stage comprising L110 liquid stage and C25 cryogenic stage.
- The PSLV is much lighter and can carry between 1.4 and 1.75-tonne payloads.

DOUBLE ASTEROID REDIRECTION TEST (DART)

News: On September 26, 2022, NASA's DART spacecraft will intentionally crash into a small asteroid named Dimorphous, however, the asteroid poses no threat to earth.



About

- DART stands for **Double Asteroid Redirection Test**.
- **Launched by:** DART mission is being developed and led for NASA by the Johns Hopkins University Applied Physics Laboratory.
- **Purpose:** It is the first-ever mission dedicated to investigating and demonstrating one method of asteroid deflection by changing an asteroid's motion in space through kinetic impact.
- **Target:** DART's target is the binary asteroid system Didymos, which means "twin" in Greek (and explains the word "double" in the mission's name).
- **Didymos is the ideal candidate for humankind's first planetary defense experiment**, although it is not on a path to collide with Earth and therefore poses no actual threat to the planet.
- **Significance:**
 - DART is a spacecraft **designed to impact an asteroid as a test of the technology**.
 - DART's **target asteroid is NOT a threat to Earth**.
 - This asteroid system is a perfect testing ground to see if intentionally crashing a spacecraft into an asteroid is an effective way to change its course, should an Earth-threatening asteroid be discovered in the future.

RH-200

News: Recently, ISRO is planning the 200th successful launch of the Rohini RH-200 sounding rocket in a row.

About

- RH-200 is a **part of the Rohini-sounding rocket family used by the ISRO for atmospheric studies**. It has completed 198 consecutive successful flights so far.
- **Features:** It is a two-stage rocket capable of climbing to a height of 70 km bearing scientific payloads. The first and second stages of RH-200 are powered by solid motors.
- **Note:** The '200' in the name denotes the diameter of the rocket in mm.

Sounding Rockets

- **Sounding rockets are usually one or two-stage solid propellant rockets.** They are primarily intended for probing the upper atmospheric regions using rocket-borne instrumentation.
- **They also serve as platforms for testing prototypes of new components or subsystems** intended for use in launch vehicles and satellites.
- **History of Sounding Rockets in India:** The launch of the first sounding rocket US made 'Nike Apache' from

Thumba near Thiruvananthapuram, Kerala in 1963 marked the beginning of the Indian Space Programme.

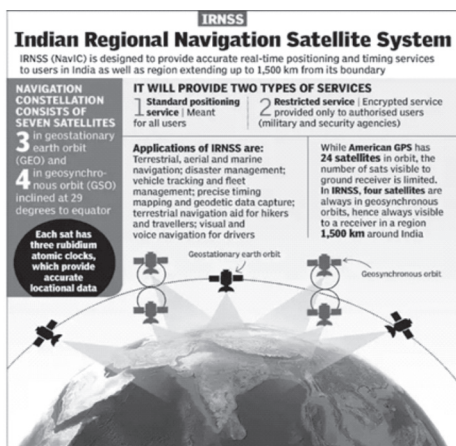
- **Later days saw the launching of two-stage rockets imported from Russia (M-100) and France (Centaure).**
- In 1967, ISRO started launching a series of its own sounding rockets named Rohini from the Thumba Equatorial Rocket Launching Station (TERLS).
- **RH-75 was the first truly Indian-sounding rocket which was followed by RH-100 and RH-125 rockets.**
- Currently, the RH200, RH300 MkII and RH560 Mk-III rockets are operational.

NAVIC

News: India is pushing tech giants to make their smartphones compatible with its NavIC system. However, the manufacturers, including companies like Samsung, Xiaomi and Apple are worried about the elevated costs and disruptions as the move requires hardware changes.

About

- NavIC, or **Navigation with Indian Constellation** is an independent stand-alone navigation satellite system developed by the Indian Space Research Organization (ISRO).
- NavIC was **originally approved in 2006**. It was expected to be completed by late 2011 but only became operational in 2018.
- NavIC **consists of eight satellites and covers the whole of India's landmass and up to 1,500 km from its boundaries.**
- **Currently, NavIC's use is limited. It is being used in public vehicle tracking in India**, for providing emergency warning alerts to fishermen venturing into the deep sea where there is no terrestrial network connectivity, and for tracking and providing information related to natural disasters.



How does NavIC Work Compared to Other Satellite Navigation Systems Like GPS?

- The main difference is the **serviceable area covered by these systems.**
- **GPS caters to users across the globe and its satellites circle the earth twice a day** while NavIC is currently for use in India and adjacent areas.
- Moreover, like GPS, **there are three more navigation systems that have a global coverage — Galileo from the European Union, Russia-owned GLONASS and China's Beidou.**
- **QZSS operated by Japan is another regional navigation system** covering the Asia-Oceania region with a focus on Japan.

ENCELADUS OCEAN

News: Recently Scientists discovered evidence for life in one of the moons of Saturn.

About

- Enceladus is **one of the moons of Saturn.**
- **It is discovered that beneath its icy surface are oceans.**
- It is **rich in dissolved phosphorus**, an essential ingredient for life.
- The **spacecraft Cassini**, which orbited Saturn for nearly 13 years, discovered Enceladus's subsurface liquid water.
- **From the cracks of the moon's icy surface, plumes of ice grains and water vapour erupted into space.**
- The plume contains almost all the basic requirements of life.
- **Phosphorus in the form of phosphates is also vital for all life on Earth.**
- **Phosphorus is used for the creation of DNA and RNA**, energy-carrying molecules, cell membranes, bones and teeth in people and animals, and even the sea's microbiome of plankton.
- **But, phosphorus is yet to be identified** as its availability in the ocean beneath the moon's icy crust. By Cassini, scientists predicted that phosphate minerals would be unusually soluble there.

ISRO'S MANGALYAAN MISSION

News: Recently, the ISRO confirmed that the Mars Orbiter craft has lost communication with ground station, it's non-recoverable and with this the Mangalyaan mission has attained end-of-life.

Basics:	- The Mars Orbiter Mission (MOM) or Mangalyaan is a space probe launched by the ISRO in 2013. - Mangalyaan was India's first interplanetary mission. - The indigenously-built space probe has been in Martian orbit since 2014. - The mission made India the first Asian country and the fourth in the world after Roscosmos, NASA, and the European Space Agency, to get to the planet.
Objective of Mangalyaan:	- India's Mangalyaan mission is aimed at studying Martian atmosphere. Its objective is to explore Martian surface features, mineralogy, morphology and atmosphere using indigenous scientific instruments. - A crucial objective of MOM was to develop technologies required in planning, designing, management and operations of an interplanetary mission.
Rocket used:	MOM was launched aboard PSLV C-25 (an XL version of the PSLV).
Cost of Mangalyaan:	ISRO spent \$75 million to launch the mission, making it the least-expensive Mars mission to date.

NEXT-GEN LAUNCH VEHICLE (NGLV)

News: The Indian Space Research Organisation (ISRO) is developing a Next-Gen Launch Vehicle (NGLV), which will replace operational systems like the Polar Satellite Launch Vehicle (PSLV).

About

- In NGLV, ISRO is looking at a **cost-efficient, three-stage to-orbit, a reusable heavy-lift vehicle with a payload capability of ten tonnes to Geostationary Transfer Orbit (GTO).**
- Propulsion:** NGLV will have semi-cryogenic propulsion (refined kerosene as fuel with liquid oxygen (LOX) as oxidiser) for the booster stages which is cheaper and more efficient.
- NGLV will feature a simple, robust design which allows bulk manufacturing, modularity in systems, sub-systems and stages and minimal turnaround time.
- Potential applications:** The uses of NGLVs will be in the areas of launching communication satellites, deep space missions, future human spaceflight and cargo missions.

SAMPURNANAND TELESCOPE (ST)

News: The Governor of Uttarakhand recently highlighted the need for discussing future possibilities of the 104 cm Sampurnanand Telescope (ST), at a workshop organised to commemorate the completion of 50 years of successful operations of the telescope.

About

- It is a world-class telescope **located near Nainital.**
- The telescope at Manora Peak was established

in 1972 when ARIES was known as the UP-State Observatory (UPSO).

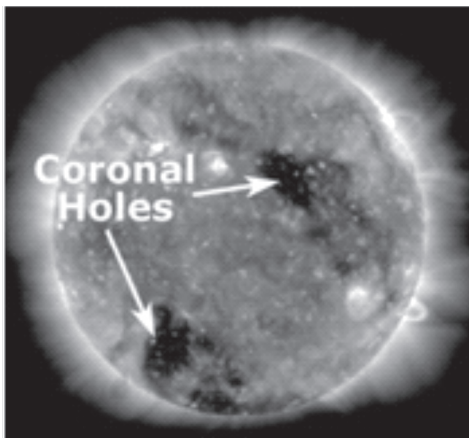
- It has been **extensively used for optical observations of comets, occultation by planets and asteroids, star-forming regions and star clusters, variable stars, transients, active galactic nuclei, etc.**
- Some of the breakthrough science results contributed by the telescope include the discovery of new rings around Saturn and the rings of Uranus.
- The instrumentation and science capabilities of ST have paved the way for setting up National and International facilities by ARIES, such as the 3.6m DOT and the 4-meter International Liquid Mirror Telescope at Devasthal.

CORONAL HOLES

News: NASA released an image taken by its Solar Dynamics Observatory (SDO) where the Sun seems to be smiling.

About

- The Sun in the image seems to have two dark eyes, a bright round nose and a wide-open smile.
- These **dark patches on the Sun** are known as coronal holes.
- Coronal holes are cooler denser regions in the Sun's corona.
- They **appear as irregular black patches** when the sun is imaged in ultraviolet light or certain types of X-ray images.
- These regions also appear when fast solar wind gushes out into space.**
- They are **not periodical** and **can pop up on the solar surface at any time.**



Solar Dynamics Observatory (SDO)

- NASA launched Solar Dynamics Observatory (SDO) in 2010.
- SDO is the first satellite in NASA's Living with a Star program, which studies space weather.
- SDO studies how solar activity happens and how that impacts the Earth's magnetosphere.
- SDO takes observations of the Sun's interior, surface and atmosphere.
- SDO carries three instruments: Helioseismic and Magnetic Imager (HMI), Atmospheric Imaging Assembly (AIA), Extreme Ultraviolet Variability Experiment (EVE).

GAIA BH1

News: Astronomers have discovered the closest known black hole to Earth, initially identified using Gaia Space Telescope.

About

- The **Black hole**, named Gaia BH1 is the **closest known black hole to Earth**.
- It is located in the **constellation Ophiuchus**, the serpent-bearer.
- This black hole is 10 times more massive than our sun and is dormant.
- It is 1600 light-years away i.e., three times closer than the previous closest black hole.

Gaia Space Telescope

- The **European Space Agency** launched Gaia Space Telescope in 2013.
- It measures the precise positions, speeds and trajectories of about 2 billion of the brightest stars in the Milky Way Galaxy.
- The telescope will be **active till 2025**.

ISRO'S RISAT-2 SATELLITE

News: ISRO's RISAT-2 satellite has made an uncontrolled re-entry into the Earth's atmosphere in the Indian Ocean near Jakarta.

About

- Risat-2, weighing about 300 kg was launched on April 20, 2009, by the PSLV-C12 launch vehicle.
- **The principal sensor of Risat-2, considered a 'spy' satellite**, was an X-band synthetic aperture radar from Israel Aerospace Industries.
- Risat-2 was built more quickly following the 2008 Mumbai terror attacks due to delay with the indigenously developed C-band for Risat-1 satellite.
- The satellite, which was **India's first dedicated reconnaissance satellite, possessed day-night as well as all-weather monitoring capability**.
- It was also used to track hostile ships at sea that were deemed a military threat.

Significance

- Risat-2 provided beneficial payload data for over 13 years.
- Since its injection, Risat-2's radar payload services were provided for various space applications.
- Risat-2 is a clear example of ISRO's capability to carry out spacecraft orbital operations in an efficient and optimal way.
- As Risat-2 re-entered within 13.5 years, it complied with all necessary international mitigation guidelines for space debris, showing the space agency's commitment towards the long-term sustainability of outer space.

Upcoming Projects of ISRO

- **Gaganyaan:** Indian Human Spaceflight Programme.
- **Aditya-L1:** To Study the Sun's atmosphere.
- **NASA-ISRO Synthetic Aperture Radar Mission:** To study hazards and global environmental change.
- **Shukrayaan-1:** Orbiter to Venus.

FALCON HEAVY ROCKET

News: SpaceX launched the Falcon Heavy rocket into a geosynchronous Earth orbit from Launch Complex 39A at the Kennedy Space Center in Florida, US.

About

- SpaceX claims Falcon Heavy to be the most powerful rocket in the world by a factor of two.

- The rocket has a height of 70 m, a width of 12.2 m and a mass of 1,420,788 kg.
- **Falcon Heavy has 27 Merlin engines** which together generate more than five million pounds of thrust at lift-off, equalling around eighteen 747 aircraft at full power which makes it the most capable rocket flying.
- **Merlin is a family of rocket engines developed by SpaceX** for use on its Falcon 1, Falcon 9 and Falcon Heavy launch vehicles.
- Merlin engines use RP-1 and liquid oxygen as rocket propellants in a gas-generator power cycle.
- These engines were **designed for recovery and reuse**.
- The rocket has a lifting capacity of around 64 metric tonnes into orbit.
- The Falcon Heavy uses three boosters for added thrust and lift capacity.
- SpaceX last launched its Falcon Heavy rocket in June 2019 from NASA's Kennedy Space Center.
- It carried 24 satellites as part of the Department of Defense's Space Test Program-2.

Current Mission

- The rocket is carrying satellites to space for the U.S. military in a mission named as US Space Force (USSF)-44.
- The mission deployed two spacecraft payloads, one of which is the TETRA 1 microsatellite created for various prototype missions in and around the geosynchronous earth orbit.
- It will place the satellites for the Space Systems Command's Innovation and Prototyping.

VIKRAM-S

News: Hyderabad-based space firm Skyroot Aerospace is going to launch Vikram-S, India's first privately manufactured rocket. It is being launched as part of Skyroot Aerospace's first mission "Prarambh".

About

- Vikram-S is **India's first privately manufactured rocket being developed by Skyroot Aerospace, a Hyderabad-based startup in the aerospace business.**
- **Purpose:** It is a single-stage sub-orbital launch vehicle that will carry three client payloads and assist test and verifying most of the technology in the Vikram family of space launch vehicles.
- **Sub-orbital flight** are those vehicles which are travelling slower than the orbital velocity – meaning it is fast enough to reach outer space but not fast enough to stay in an orbit around the Earth.

- **Features:** Skyroot is designing three Vikram rockets that will use various solid and cryogenic fuels to carry between 290 kg and 560 kg payloads to sun-synchronous polar orbits.

Other Initiatives Taken by Private Players In the Space Sector

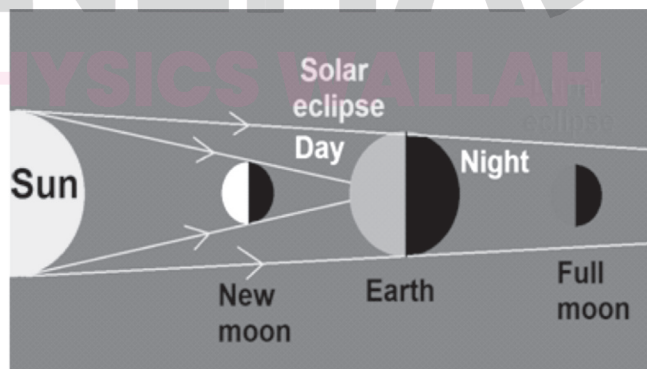
- Rocket manufacturing startup, Agnikul Cosmos has tested its semi-cryogenic Agnilet engine for 15 seconds at ISRO's vertical testing facility at Thumba Equatorial Rocket Launching Station (TERLS), Thiruvananthapuram.
- ISRO's Small Satellite Launch Vehicles (SSLV) are also likely to be manufactured and operated by private players soon.

BEAVER BLOOD MOON

News: Total lunar eclipses which occurred in October will be the last of 2022 and will only occur again after three years.

About

- A total lunar eclipse occurs when the **Earth casts its shadow completely over a full moon**, blocking reflection of all direct sunlight from the lunar orb and dimming the colour of the moon to a reddish hue.



- **Total lunar eclipses usually occur on average about once every year and a half.**
- **Blood Moon:** When the moon is within the umbra, it appears with a reddish hue due to **Rayleigh's scattering** of light by the earth's atmosphere.
- **Rayleigh scattering effect:** the scattering of light by particles in a medium without a change in wavelength.
- **A November full moon is called Beaver Moon** because it happens during the month of November when the beavers begin taking shelter in their lodges.
- **The combined phenomena of total lunar eclipse and the Beaver moon is called Beaver Blood Moon.**

Lunar Eclipse

- A lunar eclipse happens when the Earth is positioned between the Sun and the Moon and the Earth casts a shadow on the Moon.
- **The shadow is categorised into two parts:**
 1. **Umbra** - The darkest shadow of the earth that blocks out sunlight completely.
 2. **Penumbra** - The outermost part of the shadow, where sunlight is blocked out only partially.

CE20 CRYOGENIC ENGINE

News: The Indian Space Research Organisation (ISRO) has successfully conducted the hot test of the CE20 cryogenic engines.

About

- CE20 cryogenic engine is **indigenously developed for LVM3**.
- A 3D printed LOX and LH2 turbine exhaust casings were also inducted in the engine for the first time.
- The hot test was conducted at an **uprated thrust level of 21.8** tone for the first time.
- LVM-3 can **carry up to 4 tones to a geostationary orbit** and up to 6 tones to a Low Earth Orbit.
- This uprated thrust level will enhance the LVM3 **payload capability up to 450 kg** with additional propellant loading.
- **LVM3 is the heaviest launch vehicle of ISRO.**
- **LVM3 is a three-stage vehicle with two solid motor strap-ons, a liquid propellant core stage and a cryogenic upper stage.**

LOFTID MISSION

News: NASA completed the technology demonstration of its Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID) mission.

About

- **The Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID) orbital flight** test was the next step of the HIAD program.
- The LOFTID mission demonstrates the re-entry of the inflatable decelerator Hypersonic Inflatable Aerodynamic Decelerator (HIAD) from the Lower-Earth Orbit.
- In LOFTID a small re-entry vehicle is attached to the HIAD aeroshell.

- After reorienting towards earth, the shell inflates and separates from the upper stage of the rocket to enter the atmosphere.
- LOFTID demonstrates the inflatable aeroshell, heat shield's ability to slow down and survive re-entry.
- LOFTID could potentially help land astronauts on Mars in the future.

HIAD Aeroshell

- **Aeroshell is a type of heat shield used for atmospheric re-entry.**
- Traditionally NASA relied on rigid aeroshells but over a decade has developed inflatable aeroshells.
- This inflatable aeroshell is called **Hypersonic Inflatable Aerodynamic Decelerator (HIAD)**.
- HIAD is a large deployable inflatable aeroshell protected by a flexible heat shield.
- The inflatable structure is made with a stack of pressurized concentric rings that are strapped to form a cone-shaped structure.

GAMMA RAY BURST (GRB)

News: The brightest flash of light ever seen, which occurred 2.4 billion light years from Earth, has been witnessed by astronomers.

About

- This particular GRB (GRB221009A) is expected to happen when a large star supernova, leaving a black hole in its wake.
- **Since the Big Bang, GRBs have been the universe's most potent explosions.**
- They are transient but powerful gamma radiation flashes.
- **They generate as much energy as the Sun will discharge throughout the course of its 10-billion-year lifespan.**

TIDAL DISRUPTION EVENTS (TDES)

News: It was recently observed in the universe.

About

- In 2018, researchers witnessed a black hole tearing apart a star because it was too close.
- It was found when researchers looked back at TDES from the previous few years.
- TDE is a term used to describe an occurrence in which too-near stars are severely torn apart by black holes.
- **Whenever a star approaches a black hole, gravitational forces cause the star to stretch or "spaghettify."**

- Then, heated, elongated matter spirals around the black hole, causing a flash that can be seen by us from millions of light years distant.

EARTH RECORDS SHORTEST DAY

News: According to a report, the **29th of July 2022** set a record for the shortest day, with Earth completing a full spin in 1.59 milliseconds less than its standard 24 hours.



About

- **Researchers are still uncertain of the cause of the increased rotational speed of the Earth**, but they speculate that processes in the core's inner or outer layers, oceans, tides, or even changes in climate could be to blame.
- Some believe that the movement of the Earth's geographic poles across its surface, known as the "Chandler wobble".
- The **Chandler wobble is the change in Earth's spin on its axis.**



- To compensate for the long-term slowing of the Earth's rotation caused by the constant melting and refreezing of ice caps, **leap seconds were added to our calendars on occasion.**
- The International Earth Rotation and Reference Systems Service introduced the leap second in 1972.
- Leap seconds are also used to quantify the imprecision of observed solar time. Since 1972, 27 leap seconds have been added.
- The most recent leap second was added on **December 31, 2016.**
- Many researchers believe that if Earth continues to rotate at an increasing rate, negative leap seconds will be required to keep the planet's orbit around the Sun consistent with atomic clock measurements.
- **Atomic clocks are designed to precisely measure the length of a second, the fundamental unit of modern timekeeping.**

EXO-MOONS

News: The Indian Institute of Astrophysics has developed a model to track habitable exomoons using the James Webb Space Telescope (JWST).

About

- They are **natural satellites that orbit exoplanets** (planets that orbit stars other than the Sun).
- So far, 5000 exoplanets have been discovered using various telescopes (Kepler and Hubble space telescopes, for example).
- However, the natural satellites or exo-moons orbiting any of these planets have yet to be discovered.

MENTORSHIP AND DOUBT ENGINE



PW DOUBT ENGINE

- It's an exclusive platform for students to clear their doubts anytime and from anywhere.
- Ask your doubts for particular lecture slide & get detailed answers.
- Feature that compliments teaching in classes.

PW SAARTHI PROGRAM

- Live mentorship by qualified coaches.
- Hand holding approach for academic and non-academic problems.
- Get Mentor's help to make your study plans and weekly planners.
- Get "Friend, Philosopher and Guide" for your civil services journey.

LAUNCHING SOON



SIDE-CHANNEL ATTACKS

News: Indian researchers have built a low-energy security chip that is designed to prevent **Side-channel attacks** (SCAs) on IoT (Internet of Things) devices.

About

- SCA is a **security exploit that aims to gather information from the indirect effects of the functioning of the system hardware rather than attacking a programme or software directly.**
- They basically aim to extract sensitive information like **cryptographic keys, proprietary machine learning models** and parameters by measuring things like timing information, power consumption and electromagnetic leaks of a system.
- **For example,** it can be used on a smartwatch to extract ECG and heart rate signals that one wants to keep secret.

What have The Researchers Done to Prevent SCA Attacks?

- Researchers have **developed a low-energy security chip** that is designed to prevent Side-channel attacks (SCAs) on IoT (Internet of Things) devices.
- The chip **uses near-threshold computing, a computing method where the data is split into separate, unique and random components.**
- **The chip then conducts operations separately** on each component in a random order before aggregating the results for a final result.
- **Due to this method, the information leak from the device through power-consumption measurements are random and would reveal nothing but gibberish in an SCA.**

MAGNETICALLY IMPELLED ARC BUTT (MAIB) WELDING EQUIPMENT

News: Researchers have developed a smart Internet of Things (IoT) integrated machine called “Magnetically Impelled Arc Butt Welding Equipment”.

About

- It is an **Internet of Things (IoT) integrated machine developed for welding ferrous tubes faster than conventional fusion welding or solid-state processes.**
- The Internet of Things integrates everyday “things” with the internet.
- The term “Internet of things” **refers to actual physical things that have sensors, computing power, software, and other technologies and can link to other systems and devices via the Internet or other communications networks and exchange data with them.**

VYOM MITRA

News: Recently, the humanoid “Vyom Mitra” was designed and developed by the Indian Space Research Organisation (ISRO).

About

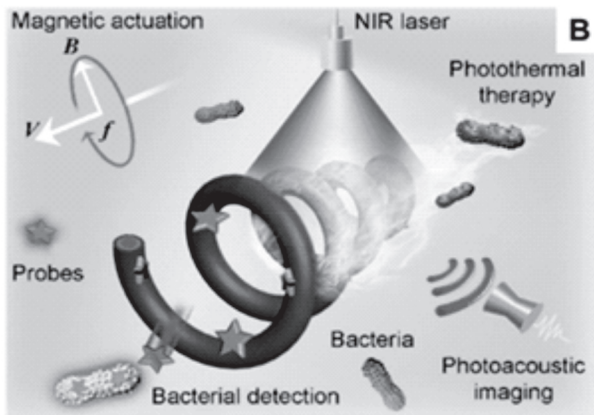
- It is the **‘female’ AI-enabled robot astronaut.** It is a half-humanoid lacking lower limbs.
- **Characteristics:** It has been designed to resemble a human with facial expressions and speech and sight capabilities.
- **Development:** IISU was responsible for the design, development, and integration of the robot, while ISRO centre Vikram Sarabhai Space Centre (VSSC) at Thumba developed its fingers.
- **Significance:**
 - To fly aboard unmanned test missions ahead of the Gaganyaan human space-flight mission.
 - **ISRO Inertial Systems Unit (IISU) has successfully integrated** it with a computer ‘brain’ which enables it to ‘read’ control panels aboard the unmanned test flights and communicate with the ISRO ground stations.

MICRO-SWIMMERS

News: ‘Micro-swimmers’ may soon help with drug delivery- Studies.

About

- Researchers have developed a microbot made from the two-dimensional compound poly (heptazine imide) carbon nitride (aka PHI carbon nitride).
- These **microbots are like miniaturized humans**. They range from 1-to 10 micrometres in size and can self-propel when energized by shining light.



How do These Microbots Swim?

- The PHI carbon nitride micro particles are photocatalytic.
- This means that, just like in a solar cell, the incident light is converted into electrons and holes.
- **These charges drive reactions in the surrounding liquid.** This reaction combined with the **particle's electric field makes** the microbots swim.
- As long as there is light, electrons and holes are produced on the surface of the swimmers, which in turn

react to form ions and an electric field around the swimmer.

- These ions move around the particle and cause fluid to flow around the particle. **So, this fluid flow causes the microbots to swim.**
- **Significance of this development:** This development has shown that it is possible to have microrobots streaming through blood or through other fluids in the human body, which are driven by light and can carry drugs to cancer cells and drop off the medication on the spot.

CYBER-KNIFE

News: PM Modi recently laid the foundation stone of various healthcare facilities in Civil Hospital Asarwa, Ahmedabad.

About

- The new **Civil Hospital Asarwa will be the first government hospital in the country** where state-of-the-art technology like Cyberknife will be available.
- The CyberKnife System is a **non-invasive treatment for cancerous and non-cancerous tumors and other conditions where radiation therapy is indicated.**
- CyberKnife treatments are typically performed in 1 to 5 sessions.
- It is used **to treat conditions throughout the body**, including the prostate, lung, brain, spine, head and neck, liver, pancreas and kidney.
- **It can be an alternative to surgery or for patients who have inoperable or surgically complex tumors.**



NANOALLOYS

News: Under the 'National Supercomputing Mission', scientists have used Machine Learning to develop a design map of alloys at the nanoscale which can help predict the match of pairs of metals that can form bimetallic nanoalloys.

