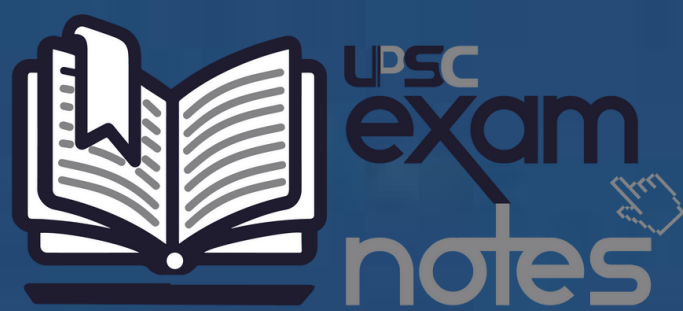


SCIENCE & TECHNOLOGY REVISION MODULE (APRIL 2022-DECEMBER 2022)



SCIENCE & TECHNOLOGY
(REVISION MODULE)
(APRIL 2022 to DECEMBER 2022)



Table of Contents

SCIENCE & TECHNOLOGY	1
(REVISION MODULE)	1
THERMOPHOTOVOLTAIC CELL.....	1
STRONTIUM	2
1.Context	2
2.About	2
3.How does it attack networks?	2
4.Government and security agencies reaction.....	3
BLUE STRAGGLER.....	3
2. Indian Research on Blue straggler.....	4
3. Importance of the Study	4
CERT-In.....	4
1.Context:	5
2.New Guidelines:.....	5
3.About CERT-In.....	5
5.Functions/ Activities	5
Trieces Irwini	6
LAND-BASED PATHOGENS	6
1.Microplastics	6
3.Effects	7
4.Sollution.....	7
TOTAL FERTILITY RATE	8
2.TFR IN DIFFERENT STATES.....	9
Platform Capitalists	10
2.About Platform Capitalists	10
3.Data.....	11
W-BOSON.....	11
□ Recent findings on the most precise measurement of the W Boson mass ever made have stunned scientists, as it could potentially rewrite particle physics.....	11
2. About	11
Electric Vehicles: rare minerals	12
1.Context	12

2.Key Points.....	12
3.Top producers of rare minerals	13
4.Measures.....	13
eVTOL.....	13
1.What is eVTOL?	13
2.Why are the developments in powering eVTOLs?	14
3.What are the challenges	14
4.How did it begin	14
ARE THERE ANY BIG PLAYERS NOW.....	14
5.How does one get an idea of the kinds of eVTOLs?	15
6.What about Certification	15
7.How will it be in India.....	15
8.What is the value in the market	16
RICE FORTIFICATION	16
1. Background	16
2. What is Rice fortification all about?	17
3. Need of Fortification	17
4. WHO Recommendations on Food fortification.....	17
Web 5.0.....	17
1.Context	17
2.Web versions	17
3.Web 5.0 Changes:.....	18
4.About the control of data	18
Malnutrition.....	18
1.Context	18
2.Key points.....	18
3.Marginal improvement	19
4.Stunting, wasting, anaemia	19
4.Step up the financing.....	20
5.Monitor constituencies too	20
6.Other steps.....	20
LaMDA	21
1.Context	21
2.Is AI technology here?.....	21
3.Which were the first chatbots to be devised?	21
4.What is a neural network?	22
5.What is LaMDA?	22

6.How is LaMDA different from other chatbots?	23
7.AI Intelligent	23
8.Is the technology dangerous?	23
VIRTUAL PRIVATE NETWORK (VPN).....	24
1. Background	24
2. Effect of New Rules	24
3. The aspect of virtual servers and their uses	24
4. Can the VPN providers circumvent the new rules and regulations?	25
5. Impact of new VPN rules on India.....	25
6. Approach of China towards dealing with VPN usage?	26
ISKANDER-M MISSILE SYSTEM	26
1.Context	26
2.The Missile system.....	26
3.Firepower	26
4.Development	27
5.Projection power	27
INTERNET OF THINGS (IoT).....	27
1. Background	27
2. Key features.....	27
☐ AI – IoT.....	28
☐ Connectivity.....	28
☐ Sensors	28
☐ Active Engagement.....	28
☐ Small Devices –	28
2. Advantages of IoT	28
☐ Improved Customer Engagement –	28
☐ Technology Optimization	28
☐ Reduced Waste	28
☐ Enhanced Data Collection –	28
3. Disadvantages of IoT.....	28
☐ Privacy	29
☐ Complexity.....	29
☐ Flexibility	29
☐ Compliance	29
4. Areas, where the internet of things can be efficiently, implemented	29
5. Areas to ensure user-friendly Internet of Things	29
☐ Universal Default Passwords.....	29