About

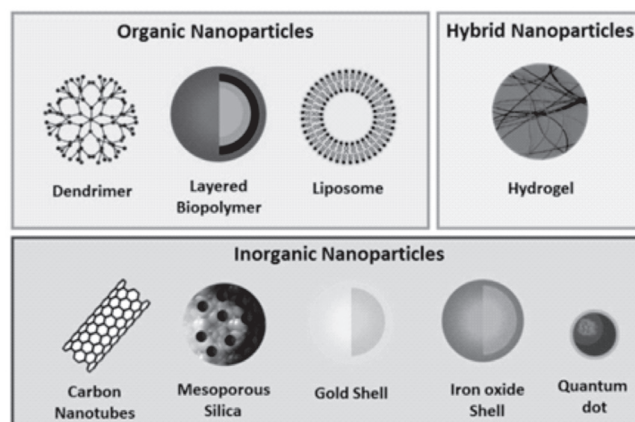
- Nanoalloy is an alloy consisting of dispersed nanoparticles of two or more metals.
- In these nanoalloys, one metal forms the core and the other stays on the surface as a shell. So, they are called **core-shell nanocluster alloys**.
- The following factors play a part in which metal forms the core, and which stays on the surface as a shell in the core-shell structures-
 - Cohesive energy difference,
 - Atomic radius difference,
 - Surface energy difference and
 - Electronegativity of the two atoms.
- Relative importance of the key factors depends on the subset combinations like alkali metal-alkaline earth, transition metal-transition metal etc.
- If the difference in the cohesive energies between the two types of atoms is very small, the nanoclusters constitute a random mix of both the metals.
- If the difference in the cohesive energies is very large, the atoms get segregated into a structure having two faces.
- The faces will be one face of A atoms and another face of B atoms called the **Janus structure named after the two-faced Greek God**.
- Using 'Machine Learning', the computers can be programmed to predict the behaviour of these nano alloys and more.
- **Use:** Machine learning was used to search for cheaper substitutes of naturally occurring rare earth material, whose supply is monopolised by the countries where their mines happen to be located.

CORDY GOLD NANOPARTICLES

News: Collaborative research on a fungus-powered biosynthesised Nano gold particle has received an international patent from Germany.

About

- **Cordy gold nanoparticles (Cor-AuNPs)** is the outcome of a collaborative experiment by scientists from four Indian institutions.



- These nanoparticles could make drug delivery in the human body faster and safer.
- Cor-AuNP is derived from the **synthesis of the extracts of Cordyceps militaris and gold salts**.
- **Cordyceps militaris** is a parasitic fungus that forms a small, 3- or 4-centimeter (about 1.3-inch) mushroom-like fruiting structure with a bright orange head, or cap.
- Gold salts are ionic chemical compounds of gold generally used in medicine.

Cordyceps Militaris

- Cordyceps militaris are called **super mushrooms because of their tremendous medicinal properties**.
- Cordyceps have been used in **traditional medicine for centuries for its anti-aging and anti-inflammatory properties**.

- It adds bioactive components to the synthesis of gold nanoparticles for better penetration.
- Biosynthesized Nano gold particles indicate a new application of nanoparticles in the development of therapeutic drugs which can be delivered as ointments, tablets, capsules, and in other forms.

About Nanoparticles

- A nanoparticle is a small particle that ranges between 1 to 100 nanometres in size.
- Undetectable by the human eye, nanoparticles can exhibit significantly different physical and chemical properties to their larger material counterparts.

LIQUID NANO UREA FERTILIZER

News: Prime Minister (PM) inaugurated the country's first liquid nano urea plant at Kalol (Gujarat).

About Liquid Nano Urea Fertilizer

- Liquid nano urea is a type of nitrogen fertilizer that has been developed using nanotechnology.
- It is made up of very small particles of nitrogen, measuring between 20-50 nanometers in size.
- The fertilizer is sprayed directly onto the leaves of plants, where it is absorbed by the stomata, or small pores found on the surface of the leaves.
- This fertilizer was developed by the Nano Biotechnology Research Centre at Kalol, and is the first of its kind in the world.



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Information and Communication Technology (ICT)

SOVA VIRUS ATTACK

News: The Indian Computer Emergency Response Team (CERT-In) has issued a detailed safety advisory against a new mobile banking ‘Trojan’ virus, SOVA, prowling in Indian cyberspace, which stealthily encrypts an android phone for ransom.

About

- A **new banking malware is targeting bank customers using SOVA android Trojan** with the ability to harvest usernames and passwords.
- **The malware hides itself within fake android applications** displaying logos of legitimate applications like Chrome, Amazon, and NFT (non-fungible token) platforms and deceives users into installing them.
- This **malware captures user credentials when users access their bank accounts through net banking applications.**
- This version of SOVA is targeting over 200 mobile applications and its attacks can result in ‘large-scale’ financial fraud.

ALGAN/GAN HIGH ELECTRON MOBILITY TRANSISTORS

News: Recently, Indian researchers have developed a high-performance industry-standard model for Aluminium gallium nitride (AlGaN/GaN) High Electron Mobility Transistors (HEMTs).

About

- HEMT or High Electron Mobility Transistor is a **type of field effect transistor (FET) which is used to produce high performance at microwave frequencies.**
- Researchers have now developed a high-performance industry-standard model for HEMT devices made from **Aluminium gallium nitride (AlGaN/GaN).**
- The **device has two excellent properties** – high mobility and high-power performance.

- These properties reduce the noise figure and complexity while designing Low Noise Amplifiers (LNAs) (used in wireless transmission like mobile phones, base stations) while increasing the achievable bandwidth.
- This device can also be used to make **high-power Radio Frequency (RF) circuits**, which are used in wireless transmission and are useful for space and defence applications.
- It has also become technology of choice for high-frequency and high-power applications like 5G, radars, base stations, satellite communications.

CENTRAL EQUIPMENT IDENTITY REGISTER (CEIR)

News: The Central Equipment Identity Register (CEIR) project has been launched in Delhi, Mumbai and Maharashtra licensed service areas (LSAs) in a phased manner.

About

- **The Central Equipment Identity Registry (CEIR)** tries to connect the 15-digit International Mobile Equipment Identity (IMEI) database of all the mobile Operators.
- **CEIR acts as a central system for all network Operators to share black listed mobile devices** so even if the Subscriber Identity Module (SIM) card in the device is changed these devices won’t work in any network.
- **The Department of Telecommunications intends to implement the CEIR with the aim to:**
 - Curtail the counterfeit mobile phone market,
 - Discourage mobile phone theft,
 - Protect consumer interest and
 - Facilitate law enforcement authorities for lawful interception.
- **Functions:** The CEIR project facilitates the blocking and tracing of lost and stolen mobile phones using the IMEI.

- The traceability data for the IMEIs will be made available to police of the respective LSA to facilitate recovery of handsets. **People can request the CEIR system for blocking the IMEI number.**
- **Accessibility:** CEIR is a multi-stakeholder system where respective stakeholders have limited access as per their defined roles and responsibilities.
- **Currently, this accessibility includes:**
 - Information to the subscriber about the make & model corresponding to IMEI of his/her mobile handset,
 - Information to mobile phone manufacturers about genuineness of IMEI during import of consignment of mobile phones etc.

ALTIMETER

News: The US Federal Aviation Administration (FAA) has warned that the new 5G technology could interfere with instruments such as altimeters.

About

- An altimeter or an altitude meter is **an instrument used to measure the altitude of an object above a fixed level.** So, in aviation it **measures how far above the ground an airplane is traveling.**
- In addition to altitude, **altimeter readouts are also used to facilitate automated landings and to help detect dangerous currents called wind shear.**

Concern

- The United States auctioned mid-range 5G bandwidth to mobile phone companies in early 2021 in the C band, for about USD 80 billion.
- **Altimeters operate in the 4.2-4.4 GHz range** and the concern is that the auctioned frequencies sit too close to this range.
- **Companies have argued that C band 5G has been deployed in about 40 other countries without aviation interference issues.**

WEB 3.0

News: Recently, Indian venture capital firms are betting on Web 3.0 startups as they view such companies as developers of products for the next stage of the internet.

About

- **Web 3.0 is an evolving term.** It refers to the **next generation “read-write-execute”** Internet with decentralization as its bedrock.
- It **leverages the use of block chain technology** where people can interact with each other without the need of an intermediary.

- **Web 3.0 will be driven by Artificial Intelligence and machine learning** where machines will be able to interpret information like humans.
- **It is more centralised and focused on user-created content.** E.g. Use of Facebook.

Web 1.0	Web 2.0	Web 3.0
Users could only read content.	Users can read content and leave feedback.	Users can create and ‘share’ personalised content.
Focus was only on website landing pages (static content)	Focus is on interaction enable content platform (Blogs, Wikis, etc.)	Focus on content aesthetic as well as user needs. (Livestreams).
Content was owned	Content is shared	Content will be collectively owned and shared
Content directions contained all the informations.	Tagging on content pages has enabled information sharing with other users.	Custom content will be displayed for each user based on feedback.

- **Goal of Web 3.0:** To create more intelligent, connected, and open websites.
- **Web 1.0:** It is a read-only Internet made of static web-pages.
- **Web 2.0:** It is a read and write Internet. Users were able to communicate with servers and other users leading to the creation of the social web. This is the World Wide Web that we use today.

Web 5.0

- Web 5.0 is Web 2.0 plus Web 3.0 that will allow users to **‘own their identity’** on the Internet and **‘control their data’.**
- It is being developed by former Twitter CEO Jack Dorsey’s Bitcoin business unit, The Block Head.
- It aims at building an extra decentralized web that puts you in control of your data and identity.
- It is built with an aim to return “ownership of data and identity to individuals”.
- **Difference between Web 3.0 and Web 5.0:** Both Web 3.0 and Web 5.0 envision an Internet without censorship from governments or big tech.

PARAM PRAVEGA

News: The Indian Institute of Science (IISc) has installed and commissioned Param Pravega, **one of the most powerful supercomputers in India.**

About:	- Designed by the Centre for Development of Advanced Computing (C-DAC). - It is the largest supercomputer in an Indian academic institution. - It was installed and commissioned under the National Supercomputing Mission (NSM). - The system is expected to power diverse research and educational pursuits. - It has a supercomputing capacity of 3.3 petaflops (1 petaflop equals a quadrillion, or 1015 operations per second).
Peta Flops:	- In computing, floating-point operations per second (FLOPS, flops or flop/s) is a measure of computer performance, useful in fields of scientific computations that require floating-point calculations. - For such cases it is a more accurate measure than measuring instructions per second.

About National Supercomputing Mission (NSM)

- The mission was **announced in 2015**.
- NSM **envisaged setting up a network of 70 high-performance computing facilities** with an aim to connect national academic and R&D institutions across India over a seven-year period at an estimated cost of Rs 4500 Crores.
- Parent Body:** Ministry of Electronics and IT (MeitY) and Department of Science and Technology (DST).
- Nodal Agencies of NSM:** Centre for Development of Advanced Computing (C-DAC), Pune, and the Indian Institute of Science (IISc), Bengaluru.
- Under NSM, the long-term plan is to build a strong base of 20,000 skilled persons** over the next five years who will be equipped to handle the complexities of supercomputers.
- In 2020, a RTI reply revealed that India has produced just three supercomputers since 2015 under NSM:**
 - PARAM Shivay** installed in IIT-BHU, Varanasi with 837 TeraFlop capacity
 - PARAM Shakti** at IIT-Kharagpur with 1.66 PetaFlop capacity
 - PARAM Brahma** at ISER-Pune, has a capacity of 797 TeraFlop.

PARAM GANGA

News: The National Supercomputing Mission (NSM) has deployed PARAM Ganga-a High-Performance Computational (HPC) facility at IIT Roorkee, with a supercomputing capacity of 1.66 Petaflops.

About	- It has been established by the Centre for Development of Advanced Computing (C-DAC) under the approach of NSM. - It has a supercomputing capacity of 1.66 Petaflops (1 petaflop equals a quadrillion or 1015 operations per second). - This supercomputer will accelerate the research and development activities with a focus on providing computational power to the user community of IIT Roorkee and neighboring academic institutions.
Supercomputer in India:	India's first supercomputer was PARAM 8000. PARAM Shivay, the first supercomputer assembled indigenously, was installed in IIT (BHU), followed by PARAM Shakti, PARAM Brahma, PARAM Yukti, PARAM Sanganak at IIT-Kharagpur, IISER, Pune, JNCASR, Bengaluru and IIT Kanpur respectively. - In 2020, PARAM Siddhi, the High-Performance Computing-Artificial Intelligence (HPC-AI) supercomputer, achieved global ranking of 62nd in Top 500 most powerful supercomputer systems in the world.

SATELLITE BROADBAND SERVICES

News: Digital services company Jio Platforms has formed a joint-venture with Luxembourg-based satellite linked content connectivity solutions provider SES to deliver satellite broadband services across India.

About	• The joint venture will use multi-orbit space networks that is a combination of GEO (geostationary equatorial orbit) and MEO (medium earth orbit) satellite constellations capable of delivering multi-gigabit links and capacity to enterprises, mobile backhaul and retail customers across the length and breadth of India and neighbouring regions. • The joint venture will be the vehicle for providing SES's satellite data and connectivity services in India, except for certain international aeronautical and maritime customers who may be served by SES. • It will have availability of up to 100 Gbps capacity from SES.
Jio's proposed satellite broadband service vs Starlink or OneWeb:	• SES primarily has satellites in the GEO and the MEO, while those of Elon Musk-led Starlink and Bharti Group's OneWeb is in Low Earth Orbit (LEO). • While GEO satellites are positioned at an altitude of 36,000 km, MEO and LEO are lower at altitudes of 5,000- 20,000km and 500-1,200 km, respectively. • The altitude of the satellite is directly proportional to the area of earth that it covers. Therefore, the higher a satellite is positioned, the larger an area it covers.

QUANTUM KEY DISTRIBUTION (QKD)

News: Recently, a joint team of scientists from Defence Research and Development Organisation (DRDO) and Indian Institute of Technology (IIT) Delhi, for the first time in the country successfully demonstrated Quantum Key Distribution link between Prayagraj and Vindhyachal in Uttar Pradesh, a distance of more than 100 kilometres.

About	• QKD is primarily a mechanism to undertake secure communication which utilizes a cryptographic protocol involving various components of quantum mechanics. • The technology enables two communicating sides to come up with random secret keys shared by both of them and known exclusively to them, so only they can use it to encrypt and decrypt messages, thus achieving a very highly- secure communication. • In the QKD, encryption keys are sent as 'qubits' (or quantum bits) in an optical fibre.
What makes QKD unbreakable?	• The security of QKD stems from the ability to detect any intrusion on the QKD transmission. • Because of the unique and fragile properties of photons, any third party (or eavesdropper) who tries to read or copy the photons in any way will change the photons' state. • The change will be detected by the endpoints, alerting them that the key has been tampered with and must be discarded. • A new key is then transmitted. Moreover, since the keys generated are truly random, they are protected from future hacking attempts.

PARAM ANANTA

News: PARAM ANANTA, a state-of-the art Super-computer has been commissioned at IIT Gandhinagar.

About

- PARAM ANANTA is a supercomputer capable of offering peak performance of 838 teraflops.
- It has been **developed jointly by the Centre for Development of Advanced Computing (C-DAC) and the Indian Institute of Technology, Gandhinagar**.
- **Established under:** Phase 2 of the National Supercomputing Mission (NSM).
- **The technology used:** It is based on Direct Contact Liquid Cooling technology to obtain a high-power usage effectiveness and thereby reduce the operational cost.
- **Applications:** Multiple applications from various scientific domains such as Weather and Climate, Bioinformatics, Computational Chemistry, Molecular Dynamics, Material Sciences, and Computational Fluid Dynamics have been installed on the system for the benefit of researchers.
- **Significance:** With Param Ananta, India now has 15 supercomputers with a combined performance capability of 24 petaflops.

QUANTUM COMPUTING

News: According to a study by IBM, India is witnessing a growing interest in quantum computing, with students, developers, and academia actively participating. Consequently, the country is emerging as a talent hub for quantum computing.

About:	- Quantum computing is a rapidly-emerging technology that harnesses the laws of quantum mechanics to solve problems too complex for classical computers. Quantum mechanics is a subfield of physics that describes the behavior of particles — atoms, electrons, photons, and almost everything in the molecular and sub molecular realm. - It is a fundamentally different way of processing information compared to today's classical computing systems.
Different from Traditional Computers:	- While today's classical computers store information as binary 0 and 1 states, quantum computers draw on the fundamental laws of nature to carry out calculations using quantum bits. - Unlike a bit that has to be a 0 or a 1, a qubit can be in a combination of states, which allows for exponentially larger calculations and gives them the potential to solve complex problems which even the most powerful classical supercomputers are not capable of.

IBM India's Initiatives around Quantum Computing

- Qiskit Challenge:** Qiskit is an open-source software development kit built by IBM for the quantum developer community.
- Qiskit India Week of Quantum:** IBM regularly organizes India-focused programmes such as **Qiskit India Week of Quantum**, which celebrated women in quantum to kickstart their journeys in quantum, and was attended by almost 300 students.
- The Qiskit Textbook:** Qiskit textbook is available in Tamil, Bengali and Hindi and was accessed more than 30,000 times by students in India in 2021 alone.
- IBM Quantum Educators Programme:** IBM is collaborating with leading educational institutions in India through the IBM Quantum Educators Programme.
- The faculty and students of these institutions will be able to access IBM Quantum systems**, quantum learning resources and quantum tools over IBM Cloud for educational purposes.

Quantum Network

- This **network aims to advance quantum computing (computing based on principles of quantum theory) skills development and research in India.**
- Quantum networks **also known as the quantum internet is an internet network that makes use of the properties of photons to transmit data.**
- It allows quantum devices to exchange information within a particular environment that **harnesses the principles of quantum mechanics.**

5G VERTICAL ENGAGEMENT AND PARTNERSHIP PROGRAMME

News: The Department of Telecommunications (DoT) has invited the Expression of Interest (EoI) for the "5G Vertical Engagement and Partnership Programme (VEPP)".

About

- Launched by:** Department of Telecommunications (DoT).
- Objective:** To build strong collaborative partnerships across 5G Use-case ecosystem stakeholders with velocity and with an exclusive emphasis to address User/Vertical Industry needs.

Key Features of the Programme:	- The programme is being offered to Industry verticals that have potential as testing cum breeding grounds for innovative 5G use cases. - Under the programme, DoT will partner with other ministries, state governments and start-up hubs to facilitate necessary approvals, and regulatory clearances to enable use case prototyping, pilots, demos, and trials at the user or vertical industry premises. - On the other hand, technology stakeholders will have to work to develop and deploy prototypes and pilots for 5G use cases as per the needs of the respective ministries or industry verticals to help accelerate commercial usage and adoption by enterprises.
Significance of the Program:	- The program will enable close collaboration between User verticals and 5G Tech stakeholders (Service providers, Solution providers & partner Original Equipment Manufacturers). - This can trigger a multiplier effect to try & finetune 5G digital solutions in respective economic verticals.
Features and benefits of the 5G technology:	5G is the next generation of mobile broadband that will eventually replace, or at least augment 4G LTE connection. - Operates in the millimeter wave spectrum (30-300 GHz) which have the advantage of sending large amounts of data at very high speeds. Operates in 3 bands, namely low, mid and high frequency spectrum. - Reduced latency will support new applications that leverage the power of 5G, the Internet of Things (IoT), and artificial intelligence. - Increased capacity on 5G networks can minimize the impact of load spikes, like those that take place during sporting events and news events.

About 6G Technology

- 6G is the **next generation of wireless communication technology** after 5G, currently under development.
- It is intended to be **faster, more reliable, and more efficient than 5G**, and will likely offer a wide range of new capabilities and use cases.

VARIABLE REFRESH RATES (VRR)

News: Google is said to be testing support for variable refresh rates (VRR) in the Chrome OS 101 Dev Channel, according to a report by About Chromebooks. The feature could improve gaming experience on Chromebooks9.

About

- Refresh rate is the **number of times a display is capable of refreshing in a second.**
- It is **measured in hertz (Hz)**. So, a 30 Hz or a 60 Hz display can refresh 30 or 60 times per second, respectively.
- The higher the refresh rate, the better the quality of viewing experience.
- Displays with over 120 Hz can deliver a smoother and more comfortable viewing experience.** This is necessary while playing video games or watching videos.
- VRR supports a wide range of refresh rates**, allowing its refresh rate to change in real-time based

on the frames-per-second (FPS) rate coming from a source device such as a gaming console.

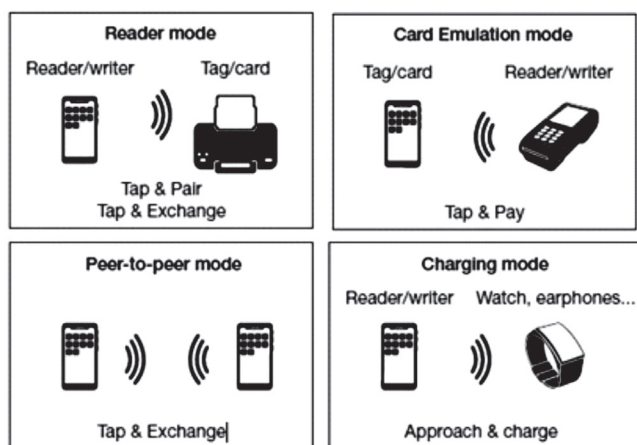
- VRR is **also termed as Dynamic Refresh Rate (DRR) or Adaptive Refresh Rate (ARR)** by different device makers.
- VRR is **designed to eliminate syncing issues that arise when the refresh rate of a display does not match with the FPS of the content from a source device.**
- Issues such as screen-tearing, judder (wobbling effect) and lag are common when refresh rate and FPS are not synchronized.

NEAR FIELD COMMUNICATION (NFC) TECHNOLOGY

News: Google Pay has recently launched a new feature in India, 'Tap to pay for UPI', in collaboration with Pine Labs. The feature makes use of Near Field Communication (NFC) technology.

About

- NFC is a **short-range wireless connectivity technology that allows NFC-enabled devices to communicate with each other and transfer information quickly and easily with a single touch.**
- It makes it possible to pay bills, exchange business cards, download coupons, or share a document.



Working of NFC

- NFC transmits data through electromagnetic radio fields to enable communication between two devices.
- Both devices must contain NFC chips as transactions take place within a very short distance.
- NFC-enabled devices must be either physically touching or within a few centimetres from each other for data transfer to occur.

How will this Technology Work with the Recently Launched Feature, 'Tap to Pay for UPI'?

- This feature will allow users with NFC-enabled Android smartphones and UPI accounts linked to Google Pay to carry out transactions just by tapping their phones on any Pine Labs Android point-of-sale (POS) terminal across the country.

Applications of NFC technology:	- Wireless Charging and generating contact-less tickets for public transport. - Driving payment services like Google Wallet and Apple Pay. - NFC is behind the cards that can wave over card readers in subway turnstiles and on buses to check tickets. - With just a touch, NFC can also set up WiFi and Bluetooth devices in homes. - It also has an application in healthcare to monitor patient stats through NFC-enabled wristbands.
Reliability of NFC Technology:	- NFC technology is designed for an operation between devices within a few centimetres from each other. - This makes it difficult for attackers to record the communication between the devices, compared to other wireless technologies which have a working distance of several meters. - The user of the NFC-enabled device determines by the touch gesture which entity the NFC communication should take place with, making it more difficult for the attacker to get connected.

SPLINTERNET

News: Russia's invasion of Ukraine does seem as a potential trigger for a splintered internet.

About

- The idea of 'Splinternet' was proposed by Clyde Wayne Crews, a researcher at libertarian think-tank Cato Institute.
- The 'Splinternet' is an **internet splintered into disparate realms controlled by different dispensations or powers.**
- It is also **referred to as cyber-balkanization or internet balkanization.**
- The fundamental proposal was to have more internet instead of having more regulations.
- For example, China's 'Great Firewall' keeps American tech giants out while pushing online services developed indigenously.

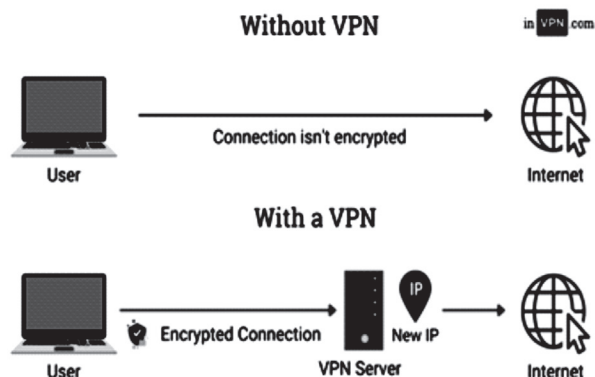
- In 2019, **Russia passed the online Iron Curtain (the sovereign internet law) that enabled it to disconnect its internet from the rest of the world.**
- In Iran, a project called the **National Information Network (NIN) or National Internet in Iran** has been initiated by the state-owned Telecommunication Company of Iran.

VIRTUAL PRIVATE NETWORK (VPN)

News: Virtual Private Network (VPN) service providers are up in arms against a new directive of The Indian Computer Emergency Response Team or Cert-In, a wing of the Ministry of Electronics and Information Technology.

About

- The new directive **mandates they must maintain all customer data for five years.**
- VPN service providers have said the new directive would mean a total loss of privacy for the users—one of the most important unique selling points of such services.

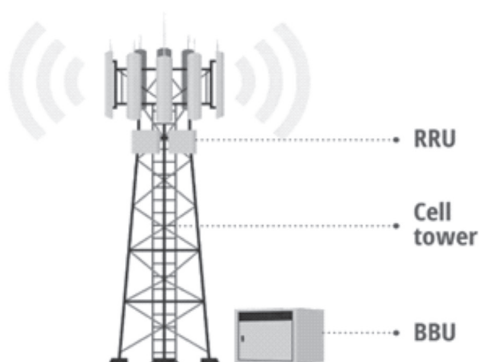


IP address:	- Any and all devices connected to the internet are a part of a large network of computers, servers and other devices spread across the world. - To identify each device connected to the internet, service providers globally assign a unique address to each such device called the internet protocol address or IP address. - It is this IP address that helps websites, law enforcement agencies and even companies track down individual users and their accurate location.
Virtual Private Network (VPN):	- A virtual private network, when switched on, essentially creates a safe network within the larger global network of the internet and masks the IP address of the user by rerouting the data. Acting as a tunnel, a VPN takes data originating from one server and masks it in a different identity before delivering it to the destination server. - In essence, a VPN creates several proxy identities for your data and delivers it safely without disturbing the content of the data.

RADIO ACCESS NETWORK (RAN)

News: Recently, Telecommunication Engineering Center (TEC), a technical arm of the Department of Telecommunications (DoT) has signed a Memorandum of Understanding (MoU) with VVDN Technologies Private Limited.

The traditional RAN architecture relies on specialized hardware and proprietary software, which raises costs, limits flexibility, and constrains vendor choice



About

- The signing of MoU will facilitate registered startups, innovators and MSMEs working in the field of Open RAN to get their products tested at the existing lab of M/s VVDN.
- It is aimed that India shall be emerging as the design leader in 5G/ORAN. This test certification ecosystem will make India as design testing and certification hub of Asia.

Radio Access Network (RAN)

- RAN is a **key part of a mobile network system that uses cellular radio connections to link individual devices to other parts of a network.**
- It comprises antennae which transmit and receive signals to and from our smartphones or other compatible devices. The signal is then digitized in the RAN-base station and connected to the network.