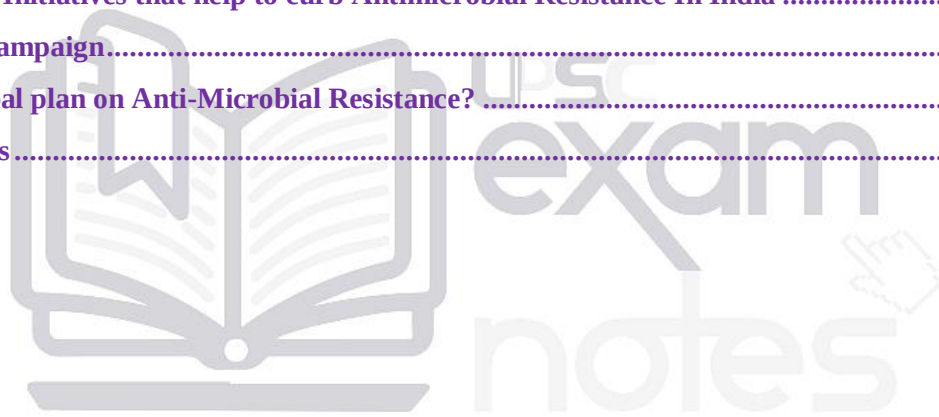
□ Implement a means to manage reports of vulnerabilities:	29
□ Keep software updated.....	29
□ Securely store sensitive security parameters:	29
□ Communicate securely	30
□ Minimise exposed attack surfaces	30
□ Ensure that personal data is secure:	30
□ Make systems resilient to outages	30
6. Government of India working towards the Internet of things	30
7. Internet of things towards sustainable development Goals.....	30
HERMIT	31
1. about Hermit	31
2. Working of Hermit.....	31
3. Deployment of Hermit.....	31
4. How did hermit surpass Firewalls of security?	32
POEM.....	32
1.Context:	32
2.About POEM.....	32
3.POEM's Stability in the Orbit	32
PS4 Junk.....	32
INDIA'S LARGEST FLOATING SOLAR PLANT	33
1.Context	33
2.Key Points.....	33
3.Solar plant	33
4.Environment-Friendly	34
DARK MATTER.....	34
1.Context	34
2.Key Points.....	34
3.Dark matter	35
4.Why is it so elusive?.....	35
5.Why do physicists believe strongly that dark matter exists?	35
6.Evidence from other distance scales	36
7.Candidates for dark matter particles	36
8.Other theories.....	36
WORMHOLE.....	36
1.Introduction:	37
2.Wormhole:	37
3.Interstellar Travel:	37

4.Observations:.....	37
5.Cutting Across Spacetime:	38
6.Wormhole fiction/ fact:	38
7.Conclusion:	38
MARBURG	38
LANCE SYSTEM.....	39
ARTEMIS	41
1.Context.....	41
2.What is Artemis?	41
3.Other Space agencies involved in Artemis.....	41
4.Importane facts about Artemis.....	41
CAPSTONE.....	42
Next Steps under Artemis	42
5.Importane Space Facts regarding Moon.....	42
ADITYA L1.....	43
7. Lagrange points of Earth and Sun:.....	44
PSYCHE.....	45
1.Context.....	45
2.What is Psyche?	45
3.About Psyche's Mission	45
4.Objectives of the Mission	45
5.Deep Space Optical Communication (DSOC)	46
SPACE DEBRIS	46
1.Context:	46
2.Space junk:	46
3.ROCKET DEBRIS:.....	47
4.UNCONTROLLABLE RE-ENTRY :.....	47
5.Laws regulating space junk:	47
ALPHA FOLD	48
ASTROBEE	51
1.Context.....	51
2. What is Astrobee?	51
3.Honey, Queen, bumble	51
4.About Astrobee.....	52
5.About SPHERES	52
Hellfire R9X	52
LUMPY SKIN DISEASE (LSD).....	54

2.About the LSD	54
3.Previous Outbreaks	54
Risk to Humans	54
SMALL SATELLITE LAUNCH VEHICLE (SSLV).....	55
iDEX.....	57
LANGYA VIRUS.....	60
.....	61
F-INSAS	62
1.Context.....	62
2.The F-INSAS project.....	62
3. F-INSAS hand grenade	62
4.Ballistic helmets and goggles	62
5.The F-INSAS Vision	63
6.Nipun Mines	63
7.The LCA	64
Tomato flu	64
ETHEREUM.....	66
1.Context	66
2.Consensus Mechanism	66
3.Bitcoin.....	67
5.Conclusion	67
DART	68
1.Background	68
2.The crash of DART with Dimorphous	68
3.About	69
CRISPR-Cas9	69
1.Background	69
2.Effective treatment of diseases	69
3.How the genetic scissors work.....	70
4.The ethical Dilemma.....	70
Glossary	71
ONCOLYTIC VIRUSES (OVs)	71
LAUNCH WINDOWS.....	73
INS VIKRANT.....	76
1.Context.....	76
2.From Vikrant to Vikrant	76
3.Design and construction	76

4.Key features	77
Performance	77
Space.....	77
16-Bed Hospital	77
Huge Aviation Hanger	77
3, 000 Rotis/ Hour.....	77
STOBAR.....	77
5.Conclusion	77
KALANAMAK RICE.....	78
METAVVERSE.....	79
2. Metaverse.....	79
3. Understanding the Metaverse	80
4. Origin of Metaverse.....	80
5. What is the Facebook Metaverse?	80
6. Metaverse Potential	80
7. Expensive Transition.....	81
8. A solution waiting for the Problem	81
DIRTY BOMB	81
1.Context.....	81
2.Dirty Bomb	81
4.How much damage they can do?.....	82
5.Response of Ukraine and the west	82
GM MUSTARD	82
PALAEOGENOMICS.....	84
2. Extracting DNA from Fossils	85
3. Advantages of Palaeogenomics	85
USB-C.....	86
1.Context.....	86
2.What are the rules	86
3.How will it help the environment?	87
4.What exactly is USB-C?	87
5.The limitations of USB-C	87
6.When can India have a single charger?	87
NavIC	87
2.What is NavIC?	87
3.NavIC vs Others	88
BLUEBUGGING	89