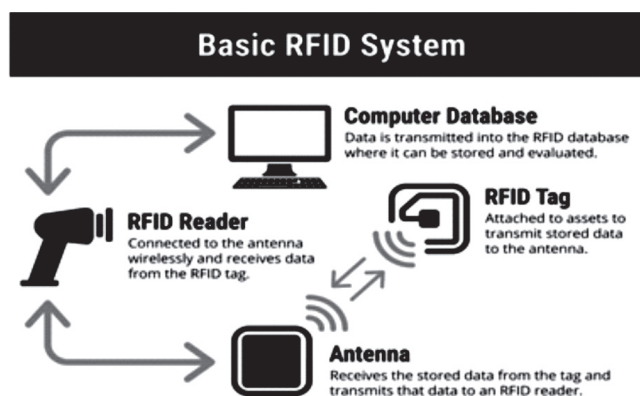
Open RAN

- Currently, RAN is provided as an integrated platform of both hardware and software.** Therefore, it is difficult to mix vendors for the radio and baseband unit and in most cases, they come from the same supplier.

- The **idea of Open RAN is to change this**. It aims to enable a multi-supplier RAN solution that allows for the separation – or disaggregation – between hardware and software.
- With Open RAN, telecom players would have the flexibility to use in-house solutions or solutions from multiple vendors for RAN services.
- **Significance:** Being software-centric, it is scalable, agile and best of networks with improved network performance using artificial intelligence and machine learning. Open RAN would reduce a telecom operator's network deployment cost.

RADIO FREQUENCY IDENTIFICATION (RFID) TAGS

News: RFID tags will now be used to track Amarnath pilgrims.



About

- Radio Frequency Identification is a **wireless tracking system that consists of tags and readers**.
- Radio waves are used to communicate information/identity of objects or people.
- The tags **can carry encrypted information, serial numbers and short descriptions**.

Types:	• Active RFIDs use their own power source, mostly batteries. • Passive RFIDs are activated through the reader using the electromagnetic energy it transmits.
Working Mechanism:	• RFID tags use an integrated circuit and an antenna to communicate with a reader using radio waves at several different frequencies – low frequency (LF), high frequency (HF), and ultra-high frequency (UHF). • The message sent back by the tag in form of radio waves is translated into data and analyzed by the host computer system. • Unlike Barcodes, RFIDs do not require direct line of sight to identify objects.
Applications of RFIDs:	• Retail giants use them for inventory tracking. RFID chips are used as access keys in labs. • They are also built into credit cards and library books. • FastTags being used for toll payments across the country are also RFID tags. • In the Budget speech this year, the Union Finance Minister spoke about the government's plan to roll out e-passports. These are likely to be paper passports carrying RFID chips in the jacket.

5G TESTBED

News: The Prime Minister inaugurated the country's first 5G testbed that will enable start-ups and industry players to test their products locally, thereby reducing dependence on facilities abroad.

About

- The 5G testbed has been developed as a multi-institute collaborative project by eight institutes led by IIT Madras.
- **Purpose:** It will enable startups and industry players to test and validate their products locally and reduce dependence on foreign facilities.
- **Note:** In the absence of a 5G testbed in India, startups and other industry players were required to go abroad

to test and validate their products for installation in a 5G network.

About 5Gi

- The 5G Radio Interface Technology, called 5Gi is a **locally designed telecommunication network that has been designed by IIT Hyderabad, IIT Madras and the Centre of Excellence in Wireless Technology**.
- The technology will be an **alternative to the global 5G standards**.
- 5Gi **offers more range at a lower frequency, which is the opposite of 5G**. The latter works between the 700 MHz to 52,000 MHz bands and sacrifices on range.
- **Benefits of 5Gi**
 - Using the 5Gi standard will allow telcos in the country to widen the 5G connectivity to villages.

- Cost-effective.
- 5Gi can make sure there is no lag between the advancement of 5Gi in cities like Delhi, Mumbai, Chennai, and rural parts of the country.

PARAM PORUL SUPERCOMPUTING FACILITY

News: PARAM PORUL, a state-of-the art Supercomputer at NIT Tiruchirappalli under National Supercomputing Mission (NSM) was inaugurated.

About	● PARAM PORUL supercomputing facility is established under Phase 2 of the NSM with 838 TeraFlops Supercomputing Facility. ● The majority of the components used to build this system have been manufactured and assembled within the country, along with an indigenous software stack developed by C-DAC, in line with the Make in India initiative. ● PARAM PORUL system is based on Direct Contact Liquid Cooling technology to obtain a high-power usage effectiveness and thereby reducing the operational cost. ● Applications installed: Multiple applications from various scientific domains such as Weather and Climate, Bioinformatics, Computational Chemistry, Molecular Dynamics, Material Sciences, etc. have been installed.
Significance:	● NIT is carrying out research in the areas of societal interest such as Health, Agriculture, Weather, and Financial Services. The facility installed under NSM will strengthen this research. ● The computer will provide a major boost to the research and development initiatives in Indian academia and industries.
Recent developments under National Supercomputing Mission:	● Under Phase 1 & Phase 2, 15 systems with computer power of 22 Petaflops (PF) have been built at IIT's, C-DAC, NIT, JNCASR, and IISER. ● NSM deployed "PARAM Ganga" at IIT Roorkee in March 2022 with a supercomputing capacity of 1.66 Petaflops as a part of phase 2. ● PARAM Siddhi-AI is the fastest supercomputer in India built under NSM with a capacity of 5.26 PF. ● Japan's Fugaku is the world's fastest supercomputer.

HERMIT

News: Hermit is the latest sophisticated spyware in the news, and it is believed to have targeted iPhones and Android devices in Italy and Kazakhstan.

About

- Hermit is a **spyware developed by the Italian commercial spyware vendor RCS Lab**.
- The spyware is distributed by text message which looks like coming from a legitimate source.
- The **malware can impersonate other apps** that are developed by telecom companies and manufacturers which tricks the victim to download the malware.

How does it Affect Devices?

- Hermit can **infect both Android and iOS devices**. It is **similar to the Pegasus spyware** by NSO Group.
- Once installed on a device, **it can record audio on the device, carry out unauthorized calls and many unauthorized activities**.

- It can also steal data from the target's calendar and address book apps, as well as take pictures with their phone's camera. It also has the capability to root an Android device.

LANGUAGE MODEL FOR DIALOGUE APPLICATIONS

News: Google's LaMDA (Language Model for Dialogue Applications) (a language model created by google AI) has **achieved the ability to engage in a free-flowing conversation**. Google believes that LaMDA has become a sentient program meaning it has started reasoning like a human being.

About

- **Google had first announced LaMDA at its flagship developer conference I/O (Input/Output)** in 2021 as its generative language model for the dialogue applications which can assure that the application will be able to converse on any topic.

- **LaMDA can engage in a free-flowing way about a seemingly endless number of topics**, an ability that the company thinks can unlock more natural ways of interacting with technology and the entirely new categories of helpful applications.
- LaMDA can have a discussion on the basis of the user's inputs thanks completely to its language processing model which has been trained on large amounts of dialogue.

LaMDA 2.0

- Google at I/O 2022 announced LaMDA 2.0 which will further build on these capabilities.
- The new model will possibly take an idea and generate imaginative and relevant descriptions, can stay on a particular topic even if a user strays off-topic, and can also suggest a list of things that are needed for a specified activity.

About Chatbot

- Chatbots, also called chatterbots, is a **form of Artificial Intelligence (AI) used in messaging apps**.
- This tool helps add convenience for customers—they are automated programs that interact with customers like a human would and cost little to nothing to engage with.
- Key examples are chatbots used by businesses in **Facebook Messenger, or as virtual assistants, such as Amazon's Alexa**.
- Chatbots tend to operate in one of two ways—either via machine learning or with set guidelines.
- However, due to advancements in AI technology, chatbots using set guidelines are becoming a historical footnote.

ARTPARK AND GIGAMESH

News: A Startup named Astrome with the help of ARTPARK will soon connect 15 villages in different parts of the country through a next-generation networking solution called GigaMesh.

About GigaMesh

- **Developed by:** Astrome with the support of ARTPARK.
- **Purpose:** It is the world's first multi-beam E-band Radio that is able to communicate from one tower to multiple towers simultaneously while delivering multi GBPS throughput to each of these towers.

- **Working:** A single GigaMesh device can provide up to forty links with 2+ Gbps capacity, communicating up to a range of ten kilometres.
- This flexibility in range makes it suitable for both decongesting the dense urban networks and extending rural coverage.

AI & Robotics Technology Park (ARTPARK)

- ARTPARK (AI & Robotics Technology Park) is a **not-for-profit foundation**. It was established by the Indian Institute of Science (IISc), Bengaluru with support from the Department of Science & Technology (DST).
- **Purpose:** To promote technology innovation missions in AI (Artificial Intelligence) and Robotics. These missions should have a societal impact in sectors such as healthcare, education, mobility, infrastructure, agriculture, retail, and cyber-security.
- **Nodal Mission:** The park was established under the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS).

EXTENDED REALITY (XR)

News: MeitY Startup Hub (MSH) in collaboration with Meta will launch a program to support and accelerate Extended Reality (XR) technology startups across India.

About

- Extended Reality (XR) is an **umbrella term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables**.
- It includes representative forms such as Augmented Reality, Mixed Reality, and Virtual Reality and the areas interpolated among them.

MeitY Startup Hub

- MeitY Startup Hub is an initiative of the **Ministry of Electronics and Information Technology (MeitY)**.
- **Purpose:** It is a national platform focused on promoting technology innovation, start-ups, and the creation of intellectual properties.

E-SIM TECHNOLOGY

News: The eSIM (or embedded SIM) is quickly becoming mainstream due to fitness-oriented smartwatches and smartphones.

About:	- An eSIM is an embedded SIM, essentially the same hardware of a regular SIM card chip, but now a permanently embedded part of the motherboard of a watch or smartphone. - eSIMs were first established a decade ago in 2012, but despite their futuristic use-cases, have not completely made physical SIMs obsolete yet.
Advantages of eSIMs:	Convenience: It will also save a trip to a telecom store/ service centre when you visit a different state or country where you may want to switch to another operator. Security: When a phone with a physical SIM card is lost or stolen, the SIM card can be used in illegal activities. An eSIM prevents this, as there is no physical element to pull out and use in another device.
Disadvantages of eSIMs:	Emergencies: Traditional SIMs can be quickly pulled out of the affected/Damaged phone and into another backup device or secondary phone. It is not possible with eSIMs. Unusable in countries with no eSIM support: It cannot be used in a country where the telecom operators simply don't support the technology yet.

EVERYTHING APP OR A SUPER APP

News: Elon Musk is thinking about creating an “everything app. According to him, buying Twitter is an accelerant to creating X, the everything app.

About

- The **concept of an everything app, often referred to as a “super app,” is massively popular in Asia and tech companies across the world have tried to replicate it.**
- A super app has been described as the Swiss army knife of mobile apps, offering a suite of services for users such as messaging, social networking, peer-to-peer payments and e-commerce shopping.
- Some examples of super apps in India:**
 - **Paytm:** It has brought together services like payments, ticket bookings, games, online shopping, banking, consumer finance, etc into one app.
 - **PhonePe:** It has tied up with companies such as Ola Cabs, Swiggy, Grofers, Ajio, Decathlon, Delhi Metro, booking.com, etc. to offer these services from within its own app.

NET NEUTRALITY

News: The debate over net neutrality has resurfaced in the country, with telecom operators supporting a proposal to regulate content delivery networks, which are used by global big tech companies to host data locally.

About

- Net Neutrality is the **idea that Internet service providers (ISPs) should treat all data that travels over their networks fairly, without favouring specific apps, sites, or services.**
- It entails ensuring that all end users can access internet content, applications, and services at the same level of service quality, speed, and price, with no preference or degradation based on the type of content, applications, or services.**

TRAI on Net Neutrality

- In its Net Neutrality recommendations, TRAI has backed the fundamental principles of an open and free internet.
- Discriminatory content treatment is prohibited.**
- Internet access services should be governed by a principle that prohibits discrimination or interference with content treatment



MEET OUR GS FACULTIES



RAJNEESH RAJ

(HISTORY)

- > MOST LOVED FACULTY FOR HISTORY OPTIONAL
- > 20+ YEARS OF EXPERIENCE AT RENOWNED INSTITUTES
- > MENTORED MORE THAN 2,00,000 UPSC CSE ASPIRANTS
- > MORE THAN 2000 SELECTIONS IN UPSC
- > POST GRADUATE FROM DLHI UNIVERSITY



AMIT KUMAR SINGH

(ETHICS)

- > 15+ YEARS OF EXPERIENCE AT RENOWNED INSTITUTES
- > MENTOR MORE THAN 1,00,000+ STUDENTS & 1000+ SELECTION
- > TAUGHT ETHICS & PHILOSOPHY IN DELHI UNIVERSITY FOR 3 YEARS
- > GRADUATE FROM ALLAHABAD UNIVERSITY IN PHILOSOPHY & POST GRADUATE FROM DELHI UNIVERSITY



DR. ADARSH KUMAR

(POLITY, GOVERNANCE AND IR)

- > EDUCATIONAL & LEGAL CONSULTANT
- > PHD IN ROLE OF BUREAUCRACY, UGC-NET QUALIFIED
- > 23+ YEARS OF EXPERIENCE IN TEACHING, MENTORING 3,00,000+ STUDENTS FOR CIVIL SERVICE EXAM
- > AUTHORED BOOKS ON INDIAN POLITY, CONSTITUTION & PUBLIC ADMINISTRATION FOR UPSC ASPIRANTS



RAJESH MISHRA

(GEOGRAPHY)

- > 10+ YEARS OF UPSC TEACHING EXPERIENCE WITH MENTORING OF 1 LAKH+ ASPIRANTS
- > UGC-NET QUALIFIED
- > EX. FACULTY FOR MULTIPLE RENOWNED INSTITUTES



DEEPAK KUMAR SINGH

(ETHICS & IR)

- > 18 YEARS+ EXPERIENCE IN BOTH ONLINE AND OFFLINE PLATFORM
- > RENOWNED FACULTY FOR ETHICS, PSIR & POLITY.
- > EX-EDUCATOR OF TOP PROMINENT INSTITUTES.
- > MENTORED MORE THAN 100000+ STUDENTS IN UPSC



RITESH R JAISWAL

(SCIENCE & TECHNOLOGY & ENVIRONMENT)

- > 15+ YEARS OF UPSC TEACHING EXPERIENCE WITH RENOWNED INSTITUTES ACROSS INDIA
- > MOCK INTERVIEW PANELIST & INTERVIEW EXPERT
- > SPECIALIZED IN TEACHING SCIENCE & TECHNOLOGY AND ENVIRONMENT



PRATIK GUPTA

(ECONOMY)

- > POST GRADUATE FROM DU & IGNOU
- > MENTORED MORE THAN 1,00,000 STUDENTS FOR CIVIL SERVICE EXAM
- > 10+ YEARS OF EXPERIENCE IN TEACHING WITH VARIOUS RENOWNED INSTITUTES



KAPIL SIKKA

(POLITY & GOVERNANCE)

- > MENTORING, GUIDING AND TEACHING UPSC STUDENTS SINCE 9 YEARS
- > SPECIALIZED IN TEACHING INDIAN POLITY, INDIAN ECONOMY, ESSAY, INTERNAL SECURITY & POST INDEPENDENCE INDIA WITH AN EXPERIENCE OF TEACHING IN LEADING INSTITUTES



DR. MOHD. ZIA

(ECONOMY & HISTORY)

- > FACULTY, COACH AND MENTOR- GS-HISTORY, GS-ECONOMY AND HISTORY OPTIONAL
- > TEACHING EXPERIENCE OF 8+ YEARS WHICH INCLUDES SERVICE AS ASSISTANT PROFESSOR AT RIE, NCERT, BHOPAL
- > MA IN HISTORY FROM IGNOU, PHD FROM A.M.U.



ABHISHEK SRIVASTAV

(HISTORY)

- > EXPERIENCED FACULTY FOR INDIAN HISTORY & CULTURE AT RENOWNED INSTITUTES
- > 7+ YEARS OF EXPERIENCE IN TEACHING AND MENTORING 45000+ STUDENTS FOR CIVIL SERVICE EXAM
- > GRADUATE FROM INDIAN MARITIME UNIVERSITY, KOLKATA



LOKESH TRIPATHI

(ECONOMY)

- > MA (ECONOMICS) , UGC NET QUALIFIED
- > APPEARED FOR 3 UPSC INTERVIEWS
- > 10+ YEARS OF EXPERIENCE IN TEACHING, MENTORING 60000+ STUDENTS FOR CIVIL SERVICE EXAM
- > FACULTY, COACH AND MENTOR- GS- INDIAN ECONOMY AND GOVERNMENT SCHEMES.



MANJU CHOUDHARY

(POLITY, NCERTS, CA)

- > M.COM (GOLD MEDALIST), MA (PUBLIC ADMINISTRATION) , UGC NET QUALIFIED
- > 6+ YEARS OF EXPERIENCE IN TEACHING, MENTORING 50000+ STUDENTS FOR CIVIL SERVICE EXAM
- > FACULTY, COACH AND MENTOR- GS- INDIAN POLITY AND NCERT BASICS, CURRENT AFFAIRS.

MEET OUR GS FACULTIES



DR. MOHD SALEEM
(SCIENCE & TECHNOLOGY)

- > RENOWNED SCIENCE & TECH FACULTY
- > 12+ YEARS YEARS OF EXPERIENCE IN TEACHING
- > MENTORED MORE THAN 100000+ STUDENTS FOR CIVIL SERVICE EXAM
- > ALUMNI OF JAMIA MILLIA ISLAMIA RESIDENTIAL COACHING
- > EX-EDUCATOR OF PROMINENT INSTITUTES



ANANT TRIPATHI
(HISTORY, CSAT)

- > MBA FROM IIFT, NET QUALIFIED IN HISTORY, MANAGEMENT & PUBLIC ADMINISTRATION.
- > MENTORED MORE THAN 1,00,000 STUDENTS FOR CIVIL SERVICE EXAM
- > 10+ YEARS OF EXPERIENCE IN TEACHING WITH VARIOUS RENOWNED INSTITUTES



BARUN
(ECONOMICS & CURRENT AFFAIRS)

- > B. TECH FROM WEST BENGAL UNIVERSITY OF TECHNOLOGY IN ELECTRICAL ENGINEERING
- > MENTORED MORE THAN 5,00,000 STUDENTS FOR CIVIL SERVICE EXAM
- > 5+ YEARS OF EXPERIENCE IN TEACHING WITH VARIOUS RENOWNED INSTITUTES



NANKI BAWEJA
(ECONOMY)

- > EX. EDUCATOR AT RENOWNED INSTITUTES WITH AN EXPERIENCE OF MENTORING 5000+ STUDENTS IN THEIR UPSC JOURNEY
- > QUALIFIED COMPANY SECRETARY AND HOLDS AN MBA IN FINANCE



DEEPAK SINGH
(HISTORY, ECONOMY & ETHICS)

- > B.COM ACCOUNTS HONORS GRADUATE
- > MENTORED MORE THAN 1,00,000 STUDENTS FOR CIVIL SERVICE EXAM
- > 8+ YEARS OF EXPERIENCE IN TEACHING WITH VARIOUS RENOWNED INSTITUTES



SHASHANK SHEKHAR ROY
(ETHICS & IR)

- > TRAINED THOUSANDS OF STUDENTS FOR UPSC AND OTHER STATE SERVICES
- > DECADES OF EXPERIENCE IN TEACHING, TRAINING AND MENTORING
- > CERTIFIED COMMUNICATION COACH, MOTIVATIONAL SPEAKER AND MENTOR



AKSHAT DWIVEDI
(POLITY & IR)

- > B.TECH IN BIOMEDICAL ENGINEERING & POST GRADUATION IN M. A. POLITICAL SCIENCE
- > 5+ YEARS OF EXPERIENCE AT RENOWNED INSTITUTE
- > MENTORED MORE THAN 20,000 UPSC CSE ASPIRANTS.
- > INVOLVED IN RESEARCH FIELD OF INTERNATIONAL RELATIONS



SNEHIL TRIPATHI
(POLITY)

- > PUBLISHED AUTHOR WITH MCGRAW HILL EDUCATION AND OXFORD UNIVERSITY PRESS
- > 7+ YEARS OF TEACHING EXPERIENCE WITH VARIOUS INSTITUTES ACROSS THE COUNTRY
- > EX. ACADEMIC HEAD AND TOP FACULTY WITH RENOWNED ED-TECH ORGANIZATION



SONIYA AHUJA
(INTERNATIONAL RELATIONS)

- > 7+ YEARS OF TEACHING EXPERIENCE IN POLITICAL SCIENCE AND PSYCHOLOGY
- > MA POLITICS WITH SPECIALIZATION IN INTERNATIONAL RELATIONS, JNU DELHI
- > SPECIALIZED IN LEARNING PEDAGOGY & CURRICULUM DESIGN
- > BA IN SOCIAL SCIENCE, TISS MUMBAI



ADITYA TIWARI
(HISTORY, ECONOMY AND ETHICS)

- > BIOCHEMICAL ENGINEER, HBTI, KANPUR
- > G.T.E. DESIGN, INDIAN OIL CORPORATION
- > UPSC INTERVIEW APPEARED

QUANTUM ENTANGLEMENT (QE)

News: Scientists have identified the first “quantum entangled” animal in history-frozen tardigrade, in a recent study.

About

- Quantum entanglement is a **physical phenomenon that occurs when a group of particles are generated, interact, or share spatial proximity in a way such that the quantum state of each particle of the group cannot be described independently of the state of the others, including when the particles are separated by a large distance.**
- Scientists have placed a tardigrade in a state of quantum entanglement.
- The researchers managed to put a tardigrade in a state where it was directly connected to the qubits in such a way that anything that happens to the water bear or the qubits would simultaneously affect all three.
- This study is perhaps the closest realization combining biological matter and quantum matter available with present-day technology.
- Moreover, this work is a new record for the conditions that a complex form of life can survive.

About Tardigrades

- Tardigrades are also **called water bears or moss piglets.** They are **near-microscopic multicellular organisms.**
- They were discovered in 1773 by the German zoologist Johann August Ephraim Goeze who dubbed them as “little water bears”.
- Tardigrades are found everywhere in terrestrial, marine, and freshwater environments** from the Arctic to the Antarctic, including great depths and altitudes.
- They are known to survive extreme conditions** — such as exposure to extreme temperatures, extreme pressures (both high and low), air deprivation through a latent state of life known as cryptobiosis. Tardigrades have also survived exposure to outer space.

- Cryptobiosis or anabiosis is a metabolic state of life entered by an organism in response to adverse environmental conditions** such as desiccation, freezing, and oxygen deficiency.

PHENOL

News: Indian researchers from the Centre for nano and soft matter sciences and CSIR – National Chemical Laboratory have regarded electrolysis as an effective way for the oxidative transformation of phenol.

About

- Phenols is an **organic compound.** The oxidative products of phenols like 1,4 hydroquinone, catechol or resorcinol **play an important role in the synthesis of medicinal and industrial organic compounds.**
- The product 1,4 hydroquinone is used as an **intermediate in the manufacturing of food preservatives, pharmaceuticals and polymers.**

What was the issue?

- Currently, phenol oxidation is carried out by chemical methods using catalysts involving precious metals, metal oxides, and enzymes along with hazardous oxidants.
- But **these methods suffer from many disadvantages**, including incomplete conversion of starting material and lack of product selectivity, along with environmental hazards.
- Due to lack of efficient processes for conversion of Phenol, India currently imports 1,4 hydroquinone** at a heavy cost.
- Indian researchers have found that electrolysis is an effective method for the oxidative transformation of phenol to 1,4 hydroquinone.

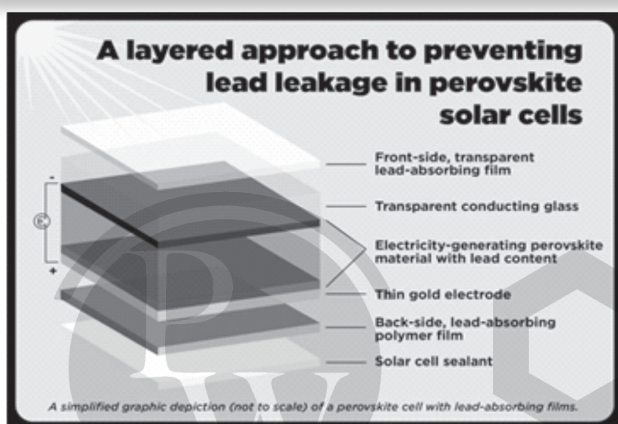
Significance

- Moreover, the **electrolysis method does not involve the release of environmentally hazardous agents**, and it is **more efficient than the chemical methods.**



PEROVSKITE SOLAR CELLS

News: Recently, Indian Scientists have devised a new process for increasing the efficiency and stability of Titanium dioxide (TiO_2) nanorods based on Perovskite Solar Cells (PSC).



About

- It is a **type of solar cell that includes a perovskite-structured compound**, most commonly a hybrid organic-inorganic lead or tin halide-based material, as the light-harvesting active layer.
- PSCs have become commercially attractive because of the **potential of achieving even higher efficiencies and very low production costs**.
- However, the **challenge lies in its short- and long-term stability**.

Recent Development

- **Scientists have increased the efficiency and stability of Titanium dioxide (TiO_2) nanorods based on Perovskite Solar Cells (PSC) by varying the length and porosity of the TiO_2 -Nanorods.**
- This will help to develop solar cells with stable light-harvesting active layers.
- **Scientists have identified co-dopants that can increase the photovoltaic performance of transparent metal oxides such as ZnO , In_2O_3 and SnO_2 thereby creating the potential for more**

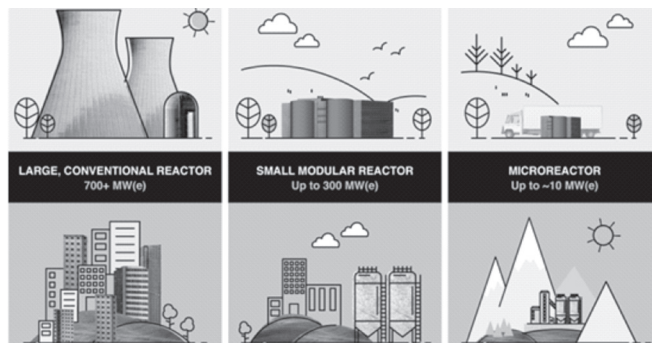
efficient, better performing and more stable solar cells.

SMALL MODULAR REACTORS

News: Recently, NITI Aayog member and scientist V K Saraswat suggested that the government should focus on setting up small modular reactors as it would help meet the country's energy needs and also in replacing aging thermal power plants.

About Small modular reactors

- Small modular reactors (SMRs) are **advanced nuclear reactors that have a power capacity of up to 300 MW(e) per unit**, which is about one-third of the generating capacity of traditional nuclear power reactors.
- The **SMR is relatively a nascent concept**, but they can make nuclear energy more scalable and flexible.
- It is projected that up to 21GW of SMRs could be added globally by 2035, making up approximately 3% of total installed nuclear capacity.
- According to the International Atomic Energy Agency (IAEA), more than 70 SMR concepts are currently under development in 18 countries.



Advantages of SMRs

- **Smaller footprint:** SMRs can be sited on locations not suitable for larger nuclear power plants.
- **Affordable:** Prefabricated units of SMRs can be manufactured and then shipped and installed on

site. This makes them more affordable to build than large power reactors, which are often designed for a particular location, sometimes leading to construction delays.

- **Savings:** SMRs offer savings in cost and construction time, and they can be deployed incrementally to match increasing energy demand.
- **Sustainable Development:** It can play a key role in the clean energy transition, while also helping countries address the Sustainable Development Goals (SDGs).
- **Reduced fuel requirements:** SMRs have reduced fuel requirements.
- Power plants based on SMRs may require less frequent refueling, every 3 to 7 years, in comparison to between 1 and 2 years for conventional plants.
- **Some SMRs are designed to operate for up to 30 years without refueling.**

About Microreactors

- **Microreactors are small modular nuclear power plants** that have a capacity of fewer than 10 megawatts (MW).
- Although the technology has not been commercially demonstrated yet, several designs are moving through licensing in North America and Europe, with anticipated demonstrations in the next few years.
- **They are expected to operate for years without refueling including the need to generate power on a small scale in remote locations,** at deployed military installations, and in locations recovering from natural disasters.

ROSHINI

News: It is India's first Saline Water Lantern which uses sea water as electrolyte between specially designed electrodes to power the LED lamps.

About

- **Developed by:** National Institute of Ocean Technology (NIOT), Chennai.
- Technology can also be used in hinterlands, as any saline/normal water mixed with common salt can be used to power the lantern
- **Significance:**
 - Cost-effective and feasible to operate.
 - Bring 'Ease of Living' to the poor and needy, particularly the fishing community.

LIGHT-EMITTING DIODES (LED)

News: Scientists have developed a material through which we can move towards bright, stable and affordable Light-Emitting Diodes (LEDs).

About

- LED is a **semiconductor device that emits infrared or visible light when charged with an electric current.**
- Cost-efficient and bright light-emitting diodes (LEDs) are commonly desired for general light sources. However, attaining desired stability and brightness of LEDs has been challenging for scientists.

Present Developments

- Scientists at the Center for Nano and Soft Matter Sciences (CeNS), an autonomous research institute under the Department of Science and Technology (DST) found that simple plasma treatment of inorganic material of cesium lead halide nanocrystals can lead to an enhanced stabilization of many folds showing the promise of bright and stable LEDs.
- Plasma treatment induces the cross-linking of the organic molecules, oleylamine, present on the surface of the nanocrystals.
- This creates a stronger network of ligands, providing better encapsulation and higher PL intensity.

FLEX FUEL

News: Toyota to launch India's first flex-fuel car.

About

- The initiative will power India's aim to be among the top global producers in every segment of vehicles over the next 25 years.
- **Flexible fuel vehicles (FFVs) have an internal combustion engine** and are capable of operating on gasoline and any blend of gasoline and ethanol up to 83%.
- **E85 (or flex fuel) is a gasoline-ethanol blend containing 51% to 83% ethanol,** depending on geography and season.
- **FFVs have one fuel system, and most components are the same as those found in a conventional gasoline-only car.**
- **Some special ethanol-compatible components are required to compensate for the different chemical properties and energy content in**

ethanol, such as modifications to the fuel pump and fuel injection system.

- FFVs have **improved acceleration performance** when operating on higher ethanol blends.

HYDROGEN FUEL CELL

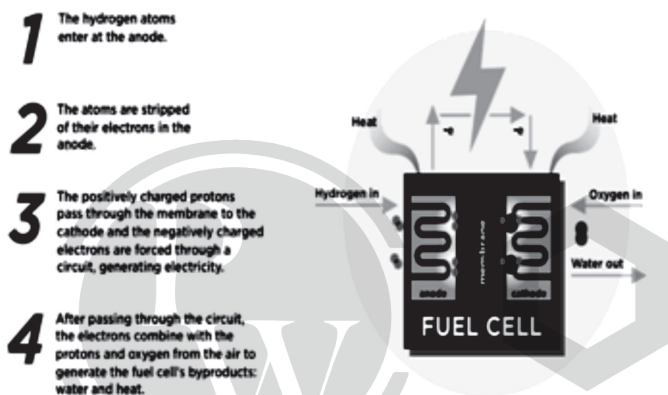
News: Recently, India's first truly indigenously developed hydrogen fuel cell bus was unveiled.

About

- It is a **collaboration between the Council of Scientific and Industrial Research (CSIR) and the private firm KPIT Technologies Ltd.**

HOW FUEL CELLS WORK

A fuel cell is an electrochemical energy conversion device - it utilizes hydrogen and oxygen to generate electricity, heat, and water.



- A fuel cell is an **electrochemical energy conversion device that uses hydrogen and air to generate electricity, heat, and water.**

Benefits of Fuel Cell

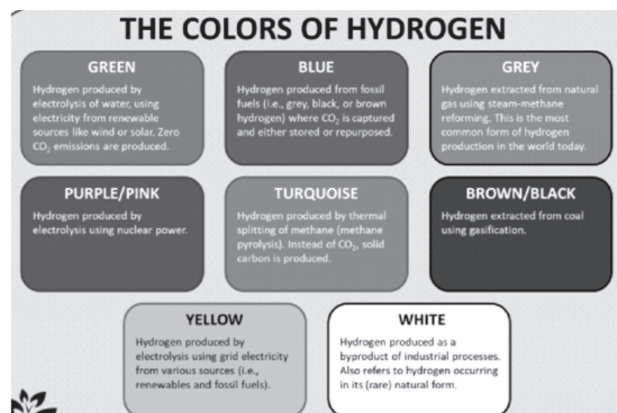
- **Lower operational costs** as a result of hydrogen's high energy density and efficiency.
- **Meet climate change targets** by decarbonizing transportation.
- Because of its quiet operation and modular design, it can be **used in small residential, automotive, and portable electronic devices.**
- **Overcome smog and health issues** caused by air pollution.
- Operating times are significantly longer than battery life.

COAL BASED HYDROGEN

News: The Ministry of Coal has established a Task Force and Expert Committee to develop a plan for producing hydrogen from coal.

About

- This effort **aims to explore the potential of using coal as a source for hydrogen production**, which could be used for various industrial and transportation applications.



About Coal Based Hydrogen:

- Coal-based hydrogen is hydrogen that is **produced from the process of coal gasification.**
- In this process, **coal is heated to high temperatures in the presence of steam and a limited amount of oxygen**, which breaks down the coal into its constituent gases, including **hydrogen, carbon monoxide, and methane.**
- The resulting mixture of gases, known as **"syngas,"** can be further processed to purify the hydrogen for use as a **fuel or chemical feedstock.**

Hydrogen Powered IC Engine:

- Recently, Rolls-Royce successfully tested a **hydrogen-powered jet engine.**
- A **hydrogen internal combustion engine (ICE)** works on the same principles as a traditional ICE, except that **it uses hydrogen in place of a petroleum-based fuel.**

Hydrogen Microgrid Project:

- NTPC awarded **India's first Green Hydrogen-based Microgrid Project at Simhadri, Andhra Pradesh.**

LITHIUM CELL PLANT

News: India's first lithium cell manufacturing facility at Tirupati, Andhra Pradesh was inaugurated.

About the Facility

- The state-of-the-art facility has been set up by the **Chennai based Munoth Industries Limited** with an outlay of Rs. 165 crores.

- The facility is **located in one of the two Electronics Manufacturing Clusters set up in the temple town**, by Prime Minister Narendra Modi in 2015.
- Currently, **India imports complete requirements of lithium-ion cells** primarily from **China, South Korea, Vietnam and Hong Kong**.
- Cells for other consumer electronics like Mobile Phones, hearable and wearable devices will also be produced.

NUCLEAR FUSION

News: Scientists in the **United Kingdom** said they have achieved a **new milestone** in producing **nuclear fusion energy**, or imitating the way energy is produced in the Sun.

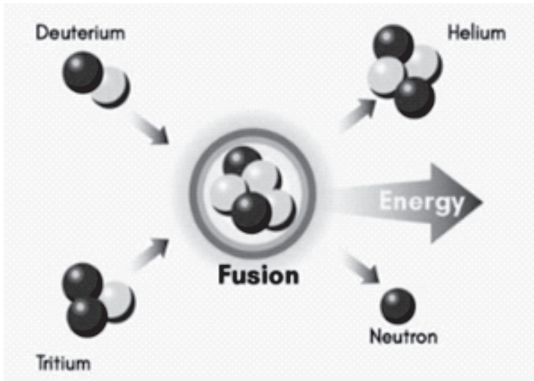
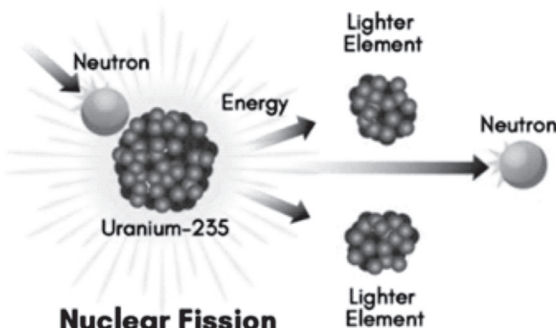
About Nuclear Fusion

- Nuclear fusion is the **process by which atomic nuclei come together to form a heavier nucleus**, releasing a **large amount of energy** in the process.
- This is the **same process that powers the sun** and other stars.
- **Three conditions** must be fulfilled to achieve fusion in a laboratory:

- **Very high temperature** (on the order of $150,000,000^{\circ}$ Celsius).
- **Sufficient plasma particle density** (to increase the likelihood that collisions do occur).
- **Sufficient confinement time** (to hold the plasma, which has a propensity to expand, within a defined volume).

About International Thermonuclear Experimental Reactor

- ITER is a large-scale **international scientific collaboration** that aims to demonstrate the feasibility of **nuclear fusion as a source of clean and sustainable energy**.
- The project is being built in the **South of France** and involves **35 countries**, including the **European Union, the United States, China, India, Japan, South Korea, and Russia**.
- ITER's **primary goal** is to produce a **self-sustaining nuclear fusion reaction**, known as "**burning plasma**," that generates more energy than it consumes.
- The project is **currently under construction**, with the first plasma expected to be produced in 2025, and the first deuterium-tritium experiments in 2035.

Nuclear Fusion	Nuclear Fission
• Nuclear fusion is the process of combining two or more atomic nuclei to form a heavier nucleus, releasing a large amount of energy in the process. • This is the process that powers the sun and other stars. • Atoms of Tritium and Deuterium (isotopes of hydrogen) are used in the process. 	• Nuclear fission is the process of splitting a heavy nucleus into two or more smaller nuclei, releasing a large amount of energy in the process. • This is the process that powers current nuclear power plants. • Nuclear fission generates heat by splitting heavy atoms like uranium and plutonium to release energy. 



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ARTIFICIAL NEURAL NETWORK (ANN)

News: The global Artificial Neural Network (ANN) Market report was published. As per the current report, ANN Market is to set phenomenal growth from 2021 to 2028.

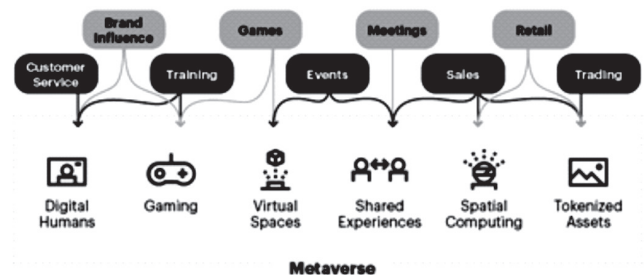
About

- **Artificial Neural Networks (ANN)** also known as **Neural Networks** are a vital subset of machine learning and are at the heart of deep learning algorithms.
- Their name and structure are inspired by the human brain, mimicking the way that biological neurons signal to one another.
- **They are not like other machine learning algorithms that process numbers or organize data**, it is an algorithm that learns from experience and repeated tasks performed by users.
- It is fed massive volumes of data in the beginning phases. In most cases, training is done by providing input and informing the network about what should be the output.
- **Backpropagation is a commonly used method for training artificial neural networks**, especially deep neural networks.
- **Applications:** The applications of Artificial Neural Network (ANN) are Image Pre-processing and Character Recognition, Forecasting, Credit rating, Fraud Detection, Portfolio Management among others.
- **Limitations of ANN:**
 - Train networks, which frequently demand an acceptable level of computational power for even complex tasks.
 - They do not have the specific decision-making capabilities.

AI RESEARCH SUPERCLUSTER

News: Facebook-parent Meta is building an AI supercomputer, the AI Research Supercluster (RSC).

Opportunities in a Metaverse (Now and in the Future)



About

- It is an **AI Supercomputer** being built by Facebook-parent Meta.
- The RSC will be **capable of quintillions of operations per second**.
- It can perform tasks like translating text between languages and help identify potentially harmful content on Meta's platform.
- **It can run computer vision workflows up to 20 times faster.**
- **It can train large-scale Natural Language Processing (NLP) models** three times faster.
- **It can help its researchers build better AI models that can work across different languages**, seamlessly analyse text, images and video together.
- **It also powers real-time voice translations** so that people can collaborate on a research project, and develop new augmented reality tools.
- **RSC can keep people safe in the metaverse through its training models** that can detect harmful content faster than earlier systems.

DAYLIGHT HARVESTING

News: The Ministry of Science & Technology has decided to promote a unique Start-up in Daylight Harvesting Technology.

About

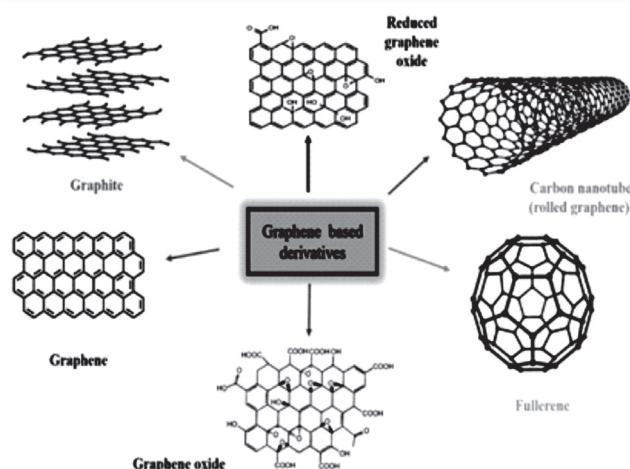
- Daylight Harvesting is a **method of saving the energy costs associated with lighting. It makes use of the available sunlight.**
- The **solar energy spectrum has 45% energy as visible light** and this can be used to harvest building illumination for about 9-11 hours a day.
- The daylight harvesting system **employs light sensors, also known as photocell sensors**, to detect the prevailing light level in the environment.
- It then sends the intensity of light received to a controller, which is connected to the lighting control system.
- The control system in turn **adjusts the electric lights automatically according to the measured light level.**
- **Benefits:** Reduced carbon footprint, Improved building energy efficiency and reduces electrical lighting energy consumption.

Government initiatives to promote Daylight Harvesting

- **The Technology Development Board (TDB) under the Ministry of Science and Technology** will provide Rs 5 crore as support to a startup called Skyshade Daylight Private Limited for developing Daylight Harvesting Technologies.
- This helps in reducing electrical lighting energy consumption by 70-80 per cent, besides reducing air-conditioning needs.

ARTIFICIAL INTELLIGENCE (AI) CHIPS

News: The adoption of Artificial Intelligence (AI) chips has risen in recent times with chipmakers designing different types of these chips to power AI applications.



About

- AI chips are built with specific architecture and have integrated AI acceleration to support deep learning-based applications.
- It combines a series of computer commands or algorithms that stimulate activity and brain structure.
- DNNs go through a training phase, learning new capabilities from existing data.
- DNNs can then infer, by applying these capabilities learned during deep learning training to make predictions against previously unseen data.
- Deep learning can make the process of collecting, analysing, and interpreting enormous amounts of data faster and easier.
- **Chips like these, with their hardware architectures, complementary packaging, memory, storage, and interconnect solutions, make it possible for AI to be integrated into applications across a wide spectrum to turn data into information and then into knowledge.**
- **Types of AI Chips Designed for Diverse AI Applications:** Application-Specific Integrated Circuits (ASICs), Field-Programmable Gate Arrays (FPGAs), Central Processing Units (CPUs) and GPUs.
- **Applications:** AI applications include Natural Language Processing (NLP), computer vision, robotics, and network security across a wide variety of sectors, including automotive, IT, healthcare, and retail.

BLOCKCHAIN GAMING

News: The vast scope and potential of blockchain technology has attracted the gaming industry over the past few years. In India too, gaming industries are exploring this option.

About

- Blockchain Gaming are online video games that are developed by integrating blockchain technology into them.
- It includes elements that use cryptography based blockchain technologies like Cryptocurrency or Non-Fungible Tokens (NFTs).
- **These elements are used by players to buy, sell, or trade with other players**, with the game publisher taking a fee from each transaction as a form of monetization.
- **Example of Blockchain Game:** In 2017, Dapper Labs had developed the first-ever blockchain game called **Crypto Kitties**.

Elements of Blockchain Gaming

- **NFTs:** NFTs represent in-game virtual assets that can be owned by players, such as maps, armor or land.
- **These NFTs act as asset tags**, identifying ownership of the in-game assets, and are stored on the blockchain.
- **Being on the blockchain allows the player to have a secure record of ownership** of the in-game assets, and also gives the assets the ability to outlive the game itself.
- **It also creates transparency**, since ownership records can independently be verified by any third party as well.
- **In doing so, it makes in-game assets marketable and creates a decentralized market**, where they can be bought and sold by people.
- **Cryptocurrency:** Cryptocurrency, such as tokens based on the Ethereum blockchain, may be used for the purchase of in-game assets.
- These in-game purchases usually enable gamers to buy items like extra lives, coins and so on directly from the game.

PROOF-OF-STAKE TECHNOLOGY

News: Merge is a software upgrade to the way transactions are validated on the Ethereum blockchain that aims to reduce energy consumption.

About

- Proof of Stake (PoS) is a **type of algorithm which aims to achieve distributed consensus in a Blockchain**.
- A stake is value/money we bet on a certain outcome. The process is called staking.
- A more particular meaning of stake will be defined later on.
- Before proof of stake, the most popular way to achieve distributed consensus was through Proof-of-Work.
- But Proof-of-Work is quite energy (electrical energy in mining a bitcoin) intensive. So, a proof-of-work based consensus mechanism increases an entity's chances of mining a new block if it has more computation resources.

MITTICOOL REFRIGERATOR

News: The Bureau of Indian Standards (BIS) has developed an Indian Standard, IS 17693: 2022 for a 'non-electric cooling cabinet made of clay' named "Mitticool refrigerator".

About

- Mitticool Refrigerator is a **non-electric cooling cabinet made of clay**.
- **Developed by:** Shri Mansukh Bhai Prajapati from Gujarat.
- **Technology:** The refrigerator operates on the principle of evaporative cooling.
- **Objective:** The programme supports grassroots innovations developed by individuals and local communities in any technological field.
- **Evaporative cooling:** Evaporative cooling, otherwise known as adiabatic cooling, works on the principle of water evaporation through which the air is cooled down to a comfortable temperature. It is a cooling and ventilation technique that uses water as its refrigerant.
- **Uses of Refrigerator:** It is a natural refrigerator **made primarily from clay to store vegetables, fruits, milk, and also for cooling water**.
- It provides natural coolness to foodstuffs stored in it **without requiring any electricity**.

ARTIFICIAL SNOW

News: In Beijing, athletes will compete on 100% artificial snow for the first time in Winter Olympics history.

About

- Artificial snow is made up of small ice particles that are used to increase the amount of snow available for winter sports like skiing and snowboarding.
- It is created by a machine that sprays a mist of water into the cold air using a high-pressure pump.
- Water droplets then crystallize to form fake snow.

CHAT GPT

News: The latest **AI tool ChatGPT** is creating a buzz among computer scientists and programmers due to its **creative capabilities**.

About Chat GPT

- The **OpenAI Company** has developed a **new Chabot called ChatGPT** which is a conversational AI that **can answer queries like a human** and is fine-tuned to provide **conversational responses**.

- It can be used for a **wide range of tasks** such as replacing basic emails, party planning lists, CVs, writing four-page essays, solving math equations and even spotting errors in code.
- ChatGPT is based on the **Generative Pre-Training (GPT) language model**, a type of **neural network** that can create new content based on input content, also known as **Training Data**.
- ChatGPT is the **latest version of GPT API (DPT3)** and is **additionally trained on conversational transcripts with human feedback**.

About OpenAI

- OpenAI is a **research institute and company** that focuses on developing artificial intelligence technology in a responsible and safe way.
- It was **founded in 2015** by a group of entrepreneurs and researchers, including **Elon Musk, Sam Altman, and Greg Brockman**.



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EXERCISE SKYLIGHT

News: The Indian Army recently conducted “Skylight Mega-Exercise”, to enhance its space domain capabilities.

About

- **Aim:** To test the operational readiness and robustness of its satellite communication systems in the event of an attack by an adversary.

Does the Indian Army have its own dedicated satellite?

- The Indian Army uses the services of a number of ISRO satellites that connect hundreds of communication terminals of various types.
- Unlike the Indian Air Force and the Navy, the Indian Army currently does not have a dedicated satellite.

Indian Army Satellite by 2025: GSAT-7B Satellite

- The **Defence Acquisition Council has cleared a proposal for a GSAT-7B communications satellite**. With this, the Indian Army is on course to get its own satellite by December 2025.
- **Note:** GSAT 7 satellites are advanced satellites developed by the Indian Space Research Organization (ISRO) to meet the communication needs of the defence services.

FACIAL RECOGNITION TECHNOLOGY

News: Right to Information (RTI) responses received by the Internet Freedom Foundation reveal that the Delhi Police treats matches of above 80% similarity generated by its facial recognition technology (FRT) system as positive results.

About

- Facial recognition is an algorithm-based technology which creates a digital map of the face by identifying and mapping an individual's facial features, which it then matches against the database to which it has access.

- **It can be used for two purposes:**

1. **Firstly**, 1:1 verification of identity wherein the facial map is obtained for the purpose of matching it against the person's photograph on a database to authenticate their identity. For example, 1:1 verification is used to unlock phones. However, increasingly it is being used to provide access to any benefits or government schemes.
2. **Secondly**, there is the 1: n identification of identity wherein the facial map is obtained from a photograph or video and then matched against the entire database to identify the person in the photograph or video. Law enforcement agencies such as the Delhi Police usually procure FRT for 1: n identification.

- **The use of FRT presents two issues:** Issues related to misidentification due to inaccuracy of the technology and issues related to mass surveillance due to misuse of the technology.

BRAHMOS MISSILES

News: The Ministry of Defense has signed a Rs 1700 crore contract with BrahMos Aerospace Pvt Ltd to buy additional dual-role capable BrahMos missiles for the Indian Navy.

About

- The BrahMos missile, an **Indo-Russian joint venture**.
- **Features:**
 - It has a range of 290 km and is the fastest cruise missile in the world with a top speed of Mach 2.8 (nearly three times the speed of sound).
 - BrahMos is named for the **rivers Brahmaputra and Moskva**.
 - It is a two-stage (solid propellant engine in the first stage and liquid ramjet in second) missile.
 - It is a **multiplatform missile** i.e., it can be launched from land, air, and sea and multi capability missile with pinpoint accuracy that works in both day and night irrespective of the weather conditions.
 - It **operates on the “Fire and Forgets” principle** i.e., it does not require further guidance after launch.

- The range of the missile was originally capped at 290 km as per obligations of the **Missile Technology Control Regime (MTCR)**.
- Following India's entry into the MTCR club in 2016, the range has been extended to 450 km and to 600 km.

Recent Development

- In April 2022, an anti-ship version of the BrahMos supersonic cruise missile was successfully test-fired jointly by the Indian Navy and the Andaman and Nicobar Command.
- In January 2022, an extended range sea-to-sea variant of the BrahMos supersonic cruise missile was test fired from stealth guided missile destroyer INS Visakhapatnam.

Naval Variant of Brahmos Missile

- The Naval Variant of the BrahMos supersonic cruise missile has an extended range of 350 to 400 km.
- The missile can fly at 2.8 Mach speed which is almost three times the speed of sound.

INS Visakhapatnam

- INS Visakhapatnam is the first of four indigenously designed and built Project-15B class stealth guided-missile destroyers.
- It was commissioned in November 2021.
- Other Three Ships of Project 15B: **Mormugao, Imphal, Surat.**

C295 AIRCRAFT

News: The Prime Minister has laid the foundation stone of a C295 aircraft manufacturing plant in Vadodra, Gujarat, of the Tata-Airbus consortium that will manufacture the transport aircraft for the Indian Air Force (IAF).

About

- C295 is a new-generation tactical airlifter in the light and medium segment. **It is manufactured by Airbus Defence and Space in Spain.**
- **Equipped with Two Pratt & Whitney engines.**
- **Purpose:**
 - C295 can carry troops and logistical supplies from main airfields to forward operating airfields of the country.
 - It can also operate on short unprepared airstrips as it is capable of Short Take-off and Landing (STOL).
 - **It can additionally be used for casualty or medical evacuation**, performing special missions, disaster response and maritime patrol duties
- India has concluded a deal with Airbus for C295 medium transport aircraft (MTA).

AD-1 (AIR DEFENCE)

News: The Defence Research & Development Organisation (DRDO) conducted the maiden flight-test of Phase-II of the ballistic missile defence (BMD) interceptor AD-1 missile successfully.

About

- The AD-1 (Air Defence) is a long-range interceptor missile designed for both low exo-atmospheric and endo-atmospheric interception of long-range ballistic missiles as well as aircraft.
- The missile is propelled by a two-stage solid motor.
- It is equipped with an indigenously developed advanced control system and a navigation and guidance algorithm.

FIVE MAKE II PROJECTS

News: Recently, Indian Army has approved project sanction orders for five Make-II projects providing further impetus to Atma Nirbharta.

About

- Make-II projects are essentially industry-funded projects involving design, development and innovative solutions by Indian vendors for the development of prototypes.

What are the Projects Approved?

- **High-Frequency Man-Packed Software Defined Radio (HFSDR):** It will facilitate blue-force tracking with map-based navigation using a geographic information system (GIS) thereby increasing real-time situational awareness.
- These radio sets will replace the existing HF radio sets in the inventory which have limited data handling capability and obsolete technology.
- **Drone Kill System:** A drone Kill System is a hard kill anti-drone system against low Radio Cross-Section (RCS) Drone/unmanned Aerial System (UAS), being developed to function in all types of terrains, both during day and night. The development of this project is reserved for MSMEs/start-ups.
- **Infantry Training Weapon Simulator (IWTS):** It is a modern training aid which will reduce recurrent expenditures on live ammunition, besides obviating the challenges of availability of firing ranges and inclement weather. Each IWTS will facilitate the training of 10 personnel at any one point in time.
- **155mm Terminally Guided Munitions:** The Indian Army plans to procure approximately 2000 rounds of 155mm TGM against High-Value Targets with assured Precision and Lethality for mission accomplishment and minimum collateral damage.

- **Medium Range Precision Kill System (MRPKS):** These systems can 'Loiter' in the air for up to two hours and acquire, designate and engage real-time high-value targets up to 40 km.

SUBMERSIBLE PLATFORM FOR ACOUSTIC CHARACTERIZATION & EVALUATION (SPACE)

News: Defence Research & Development Organization (DRDO) launched the Hull Module of SPACE facility at Naval Physical & Oceanographic Laboratory (NPOL) Kochi recently.

About

- **It is a state-of-the-art testing and evaluation facility for sonar systems** developed for use by the Indian navy onboard various platforms, including ships, submarines and helicopters.
- **Design and Construction:**
 - The SPACE facility is based on the concept design and requirements projected by NPOL and has been constructed by M/s L&T Shipbuilding, Chennai.
 - The design and construction of the platform meet all the statutory needs of Indian Register of Shipping and the vessel classifying authority and strictly adhere to the inspection and registration criteria as per Kerala Inland Vessel Rules.
- **Use:** This will be mainly utilized for evaluating Sonar systems, allowing for quick deployment and easy recovery of scientific packages such as sensors and transducers.
- **Features:** The uniqueness of this facility lies in the specially designed submersible platform, which can be lowered up to depths of 100 meters using a series of synchronously operated winches.

HWASONG-17

News: North Korea said it test-fired its massive new Hwasong-17 Intercontinental Ballistic Missile (ICBM).