1. Context.....	89
2. What is BlueBugging?	89
3. How Does Bluebugging Occur?	89
4. How Does Bluebugging differ from Bluejacking and Bluesnarfing?	89
5. How do you protect against Bluebugging?	90
6. Way Forward.....	90
ANTIMICROBIAL RESISTANCE	90
1. Context.....	91
2. What is Anti Microbial Resistance?	91
3. Emergence and spread of AMR	91
4. Factors causing AMR in India	91
6. Government Initiatives that help to curb Antimicrobial Resistance In India	92
6.1 Red Line Campaign.....	92
7. WHO's Global plan on Anti-Microbial Resistance?	92
8. Global efforts	93



THERMOPHOTOVOLTAIC CELL

1. About

- **Thermo photovoltaic (TPV)** energy conversion is a direct conversion process from heat to electricity via photons.
- A basic thermo photovoltaic system consists of a **thermal emitter and a photovoltaic diode cell**.
- The temperature of thermal emitters varies from about 900 °C to about 1300 °C, although in principle TPV devices can extract energy from any emitter with temperature elevated above that of the photovoltaic device (forming an optical heat engine).
- The **emitter can be a piece of solid material or an engineered structure. Thermal emission is the spontaneous emission of photons due to the thermal motion of charges in the material.**
- At TPV temperatures, this radiation is mostly at near-infrared and infrared frequencies.
- The photovoltaic diode absorbs some of these radiated photons and converts them into electricity.
- Thermo photovoltaic systems have few to no moving parts. They operate quietly and require little maintenance. These properties make thermo photovoltaic systems suitable for remote-site and portable electricity-generating applications.
- Their efficiency-cost properties, however, are often poor compared to other electricity-generating technologies. Current research in the area aims at increasing system efficiencies while keeping the system cost low.

2. Principle behind Thermo photovoltaic Energy

- The basic principle is similar to that of traditional photovoltaic (PV) where a p-n junction is used to absorb optical energy, generate and separate electron/hole pairs, and in doing so convert that energy into electricity.
- The difference is that the optical energy is not directly generated by the Sun, but instead by a material at high temperature (termed the emitter), that causes it to emit light. In this way thermal energy is converted to electrical energy.
- The emitter can be heated by sunlight or other techniques. In this sense, TPVs provide a great deal of versatility in potential fuels.
- Solar TPVs require large concentrators to provide adequate temperatures for efficient operation.

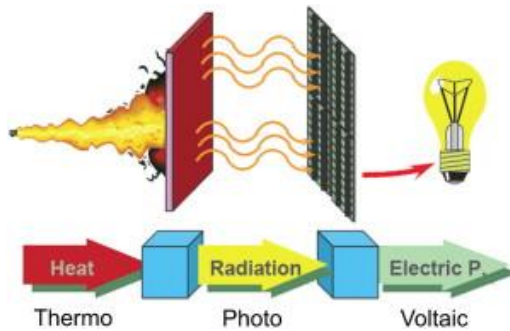


Image Source- [Science Direct](#)

3. Applications

- PV systems can supply the electricity in locations where electricity distribution systems (power lines) do not exist, and they can also supply electricity to an electric power grid.
- PV arrays can be installed quickly and can be any size.
- The environmental effects of PV systems located on buildings are minimal.

STRONTIUM

1.Context

‘Strontium’ is a cyber-attack on Ukrainian corporations, media organisations, authorities our bodies, and supposes tanks within the U.S. and the EU.

2.About

Strontium (aka Fancy Bear) is an extremely energetic cyber-espionage group.

The group is claimed to be related to the GRU, the Russian Armed Forces’ principal navy intelligence wing. The GRU’s unit 26165 is recognized as Fancy Bear.

3.How does it attack networks?

- The group deploys numerous malware and malicious instruments to breach networks.
- These instruments can be utilized as hooks in system drivers to enter native passwords and might observe keystrokes, mouse actions, and management webcam and USB drives.
- They will additionally search and substitute native information and keep related to the community.
- The Democratic Nationwide Committee (DNC) hack through the 2016 U.S. presidential election, the worldwide TV community TV5Monde cyber-attack, the World Anti-Doping Company (WADA) electronic mail leak, and several other different high-profile breaches are mentioned to be the work of Fancy Bear.

4. Government and security agencies reaction

U.S and U.k imposed a travel ban on the members of the GRU.

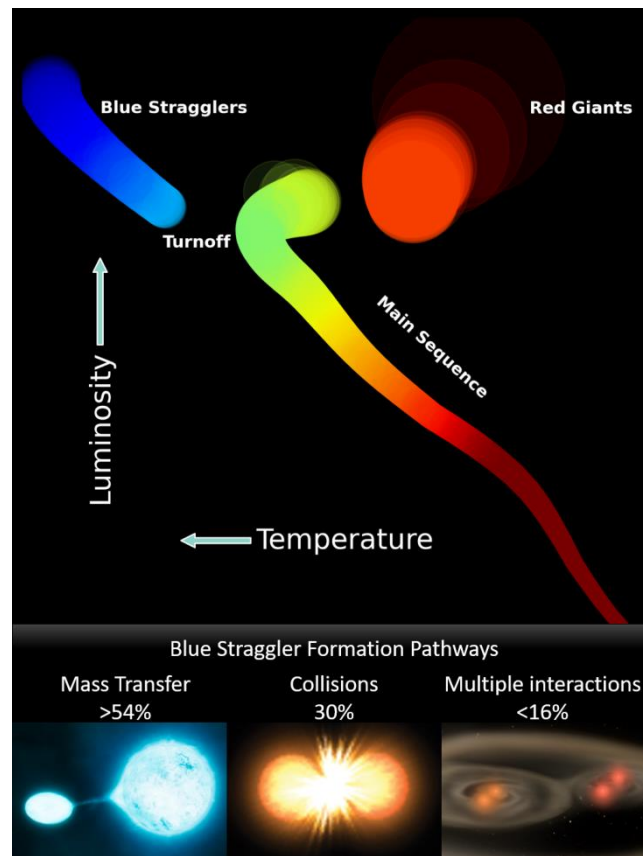
Along with safety businesses, software programs and cyber security corporations in addition to researchers have printed detailed studies, describing Fancy Bear's infamous cyber-attacks and the instruments utilized in executing them.