About

- The Hwasong-17 is nuclear-armed North Korea's biggest missile yet, and is the largest road-mobile, liquid-fueled ICBM in the world.
- Its diameter is estimated to be between 2.4 and 2.5 meters, and its total mass, when fully fueled, is likely somewhere between 80,000 and 110,000 kg.
- Unlike North Korea's earlier ICBMs, the Hwasong-17 is launched directly from a transporter, erector, and launcher (TEL) vehicle with 11 axles, photos by state media showed.

- The missile launched on Friday flew nearly 1,000 km (621 miles) for about 69 minutes and reached a maximum altitude of 6,041 km.
- The weapon could travel as far as 15,000 km (9,320 miles), enough to reach the continental United States.

AGNI-IV

News: India conducted a test of the nuclear capable Agni-IV ballistic missile, which has a strike range of 4,000 km, as part of a "night user trial in operational configuration" by the Strategic Forces Command (SFC).

About

- **Developed by:** Defence Research and Development Organization (DRDO).
- Agni-IV is an Intermediate Range Ballistic Missile (ICBM).
- **Range and Payload:** It has a range of around 4,000 km. It can carry a 1,000-kg payload and can go as high as 900 km.

Agni Missiles

- Agni missiles are long range, nuclear weapons capable of surface-to-surface ballistic missiles.
- **The first missile of the series, Agni-I** was developed under the Integrated Guided Missile Development Program (IGMDP) and tested in 1989.
- **Variants of Agni missiles:**
 - **Agni-I:** It is a Medium Range Ballistic Missile with a Range of 700-800 km.
 - **Agni-II:** It is also a Medium Range Ballistic Missile with a Range more than 2000 km.
 - **Agni-III:** It is also an Inter-Medium Range Ballistic Missile with Range of more than 2,500 Km
 - **Agni-IV:** It is also an Inter-Medium Range Ballistic Missile with Range is more than 3,500 km and can fire from a road mobile launcher.
 - **Agni-V:** Currently it is the longest of the Agni series, an Inter-Continental Ballistic Missile (ICBM) with a range of over 5,000 km.
 - **Agni-VI:** The longest of the Agni series, an Inter-Continental Ballistic Missile (ICBM) with a range of ICBM 11,000–12,000 km.

AGNI-PRIME MISSILE

News: India has successfully test-fired indigenously-developed new generation medium-range ballistic missile Agni Prime from the Odisha coast.

About

- Agni-P is a new generation **advanced variant of the Agni class of missiles**.
- It is the sixth missile in the Agni series of ballistic missiles.
- **It is a two-staged canisterized missile with a range capability between 1,000 and 2,000 km.**
- Many advanced technologies including composites, propulsion systems, innovative guidance and control mechanisms and state-of-the-art navigation systems have been introduced.
- **Significantly, it weighs 50 per cent less than the Agni 3 missile** and has new guidance and propulsion systems
- The missile strengthens India's credible deterrence capabilities.

BLUE BUGGING

News: Cybersecurity experts recently noted that apps that let users connect smartphones or laptops to wireless earplugs can record conversations, and are vulnerable to hacks.

About

- **Bluebugging is a form of hacking that lets attackers access a device through its discoverable Bluetooth connection.**
- Once a device or phone is bluebugged, a hacker can listen to the calls, read and send messages and steal and modify contacts.
- It started out as a threat to laptops with Bluetooth capability. Later hackers used the technique to target mobile phones and other devices.
- **Bluebugging attacks by exploiting Bluetooth-enabled devices.** The device's Bluetooth must be in discoverable mode, which is the default setting on most devices.
- **The bluetooth enabled device must also be within a 10-metre radius of the hacker.**
- The hacker then tries to pair with the device via Bluetooth. Once a connection is established, hackers can use brute force attacks to bypass authentication.
- They can install the malware in the compromised device to gain unauthorized access to it.

Devices Susceptible to Bluebugging:

- **Any Bluetooth-enabled device can be bluebugged.** Wireless earbuds are also susceptible to such hacks.
- Apps that enable users to connect to their TWS (True Wireless Stereo) devices or earbuds can record conversations.

Techniques to Prevent Bluebugging

- Turning off Bluetooth and disconnecting paired Bluetooth devices when not in use,
- Updating the device's system software to the latest version,
- Limited use of public Wi-Fi and
- Using VPN as an additional security measure.

P-8I PATROL AIRCRAFT

News: Aircraft manufacturer Boeing has delivered the 12th P-8I long-range maritime patrol aircraft to the Indian Navy. This completes the follow-on clause for four additional P-8I aircraft contracted in 2016.

About

- It is a **long-range Maritime Reconnaissance and Anti-Submarine Warfare Aircraft.**
- It is an Indian variant of the P-8A Poseidon aircraft that Boeing company developed as a replacement for the US Navy's ageing P-3 fleet.
- With a maximum speed of 907 kmph and an operating range of over 1,200 nautical miles, the P-8Is detect threats and neutralize them if required, far before they come anywhere near Indian shores.
- **The Indian Navy became the first international customer** for the P-8 aircraft in 2009.
- The Navy had procured eight P-8Is under a USD 2.2 billion deal in 2009. The aircraft are part of the 312A Naval Air Squadron based at Arakkonam in Tamil Nadu.
- The six P-8Is will come installed with encrypted communication systems since India has now signed the foundational agreement **Communications Compatibility and Security Agreement (COMCASA) with the US.**

INS VIKRANT

News: INS Vikrant is heading out to sea for its third set of sea trials.

About:

- INS Vikrant is **India's first indigenously built aircraft carrier (IAC-1).**
- It has been **designed by the Indian Navy's Directorate of Naval Design (DND)**, and is being built at Cochin Shipyard Limited (CSL), a public sector shipyard under the Ministry of Shipping.
- **It is named 'Vikrant' as a tribute to India's first aircraft carrier, Vikrant (R11).**
- The motto of the ship is "Jayema Say Yudhi Sprdhah", which is taken from Rigveda and means "I defeat those who fight against me".

Key Features:	• The IAC-1, the biggest warship made indigenously, has an overall length of 263 m and a breadth of 63 m. • It is capable of carrying 30 assorted aircraft including combat jets and helicopters. • Type of Aircraft Carrier: STOBAR (short take-off but arrested landing).
Present Status of INS Vikrant:	• Currently, the Indian Navy operates an aircraft carrier, INS Vikramaditya, which was bought from Russia. • INS Vikrant is commissioned into service by August 2022. • After this, the Indian Navy is planning a second indigenous aircraft carrier (IAC-2), to follow INS Vikrant. It is believed that the IAC-2 will be named INS Vishal.

LIGHT COMBAT AIRCRAFT PROGRAMME

News: Hindustan Aeronautics Limited (HAL), expects to deliver all Final Operational Clearance (FOC) variant aircraft to the Indian Air Force (IAF) in 2022, while the LCA-MK1A is expected to take flight in June 2022.

About

- In 2021, the Ministry of Defence signed a deal with HAL to supply 73 LCA Tejas Mk-1A fighter aircraft and 10 LCA Mk-1 trainer aircraft to the IAF.
- The MK-1A will have over 40 modifications over the MK1 variant.
- **Twin objectives of the LCA programme:**
 1. To develop LCA for the IAF and
 2. To reduce the gap in the field of aeronautical technology available in India and the advanced nations of the West.
- **LCA is designed by Aeronautical Development Agency (ADA)** under the Department of Defence Research and Development (DRDO).
- The first LCA squadron No. 45 'Flying Daggers' in the IAF was formed in 2016.
- The second LCA squadron No. 18 'Flying Bullets' was operationalised in 2020.

Light Combat Aircraft (LCA)

- Light Combat Aircraft (LCA)-Tejas was conceptualized in 1984.
- LCA are the lightest, smallest and tailless multi-role supersonic fighter aircraft in its class.
- **It is designed to carry precision-guided air-to-air and air-to-surface weapons.**
- **Since the first flight of the LCA technology demonstrator in 2001**, the indigenous single engine 4.5 generation multi-role fighter jet christened as 'Tejas' by then Prime Minister in 2003.

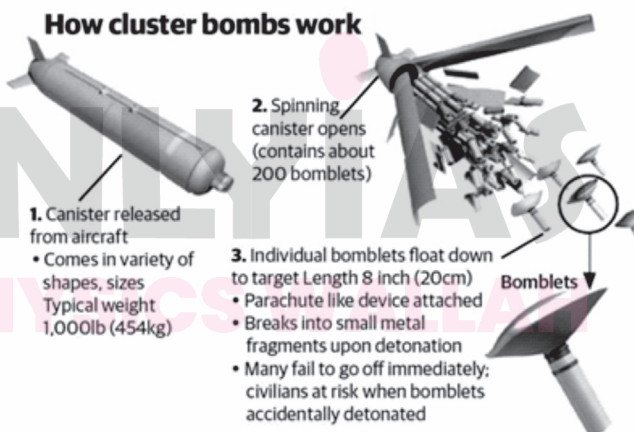
CLUSTER BOMBS AND VACUUM BOMBS

News: Amnesty International and Human Rights Watch, and Ukraine's ambassador to the United States accused Russia of using cluster bombs and vacuum bombs in the ongoing war.

CLUSTER BOMBS

Nearly 100 countries are signing a treaty to ban cluster bombs, while the leading producers of the bombs, including the US, Russia, China and Israel, remain outside the pact.

How cluster bombs work



Cluster Bombs

- Cluster Munitions are non-precision weapons that are designed to injure or kill human beings indiscriminately over a large area and to destroy vehicles and infrastructure such as runways, railway, or power transmission lines.
- They can be dropped from an aircraft or launched in a projectile that spins in flight, scattering many bomblets as it travels.
- Many of these cluster bombs end up not exploding, but continue to lie on the ground, often partially or fully hidden, posing a threat to people for long after the fighting has ceased.

Vacuum Bombs

- **Vacuum bombs are also known as aerosol bombs, fuel air explosives, or thermo-baric weapons.**

- A vacuum bomb consists of a fuel container with two separate explosive charges.
- They use oxygen from the air for a large, high-temperature blast.
- They cause significantly greater devastation than a conventional bomb of comparable size.
- The weapons, which go off in two separate stages, can be fired as rockets from tank-mounted launchers or dropped from aircraft.
- **Two stages:** As they hit their target, a first explosion splits open the bomb's fuel container, releasing a cloud of fuel and metal particles that spreads over a large area.
- A second explosion then occurs, igniting the aerosol cloud into a giant ball of fire and sending out intense blast waves that can destroy even reinforced buildings or equipment and vaporise human beings.

Is using Cluster and Thermobaric Weapons illegal?

- **Cluster Munitions:** There is a Convention on Cluster Munitions (CCM). It is an international treaty adopted in 2008.
- It prohibits the use, transfer, production, and stockpiling of cluster bombs.
- Currently, 110 states are parties to the convention and 13 other countries have signed up but are yet to ratify it.
- Neither Russia nor Ukraine are signatories.
- Thermobaric weapons are not prohibited by any international law or agreement, but their use against civilian populations in built-up areas, schools, or hospitals, could attract action under The Hague Conventions of 1899 and 1907.

HERMETIC WIPER

News: Several Ukrainian computers and websites faced cyberattacks by a destructive data-wiper malware hours before Russia began its military assault in the country. Moreover, Ukraine's largest commercial bank was also hit by a DDoS or distributed denial-of-service attack.

About

- **Hematic Wiper or data wiper malware can erase all the data from the system that it has infected.**
- The thing that makes this malware dangerous is that the data once deleted, the **data cannot be recovered**.
- This malware is quite different from most of the malware out there as **it doesn't steal information, it just destroys it**.
- The malware can even attack the system recovery tools without leaving any traces of the attack.

DDoS or Distributed Denial-of-Service Attack

- A DDoS attack essentially floods a website with countless frivolous requests for information, eventually leading it to paralyze or crash.
- It uses bots to send these queries that bombard the site, leaving it inaccessible to legitimate users.
- Such attacks, in a conflict situation, can damage critical digital infrastructure, disable government communication and the information ecosystem in a country.

HANSA-NG

News: Recently, HANSA-NG, a first of its kind, indigenously developed aircraft trainer has completed sea level trials.

About

- It is a first of its kind, **indigenously developed aircraft trainer**.
- **Developed by:** CSIR-National Aerospace Laboratories, Bangalore under the aegis of Council of Scientific and Industrial Research.
- The HANSA-NG, or HANSA-New Generation, is one of the most advanced flying trainers.
- HANSA-NG is an upgraded version of HANSA, which saw the first flight in 1993, and was certified in 2000.
- **The Centre approved HANSA-NG in 2018 and NAL retro-modified HANSA-3 aircraft** with a glass cockpit and got it certified by DGCA (Directorate General of Civil Aviation). The aircraft was demonstrated at Aero-India 2019.

WHITE PHOSPHORUS

News: Ukrainian police have accused Russian forces of launching phosphorus bomb attacks (chemical weapons) in the Lugansk and Donetsk regions of eastern Ukraine, collectively known as the Donbas.

About

- It is a **colorless, white or yellow, waxy solid**.
- It **does not occur naturally**.
- It is **manufactured using phosphate rocks**.
- It is a **highly combustible substance that reacts with oxygen in the air**.
- It can catch fire at temperatures as low as 10 to 15 degrees above room temperature.
- Due to its combustible nature, every country has strict regulations regarding its manufacturing and handling.
- **Applications:** It is used mainly in the military, and other applications may include as a component in

fertilizers, food additives and cleaning compounds. Initially, it was also used in pesticides and fireworks, but many countries have banned its use in several sectors.

Is White Phosphorus an incendiary or chemical weapon?

- **White Phosphorus** has not been categorized as an incendiary or chemical weapon by international agencies.
- The **Organisation for the Prohibition of Chemical Weapons**, which is an intergovernmental organization and the implementing body for the Chemical Weapons Convention, has **not listed WP in any of the three Schedules of Chemical Weapons**.
- However, the **United Nations considers it as an incendiary chemical**.
- The general regulations of Protocol III on Prohibitions or Restrictions on the Use of Incendiary Weapons may apply when it is used in military actions.

Chemical Weapons Convention:

- Chemical Weapons Convention (CWC) is a **multilateral treaty banning chemical weapons and requiring their destruction within the stipulated time**.
- It became effective from April 1997.
- It makes it **mandatory to destroy old and abandoned chemical weapons**.
- Members should also declare the riot-control agents (sometimes referred to as 'tear gas') in possession of them.
- **India signed the treaty in January 1993**. The Chemical Weapons Convention Act, 2000 was passed to implement the CWC.
- **Convention Prohibits:**
 - The development, production, acquisition, stockpiling, or retention of chemical weapons.
 - Transferring of chemical weapons.
 - Using chemical weapons.
 - Assisting other States to indulge in activities that are prohibited by the CWC.
 - Using riot-control devices as 'warfare methods'.

MAN-PORTABLE AIR-DEFENCE SYSTEMS (MANPADS)

News: The United States and NATO allies are shipping weapons into Ukraine at break-neck speed, including highly sensitive items such as Man-Portable Air-Defense Systems (MANPADS).

About

- Man-Portable Air-Defence Systems (MANPADS) are **short-range, lightweight and portable surface-to-air missiles used to destroy aircraft or helicopters**.
- Man-Portable Anti-Tank Systems (MANPATs) work in a similar manner but are used to destroy or incapacitate military tanks.
- **MANPADS are often described as shoulder-fired anti-aircraft missiles**.
- They can be **shoulder-fired by individuals or small groups, or can be launched from atop a ground-vehicle, or fired from a tripod or stand, and from a helicopter or boat**.
- They help shield troops from aerial attacks and are most effective in targeting low-flying aircrafts.
- Most MANPADS have passive or 'fire and forget' guidance systems, meaning the operator is not required to guide the missile to its target, enabling them to run and relocate immediately after firing.

KAMIKAZE DRONES

News: US President announced \$800 million in new military aid for Ukraine, including 800 additional Stinger anti-aircraft missiles, 9,000 antitank weapons, 100 tactical drones including Kamikaze or suicide drones.

About

- **Also called Switchblade drones**, these are small unmanned aircraft that are packed with explosives that can be flown directly at a tank or a group of troops.
- The Switchblade drones have cameras that show a target seconds before impact.
- The drones are difficult to detect on radar, and they can even be programmed to hit targets without human intervention, based on facial recognition.
- **Technical specifications:** Weighing just **five-and-a-half pounds**, Switchblade can be taken into battle in a backpack and **fly up to 7 miles to hit a target**.
- **They are called Switchblade because their bladelike wings spring out on launch**.

KINZHAL HYPERSONIC MISSILE

News: Russia said that it had unleashed hypersonic missiles against an arms depot in Ukraine, the first use of the next-generation weapons in combat.

About

- **Russia's new Kinzhal (Dagger) hypersonic missile** is a nuclear-capable air-launched ballistic missile that

flies at 10 times the speed of sound and can overcome air-defence systems.

- The missile has a **range of approximately 1,500-2,000km** and can carry a nuclear payload or conventional payload of 480 kg.

Hypersonic weapons

- They are normally defined as fast, low-flying, and highly manoeuvrable weapons designed to be too quick and agile for traditional missile defence systems to detect in time.
- Unlike ballistic missiles, hypersonic weapons don't follow a predetermined, arched trajectory and can maneuver on the way to their destination.
- **The term "hypersonic" describes any speed faster than five times that of sound, which is roughly 760 miles (1,220 kilometers) per hour at sea level, meaning these weapons can travel at least 3,800 miles per hour.**
- **At hypersonic speeds, the air molecules around the flight vehicle start to change, breaking apart or gaining a charge in a process called ionization.** This subjects the hypersonic vehicle to "tremendous" stresses as it pushes through the atmosphere.
- There are two main types of these weapons — Glide Vehicles and Cruise Missiles.
- Analysts say Russia is leading the hypersonics race, followed by China and the U.S.

INS SHIVAJI

News: The Ministry of Skill Development and Entrepreneurship (MSDE) has recognised INS Shivaji as the Centre of Excellence (CoE) in the field of Marine Engineering.

About

- It is an **Indian Naval Station in Lonavala, Maharashtra.**
- It **houses the Naval College of Engineering**, which educates and trains Indian Navy and Coast Guard officials.
- It has three premier training entities, namely Centre of Marine Engineering and Technology (CMET), Centre of Excellence in Marine Engineering and School of Basic Sciences.
- The **Nuclear Biological Chemical Defence School**, which trains naval personnel on all aspects of NBCD, is also located in the station.
- The **naval Station was commissioned** as HMIS (His Majesty's Indian Ship) Shivaji in February, 1945.

- **INS Shivaji's Centre of Excellence (Marine Engineering) was established in 2014** with a broad mandate that included the induction of niche technologies for naval applications, quality research in collaboration with R&D (Research and Development) and academic institutes of high reputation.

INS VALSURA

News: President Ram Nath Kovind presented the President's Colour to INS Valsura, the Navy's premier technological training establishment.

About

- The President's Colour is bestowed on a military unit in recognition of the exceptional service rendered to the nation, both in peace and in war.
- **INS Valsura, is a premier technological training institution of the Indian Navy based in Jamnagar, Gujarat.**
- INS Valsura trains officers and men on operation and maintenance of sophisticated and technologically advanced equipment on board warships.
- **The Navy was the first Indian armed force to be awarded the President's Colour by Dr Rajendra Prasad on May 27, 1951.**
- **INS Valsura, started on 30 acres of land as a torpedo school in 1942 under the British**, has today grown into one of the foremost technological training institutions of the country spread over 600 acres.

MEDIUM RANGE SURFACE TO AIR MISSILE (MRSAM)

News: Recently, the Defence Research and Development Organisation (DRDO) conducted two successful flight tests of the Army version of Medium Range Surface to Air Missile (MRSAM) at the Integrated Test Range, Chandipur, off the coast of Odisha.

About

- It is a **surface-to-air missile developed for use by the Indian Army.**
- Developed by **DRDO** and Israel Aerospace Industries (IAI).
- **The missile provides air defence against aerial threats like fighter aircraft, UAVs, guided and unguided munitions & cruise missiles.**
- **Key features:**
 - **The MRSAM weapon system comprises multi-function radar**, mobile launcher system and other vehicles. It has Army, Navy and Air Force variants.

- **The missile's management system uses the radar to track and correctly identify the target**, calculates the distance from it and gives all the information to the Commander for a decision to be made on the interception.
- **Length and Weight:** The missile is 4.5 meters in length with a weight of around 275 kg. It is equipped with fins and canards to stabilize and provide manoeuvrability.
- **Speed and Range:** The missile can move at a maximum speed of Mach 2 (twice the speed of sound). It can engage multiple targets up to a range of 70 km.

DRDO'S CORNER-SHOT WEAPON SYSTEM

News: A corner-shot weapon system (CSWS), designed and developed by the Defence Research and Development Organisation (DRDO), is at an advanced stage of being inducted by the Central Reserve Police Force (CRPF) and the Jammu and Kashmir police.

About

- The CSWS is a **special purpose weapon designed by the Armament Research and Development Establishment (ARDE), Pune.**
- It can engage targets located around the corners as the system bends and captures video feed thus saving soldiers from any surprise counter-attack and is best suited for urban, close quarter situations.
- It is equipped with a weapon, camera, laser, infrared illuminator and torch in front portion, while display, electronics, battery and swiveling mechanism are located at rear portion.
- The body is made from high-grade aluminum alloy to make it lighter and durable.
- **Day-night firing capability, color display, digital zoom, zeroing facility, hot keys,** high power battery along with status display and compliance with JSS 5855 makes it a very potent system for security forces.
- It is very helpful in Counter Insurgency and Counter Terror (CI/CT) operations.

WEAPONIZATION OF SPACE

News: IAF chief cautioned about the newer threats in the race to weaponize the space domain, a domain which was hitherto considered relatively safe.

About

- **It includes placing weapons in outer space or on heavenly bodies** as well as creating weapons that will transit outer space or simply travel from Earth to attack or destroy targets in space.

- **Examples include the placing of orbital or suborbital satellites** with the intention of attacking enemy satellites, using ground-based direct ascent missiles to attack space assets, jamming signals sent from enemy satellites, satellite attacks on Earth targets etc.
- **The weaponization of space is different from the militarization of space, which includes using space-based assets for C4ISR** (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance).
- **The militarization of space assists armies on the conventional battlefield**, whereas via the weaponization of space, outer space itself emerges as the battleground, **sometimes referred to as the "fourth frontier of war."**
- Development projects for militarisation and weaponization of outer space have been on the increase with the aim of one country achieving military dominance over the other in outer space.
- **India in the race of space power.**
- **Anti-satellite (ASAT) missile test (Mission Shakti):** India is now the fourth country in the world to conduct an ASAT missile test, after the United States, Russia, and China. The test entailed launching a ballistic missile into outer space to destroy an Indian satellite located about 300 kilometres above the earth's surface in low earth orbit (LEO).
- **United States' programme for developing space weapons:** Some of its declared projects for space Weaponization include:
 - **Space-Based Lasers (SBLs):** These would operate in LEO and destroy hostile ballistic missiles during their boost phase.
 - **Anti-Satellite (ASAT) Weapons:** It includes high powered lasers, micro-satellites, Kinetic-Energy Anti-Satellites (KE-ASAT) weapons, Near Field IR Experiment (NFIRE), etc.

Global Framework to prevent Weaponization of Space

- **Outer Space Treaty:** It was conceptualized by the United Nations in 1967. **It emphasizes the fact that the exploration of outer space** should be beneficial to all mankind and nations and it should be for peaceful purposes. It claims that one nation cannot claim national sovereignty in outer space.
- **Prevention of an Outer Space Arms Race:** It re-emphasized the importance of using space for peaceful purposes, the importance of avoiding an arms race and the readiness of all states to contribute to that common objective, in conformity with the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

DEFCONNECT 2.0

News: Recently, the Ministry of Defence has launched Innovations for Defence Excellence (iDEX) Prime and the sixth Defence India Start-up Challenge (DISC 6) during DefConnect 2.0 in New Delhi.

About DefConnect 2.0

- **Organized by:** Innovations for Defence Excellence (iDEX), Defence Innovation Organisation (DIO), under the aegis of the Department of Defense Production (DDP), Ministry of Defence (MoD).
- **Purpose:** To bring together start-ups, big companies and armed forces personnel to boost indigenous innovation in the defence sector.

Initiatives launched at this event:	• Innovations for Defence Excellence (iDEX) Prime: It is aimed at supporting projects, requiring support beyond Rs 1.5 crore up to Rs 10 crore in the ever-growing defence start-ups. • Defence India Start-up Challenge (DISC 6): It has been launched under the ongoing iDEX initiative. It aims to achieve self-reliance and foster innovation and technology development in the defence and aerospace sectors. • Innovate4Defence Internship (i4D): It is an acceleration program for students of Higher Educational Institutions (HEIs). It is an opportunity for them to learn about developing their ideas, creating innovative Defence products and eventually becoming a part of the Indian Defence ecosystem and procurement.
Innovations for Defence Excellence (iDEX):	• iDEX, launched in 2018, is an ecosystem to foster innovation & technology development in Defence and Aerospace by engaging innovators & entrepreneurs to deliver technologically advanced solutions for modernizing the Indian Military. • It provides funding/grants to MSMEs, start-ups, individual innovators, R&D institutes and academia to carry out research and development. • iDEX is funded and managed by "Defence Innovation Organisation".
Defence Innovation Organisation (DIO):	• DIO is a not-for-profit organisation formed under section 8 of the Companies Act 2013. • It is funded by Hindustan Aeronautics Limited (HAL) and Bharat Electronics Limited (BEL). • It provides high-level policy guidance to iDEX.

INS VAGSHEER

News: Recently, the Defence Secretary has launched INS Vagsheer. It is the last of the Scorpene-class submarines made under Project 75 and can join the Navy fleet within 12-18 months after sea trials.

- It is enabled with a **C303 anti-torpedo countermeasure system**. It can carry up to 18 torpedoes or Exocet anti-ship missiles, or 30 mines in place of torpedoes.
- Under P75, INS Kalvari, INS Khanderi, INS Karanj and INS Vela have been commissioned.

About

- INS Vagsheer is the **sixth submarine of Project 75 of the Indian Navy**.
- Manufactured by **Mazagon Dock Shipbuilders Limited (MDL) in collaboration with Naval Group, France**.
- INS Vagsheer is named after the sandfish, a deep-sea predator of the Indian Ocean. It is also named after the first submarine Vagsheer from Russia which was commissioned into the Indian Navy in 1974 and was decommissioned in 1997.
- It can reach a top speed of 20 knots when submerged and a top speed of 11 knots when it surfaces.
- It can do offensive operations such as anti-surface warfare, anti-submarine warfare, intelligence gathering and area surveillance.

SARMAT INTERCONTINENTAL BALLISTIC MISSILE

News: Russia has successfully test-fired the Sarmat intercontinental ballistic missile.

About

- The Sarmat is a Russian **liquid-fuelled intercontinental ballistic missile capable of nuclear charges**.
- This multiple independently targetable reentry vehicle (MIRV)-equipped weapon can be deployed with 10 or more warheads on each missile.
- It is claimed that it has the longest range of destruction of targets in the world.

- The name Sarmat is based upon the nomadic Sarmatian tribes which used to live between 6th and 4th century BC in current territories of Russia, Ukraine and Kazakhstan.

HELINA

News: India has successfully flight-tested Helina, an Anti-Tank Guided Missile (ATGM), in Pokhran.