That is to assist and put together organisations towards the persistent cyber threats from APT teams working in affiliation with nation-states.

BLUE STRAGGLER

1. About

- In general a bunch of stars are born at the same time from the same cloud that forms a **star cluster**.
- As time passes, each star evolves differently depending on its mass.
- The most massive and **bright stars evolve and move off the main sequence creating a bend in their track, known as the turnoff**.
- Stars above this bend or brighter and hotter stars are not expected in a cluster, as they leave the main sequence to become red giants.
- But in 1953, Allan Sandage found that **some stars seem to be hotter than the turnoff of the parent cluster**.
- Initially, these blue stars, still straggling above the turnoff, were not part of these clusters.
- However, later studies confirmed that these stars are indeed cluster members, and they were termed "**Blue Stragglers**".



2. Indian Research on Blue straggler

- **Indian researchers have found that:**
 - Half of the blue stragglers are formed through mass transfer from a close binary companion star.
 - One third is likely formed through collisions of two stars.
 - Remains are formed through interactions of more than two stars.

3. Importance of the Study

- The study will help improve understanding of these stellar systems to uncover exciting results in studies of large stellar populations, including galaxies.
- Following these findings, the researchers are conducting detailed analyses of individual blue stragglers in the catalog to obtain their stellar properties.
- Furthermore, interesting clusters and blue stragglers identified in this study will be followed up with ultraviolet imaging with Ultraviolet Imaging Telescope on **AstroSat**, **India's first dedicated space observatory**, as well as the 3.6 m **Devasthal Optical Telescope in Nainital**.

CERT-In

1.Context:

Computer emergency response team (CERT) has directed all service providers, intermediaries, data center providers, corporate and government organisations to report cyber incidents within 6 hours of their detection

2.New Guidelines:

- CERT-In also asked virtual asset, exchange, wallet providers to maintain records on KYC and financial transactions for a period of Five Years
- Companies providing food, a virtual private network (VPN) will also have to register valid names, emails, and IP addresses of Subscribers
- Service Providers will also have to provide information and assistance CERT-In for any action taken to mitigate the impact of the Cyber incident
- The information has to be provided in a specific format and time frame, failing which it will be treated as non-compliance, CERT-In warned
- CERT-In asked all the service providers to enable and securely maintain logs of all their ICT systems for a period of 180 days

3.About CERT-In

It is a functional organisation of the [Ministry of Electronics and Information Technology](#), Government of India

4.Objective:

To secure Indian Cyber Space and to provide Incident Prevention and Response services as well as security quality management Services

CERT-In has a vision of Proactive Contribution in securing Indian Cyber Space

5.Functions/ Activities

- Collection, analysis, and dissemination of information on cyber incidents
- Forecast and alert of cyber security incidents
- Emergency measures for handling cyber security incidents
- Coordination of cyber incident response activities
- Issue guidelines, advisories, vulnerability notes and whitepapers relating to information security practices, procedures, prevention, response and reporting of cyber incidents

- Such other functions related to cyber security maybe prescribed

Trieces Irwini

Scientists found a brand new species of **parasitoid wasp** in **Bilgiri Rangaswamy** hills of Karnataka

Scientists have named it as Trieces Irwini after the American scientist Michael Edward Irwin.

These are recognized to inject their eggs into our bodies of different bugs, killing their host before rising out



Scientists have recorded the Trieces genus for the primary time in a dry deciduous, evergreen and moist forest; **they'll inhabitant in moist climates**

Sysica Indica- it is an ant which is blind which is uncommon and is in reddish brown colour, researchers recorded the species for the primary time in India naming it "Sysica Indica" They dwell with in Asia and American tropics

LAND-BASED PATHOGENS

1. Microplastics

- Micro plastics are fragments of any type of plastic less than 5MM in length.
- Generally there are two sources of micro plastics, either directly from industry (cosmetic exfoliants), or indirectly from physical, chemical and biological fragmentation of large plastic residues.
- If ingested, micro plastics can block gastrointestinal tracts of organisms or make them into a thought of starvation, finally leading to death.

Micro plastics can either float over long distances, spreading pathogens, or they can

sink to oceanic depths, where filter-feeding animals reside and spread pathogens.

2.Key Points

- Land-based pathogens may piggyback on micro plastics flowing into the sea, potentially posing a threat to marine life.
- Pathogens like *Toxoplasma Gondi*, *Cryptosporidium*, *Giardia*, etc., infect humans and animals and may infect marine organisms.
- *Toxoplasma Gondi*, is found in cat poop, is linked to the death of sea otters, Hector's dolphins, and Hawaiian monk seals.
- Some water-loving germs like *Vibrio* thrive in seawater.
- These microbes may get attached to micro plastics, which are formed when plastics break down to form particles measuring less than 5mm in size.
- These pathogens are exposed to 2types of micro plastics. 1. Polythene micro beads 2. Polyester microfibers which are already submerged in seawater.
- The polythene micro beads can be traced back to cosmetics like cleansers, and exfoliants and the latter to clothing and fishing nets.
- The experiment showed that pathogens attach to both micro plastics, although they showed a higher preference for microfibers.
- Micro plastics might ferry pathogens into the sea and impact marine life in two ways. These particles can float and travel long distances, spreading the pathogens.
- Micro plastics could sink into oceanic depths, which may be swallowed by filter-feeding animals like zooplankton, clams, mussels, oysters, abalone and other shellfish.
- Filter-feeding animals, which swallow water to filter food, are particularly susceptible to ingesting high levels of microplastics.

Disease transmission must depend on the physical transport of these pathogens from the poop of infected animals and people to a susceptible host in the ocean or a human that consumes contaminated seafood.

3.Effects

- Micro plastics cause problems to humans, and marine animals.
- The problem requires collaboration across human, wildlife and environmental disciplines as we all depend on the ocean.

4.Sollution

- Adding filters on washing machines and dryers could control the release of microfibers into the environment.
- Other solutions include deploying technologies to treat storm water and best management practices to prevent the release of micro plastics from plastic industries and construction sites.

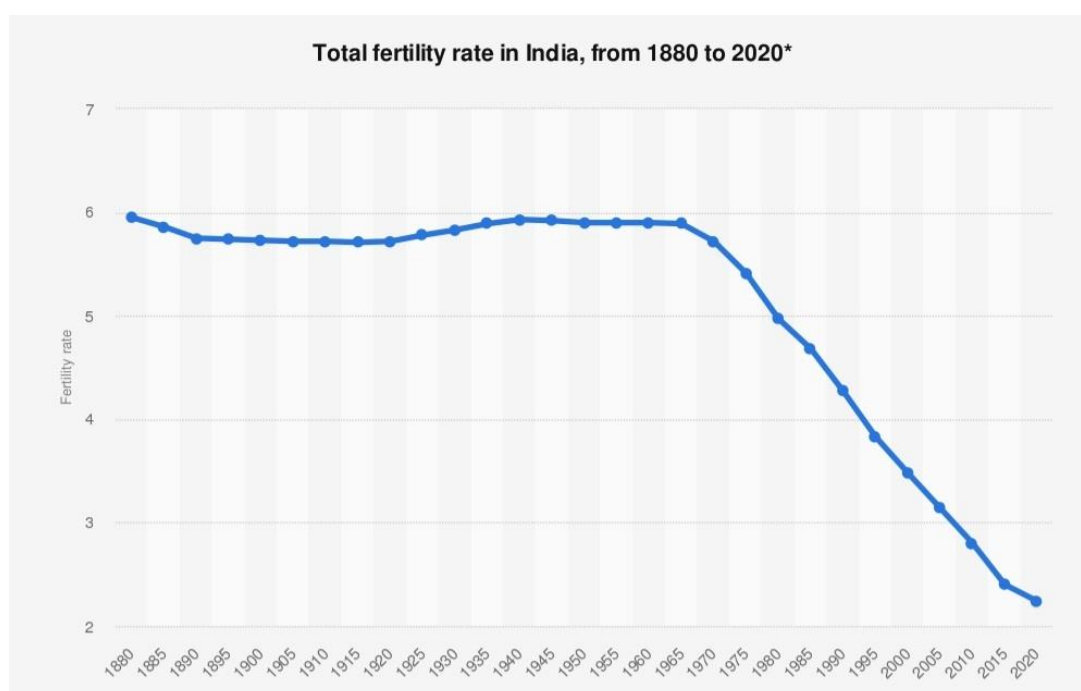
Scientists detected micro plastics in air, water, food and in our bodies too. They are found hiding deep in the lungs of a human body, blood samples. These particles were fragments of

polypropylene used in plastic packaging and pipes, and polyethylene terephthalate used in bottles.

TOTAL FERTILITY RATE

The Total Fertility Rate (TFR) is the average number of children per woman. There is decline in TFR from 2.2 in 2015-16 to 2.0 in 2021.

A population explosion is a sudden increase in the number of individuals in a particular species.



1.NFHS-National Family Health Survey

- NFHS is the most thorough survey on health and nutrition indicators of citizens of India.
- Since 1992-93, the NFHS provided various health, nutrition, family welfare and social indicators at regular intervals.
- NFHS serves as a mirror of India's achievements in maternal and child health when compared with other countries.
- It is a major exercise as it surveys on antenatal care, institutional delivery, child immunization, malnourishment, age at marriage, fertility, contraception, sexual behaviour, gender based violence, women's empowerment and access and utilization of health care services.
- The key highlights of this survey include institutional birth rate increased from 79% to 89%.
- More than 77% of the children aging between 12 and 23 months were fully immunized.

- The level of stunting among children under 5 years has marginally declined from 38% to 36%.

The data in NFHS shows that the fertility rate at 1.6 in urban areas and 2.1 in rural India

According to the United Nations' population division, countries experiencing below-replacement fertility lower than 2.1 children woman, indicates that a generation is not producing enough children to replace itself, eventually leading to an outright reduction in population.

With the above mentioned TFR, in long run, we may have a potential growth rate of zero. Experts highlighted three key points from the TFR declining to 2.0 :

1. A diminished challenge to development
2. The importance of investing in public health and education with skills
3. The need to focus on environmental protection

India has been aiming for a TFR of 2.1 and a fall to 2.0 means, the goal of population stabilization is achieved.

The numbers also tell us that there is a stabilization in Human Resources. The younger population profile for next 2-3 decades will provide an opportunity for accelerated economic growth.