About

- Helina has been **developed by the Defence Research and Development Laboratory (DRDL), Hyderabad** under the **Missiles and Strategic Systems (MSS) cluster of the DRDO**.
- HELINA (Helicopter based NAG) is a third-generation fire and forget class anti-tank guided missile (ATGM) system mounted on the Advanced Light Helicopter (ALH).
- **Key Features of HELINA:**
 - It has a maximum range of 7 kilometres.
 - It has all-weather, day and night capability and can defeat battle tanks with conventional armour as well as explosive reactive armour.
 - It has been developed for integration with choppers in both the Army and the Air Force. The Air Force version of Helina is sometimes referred to as **Dhruvastra**.

PINAKA MK-I (ENHANCED) ROCKET SYSTEM (EPRS)

News: Defence Research and Development Organization (DRDO) and the Indian Army have successfully flight-tested Pinaka Mk-I (Enhanced) Rocket System (EPRS) and Pinaka Area Denial Munition (ADM) rocket systems.

About

- **Developed by Pune-based DRDO laboratories** – Armament Research and Development Establishment (ARDE) and High Energy Materials Research Laboratory (HEMRL).
- **EPRS is the upgraded version of the Pinaka variant** that has been in service with the Indian Army for the last decades.
- **Purpose:** It is a long-range artillery system used for attacking the enemy before close battles.
- **Range:** It can destroy targets at distances up to 45 km.

Pinaka Area Denial Munition (ADM) Rocket Systems

- **Developed by:** Designed by Armament Research and Development Establishment (ARDE) and

manufactured by the industry partners under technology transfer.

- **Purpose:** ADMs are a category of ammunition used to prohibit the adversary from occupying or passing through a particular area.

ADVANCED TOWED ARTILLERY GUN SYSTEM

News: India has successfully conducted the trials of the indigenous Advanced Towed Artillery Gun System (ATAGS).

About

- **Developed by:** Defence Research and Development Organization (DRDO) and manufactured by Bharat Forge and Tata Power SED.
- **Developed for the Indian Army.**
- ATAGS is a large calibre Gun system with the capability to program and fire future Long-Range Guided Munitions (LRGM) to achieve precision and deep strike.

Features of ATAGS

- **Range:** It consists of a barrel, breech mechanism, muzzle brake and recoil mechanism to fire 155 mm calibre ammunition with a firing range of 48 kilometers.
- **Maintenance Free:** The system is configured with an all-electric drive that will ensure maintenance-free and reliable operation over long periods of time.
- **Advanced Features:** It is integrated with advanced features like high mobility, quick deployability, auxiliary power mode, automatic command and control system and an advanced communication system with night vision capability in direct-fire mode.
- **Firing Capability:** It can fire three rounds in 15 seconds in burst mode, and as many as 60 rounds in 60 minutes in sustained mode

AIR INDEPENDENT PROPULSION TECHNOLOGY

News: France's Naval Group declined the bid for the P-75I Project, citing it does not use AIP (Air-Independent Propulsion) Technology yet.

About

- AIP technology allows a conventional submarine to remain submerged for much longer than ordinary diesel-electric submarines.
- **All conventional submarines have to surface to run their generators that recharge the batteries that allow the boat to function underwater.**

- However, the more frequently a submarine surfaces, the higher the chances of it being detected.
- AIP allows a submarine to remain submerged for more than a fortnight compared to two to three days for diesel-electric boats.
- **Types of AIPs:** There are different types of AIP mechanisms available; what India is looking for under the P-75I project is AIP based on fuel cells. These cells convert chemical energy into electrical energy, recharging the batteries of the submarine.
- **The backdrop of AIP:** Installing AIP increases the length and weight of the boats as it requires pressurized Liquid O₂ (LOX) storage onboard and supplies for all three technologies.

What submarines does India have now?

- India has 16 conventional diesel-electric submarines which are classified as SSKs. After the last two Kalvari Class subs are commissioned under P-75, this number will go up to 18.
- **Note:** India also has two nuclear ballistic submarines classified SSBN.

P-75I project

- In June 1999, the Cabinet Committee on Security approved a 30-year plan for the Navy to indigenously build and induct 24 submarines by 2030.
- In the first phase, two lines of production were to be established — the first, P-75; the second, P-75I. Each line was to produce six submarines.
- While the six P-75 submarines are diesel-electric, they can be fitted with AIP technology later in their lives.
- This P-75I project envisages indigenous construction of submarines equipped with the state-of-the-art Air Independent Propulsion system at an estimated cost of Rs. 43,000 crores.

INS SURAT AND INS UDAYGIRI

News: Recently, the Defence Minister launched the Indian Navy destroyer warship INS Surat and frigate INS Udaygiri in Mumbai.

About

- INS Udaygiri is the third ship of Project 17A Frigates.
- **Named After:** It is named after a mountain range in the state of Andhra Pradesh. It is also considered as the reincarnation of erstwhile 'Udaygiri', the Leander Class ASW Frigate.

Project 17A

- The Project 17A programme was approved by the

Indian Government in 2015 to enhance the combat capabilities of the Indian Navy.

- Project 17A is a follow-on of the Project 17 Shivalik-class frigate for the Indian Navy.
- The ships have been named after the first major warships to be built in India which in turn were named after hill ranges in India.
- A total of seven ships will be built under Project 17-A.
- The seven ships under this project are: 1) INS Nilgiri 2) INS Himgiri 3) INS Udaygiri 4) INS Dunagiri 5) INS Taragiri 6) INS Vindhyagiri and 7) INS Mahendragiri.

INS Surat

- INS Surat is the fourth ship of Project 15B Destroyers.
- **Note:** Project 15B class of ships are the next generation stealth guided-missile destroyers of the Indian Navy being built at the Mazgaon Docks Ltd, Mumbai.
- **Named After:** It is named after the commercial capital of the state of Gujarat and also the second-largest commercial hub of western India after Mumbai.
- **The method used:** The ship has been built using the Block construction methodology which involved hull construction at two different geographical locations and has been joined together at Mazgaon Docks Limited (MDL), Mumbai.

Y-3023 DUNAGIRI

News: Recently, the Defence Minister of India launched Y- 3023 Dunagiri, a Project 17A frigate built by Garden Reach Shipbuilders Limited (GRSE) in Kolkata.

About

- Y- 3023 Dunagiri is the fourth warship of Project 17A.
- **Named After:** It is named after a mountain range in the state of Uttarakhand.
- **'Dunagiri' is the reincarnation of the erstwhile 'Dunagiri', the Leander Class ASW Frigate**, which in her 33 years of service had witnessed various challenging operations and multinational exercises.
- **Built by:** Garden Reach Shipbuilders Limited (GRSE) for the Indian Navy.
- **Features:** The ships are designed with extensive use of low-observability technologies, including the use of composite materials and radar-absorbing coatings.
- These materials assist the vessel in maintaining a low radar cross-section (RCS).

INS SINDHUDHVAJ

News: Indian Navy has decommissioned INS Sindhudhvaj from service.

About

- INS Sindhudhvaj was commissioned into the Indian Navy in June 1987.
- It was one of the 10 Kilo-class submarines India acquired from Russia between 1986 and 2000.
- **Note:** Of these 10 kilo class submarines, INS Sindhurakshak was lost in an accident in Mumbai harbour in 2013 while Sindhuvir was transferred to Myanmar in 2020.
- **Achievements:** INS Sindhudhvaj had many firsts to her credit including operationalisation of the indigenised sonar USHUS, indigenised satellite communication systems Rukmani and MSS and indigenised torpedo fire control system.
- It had also successfully undertaken mating and personnel transfer with the Deep Submergence Rescue Vessel.
- **It was also the only submarine to be awarded the Chief of Naval Staff (CNS) rolling trophy for Innovation by the Prime Minister.**

NAVAL ANTI-SHIP MISSILE

News: The Defence Research and Development Organization (DRDO) and Indian Navy have successfully conducted the maiden flight test of an indigenously-developed Naval anti-ship missile.

About

- **Developed by:** Defence Research and Development Organization (DRDO) for the Indian Navy.
- **Weight and Range:** The missile has a weight of 380 kg and a range of up to 55 km and is meant for launch from helicopters.
- The missile can cruise at just 5 meters above sea level making it difficult for enemy radars to detect and track and shoot down with surface-to-air missiles or guns.
- This low-level capability of anti-ship missiles is known as **sea-skimming**.
- **Significance:** It is the first indigenous air-launched anti-ship missile system for the Indian Navy.

PROJECT WARDEC

News: The Army Training Command signed a MoU with Gandhinagar-based Rashtriya Raksha University (RRU) to develop a 'Wargame Research and Development Centre' in New Delhi.

About

- **WARDEC will be a first-of-its-kind simulation-based training center in India** that will use artificial intelligence (AI) to design virtual reality wargames.

- **Purpose:** The centre will be used by the Army to train its soldiers and test their strategies through metaverse-enabled gameplay.
- **Soldiers will test their skills in the metaverse where their surroundings will be simulated** using a combination of virtual reality (VR) and augmented reality (AR).
- **Location:** The centre will come up in a military zone in New Delhi.
- **Significance:** The centre will help soldiers prepare for wars as well as counter-terror and counter-insurgency operations.

Rashtriya Raksha University (RRU)

- The RRU, an **institute under the Ministry of Home Affairs (MHA)**, specialises in **national security and policing**.
- **Located in Gandhinagar's Lavad village, it is an "Institute of National Importance"** – a status granted to it by an Act of Parliament.

INS GOMATI

News: INS Gomati was decommissioned at the Naval Dockyard in Mumbai.

About

- INS Gomati **derives her name from the vibrant river Gomti** and was commissioned on 16 April 1988 by the then Defence Minister, KC Pant, at Mazgaon Dock Ltd, Bombay.
- The third ship of the Godavari class guided-missile frigates, INS Gomati was also the oldest warrior of the Western Fleet when decommissioned.
- During her service, she participated in Operations Cactus, Parakram and Rainbow, and several bilateral and multinational naval exercises.
- For her remarkable spirit and stellar contribution to national maritime security, she was twice awarded the coveted Unit Citation, once in 2007-08 and again in 2019-20.

LASER-GUIDED ANTI-TANK GUIDED MISSILES

News: Defence Research and Development Organisation (DRDO) has successfully test fired indigenously developed Laser-Guided Anti-Tank Guided Missiles (ATGM).

About

- ATGMs are primarily designed to hit and destroy heavily armored military vehicles.

- **The missiles can be transported by a single soldier, to larger tripod-mounted weapons**, which require a squad or team to transport and fire, to vehicle and aircraft mounted missile systems.
- **Developed by:** Two Pune-based facilities of the DRDO's Armament and Combat Engineering (ACE) Cluster — the Armament Research and Development Establishment (ARDE) and High Energy Materials Research Laboratory (HEMRL) — in association with Instruments Research and Development Establishment (IRDE), Dehradun.
- **Range:** The missile has the capability to defeat the protected armoured vehicles in ranges from 1.5 to 5 kilometers.
- This type of guided missile relies on an electro-optical imager (IIR) seeker, a laser or a W-band radar seeker in the nose of the missile.
- These are **'fire-and-forget' missiles** where the operator can retreat right after firing as there is no more guidance required.
- **The all-indigenous Laser Guided ATGM employs a tandem High Explosive Anti-Tank (HEAT) warhead** to defeat Explosive Reactive Armour (ERA) protected armoured vehicles.
- The ATGM has been developed with multi-platform launch capability and is currently undergoing technical evaluation trials from the 120 mm rifled gun of MBT Arjun.

Other Anti-tank Missiles

- **Helina:** It has a maximum range of seven kilometers and has been designed and developed for integration on the weaponized version of the ALH (Advanced Light Helicopter).
- **The Nag:** It is a third-generation fire-and-forget missile developed for mechanized formations to engage heavily fortified enemy tanks.
- **MPATGM:** It stands for Man-Portable Anti-Tank Guided Missile which has a range of 2.5 kilometers, with fire-and-forget and top attack capabilities for infantry use.
- **SANT:** It is a Smart Stand-off Anti-Tank Missile being developed for launch from the Mi-35 Helicopter for the Air Force's anti-tank operations.

ISKANDER-M MISSILE

News: Russia has promised its ally Belarus the delivery of Iskander-M tactical missile systems.

About

- The Iskander-M tactical missile systems are the nuclear-capable missiles, which can use ballistic or cruise missiles.

- Codenamed as "SS-26 Stone", it is a road-mobile; surface-to-surface short-range ballistic missile (SRBM).
- The missile is a transporter-erector launch system.
- **It can also fire ground-launched cruise missiles (GLCMs).**
- The Iskander-M system has been **exclusively used by the Russian military**, whereas Iskander-E is the one meant for export.

VL-SRSAM

News: Vertical Launch Short Range Surface to Air Missile (VL-SRSAM) was successfully flight-tested by the Defence Research & Development Organization (DRDO) and the Indian Navy from an Indian Naval Ship at Integrated Test Range (ITR), Chandipur off the coast of Odisha.

About

- VL-SRSAM is a ship-borne weapon system **developed by the Defence Research and Development Organization (DRDO) for deployment in the Indian Naval warships.**
- It is meant for neutralising various aerial threats at close ranges including sea-skimming targets.
- **Sea skimming:** Sea skimming is a technique of flying as low as possible (always below 50 meters from sea level).
- **This will make it hard to detect the flying object by radar, and infrared detection techniques in ships. Further, it will reduce the probability of getting shot down while approaching a target.**

Features

- The missile has been designed based on the Astra missile, which is a Beyond Visual Range Air to Air missile.
- **It can strike a target at the range of 40 to 50 km.**
- **VL-SRSAM is a canisterised based missile system.**
 - Hence, it is stored and operated from specially designed compartments.
 - In the canister, the inside environment is controlled, thus making its transport and storage easier and improving the shelf life of weapons.
- The launch of this indigenous missile system will further strengthen the defensive capabilities of the Indian Navy.

PRITHVI-II MISSILE

News: India successfully conducted the night trial of surface-to-surface nuclear-capable short-range ballistic missile Prithvi-II.

About

- **Developed by:** Defence Research and Development Organisation (DRDO) of India under its Integrated Guided Missile Development Programme (IGMDP).
- Prithvi II is a **Surface-to-Surface short-range ballistic missile (SRBM)**.
- **Range:** 350 km
- **Warhead Capacity:** It is capable of carrying 500 kg to 1,000 kg of warheads.
- **Features:** The missile is a proven system and is capable of striking targets with a very high degree of precision.
- **The missile is powered by liquid propulsion twin engines.** The missile also uses an advanced inertial guidance system with manoeuvring trajectory to hit its target.

Integrated Guided Missile Development Programme (IGMDP)

- IGMDP was an **Indian Ministry of Defence programme to research and develop a comprehensive range of missiles.**
- The project started in 1982–1983 under the **leadership of Dr APJ Abdul Kalam.** This Programme made Dr APJ Abdul Kalam the “**Missile Man of India**”.
- The integrated guided missile programme was **completed in 2008.**
- **Five Missiles Developed under the IGMDP:**
 1. **PRITHVI** (Short range surface-to-surface ballistic missile);
 2. **AGNI** (Medium to intercontinental surface-to-surface missile);
 3. **TRISHUL** (Short range low-level surface-to-air missile);
 4. **AKASH** (Surface-to-air missile having a range of up to 25 Km and multi-target handling system);
 5. **NAG** (Third generation “fire & forget”, “top attack” anti-tank missile).

HIMARS

News: Recently, The United States has announced that it is sending its High Mobility Artillery Rocket Systems known as HIMARS to Ukraine.

About

- The **US-made High Mobility Artillery Rocket Systems** are known as HIMARS.
- It is a multiple launch rocket system or MLRS – a mobile unit that can simultaneously launch multiple precision-guided missiles.

- It is considered a modernized, lighter and more agile version of the M270 MLRS developed in the 1970s for US and allied forces.

Artillery Rocket

- **An artillery rocket is a weapon that is typically propelled by a solid-fuel motor and can carry a variety of warheads.**
- During the Cold War, most artillery rockets were unguided and imprecise when fired at greater distances.

Difference between a Rocket and a Missile

- The nomenclature can be confusing sometimes, but generally, the word “rocket” is used in a military context to refer to relatively inexpensive unguided weapons powered by solid-fuel motors.
- **On the other hand, “missile” is generally shorthand for “guided missiles,”** more expensive and complicated weapons that use movable fins to steer themselves to their targets and can fly much farther.

ASTRA MARK-1

News: Recently, the Ministry of Defence has signed a contract with the Hyderabad-based public-sector Bharat Dynamics Ltd (BDL) for supply of the Astra Mark-1.

About

- The Astra Mk-1 is a Beyond Visual Range (BVR), Air-to-Air Missile (AAM).
- BVM missiles are capable of engaging beyond the range of 20 nautical miles or 37 kilometers.
- AAMs are fired from an airborne asset to destroy an airborne target.
- **Developed and designed by:** The Defense Research and Development Organization (DRDO) for deployment on fighter jets like Sukhoi-30 MKI and Tejas of the IAF and the Mig-29K of the Navy.
- **Range:** 110 km.
- **Speed:** The missile can travel at speeds more than four times that of sound and can reach a maximum altitude of 20 km making it extremely flexible for air combat.

UNMANNED AERIAL VEHICLE (UAV)

News: DRDO has successfully carried out the maiden test flight of a new Unmanned Aerial Vehicle (UAV), an autonomous Flying Wing Technology Demonstrator from the Aeronautical Test Range, Chitradurga, Karnataka.

About

- **Designed and developed by:** Aeronautical Development Establishment (ADE), Bengaluru, a premier research laboratory under DRDO.
- **Specifications:** It is powered by a small turbofan engine. It is a stealth drone.
- **A turbofan engine is a jet engine variant which produces thrust using a combination of jet core efflux and bypass air which has been accelerated by a ducted fan that is driven by the jet core.**
- **Stealth aircraft tend to adopt the design referred to as a “flying wing”.** This is a tailless, fixed-wing design that has no fuselage.
- Its crew, payload, fuel, and equipment are housed inside the main wing structure. It works by balancing its airflow and centre of gravity so that no tail is needed.

Other UAVs being developed by DRDO

- **Ghatak armed stealth drone programme or Autonomous Unmanned Research Aircraft (AURA):** It is a self-defending, high-speed, reconnaissance UAV with a weapon firing capability.
- **Rustom-2:** It is an indigenous Medium Altitude Long Endurance (MALE) UAV.
- This drone is being designed to reach an altitude of 30,000 feet and 18 hours of endurance.
- **It has been designed and developed by the Aeronautical Development Establishment (ADE), Bengaluru,** with the production partners being HAL and Bharat Electronics Ltd.
- **It is being developed to carry out surveillance and reconnaissance (ISR) roles and is capable of carrying different combinations of advanced payload and capable of auto landing, among others.**

FUJIAN

News: China unveiled its first indigenous aircraft carrier, the new-generation Fujian (Type 003).

About

- **Named after:** Fujian has been named after China's eastern coastal province which lies across from Taiwan.
- The Fujian joins two other carriers currently operated by China — Shandong (Type 001), commissioned in 2019, and the Liaoning (Type 002), bought second-hand from Ukraine in 1998.
- **Features:**
 - The Fujian's displacement is 80,000 tonnes, much more than the existing Chinese carriers, and comparable to U.S. Navy aircraft carriers.

- The Fujian has been fitted with the latest launch technology — the Electromagnetic Aircraft Launch System (EMALS), first developed by the U.S. Navy.
- **It also has a straight flat-top flight deck for take-offs and landings,**
- **The two existing vessels use a ski jump-style ramp.** A ski-jump is an upward-curved ramp that allows aircraft to take off from a runway that is shorter than the aircraft's required takeoff roll.
- **Significance:** China now has the greatest number of aircraft carriers after the U.S.

INS TARKASH

News: Indian Navy's stealth frigate INS Tarkash visited Djibouti as part of her long-range overseas deployment, followed by a Maritime Partnership Exercise with Sudan Navy.

About

- INS Tarkash is a state-of-the-art stealth frigate of the Indian Navy.
- **Built by:** Yantar Shipyard at Kaliningrad, Russia.
- It is equipped with a versatile range of weapons and sensors capable of addressing threats in all three dimensions.
- The ship incorporates the latest stealth features such as reduced radar, infra-red, acoustic, and magnetic signatures, thus making it difficult to detect at sea.
- The ship is part of the Indian Navy's Western Fleet based at Mumbai under the Western Naval Command.

MIG 21

News: A MiG-21 Bison aircraft of the Indian Air Force (IAF) crashed in Barmer, Rajasthan, killing the two pilots aboard the trainer version of the fighter aircraft.

About

- **The Mikoyan-Gurevich MiG 21 is a supersonic jet fighter and interceptor aircraft,** designed by the Mikoyan-Gurevich Design Bureau in the Soviet Union.
- **MiG is a product of the Soviet Union which entered into service in 1959.**
- Approximately 60 countries on four continents have flown the MiG-21, and it still serves many nations six decades after its maiden flight.
- India inducted the MiG-21 in 1963 and got full technology transfer and rights to license-build the aircraft in the country.
- **Russia stopped producing the aircraft in 1985, while India continued operating the upgraded variants.**

HELLFIRE R9X MISSILE

News: The US military used its 'secret weapon' — the Hellfire R9X missile – to kill Al Qaeda chief Ayman al-Zawahiri.

About

- Hellfire R9X missile is also known as AGM-114 R9X or Ninja Missile.
- It is a US-origin missile known to cause minimum collateral damage while engaging individual targets.
- The weapon does not carry a warhead and instead deploys razor-sharp blades at the terminal stage of its attack trajectory.
- This helps it to break through even thick steel sheets and cut down the target using the kinetic energy of its propulsion without causing any damage to the persons in the general vicinity or to the structure of the building.
- **The blades pop out of the missile and cut down the intended target** without causing the massive damage to the surroundings which would be the case with a missile carrying an explosive warhead.

YUAN WANG 5

News: India is closely monitoring the movement of a Chinese "spy ship" that is on its way to Sri Lanka and will dock at its Hambantota port around August 11.

About

- **The 'Yuan Wang 5', a Chinese research and survey vessel, is in route to Hambantota**, a strategically important deep-sea port developed mostly using loans from Beijing.
- **'Yuan Wang'-class ships are used to track satellite, rocket and intercontinental ballistic missile (ICBM) launches.**
- China has around seven of these tracking ships that are capable of operating throughout the Pacific, Atlantic, and Indian oceans. The ships supplement Beijing's land-based tracking stations.

BUTTERFLY MINES

News: The UK Ministry of Defence, in its intelligence assessment of the ongoing war in Ukraine, has and sounded an alarm on the possible use of PFM-1 series 'Butterfly Mines' by the Russian military in Donetsk and Kramatorsk.

About

- The PFM-1 and PFM-1S are two kinds of **anti-personnel landmines** that are commonly referred to as 'Butterfly mines' or 'Green Parrots'.
- **These names are derived from the shape and colour of the mines.**
- **The main difference between the PFM-1 and PFM-1S mine is that the latter comes with a self-destruction mechanism which gets activated within one to 40 hours.**

Ottawa Convention

- It is the 1997 **Convention on the use, stockpiling, production, and transfer of Anti-Personnel landmines (APLs) and on their Destruction.**
- Usually referred to as the **Anti-Personnel Mine Ban Treaty**, this international agreement bans APLs.
- **This Convention requires states-parties:**
 - To destroy their stockpiled APLs within 4 years and
 - To eliminate all APL holdings, including mines currently planted in the soil, within 10 years.
- **Some key current and past producers and users of landmines, including the US, China, India, Pakistan, and Russia, have not signed the treaty.**

F-INSAS SYSTEM

News: Defence Minister Rajnath Singh handed over two new weapons, the Nipun mines, the Landing Craft Assault (LCA) and the F-INSAS system, to the Army.

About F-INSAS System

- **F-INSAS stands for Future Infantry Soldier as A System.**
- It is a programme for infantry modernisation aimed at enhancing the operational capability of the soldier.
- Under this programme, **soldiers are being equipped with modern systems which will be lightweight, all-weather-all-terrain, economical and would require low maintenance.**
- **The full gear of the F-INSAS system includes an AK-203 assault rifle and a multimode hand grenade.**
- Apart from this, **soldiers are also provided with ballistic helmets and ballistic goggles** for protection against small projectiles and fragments, along with a bullet-proof vest.
- **F-INSAS also comes with hands-free, secured advanced communications** set for real-time exchange of information with the command post and fellow soldiers for enhanced situational awareness.

About Nipun Mines

- **Nipun mines are indigenously designed and developed anti-personnel mines termed by the DRDO as 'soft target blast munition'.**
- These mines are meant to act as the first line of defense against infiltrators and enemy infantry.
- **Developed by: Armament Research and Development Establishment,** a Pune-based DRDO facility, and Indian industry.
- **Note: Anti-personnel mines are meant to be used against humans as against anti-tank mines** that are aimed at heavy vehicles. They are smaller in size and can be deployed in large numbers.

ZORAWAR

News: The Indian Army is prioritizing the procurement of the indigenous Indian light tank named 'Zorawar' for deployment in the mountains.

About

- **The Armoured Fighting Vehicle-Indian Light Tank (AFV-ILT) 'Zorawar'** will be deployed to outmaneuver the movement of Chinese forces during the standoff in eastern Ladakh.
- It will be designed to operate from High Altitude Area, the marginal terrain to the Island territories and will be highly transportable for rapid deployment to meet any operational situation.
- It will have equal firepower as the present tank, including missile firing. The power to weight ratio will make it very agile.

Other Procurements

- **The Indian Army intends to procure a new-generation 'Future Tank' platform namely FRCV (Future Ready Combat Vehicle),** in a phased manner. The expected induction timeline is by 2030.
- **It will come along with performance-based logistics, transfer of technology,** engineering support package and other maintenance and training requirements.
- **Futuristic Infantry Combat Vehicle (FICV) will replace BMP-II.**
- **Also, Light Armoured Multi-Purpose Vehicle (LAMV) with enhanced mobility and protection for Recce Platoon** are to replace the existing modified Maruti Gypsy.

Swarm Drone Systems

- Indian Army has inducted indigenously produced Swarm Drones Systems aiming to employ them in both offensive and defensive operations.

- These drones will provide a decisive edge to the tactical commanders employing them.
- Swarm Drones being inducted into the Mechanised Forces will provide an edge to the Indian Army in meeting future security challenges.
- **Make-II case:** The Indian Army has also initiated a Make-II case, Autonomous Surveillance and Armed Drone Swarm (A-SADS) which includes a version for the High Altitude Area.

INS SUMEDHA

News: Recently, INS Sumedha visited Port Klang, Malaysia during her return passage from Australia where she participated in the Azadi Ka Amrit Mahotsav celebrations.

About

- **INS Sumedha is an indigenously built Naval Offshore Patrol Vessel** deployed for multiple roles independently and in support of Fleet Operations.
- **She is part of the Indian Navy's Eastern Fleet based at Visakhapatnam** and functions under the operational command of the Flag Officer Commanding-in-Chief, Eastern Naval Command.
- **She is the third ship of the indigenous Naval Offshore Patrol Vessel (NOPV) Project** to be inducted into the Indian Navy.
- **The ship has been designed and built by Goa Shipyard Limited.**
- **Primary role:** To undertake EEZ surveillance, anti-piracy patrols, fleet support operations, providing maritime security to offshore assets and carry out escort operations for high value assets.

PEGASUS SPYWARE

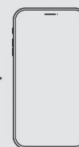
News: Recently, The Supreme Court-appointed technical committee found no conclusive evidence on use of the Pegasus spyware in phones examined by it.

How Pegasus infiltrates a phone and what it can do

Attack vectors

Pegasus can be installed on a phone through vulnerabilities in common apps, or by tricking a target into clicking a malicious link

SMS
WhatsApp
iMessage
? Unknown vulnerability



Capabilities

Once installed, Pegasus can theoretically harvest any data from the device and transmit it back to the attacker

SMS
Emails
WhatsApp chats
Photos and videos
Activate microphone
Activate camera
Record calls
GPS data
Calendar
Contacts book

About

- **Pegasus is the hacking software – or spyware.** It has the capability to infect billions of phones running either iOS or Android operating systems.
- It is developed, marketed and licensed to governments around the world by the Israeli company NSO Group.