2.TFR IN DIFFERENT STATES

STATE	TFR;NFHS-4	TFR; NFHS-5
BIHAR	3.4	3.0
MEGHALAYA	3.0	2.9
UTTAR PRADESH	2.7	2.4
JHARKAND	2.6	2.3
MANIPUR	2.6	2.2
ANDHRA	1.8	1.7
KARNATAKA	1.8	1.7
MAHARASHTRA	1.9	1.7
WEST BENGAL	1.8	1.6
PUNJAB	1.6	1.6

3.Gender Empowerment

- Although there is an improvement to earlier surveys, a large gap continues to exist between men and women in terms of owning properties, operating bank accounts or having mobile phones, showing that patriarchal norms are still prevalent.
- According to NFHS-5, nearly one third of women have experienced spousal violence.
- The poor nutritional indicators of women and children has pointed.
- The discrimination one faces in childhood, manifesting in lack of medical care, nutrition and education, continues in adulthood.
- Nearly half of all pregnant women are anaemic, despite many large-scale incentive schemes like Pradhan Mantri Matru Vandana Yojana(PMMVY).

4.Reasons for Declining TFR

- NFHS-5 found that there has been significant increase in current use of any modern contraceptive method, which stands at 56.5% in 2021 against 47.8% in 2016.
- The share of condoms is 9.5% against 5.6% in 2016.
- The uptake of female sterilization has gone up to 38% against 36% in 2016.
- Increase in cost of education of children is also compelling in the restricting the number of children.

Since the fertility levels have gone down below the replacement level in the country, population explosion is not a concern now.

Platform Capitalists

1.Context:

The Internet and its data lie in the hands of very large tech companies. Ownership of data has become the currency of the future

2.About Platform Capitalists

Platform capitalists are those who take advantage of their first-mover privilege by rapidly expanding across the digital landscape.

- They offer themselves as a platform for the third party players for a price like Amazon, Meta, Microsoft etc.
- These companies retain and expand their control through data accumulation and extraction, the importance of data accumulation in the digital economy cannot be overstated
- With the advent of the Internet of Things (IoT), smart devices and related technologies, the possibility of data goes beyond that of the virtual to even physical and social
- Control of this type of data can even predict the **behavioural patterns**
- Platform capitalists have unbridled control over the data economy leading to exclusion and under-optimisation of the data for the Common good

- Since most of these companies are in the west, which leaves developing countries to fend for themselves, left out their own data's immense possibilities and uses
- State regulators have been trying to find a solution to better re-distribute and govern data structures

3.Data

Data has three layers

1. **Semantic layer**-has Encoded information
2. **Syntactic layer**-represents information as machine-readable datasets
3. **Physical layer**-Infrastructure through which one extracts data

An ideal data governance structure should prevent the processors of the syntactic and physical layers from having exclusive rights over the semantic layer

A semi-commas approach to data governance seeks to balance public and private claims to data, it fundamentally recognises data as social commons where first movers do not get exclusive rights

Data holders	Data seekers
Be it private, public or altruistic organisations can only have non-exclusive rights over the base of the base layer data	They have access to non-professional data and aggregate non-personal data
They can use and generate profit through it but are required to share data as others	Data seekers are entitled to accessibility in a semi commons approach

W-BOSON

1.Context

- Recent findings on the most precise measurement of the W Boson mass ever made have stunned scientists, as it could potentially rewrite particle physics

2. About

- Discovered in 1983, 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 behaviour of matter in our universe. **Particles of matter interact by exchanging these bosons, but only over short distances.**
- 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.**
- This burning also **creates heavier elements and, when a star dies, those elements are tossed into space as the building blocks for planets and even people.**
- The weak force was combined with the electromagnetic force in theories of a **unified electroweak force in the 1960s, in an effort to make the basic physics mathematically consistent.**
- But the theory called for the force-carrying particles to be massless, even though scientists knew the theoretical W boson had to be heavy to account for its short range.
- Theorists accounted for the **mass of the W by introducing another unseen mechanism.**
- This became known as the Higgs mechanism, which calls for the existence of a Higgs boson.
- **Both W and Z bosons are carriers of the weak nuclear force, and they are formed through radioactive processes.**
- The collider at CDF smashed trillions of protons and antiprotons (antimatter doubles to protons, carrying the same mass but opposite charge) into each other at high velocities as one such process, which produces a **W-Boson once every 10-million collisions.**

Electric Vehicles: rare minerals

1.Context

India's automotive industry is experiencing a paradigm shift as it tries to shift to alternative and less energy demanding options like electronic vehicles.

2.Key Points

- The change from petrol to EV is a significant step in the move to the significant step to achieve net-zero emissions in future.
- EVs like other carbon technologies use several toxic metals in their design.
- Lithium, Nickel, Cobalt, Manganese and Graphite are required for the effective functioning of EVs.
- India is not endowed with Lithium, Nickel, and Cobalt metals used to make lithium-ion batteries.
- The anode in Li-ion batteries required graphite and there is no substitute for it.

The cathode and Nickel deliver high energy density allowing the vehicle to travel further.

Cobalt prevents the cathode from overheating and extending the life of the batteries.

Manganese contributes 61 per cent of the cathode needs of the battery.

International Energy Agency states that the metals for Electric cars require six times more than conventional cars.

- The rising demand for the process of manufacturing EVs causes cost escalation.
- The semiconductor shortage could not resolve completely and hindered multiple industries.

3.Top producers of rare minerals

- In 2020 Australia 49 per cent of the global lithium production.
- 65 per cent of the graphite is produced in China.
- 68 Per cent of the cobalt in Congo.
- 33 per cent of Nickel in Indonesia.
- Apart from the graphite and nickel India has a 3 and 5.32 per cent share globally.

4.Measures

- Similarly, the hiccup can impact India's upcoming EV industries in a big way.
- State form companies form joint ventures to secure mineral assets.
- Indian exploring companies may look at the opportunities for international companies for joint exploration and refining and trading of critical minerals.
- A dedicated cell could be created to regularly monitor the availability of the rare earth and other critical metals under the ministry of mines.
- India may like to have bilateral engagement under new platforms like QUAD to secure its needs.
- Explore the possibility of the formation of an intergovernmental body amongst the developing South something akin to the OPEC of 1960.

eVTOL

1.What is eVTOL?

- Aircraft 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
- There are multiple motors for various functions, to increase efficiency and to also ensure safety.

- This technology has grown on account of success in electric propulsion based on progress in motor, battery, fuel cell and electronic controller technologies and also fuelled by the need for new vehicle technology that ensures urban air mobility.
- eVTOL has 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

2. Why are the developments in powering eVTOLs?

- The role eVTOL adopt depends on battery technology and the limits of onboard electric power
- Power is required during the key phases of flight such as take-off, landing and flight
- There is also the important factor of weight
- BAE systems for example is looking at formats using a variety of Lithium batteries
- Nano Diamond Batteries is looking at Diamond Nuclear Voltaic technology using minute amounts of carbon -14 nuclear waste encased in layered industrial diamonds to create self-charging batteries

3. What are the challenges

- Cash prevention system- these use cameras, radar, GPS AND infrared scanners
- Ensuring safety in case of power plant or rotor failure
- Aircraft protection from cyber attacks
- Navigation and flight safety and the use of technology when operating in difficult terrain, unsafe operating environments and also bad weather

4. How did it begin

- NASA researcher Mark D. Moore who came up with the concept of a personal air vehicle while working towards his doctorate .called the Puffin and thought of in 2009-10
- A prototype was unveiled in 2010 and the concept was discussed at a conference on aeromechanics in 2010
- In his paper NASA Puffin Electric Tailsitter VTOL concept Moore described –electric propulsion as offering dramatic new vehicle mission capabilities but the only penalizing characteristic being the current energy storage technology level

ARE THERE ANY BIG PLAYERS NOW

- Since then there have been a number of ideas by industry, such as volocopter VCI from Germany and the Opener Blackly from the U.S
- The top aircraft manufacturers, Airbus and Boeing have also joined the race
- Airbus unveiled its prototype, Vahana Alpha One or the Airbus Vahana at the Paris Air Show in 2017
- Airbus then shifted to the City airbus project which has propellers and direct–drive electric motors

- Boeing is working on the Boeing passenger Air Vehicle, as an American autonomous personal air vehicle prototype
- A Company Lilium started in 2015 and claims to be the developer of the first all-electric vertical takeoff and landing Evtol jet, it says that the concept looks to connect towns and cities at speed of up to 300km/h, it has called this as aimed at Regional Air Mobility which it clarifies is not to be confused with Urban Air Mobility-connecting Intra –city points over shorter distances or less than 20 km
- China, Israel and the U.K. to have programmes to look out for

5.How does one get an idea of the kinds of eVTOLs?

It Started in 2016 and listing half a dozen known designs, it has now progressed to categorizing almost all known electric and hybrid eVTOL concepts. Categorised are vectored Thrust where any thruster is used for lift and cruise, Hover Bikes /Personal Flying Devices which are single-person Evtol aircraft and in multicopter-type wingless configurations, Lift and Cruise where independent thrusters are used for cruise and lift without any thrust vectoring, wingless or where there is no thruster for a cruise but only for lift and Electric Rotorcraft or Evtol that use a rotor such as an electric helicopter or autogyro

6.What about Certification

- The Federal Aviation Administration (FAA) and the United Kingdom Civil Aviation Authority announced being engaged in discussions focused on facilitating certification and validating new Evtol aircraft, their production, continued airworthiness, operations and personnel licensing.
- The FAA has clarified that it plans to certify eVTOLs as powered-lift aircraft (an existing category) but in future, develop additional powered-lift regulations for innovation in operations and pilot training
- It plans to use a special class process in 14CFR 21.17(b) to oversee the unique features of emerging powered lift models
- But this certification will use the performance-based airworthiness standards found in part 23 of the FAA regulations

7.How will it be in India

- The blade is an urban air mobility company that aims to connect places that are heavily congested and also not well connected by air services.
- The concept of Advanced Air Mobility comes in i.e. connecting places through vertical aircraft and thus skipping road travel. This is being done by now helicopters, but eVTOLs will step into this space.
- The Blade U.S is currently working with electric vertical aircraft (EVA) manufacturers such as Beta Technologies and has partnered with them for an all-electric fleet by the year 2024
- eVTOL is noise-free, has a zero carbon footprint and is more affordable.
- Beta technologies and other EVA manufacturers have been extended an invitation to manufacture in India.