Techniques

- **The earliest version of Pegasus discovered in 2016,** infected phones through spear-phishing – text messages or emails that trick a target into clicking on a malicious link.
- **Pegasus infections can also be achieved through “zero-click” attacks,** which do not require any interaction from the phone’s owner in order to succeed.
- **These will often exploit “zero-day” vulnerabilities,** which are flaws in an operating system that the mobile phone’s manufacturer does not yet know about and so has not been able to fix.
- Amnesty International researchers have developed a tool called **Mobile Verification Toolkit (MVT)** which is aimed to identify if the Pegasus spyware has targeted your phone.

F/A-18 SUPER HORNET

News: Ahead of India commissioning its first Indigenous Aircraft Carrier (IAC) Vikrant, the US aviation major Boeing has proposed the Indian Navy to choose its F/A 18 Super Hornet fighter jet.

About

- The F/A-18 Super Hornet Block III is the world’s most advanced, combat proven, multi-role frontline naval fighter that offers unique and differentiated capabilities and full compatibility with Indian Navy carriers.
- It has been designed and built for carrier operations, and is fully compliant with INS Vikramaditya and INS Vikrant aircraft carrier.
- **F/A-18 will be able to operate on the deck,** in the hangar and on the lifts of the Indian Navy’s aircraft carriers.
- It will help further the interface between manned and unmanned systems in a carrier environment.
- **The Super Hornet’s Precision Landing Mode software is specially designed to reduce pilot workload** while landing on the Indian Navy’s Vikramaditya carrier by maintaining the proper glide slope and proper approach speeds.
- **It has fully redundant systems and is independent of the carrier’s optical landing system.**

- F/A-18 Super Hornet is in **single-seater (E-Variant) and two-seater variant (F-Variant)**, and both variants are carrier compatible to perform the full range of combat missions and can fully operate from the carrier deck

VERY SHORT-RANGE AIR DEFENSE SYSTEM (VSHORADS)

News: The Defence Research and Development Organization (DRDO) has conducted two successful test flights of the Very Short-Range Air Defense System (VSHORADS).

About

- **VSHORADS is an indigenously designed and developed Man Portable Air Defence System (MANPAD).**
- **Developed by DRDO’s Research Center Imarat (RCI), Hyderabad** in collaboration with other DRDO laboratories and Indian Industry Partners.
- **Features:** The missile is propelled by a dual-thrust solid motor. It also incorporates a number of novel technologies, including miniaturized Reaction Control System and integrated avionics.
- **Significance:** VSHORAD is considered extremely vital for the defense of any major city or any strategically important location.

CARL-GUSTAF M4

News: Swedish defence firm Saab has announced its plan to set up a manufacturing facility in India for the Carl-Gustaf M4 shoulder-fired weapon system under the Government of India’s ‘Make in India’ initiative to bolster indigenous defence manufacturing.

About

- **Carl-Gustaf recoilless rifle is a man-portable, multi-role weapon system** that allows dismounted soldiers to effectively deal with multiple challenges on the modern battlefield.
- **Key Features:**
 - It is **lightweight, robust, reliable, effective and easy to use.**
 - It can be fitted with a wide range of sights to ensure a maximum effect in any tactical situation and flexibility for the user.
 - **The system is attached with a standard clip-on telescopic sight,** with additional options, including open sight, red dot sight and advanced fire control devices available.

- **The Indian Army has been using the iconic Carl-Gustaf since 1976** and currently operates the Mk2 and Mk3 versions.

TARAGIRI

News: Mazagon Dock Shipbuilders Ltd (MDL) has launched Taragiri, the third stealth frigate of Project 17A.

About

- It is the **third stealth frigate of Project 17A**.
- **Built by:** Mazagon Dock Shipbuilders Ltd (MDL).
- **Features:** The ship has state-of-the-art weapons, sensors, an advanced action information system, an integrated platform management system, world-class modular living spaces, a sophisticated power distribution system and a host of other advanced features.
- The ship's air defence capability is designed to counter the threat of enemy aircraft and anti-ship cruise missiles will revolve around the vertical launch and long-range surface-to-air missile system.
- **Two 30 mm rapid-fire guns will provide the ship** with close-in-defence capability while an SRGM (Super Rapid Gun Mount) gun will enable her to provide effective naval gunfire support.
- **Indigenously developed triple tube lightweight torpedo launchers** and rocket launchers will add punch to the ship's anti-submarine capability.

QUICK REACTION SURFACE TO AIR MISSILE (QRSAM) SYSTEM

News: Defence Research and Development Organisation (DRDO) and Indian Army have successfully completed six flight-tests of the Quick Reaction Surface to Air Missile (QRSAM) system.

About

- It is a **short-range Surface to Air Missile (SAM) system**, primarily designed and developed by the DRDO to provide a protective shield to the moving armoured columns of the Army from aerial attacks.
- It is **equipped with state-of-the-art guidance and control algorithms including warhead chains**.
- The uniqueness of the QRSAM weapon system is that it can operate on the move with search and track capability and fire on a short halt.
- Data captured by range instruments like telemetry, radar and Electro Optical Tracking Systems (EOTS) were used to confirm the system performance.

VIRTUAL CYBER EXERCISE ON RANSOMWARE RESILIENCE

News: India's National Security Council Secretariat (NSCS) and the UK Government in collaboration with BAE Systems has successfully conducted the virtual Cyber Exercise on Ransomware Resilience for 26 Countries.

About

- **Conducted by:** India's National Security Council Secretariat (NSCS) and the UK Government in collaboration with BAE Systems
- **Part of the exercise has been conducted as part of the International Counter Ransomware Initiative-Resilience Working Group** which is being led by India under the leadership of the National Cyber Security Coordinator (NCSC).
- **Aim of the exercise:** To allow participating countries to test their capability to respond to a major ransomware incident and to demonstrate the benefit of sharing information and collaborating during a major cyber incident.
- Around 26 countries and their respective organizations participated in the exercise.
- **Theme of the exercise:** It is based on the Energy Sector in which the respective National Cyber Crisis Management Teams of the participating nations will have to deal with a ransomware attack on multiple electricity distribution companies.

National Security Council

- The National Security Council (NSC) of India is an **executive government agency tasked with advising the Prime Minister's Office on matters of national security and strategic interest**.
- It was established by the former Prime Minister of India Atal Bihari Vajpayee on 19 November 1998, with Brajesh Mishra as the first National Security Advisor.

INFLATABLE AERODYNAMIC DECELERATOR

News: The Indian Space Research Organisation (ISRO) has successfully tested the Inflatable Aerodynamic Decelerator technology on a Rohini-300 (RH300 Mk II) sounding rocket from the Thumba Equatorial Rocket Launching Station.

About

- The Inflatable Aerodynamic Decelerator (IAD) is a technique used for an atmospheric entry payload.

- An inflatable envelope and an inflatable (anything that inflates the envelope, like air or helium) make up the IAD.
- **The IAD was designed and developed by ISRO's Vikram Sarabhai Space Centre (VSSC).** This IAD was made of Kevlar fabric coated with polychloroprene.
- **Purpose:** The IAD serves to decelerate an object plunging down through the atmosphere. It systematically reduced the velocity of the payload through aerodynamic drag.
- **Working:** At around 84 km altitude, the IAD was inflated using compressed nitrogen stored in a gas bottle.
 - Then, it descended through the atmosphere with the payload part of a sounding rocket.
 - Once the IAD falls into the sea, it will get deflated by firing a deflation pyro valve.
 - The pneumatic system used for inflating the IAD was developed by the Liquid Propulsion Systems Centre (LPSC), Valiyamala.
- **Significance:** The IAD technology could aid cost-effective recovery of spent rocket stages and safely land payloads on other planets. It can also be used in ISRO's future missions to Venus and Mars.

CHINOOK HELICOPTERS

News: The US Army has grounded its fleet of workhorse H-47 Chinook helicopters, after several experienced engine fires as the “suspect O-rings” used in some of the aircraft that did not meet its specifications.

About

- Originally **known as the CH-47, the Chinook helicopters were an icon of US wars from Vietnam to the Middle East.**
- They are **advanced medium-lift, multi-role helicopters made by Boeing.**
- It is in service across the US armed forces as well as in Britain and nearly 20 other countries.
- **With two rotors, the helicopters can carry heavy loads and are well-armed for combat situations.**
- They are **frequently used in disaster relief missions as well.**
- The Indian Air Force operates its fleet of 15 Boeing-made Chinook helicopters.

SCORCHED-EARTH TACTICS

News: The German chancellor accuses Russia of using scorched-earth tactics in Ukraine.

About

- It is a **form of a military strategy which destroys anything that could be of use to the enemy**, including energy supplies, bridges, provision stores, agricultural fields, road and railway links, etc.
- The destruction could be carried out by the enemy, or by the retreating army of a country which does not want invaders to use its resources.
- Harming civilians as part of this strategy has been **banned under the 1977 Geneva Convention.**
- The strategy seeks to deplete the enemy's resources to sustain warfare, and also break their morale by inflicting heavy hardships on combatants and non-combatants alike.

DIRTY BOMB

News: Moscow has recently accused that Kyiv might be planning to use a so-called dirty bomb.

About

- A **dirty bomb is a mix of explosives, such as dynamite, with radioactive powder or pellets.**
- A dirty bomb **works completely differently from an atomic bomb.** For example, an atomic bomb, like those bombs dropped on Hiroshima and Nagasaki, involves the splitting of atoms and a huge release of energy that produces the atomic mushroom cloud.
- A **dirty bomb uses dynamite or other explosives to scatter radioactive dust, smoke, or other material** in order to cause radioactive contamination.
- The immediate health impact of this event was believed to be limited, since most people in an affected area would be able to escape before experiencing lethal doses of radiation.
- **However, the economic damage could be massive** from having to evacuate urban areas or even abandon whole cities. For example, a bomb using radioactive cesium might require the evacuation of an entire area, making it unsafe for decades.

HAWK AIR DEFENSE EQUIPMENT

News: The United States is considering sending older HAWK air defense equipment from storage to Ukraine to help it defend against Russian drone and cruise missile attacks.

About

- **HAWK, short for 'Homing All the Way Killer',** entered service with the US Army in 1959, during the Vietnam War.
 - It is a mobile air defense system.
 - It is a medium-range surface to air missile.

- It underwent upgrades over the decades that followed, including a major one in 1971 that produced the so-called I-HAWK (or improved HAWK), with a kill probability of 85%. The first versions of the system had a range of 25 km for aerial targets, and an altitude of 14 km.
- **After modernization:** The maximum target interception range increased to 40 km with a maximum interception altitude of 18 km.
- **The HAWK system was the predecessor to the PATRIOT missile defence system** that Raytheon built in the 1990s.
- US forces largely stopped using HAWK from the early years of the new century.

CLUSTER BOMBS AND THERMOBARIC WEAPONS

News: Human rights organizations have accused Russia of using cluster bombs and thermobaric weapons in the ongoing conflict.

About

- **Cluster munitions:** These are non-precision weapons designed to injure or kill people indiscriminately over a large area, as well as destroy vehicles and infrastructure.
 - They can be dropped from an aircraft or launched in a projectile, scattering many bomblets as they travel.
 - Many of these bomblets do not explode and remain on the ground, posing a threat to civilians long after the fighting has stopped.
- **Thermobaric weapon:** They use airborne oxygen to create a large, high-temperature blast. It causes far more destruction than a conventional bomb of comparable size.



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PRATIBHA
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SHWETA BHARTI
AIR-356
UPSC CSE 2021

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH (CSIR)

News: Council of Scientific and Industrial Research (CSIR) celebrated its 81st Foundation Day.

About

- **Established:** September 1942.
- CSIR is the **largest research and development (R&D) organisation in India.**
- **Objectives:** The objectives of the Council are scientific and industrial/applied research of national importance.
- **CSIR has a pan-India presence** and has a dynamic network of 37 national laboratories, 39 outreach centers, 3 Innovation Complexes and 5 units.
- **Headquarter:** New Delhi.
- **Funded by:** CSIR is funded by the Ministry of Science and Technology and it operates as an autonomous body through the Societies Registration Act, 1860.
- **CSIR covers a wide spectrum of streams** – from radio and space physics, oceanography, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology.
- **It provides significant technological intervention in many areas** with regard to societal efforts which include the environment, health, drinking water, food, housing, energy, and farm and non-farm sectors.

Organisational Structure of CSIR

- **President:** Prime Minister of India (Ex-officio)
- **Vice President:** Union Minister of Science and Technology (Ex-officio)
- **Governing Body:** The Director-General is the head of the governing body.
- **CSIR Advisory Board:** 15-member body composed of prominent members from respective fields of science and technology. Its function is to provide science and technology input to the governing body.

CERT-IN

News: Recently, CERT-In has asked all government and private agencies to mandatorily report cyber security breach incidents to it within six hours of noticing them.

About CERT-In

- CERT-In was **established in 2004** as a functional organization of the **Ministry of Electronics and Information Technology.**
- CERT-In is the national **nodal agency for responding to computer security incidents as and when they occur.**
- The constituency of CERT-In is the Indian Cyber Community.
- **Functions:** The Information Technology (Amendment) Act 2008 designated CERT-In to serve as the national agency to perform the critical functions in the area of cyber security.

NATGRID

News: Union Minister for Home and Cooperation Amit Shah inaugurated the National Intelligence Grid (NATGRID) campus in Bengaluru.

About

- C-DAC Pune has been roped in as Technology Partner and IIT, Bhilai as Plan Management Consultant for the development of NATGRID solution.
- Envisaged as a robust mechanism to track suspects, the NATGRID can help in preventing terrorist attacks with real-time data and access to classified information like immigration, banking, individual taxpayers, air and train travels.
- It will be a medium for 11 Central agencies such as the Intelligence Bureau (IB) and the Research and Analysis Wing (R&AW) to access data on a secured platform.

- The data will be procured by NATGRID from 21 providing organizations such as the telecom, tax records, bank, immigration etc.

REGIONAL STANDARDIZATION FORUM

News: The Ministry of Communications hosted the International Telecommunication Union's (ITU) Regional Support Facility (RSF) for Asia and Oceania.

About

- The **International Telecommunication Union (ITU)** is the United Nations specialised agency for information and communication technologies (ICTs).
- RSF is a discussion forum for standardization topics such as Sustainable Digital Transformation.

THE GLOBAL LIGHTHOUSE NETWORK

News: Three manufacturers have been added to the Global Lighthouse Network, according to the World Economic Forum.

About

- A project of the **World Economic Forum (WEF)** and **McKinsey & Company** is the Global Lighthouse Network.
- The **Global Lighthouse Network** is a platform to develop, replicate and scale innovations in manufacturing, creating opportunities for cross-company learning and collaboration.
- 114 factories are now engaged in the network, boosting productivity, sustainability and resilient supply chains.



Government Policies and Initiatives

GRAPHENE INNOVATION CENTRE

News: The Kerala government announced that the country's first Graphene Innovation Centre would come up in Thrissur, Kerala.

About

- An Innovation Center is a cross-functional plan that creates a safe haven for new ideas.
- With opportunities for individual and group collaboration across time zones and continents, it's a place that fosters a culture of innovation through the creation, sharing, and testing of ideas.
- The India Innovation Centre for Graphene would come up in **Thrissur (Kerala)** at a cost of Rs 86.41 crore.

About Graphene

- Graphene is a **one-atom-thick layer of carbon atoms** arranged in a hexagonal lattice.
- It is the thinnest, most electrically and thermally conductive material in the world. It is also flexible, transparent and incredibly strong.
- **Often referred to as a wonder material for its extraordinary electrical and electronics properties.**
- **Graphene could replace Indium and thereby bring down the cost of OLED screens** in smartphones, studies.
- **Graphene has a lot of promise for additional applications:** Anti-corrosion coatings and paints, efficient and precise sensors, faster and efficient electronics, flexible displays, efficient solar panels, **faster DNA sequencing, drug delivery**, and more.

ADDITIVE MANUFACTURING

News: The Ministry of Electronics and Information Technology (MeitY) published the National Strategy on Additive Manufacturing.

About

- Additive Manufacturing is the process of creating a three-dimensional object from a computer-aided design (CAD) model, typically by adding materials layer by layer.
- Material can be added in a variety of ways, including power deposition, resin curing, and filament fusing.
- A computer controls deposition and solidification to produce a three-dimensional object.

Initiatives Taken in India

- The **National Institute of Electronics and Information Technology in Aurangabad** has established a 3D printing Manufacturing Lab.
- **Under the Atal Innovation Mission**, Atal Tinkering Labs have been established, where do-it-yourself (DIY) kits on cutting-edge technologies such as 3D printers, robotics, and miniaturized electronics are installed with government funding.
- The Department of Heavy Industries collaborated with Wipro to build India's first industrial grade 3D printer.

National Strategy for Additive Manufacturing

- It aims to inspire an effective AM strategy that maximizes economic benefits from future growth opportunities while mitigating risks and challenges.
- Make India a global center for AM development and deployment.
- Develop and safeguard the integrity of India's AM intellectual property.

Subtractive Manufacturing

- Subtractive manufacturing is an umbrella term for various controlled machining and material removal processes that start with solid blocks, bars, rods of plastic, metal, or other materials that are shaped by removing material through cutting, boring, drilling, and grinding.

VIGYAN JYOTI SCHEME

News: The Vigyan Jyoti programme is being implemented in 100 schools in the country and all the schools are situated in rural areas.

About

- It is an initiative to encourage girls to take interest in science and build a career in Science, Technology, Engineering and Mathematics (STEM).
- It was **launched by the Department of Science & Technology (DST)** to create a level-playing field for the meritorious girls to pursue STEM.
- The scheme envisages hand-holding and interventions right from the school level i.e., Class IX and which will continue till the PhD level to encourage girls to pursue a career in underrepresented areas of STEM.
- **Activities under the scheme:** Various activities such as science camps, special lectures/ classes, counselling of students and parents, interaction with role models, tinkering activities, and visits to Knowledge Partners/ Research Labs are being conducted in order to motivate girls.
- **Implementation Partner:** Navodaya Vidyalaya Samiti (NVS), an autonomous organization of the Ministry of Education, is the implementation partner of Vigyan Jyoti.

VIGYAN SARVATRA PUJYATE

News: Recently, The Government of India is organizing "Vigyan Sarvatra Pujyate (science is revered all over)" as part of Azadi ka Amrit Mahotsav.

About

- It is a nationwide week-long programme of competitions and lectures for school students and collegians.
- **Aim:** To attract students towards scientific knowledge of articles of daily use and propagating scientific theories.
- **Organized by:** Department of Science and Technology (DST), Department of Biotechnology, CSIR, DRDO and other ministries under the leadership of the office of the Principal Scientific Officer to the Government of India and the Ministry of Culture.
- **Coordinating Agency:** Vigyan Prasar, an autonomous organization of DST with a mandate to promote science communication in the country is the coordinating agency.
- **Themes under the programme:** The programme has been grouped under four themes:

- The first theme is from the annals of the history of S&T'. This section traces the contributions of founders of modern science and institutions of national importance to nation-building.
- **The second theme is 'Milestones of Modern S&T'.** It will highlight critical discoveries, innovations, or inventions that made a mark in the global science or India's development story.
- **The third theme is 'Swadeshi Paramparik Inventions and Innovations'.** It will showcase 75 inventions or technologies that made India self-reliant.
- **The fourth theme is 'transforming India'.** It will look at the road ahead for the next 25 years of Indian S&T.

DRAFT INDIA DATA ACCESSIBILITY & USE POLICY, 2022

News: Recently, The Government of India has released a policy document called "Draft India Data Accessibility & Use Policy 2022". To enhance access, quality, and use of data in line with the current and emerging technology needs of the decade.

Features of the Draft

- **Making Data Open:** All data collected, generated, and stored by every government ministry and the department will be open and shareable barring certain exceptions.
- **Indian Data Office (IDO):** It will be constituted by the Ministry of Electronics and Information Technology (MeitY) to streamline and consolidate data access and share public data repositories across the government and other stakeholders.
- **Indian Data Council (IDC):** It will comprise the IDO and data officers of five government departments.
- **Common Database:** All central and state government bodies will have to compulsorily share data with each other to create a common "searchable database".
- **The monetisation of Data:** The datasets that have undergone value addition could be monetized by the government.
- **Stakeholders like start-ups, other enterprises, individuals and researchers will be able to access enriched data** through data licensing, sharing and valuation within the frameworks of data security and privacy.
- **A data-sharing toolkit will be provided to ministries and departments** to assess and manage risks associated with data sharing.
- Guidelines will also be framed to decide how long datasets can be held by the Government.

GALLIUM NITRIDE ECOSYSTEM ENABLING CENTRE AND INCUBATOR

News: The Union Minister of State for Electronics & Information Technology and Skill Development & Entrepreneurship visited the Gallium Nitride Ecosystem Enabling Centre and Incubator (GEECI) facility.

About

- GaN is a **semiconductor commonly used in blue light-emitting diodes (LEDs)**.
- The ability to operate at much higher temperatures and voltages than **gallium arsenide (GaAs)** transistors make GaN an ideal power amplifier for microwave and terahertz (THz) devices, such as imaging and sensing.
- **Gallium Nitride Technology is of strategic importance with its application in the field of 5G, space and defense.**
- Gallium Nitride (GaN) plays a key role in **enabling e-vehicles and wireless communication.**
- Specific transistors called HEMTs made of aluminium gallium nitride, gallium nitride (AlGaIn/GaN) **provides an edge over silicon-based transistors** as they allow the systems to operate at very high voltages, switch ON and OFF faster, and occupy less space
- The GaN technology provided various benefits such as reduced energy consumption, higher switching frequency and lower system cost.

Gallium Nitride Ecosystem Enabling Centre and Incubator (GEECI) Facility

- GEECI is present at the **Indian Institute of Sciences (IISc), Bengaluru.**
- **Aim:** Establishing GaN based Development Line Foundry facility, especially for RF and power applications, including strategic applications.
- The facility has been established **jointly by the Ministry of Electronics and Information Technology and IISc Bengaluru.**

About Gallium

- **Gallium is a soft, silvery-white metal, similar to aluminium.**
- Gallium readily alloys with most metals. It is particularly used in low-melting alloys.
- **It has a high boiling point**, which makes it ideal for recording temperatures that would vaporise a thermometer.
- It is present in trace amounts in the minerals diaspore, sphalerite, germanite, bauxite and coal. It is mainly produced as a by-product of zinc refining.

PACER INITIATIVE

News: The Minister of Earth Sciences has informed Rajya Sabha about the Polar Science and Cryosphere Research (PACER) Initiative.

About

- **Initiative of:** Ministry of Earth Sciences.
- **Objective:** To study various aspects relating to Polar and the Cryosphere with special emphasis on the Antarctic, Arctic and Glaciers of the Himalayas.
- **Programmes:** The important programmes under the initiative include: the Antarctic program, Indian Arctic program, Southern Ocean program and Cryosphere and Climate program.
- **Implementing Agency:** National Centre for Polar and Ocean Research (NCPOR)
- **Duration of the Initiative:** The initiative has been approved for continuation during 2021- 2026.

ATAL NEW INDIA CHALLENGE

News: Atal Innovation Mission has launched the phase 1 of the 2nd edition of the Atal New India Challenge (ANIC 2.0).

About

- Atal New India Challenge is a **flagship program of Atal Innovation Mission, NITI Aayog.**
- **Aim:** To seek, select, support and nurture technology-based innovations that solve sectoral challenges of national importance and societal relevance.
- **Goal:** To support innovations in areas critical to India's development and growth – Education, Health, Water and Sanitation, Housing, Energy, Mobility, and Space Application among others.
- The challenge addresses the second Commercialization Valley of Death – supporting innovators scale over the risks associated with access to resources for testing, piloting and market creation.
- **Funding:** The challenge supports selected start-ups through the commercialization stage over a course of 12 – 18 months with a funding of up to INR 1 crore along with other associated support from the AIM's innovation ecosystem.

Valley of Death

- The Valley of death is **an expression used by Venture Capitalists (VCs) to describe the critical initial phase of a startup company.**
- **During this period, startup companies operate without any existing revenue**, relying on their initial invested capital.
- **Surviving the Death Valley curve means beginning to generate sufficient revenue** to become self-sustainable before the initial invested capital runs dry.

AIM-PRIME PLAYBOOK

News: AIM-PRIME (Program for Researchers in Innovation, Market Readiness, and Entrepreneurship) Playbook was launched by NITI Aayog.

About

- **Aim:** AIM-PRIME Playbook aims to be a comprehensive resource for academic researchers, entrepreneurs and incubators involved in building science-based enterprises from lab to-market.

Aim Prime

- **Launched in:** April 2021 by Atal Innovation Mission (AIM), NITI Aayog in collaboration with the Bill & Melinda Gates Foundation.
- **Aim:** To promote science-based, deep technology ideas to market, through training and guidance over a period of 12 months.
- **Focus Area:** Science-based, knowledge-intensive, deep technology entrepreneurship.
- **Implemented by:** Venture Center.

Venture Center

- The Venture Center is **India's leading science-based business and inventive enterprises' incubator.**
- It is **located in Pune.**
- It is a non-profit incubator hosted by the CSIR-National Chemical Laboratory, Pune and part of the Pune Knowledge Cluster.
- The Venture Center is a partner incubator of the Department of Science and Technology, BIRAC and IDEX.

TELANGANA SPACETECH FRAMEWORK

News: It's a first-of-its-kind attempt in the government sector to launch a spacetech framework.

About

- **It aims to:**
 - Help the state emerge as a commercial hub for all space-related products and services.
 - Promote domestic production of launch vehicles, satellite systems and subsystems, ground equipment manufacturing and other facilities.
 - Establish Telangana as a one-stop global destination for space technology.
- Telangana, which is already a base for defence & aerospace companies, has over 1,000 MSMEs catering to aerospace, defence and space sectors.

EVTOL

News: The Union Civil Aviation Minister recently said that the Government of India is exploring the possibility of inviting manufacturers of Electric Vertical Take-off and Landing (eVTOL) aircraft to set up bases in India.

About

- **An eVTOL aircraft is one that uses electric power to hover, take off, and land vertically.**
- Most eVTOLs also use what is called distributed electric propulsion technology, which means integrating a complex propulsion system with the airframe.
- This technology has grown on account of successes in electric propulsion based on progress in motor, battery, fuel cell and electronic controller technologies.
- **Significance of eVTOL:**
 - **eVTOL is being seen as a runway independent technological solution** for the globe's transportation needs.
 - This is because it opens up new possibilities that aircraft with engines cannot carry out in areas such as manoeuvrability, efficiency and even from the environmental point of view.
 - **Moreover, eVTOLs have also been likened to a third wave in an aerial revolution;** the first being the advent of commercial flying and the second the age of helicopters.

VRITIKA

News: Recently, the one-month-long Vritika Research Internship was concluded with the valedictory function organized by CSIR-NIScPR.

About

- **VRITIKA is the call for initiation and practice in science through the Training and Skill Internship.**
- **Objective:** To provide necessary knowledge on converting research data into an indexed publication and exposure to processing of research manuscripts from preparation to publication.
- **Funded by:** Science & Engineering Research Board (SERB), Department of Science and Technology (DST) under **Accelerate Vigyan scheme.**
- **Eligibility:** Masters and PhD (Science Stream) students enrolled in any Indian University or Institution can apply.
- **Implementation:** The internships will primarily be facilitated by organizations, institutions, laboratories of national importance such as IITs, IISc, IISERs, NITs, CSIR, ICAR, ICMR etc.

FIBERISATION

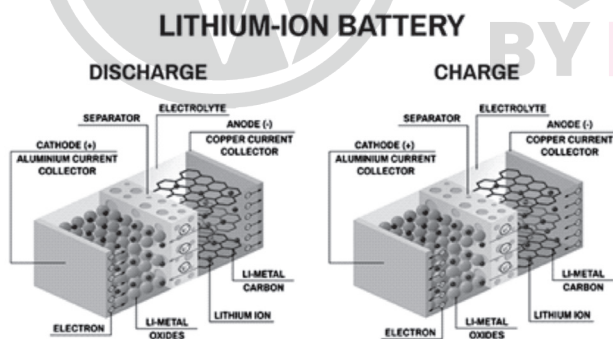
News: In the backdrop of the 5G spectrum auction for telecom airwaves by the government, the challenge for requisite infrastructure in terms of fiberization challenge is underscored.

About

- **Fiberisation is the process of connecting radio towers with each other via optical fibre cables.**
- It represents the part of the network that connects the core of the network to the edge facilitating large amounts of data used in 5G services.
- **Also, it provides additional bandwidth and stronger backhaul support.**
- In India, **currently only 33% of the towers are fiberised**, compared to the 80%-90% in the U.S., Japan and China.
- To transition to 5G, India needs at least 16 times more fibre.

BATTERY CERTIFICATION AND QUALITY CONTROL

News: Amid increasing instances of fires in EVs, Centre has formed a panel to formulate procedures on battery certification and quality control.



About

- **Reasons for fire may include** manufacturing defects, external damage, faulty charging or faults in the deployment in the battery management system, which could result in these batteries becoming a fire risk.
- With growing concern over climate change and a larger aim to reduce its crude import bill, the government's focus is on pushing passenger vehicle owners to shift to EVs.
- **Different types of batteries are available to power EVs** such as Li-ion, Solid state, Nickel-Metal Hydride etc.

- **However, Li-ion batteries are most preferred** because of their high power-to-weight ratio, high energy efficiency, low self-discharge etc.

DRAFT GUIDELINES ON ANONYMISATION OF DATA (AOD)

News: The Ministry of Electronics and Information Technology (MeitY), through e-Governance Standards and Guidelines, has released drafts on AoD Guidelines and Mobile Security Guidelines (MSG) for public consultation.

About

- These guidelines have been prepared by Standardization Testing Quality Certification (STQC) Directorate and Centre for Development of Advanced Computing (C-DAC) Pune.
- Data Anonymisation is a **processing technique that removes or modifies direct and indirect personally identifiable attributes to eliminate or significantly reduce identifiability.**
- Data which has undergone the process of anonymization is referred to as anonymized data.

Purpose of AoD Guidelines

- **Enhance privacy protection through case dependent data anonymisation** while processing, publishing, storing or sharing data with other entities.
- Provide Standard Operating Procedures to enable data anonymisation concepts to be implemented by various organisations and government departments.
- **MSG has been proposed to achieve mobile security goals** such as confidentiality, integrity, authentication, accountability, etc.
- **MSG categorizes mobile security into three sections** i.e. mobile device security, mobile communication security, and mobile services security.
- **It defined three categories of mobile security control measures** (policy-based measures, technology-based, and user-oriented measures) to protect privacy, sensitive data, and security of transactions.

WOMEN IN ENGINEERING, SCIENCE, AND TECHNOLOGY (WEST) INITIATIVE

News: On Teachers Day, the Government of India has launched the Women in Engineering, Science, and Technology (WEST) Initiative.

About

- It is a **new I-STEM (Indian Science Technology and Engineering facilities Map) initiative.**

- **Launched by:** Office of the Principal Scientific Adviser (PSA) to the Government of India.
- **Aim:** To cater to women with a STEM background and empower them to contribute to the science, technology, and innovation ecosystem.
- **Key Features of the initiative:**
 - **Pursue Research:** Through the WEST initiative, I-STEM shall provide a separate platform to scientifically inclined women researchers, scientists, and technologists for pursuing research in basic or applied sciences in frontier areas of science and engineering.
 - **Skill Development:** The Skill Development programmes under the WEST initiative will provide training for women with S&T backgrounds to brush up on their abilities and become engaged “in the field” filling crucial gaps in the R&D infrastructure of the country.
 - **A digital consortium “Connect Quickly”** for an online discussion and immediate support has also been established through the I-STEM WhatsApp and Telegram platforms.
 - **Support to women S&T Startups:** Under the WEST initiative, the current support being provided to S&T startups by women entrepreneurs by I-STEM will be enhanced. For instance, access to R&D facilities and R&D software platforms (COMSOL, MATLAB, LABVIEW, AUTOCAD) will be available through the I-STEM portal.

SCIENTIFIC SOCIAL RESPONSIBILITY (SSR)

News: The Department of Science and Technology (DST) recently published the Scientific Social Responsibility Guidelines 2022.

About

- SSR is defined as the ethical obligation of knowledge workers in all fields of science and technology to voluntarily contribute their knowledge and resources to the broadest range of stakeholders in society, in the spirit of service and conscious reciprocity.
- Since its independence, India has made significant advances in science and technology.

SSR Guidelines 2022

- All Ministries of the Central Government and State Governments would plan and strategize their SSR in accordance with their mandates.
- **Every knowledge institution would develop its SSR implementation plan in consultation with the Anchor Scientific Institution (ASI),** as well as its SSR code of conduct.
- All knowledge workers would be educated about their

ethical responsibility to contribute to the betterment of society by their institutions as well as the Anchor Scientific Institution.

- Each institution, including the **Anchor Scientific Institution**, should have an SSR assessment cell that evaluates institutional projects and individual activities on a regular basis, and each knowledge institution should publish an annual SSR report.
- Individual and institutional SSR activities should be adequately rewarded, including with budgetary support if necessary.
- A knowledge institution's SSR activities and projects would not be outsourced or subcontracted.

Meaning of Anchor Institution

- **Non-profit institutions** such as universities, hospitals and libraries that, once established, tend to stay in place long term and that can also serve as a central location for community services.
- Also refers to centralized points of contact for needed community services.

BIOLOGICAL RESEARCH REGULATORY APPROVAL PORTAL (BIO RRAP)

News: BioRRAP was developed by the Department of Biotechnology to track regulatory approvals for a research proposal on a single portal.

About

- BioRRAP provides a **single path for applicants to be directed to regulatory agencies that provide the necessary approval for biological research.**
- This portal's BioRRAP ID is linked to the portals of various regulatory agencies.
- This will lend **more credibility to such biological research**, as well as strengthen interdepartmental synergies and increase the efficacy of agencies that regulate various aspects of biological research.

AYURVEDA AAHARA' PRODUCTS

News: Ministry Of Ayush And Food Safety & Standards Authority Of India (FSSAI) Formulates Regulations For 'Ayurveda Aahara' Products.

About

- Regulations have been drafted to ensure the production of high-quality Ayurvedic food products and to aid in the expansion of the international market for Made-in-India products.
- Furthermore, these regulations will strengthen India's global position as a custodian of the Ayush system.

- Food Safety and Standards (Ayurveda Aahara) Regulations, 2022 will now govern the manufacturing and marketing of 'Ayurveda Aahara' products.
- A special logo has been designed for the "Ayurveda Aahara" category, allowing for easier identification and reinforcing the quality of Ayurvedic food products.
- Ayurvedic drugs or proprietary Ayurvedic medicines and medicinal products, cosmetics, narcotic or psychotropic substances, and herbs are **not permitted**.

FSSAI

- The Food Safety and Standards Authority of India is a **statutory body established by the Government of India's Ministry of Health and Family Welfare** under the **Food Safety and Standards Act, 2006**, to consolidate food safety and regulation in India.
- **Food Safety and Standards Authority of India (FSSAI)** released the **State Food Safety Index (SFSI)** 2021-22.

DATA EMPOWERMENT PROTECTION ARCHITECTURE (DEPA)

News: India's Data Empowerment Protection Architecture has been approved by the Bank for International Settlements (BIS).

About

- DEPA is a **collaborative public-private effort to improve data governance**.
- It develops a digital framework that enables users to share their data on their own terms via a third-party entity called Consent Managers.
- DEPA's first application was in the financial sector, with the goal of increasing inclusion and economic growth.

Significance of DEPA

- Allows people to access and share their data with third-party institutions in a seamless and secure manner.
- It includes private 'consent manager' institutions that ensure individuals can securely provide consent for data sharing while also protecting data rights.
- Allows small businesses to easily obtain affordable loans, insurance, and better financial management products.
- Lower transaction costs and increased competition.

STUDENTSHIP PROGRAM FOR AYURVEDA RESEARCH KEN (SPARK) PROGRAM

News: The Central Council for Research in Ayurvedic Sciences (CCRAS) will offer research fellowships to young undergraduate students enrolled in Ayurveda colleges across the country.

About

- SPARK aims to support young undergraduate students' research ideas.
- CCRAS is the apex body **under the Ministry of Ayush** for conducting, coordinating, formulating, developing, and promoting scientific research in Ayurveda.

More about Ayurveda

- Ayurveda, a natural system of medicine, **originated in India more than 3,000 years ago**.
- The term Ayurveda is derived from the Sanskrit words **ayur (life)** and **veda (science or knowledge)**.
- Ayurveda places great emphasis on prevention and encourages the maintenance of health through close attention to balance in one's life, right thinking, diet, lifestyle and the use of herbs.



WISER PROGRAMME

News: The first 11 awardees of the Women Involvement in Science and Engineering Research (WISER) programme were recently felicitated.

About

- It was launched by the Indo-German Science & Technology Centre (IGSTC).
- **Launched in:** 2021.
- **Purpose:** It is a first-of-its-kind programme to promote women in the field of research and development through lateral entry.

Features

- The program will support women scientists holding regular/long-term research positions in academia or research institutes/industry.
- **The involvement in the program will be possible through lateral entry.**
- There is neither requirement for a break-in-career nor any age limit, and it will enable easy participation.
- **Financial Support:** IGSTC is going to support the awardees with a **maximum amounting to Rs. 39 Lakh from the Indian side & €48000 from the German side.**
- The WISER program offers 20 awards per year.

NOBEL PRIZE IN MEDICINE OR PHYSIOLOGY, 2022

News: Swedish scientist Svante Paabo has been awarded the Nobel Prize for Physiology for the year 2022 “for his discoveries concerning the genomes of extinct hominids and human evolution”.

About

- Svante Pääbo has spearheaded the development of new techniques that allowed researchers to compare the genome of modern humans and that of other hominins — the Neanderthals and Denisovans.

- **Found the relation between modern humans and Neanderthals.**
- His research helped to establish that modern humans and Neanderthals share a common ancestor that lived some 600,000 years ago.
- **Discovered Denisovans:** During this process, he also discovered the existence of an unknown sub-species of the human family, now called Denisovans, who lived around the same time as the Neanderthals.

NOBEL PRIZE IN PHYSICS

News: Recently, the Nobel Prize in Physics for 2022 was awarded to Alain Aspect, John F. Clauser and Anton Zeilinger for their work on quantum mechanics.

About

- The 2022 Nobel Prize in Physics has been awarded “**for experiments with entangled photons**, establishing the violation of Bell inequalities, and pioneering quantum information science.”

Individual Contributions

- **John Clauser:** He built an apparatus that emitted two entangled photons at a time, each towards a filter that tested their polarisation.
- **Alain Aspect:** He developed a setup to close an important loophole. He was able to switch the measurement settings after an entangled pair had left its source, so the setting that existed when they were emitted could not affect the result.
- **Anton Zeilinger:** He researched entangled quantum states. His area of research has demonstrated a phenomenon called quantum teleportation, which makes it possible to transfer a quantum state from one particle to one at a distance.
- **Quantum mechanics:** Quantum mechanics is a fundamental theory in physics that provides a description of the physical properties of nature at the scale of atoms and subatomic particles. It is the foundation of all quantum physics including quantum chemistry, quantum field theory, quantum technology, and quantum information science.

NOBEL PRIZE IN CHEMISTRY

News: Recently, the Nobel Prize in chemistry for 2022 was awarded to Carolyn R. Bertozzi, Morten Meldal and K. Barry Sharpless. The three have been awarded for their work in 'click chemistry'.

About

- **Barry Sharpless is the originator of the concept of 'Click Chemistry'.** The name 'click' has been taken from the click sound that airline seat belts make when they are fastened.
- The idea is that while trying to produce any particular compound or a complex molecule, one must look for starting molecules that easily react with each other.
- In other words, scientists have to look for molecules that easily fit into each other, or 'click' with each other.
- **It makes the resultant chemical reaction more efficient.**
- The reacting molecules should be in a made-for-each-other kind of situation for this particular reaction, so that the reaction was irreversible and 100% efficiency was achieved
- This **clicks approach emphasized the need to replicate nature's efficiency**, not its processes, or even products.

Applications of Click Chemistry

- The pharmaceutical industry uses a lot of naturally occurring but industrially synthesised molecules.
- Every kilogram of a drug produced results in the generation of nearly 25-100 kg of chemical waste. **This can be reduced by click chemistry.**
- For instance, Sharpless discovered that the use of copper as a catalyst eliminated all the by-products to produce a nitrogen-containing cyclic compound and ensured only the desired chemical was produced.

- Click' Chemistry could work in the chemical processes happening in the living cells as well.
- **This has shown the promise of treating advanced cancer.** Cancer drugs based on this approach are now undergoing clinical trials.

RAMANUJAN PRIZE FOR YOUNG MATHEMATICIAN

News: The award has been granted to Professor Neena Gupta for her outstanding work in affine algebraic geometry and commutative algebra for the year 2021.

About the Award

- It has been given annually since 2005 and was founded by the International Centre for Theoretical Physics (ICTP), the Niels Henrik Abel Memorial Fund, and the International Mathematical Union.
- Awarded to a researcher from a developing country who is under 45 years old and working in any branch of mathematics.
- The prize includes a \$15,000 cash award to support the recipient's research.
- The Prize was renamed the "DST-ICTP-IMU Ramanujan Prize" in 2021.

About S Ramanujan

- He was born in Madras and made significant contributions to **analytic number theory**, working on elliptic functions, continued fractions, and infinite series.
- In 1918, he became the **second Indian Fellow of the Royal Society and the first Indian Fellow of Trinity College, Cambridge.**
- **On December 22, his birthday, National Mathematics Day is observed.**



DARK SKY RESERVE

News: Recently, in a first-of-its-kind initiative, the Department of Science & Technology (DST) has announced the setting up of India's first Dark Sky Reserve in Hanle, Ladakh.

About

- A Dark Sky Reserve is a designation given to a place that has policies in place to ensure that a tract of land or region has minimal artificial light interference.
- The International Dark Sky Association is a U.S.-based non-profit that designates places as International Dark Sky Places, Parks, Sanctuaries and Reserves depending on the criteria they meet.
- Several such reserves exist around the world but none so far in India.

India's First ever Dark Sky Reserve

- **Located at:** Hanle in Ladakh as a part of Changthang Wildlife Sanctuary.
- **To be Developed by:** Ladakh administration will work with **Ladakh Autonomous Hill Development Council (LAHDC)** and the **Indian Institute of Astrophysics (IIA)** for developing this reserve.
- **Significance:** The reserve will boost Astro tourism in India and will be one of the world's highest-located sites for optical, infrared, and gamma-ray telescopes.

TIHAN TESTBED FOR AUTONOMOUS NAVIGATION

News: TiHAN Testbed for Autonomous Navigation was inaugurated in the IIT Hyderabad campus to develop unmanned ground and aerial vehicles.

About

- TiHAN - Technology Innovation Hub on Autonomous Navigation (TiHAN) is a multidisciplinary initiative of the IIT-Hyderabad.

- It aims to make India a global player in the futuristic "Smart Mobility technology".
- **TiHAN is developing and deploying a real-time Cyber Physical Systems (CPS)** utilizing autonomous UAVs and ground/surface vehicles for many application sectors of the national importance of this decade.
- **TiHAN is recognized as a Scientific and Industrial Research Organization (SIRO)** by the **Department of Scientific and Industrial Research**.
- **TiHAN testbed:** TiHAN testbed on Autonomous Navigations is a first of its kind futuristic autonomous navigation facility to develop unmanned terrestrial & aerial vehicles.
- This testbed will provide a unique platform for high quality research between academia, industry and R&D labs both at the national and international level.

AVISHKAR HYPERLOOP

News: Indian railway is collaborating with IIT Madras for the development of 'indigenous' Hyperloop system.

About

- **Team named 'Avishkar Hyperloop',** formed by **IIT Madras** has been applying scalability as well as frugal engineering concepts for the development of Hyperloop-based system for transportation.
- IIT Madras sought support from Indian Railways for manufacturing assistance, safety regulations' formulation, access to its electrical testing facilities and funding support.
- **IIT Madras** has also proposed to set up a '**Centre of Excellence for Hyperloop Technologies**'.
- The developed prototype would offer the largest Hyperloop Vacuum Tube in the world that can be utilized as a Test Bed for further research on Hyperloop by the national transporter.
- **Also, the tube will be at par with USA's Virgin Hyperloop facility in terms of functionality** but will outperform it in terms of cost significantly.
- **Project will reduce the requirement of energy and make India carbon neutral** and makes hyperloop an attractive proposition for the national transporter.

About Hyperloop System

- The Hyperloop is a **fifth mode of transportation other than road, rail, water and air**.
- It **works on a technology that utilizes magnetic levitation in low-pressure tubes** to transport both goods and people at airplane-like speed up to 750 miles per hour.
- The working principle of hyperloop technology is built on the idea of the vacuum train to create a much more advanced and feasible model.
- It consists of enclosed chambers called **pods** for carrying travellers or freight through tubes or tunnels from which most of the air has been removed, but not complete vacuum to reduce friction.
- Hyperloop uses electric propulsion to move pods through the tube -
 - Low-pressure tubes reduce aerodynamics.
 - Drag and magnetic levitation (maglev)

N-TREAT TECHNOLOGY

News: Brihanmumbai Municipal Corporation (BMC) has **planned in-situ treatment of sewage** from the drains to prevent sludge and sewage from water drains flowing into the sea.

About

- N-Treat is a **seven-stage process for waste treatment** that uses screens, gates, silt traps, curtains of coconut fibers for filtration, and disinfection **using sodium hypochlorite**.

Seven Stages in the Process

- **First stage:** It involves screening to prevent the entry of floating objects such as plastic cups, paper dishes, polythene bags, sanitary napkins, or wood.
- **Second stage:** It has proposed the construction of a silt trap which creates an inclination and 'parking spot' on the bed for sedimentation.
- **Next three stages:** These are the installation of 'bio zones' in the form of coconut fiber curtains that will act as filters and promote the growth of biofilm to help in the decomposition of organic matter.
- **Sixth stage:** It proposes a floating wetland with aquatic vegetation planted on floating mats. In the floating wetlands, plants acquire nutrition directly from the water column for their growth and development, thus reducing the organic as well as inorganic pollutants.
- **Final stage:** It will include disinfection using sodium hypochlorite to kill the bacteria in the water.

MIST SUBMARINE CABLE SYSTEM

News: The Expert Appraisal Committee under the Ministry of Environment, Forest and Climate Change has recommended Coastal Regulatory Zone (CRZ) clearance for the Myanmar/ Malaysia- India- Singapore Transit (MIST) Submarine Cable System.

About

- MIST is an **8,100 Km long international submarine cable communication network**.
- It will traverse the undersea to connect India with countries such as Myanmar, Thailand, Malaysia and Singapore.
- It will **provide secure, reliable, robust and affordable telecom facilities in Asia** with the main trunk route being from Tuas in Singapore to Mumbai in India.
- **Significance of this project:**
 - **Firstly**, it will boost telecom connectivity between India and other Asian countries, namely Myanmar, Thailand, Malaysia and Singapore.
 - **Secondly**, it will have a minimal footprint on Mumbai's coastal environment.
 - **Thirdly**, it would also help avoid conflict with various stakeholders considering the increasing number of international cable landing on the Chennai coast.

Similar Upcoming Projects

- **Reliance Jio Infocomm's India Asia Xpress (IAX)**, connecting India to the Maldives, Singapore, Sri Lanka and Thailand.
- **India Europe Xpress (IEX)**, connecting India to Italy via Saudi Arabia and Greece.
- The **SeaMeWe-6 project**, owned by a consortium of telecom providers, will connect Singapore to France via India, Bangladesh, Maldives.
- **Africa2 cable**, which will connect India with the United Kingdom via several African countries.

YOTTA D1

News: Recently, Uttar Pradesh CM inaugurated North India's first hyperscale data centre 'Yotta D1' in Greater Noida.

About Hyperscale Data Centre

- A data Centre is a dedicated space or building that houses an organization's IT equipment and servers.
- The company can draw on its data center resources to operate its business or serve those resources to the public as a service.

- A **Hyperscale data center** is essentially the premise that provides space, power and cooling for network infrastructure designed specifically for offering a portfolio of highly scalable applications and storage services to businesses.

About Yotta D1

- Yotta D1 is North India's first hyperscale data center.
- **Located in:** Greater Noida, UP
- **Built by:** Yotta Infrastructure, part of Hiranandani Group. The data center is spread across 20 acres and will offer a total capacity of 30,000 racks, 4 dedicated fiber paths and an IT power capacity of 160 MW.
- **Purpose:** It will cater to the full spectrum of digital transformation needs with an elaborate portfolio of solutions that include data center colocation services, network and connectivity, internet peering,
- **Benefits:** This data center will increase the data storage capacity of the country, which until now stood at 2% only despite the fact that 1.5 billion mobile phones and 650 million internet users in the world are from India using 20 percent of data.

SUPER-ABRASIVE TOOLS

News: A team of scientists at the Indian Institute of Technology (IIT) Madras has developed a new indigenous technology to produce new-generation super-abrasive tools.

About Abrasives

- Abrasives may be defined as a hard material that can be used for Polishing, Smoothening, and Grinding the surface of other materials.
- The essential characteristics of an abrasive are its hardness and brittleness.

Super-Abrasives

- Super-abrasives are used when the material being processed is either too hard or too delicate for regular abrasives.
- In contrast to "standard abrasives" like corundum and silicon carbide, superabrasives have better hardness and wear resistance.
- Examples of Super Abrasives include **Cubic Boron Nitride (CBN)** and **diamond**.

NIXTAMALIZATION

News: A study has shed light on how the Maya fortified their maize through a chemical process known as nixtamalisation.

About

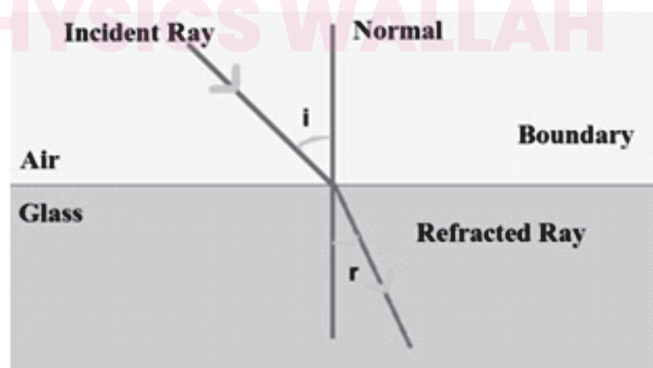
- **Nixtamalisation** is a method used by ancient Mesoamerican (a term used to describe Mexico and Central America) peoples such as the Maya to **soak and cook their maize in an alkaline solution** to make it more palatable, nutritious, and non-toxic.
- The process ensures that maize contains amino acids, calcium, and Vitamin B2, all of which the human body can use.
- It also removes certain mycotoxins found in maize.

PHOTONIC CRYSTALS

News: A soft tunable photonic crystal with enhanced thermal stability and optical purity developed by researchers that reflects vivid colours in the visible spectrum has potential applications in making more durable and better reflective displays and laser devices.

About

- Photonic crystals are optical nanostructures in which the refractive index changes periodically.
- Refractive index, also called index of refraction, is the measure of the bending of a ray of light when passing from one medium into another.
- This affects the propagation of light in the same way that the structure of natural crystals gives rise to X-ray diffraction and that the atomic lattices (crystal structure) of semiconductors affect their conductivity of electrons.



- Photonic crystals occur in nature in the form of structural coloration and animal reflectors.
- **Examples found in nature:** opal, butterfly wings, peacock feathers, etc., exhibiting distinct iridescent colours.
- Photonic crystals promise to be useful in a range of applications ranging from reflection coatings to optical computers when artificially produced or engineered in laboratories.
- They enable the PCs to exhibit structural colours in the visible spectral regime.

- Researchers have also been on the constant lookout for tuning the properties in-situ post-fabrication.

KAVACH

News: The Minister of Railways inspected the trial of the 'Kavach' working system between the railway stations of Gullaguda and Chitgidda.

About

- Kavach is the **indigenously developed train collision avoidance system** (TCAS).
- It is a collection of electronic and radio frequency identification devices installed in locomotives, the signaling system, and the tracks.
- These use **ultrahigh radio frequencies to communicate with one another** in order to control train brakes and alert drivers.
- It takes over and **applies sudden brakes in the event of a human error** in jumping a red light, and **it also prevents rear-end collisions** when they are on the same line.

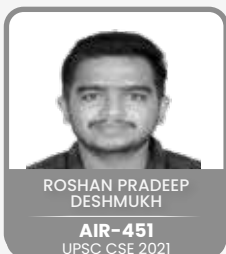
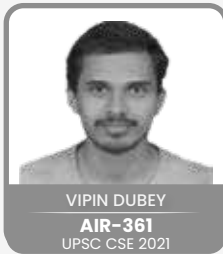
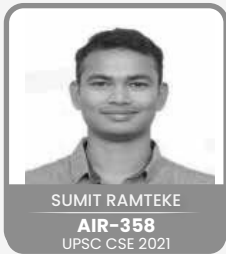
- When a level crossing is approaching, the hooter automatically sounds, assisting loco pilots during foggy conditions when visibility is reduced.
- During curves or on bridges, speeds are automatically reduced to allowable limits.
- **It has been in development since 2012, with the Research Design and Standards Organization (RDSO) collaborating with Indian industry and trials facilitated by South Central Railway.**

Research Design and Standards Organization (RDSO)

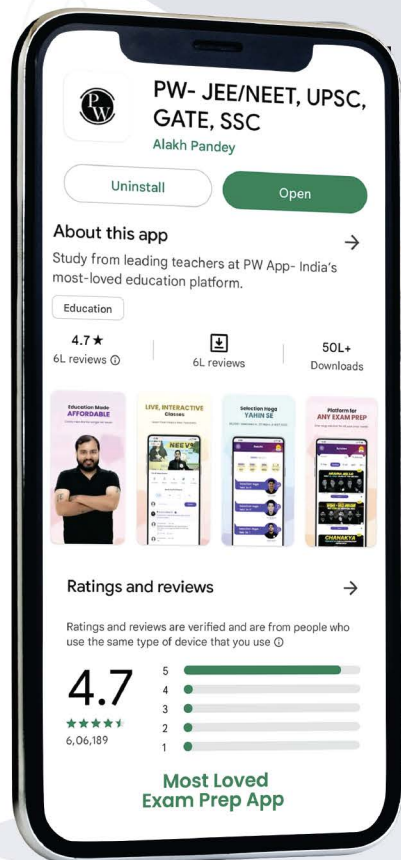
- Central Standards Office (CSO) and the Railway Testing and Research Centre (RTRC) were integrated into a single unit named Research Designs and Standards Organisation (RDSO) in 1957, under Ministry of Railways at Lucknow.
- The status of RDSO has been changed from an 'Attached Office' to 'Zonal Railway' since 01.01.2003.



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