- There are psychological barriers that need to be overcome when it comes to flying in a fully autonomous aircraft
- The current timeline for certification with India's Directorate General of Civil Aviation is two years

8. What is the value in the market

The global market for eVTOLs was put at dollar 8.5 million in 2021 and is to grow to dollar 30.8 million by 2030

The demand will be on account of green energy and noise-free aircraft, cargo carrying concepts and the need for new modes of transport

RICE FORTIFICATION

1. Background

- The Food Safety and Standards Authority of India (FSSAI) define fortification as "deliberately increasing the content of essential micronutrients in a food so as to improve the nutritional quality of food and to provide public health benefits with minimal risk to health".
- The Union Cabinet approved a scheme to distribute fortified rice under government programmes.
- Food Corporation of India and state agencies have already procured 88.65 LMT (lakh tonnes) of fortified rice for supply and distribution.
- Fortification of staple foods, when appropriately implemented, can be an efficient, simple and inexpensive strategy for supplying additional vitamins and minerals to the diets of large segments of the population.
- Rice is cultivated in many parts of the world, as it grows in diverse climates. Industrial fortification of rice with vitamins and minerals has been practised for many years in several countries in the World Health Organization (WHO) Eastern Mediterranean Region, Western Pacific Region and Region of the Americas, where rice is a staple consumed regularly in the preparation of many common local dishes.
- Decisions about the types and amounts of nutrients to add to fortified rice are commonly based on the nutritional needs and gaps in dietary intake of the target populations; the usual level of consumption of rice; the sensory and physical effects of the fortificant on the rice kernels; the fortification processing used in the production of the fortified kernels; the availability and coverage of fortification of other staple food vehicles; the population consumption of vitamin and mineral supplements; the costs; the feasibility of implementation; and the acceptability to the consumers.

2. What is Rice fortification all about?

- Various technologies are available to add micronutrients to regular rice, such as coating, dusting, and 'extrusion'.
- The last-mentioned involves the production of fortified rice kernels (FRKs) from a mixture using an 'extruder' machine. It is considered to be the best technology for India.

3. Need of Fortification

- India has very high levels of malnutrition among women and children. According to the Food Ministry, every second woman in the country is **anaemic** and **every third child is stunted**.
- Fortification of food is considered to be one of the most suitable methods to combat malnutrition.
- Rice is one of India's staple foods, consumed by about two-thirds of the population. Per capita rice consumption in India is 6.8 kg per month. Therefore, fortifying rice with micronutrients is an option to supplement the diet of the poor.

4. WHO Recommendations on Food fortification

- **Fortification of rice with iron** is recommended as a **public health strategy** to improve the iron status of populations, in settings where rice is a staple food (**strong recommendation, moderate certainty evidence**).
- Fortification of rice with **vitamin A** may be used as a public health strategy to improve the iron status and **vitamin A** nutrition of populations (conditional recommendation, low-certainty evidence).
- Fortification of rice with **folic acid** may be used as a public health strategy to improve the folate nutritional status of populations.

Web 5.0

1.Context

Twitter's ex- CEO wants to build a blockchain-powered digital network in Web 5.0.

2.Web versions

- **Web 1.0** was the first generation of the internet, made of static web pages that only allowed for passive engagement.
- **Web 2.0** the Internet of today, has created a social web, allowing users to communicate with servers and other users.
- **Web 3.0** the next generation envisages a digital world built on blockchain technology and driven by artificial intelligence, where people will interact without needing an intermediary.

- **Web 5.0** developed by Dorsey's Bitcoin business unit, The Block Head (TBH), Web 5.0 is aimed at building an extra decentralised web that puts you in control of your data and identity.
- On its website, TBH notes; "Both Web 3.0 and Web 5.0 envision an internet without threat of censorship from governments or big tech.
- Web 3.0 is not genuinely decentralised or owned by its users, but is instead controlled by various "venture capitalists and limited partners".

3.Web 5.0 Changes:

- The TBH website presents two use cases for web 5.0.
- About "Control of Identity", it says: "Alice holds a digital wallet that securely manages her identity, data and authorizations for external apps and connections.
- Alice uses her wallet to sign into a new decentralized social media app.
- Because Alice has connected to the app with her decentralized identity, she does not need to create a profile and all the connections, relationships and posts she creates through the app are stored with her, in her decentralized web node.
- Now Alice can switch apps whenever she wants, taking her social persona with her".

4.About the control of data

- It cites the example of user Bob, a music lover who dislikes having his personal data locked to a single vendor as it forces him to repeatedly create his playlists across different music apps.
- Thankfully there's a way out of this maze of vendor-locked silos:
- Bob can keep this data in his decentralized web node.
- This way Bob can grant any music app access to his settings and preferences, enabling him to take his personalized music experience wherever he chooses.

Malnutrition

1.Context

The National Family Health Survey (NFHS-5) has shown marginal improvement in different nutrition indicators, indicating that the pace of progress is slow.

2.Key points

- Poor nutrition among pregnant women affects the nutritional status of the child and has a greater chance to affect future generations.
- Undernourished children are at risk of under-performing in studies and have limited job prospects.
- This vicious cycle restrains the development of the country, whose workforce is affected mentally and physically and has reduced work capacity.

3. Marginal improvement

- There has been some progress in tackling malnutrition among children and women over the past decade, but the improvement has been modest at best.
- This is despite declining rates of poverty, increased self-sufficiency in food production and the implementation of a range of government programmes.
- Children in several states are more undernourished now than they were five years ago.

4. Stunting, wasting, anaemia

- While there was some reduction in stunting rates (35.5 Per cent from 38.4 per cent in NFHS-4).
- 13 states and Union Territories increased children since NFHS-4; this includes Gujarat, Maharashtra, West Bengal and Kerala (Stunting is defined as low height for age).
- Malnutrition trends across NFHS Surveys show that wasting, the most visible and life-threatening form of malnutrition, has either risen or has remained stagnant over the years (Wasting is defined as low weight-for-height).
- India also has the highest prevalence of anaemia in the world.
- Anaemia is defined as the condition in which the number of red blood cells or the haemoglobin concentration within them is lower than normal.

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Which the number of red blood cells or the haemoglobin concentration within them is lower than normal.

- The NFHS-5 survey indicates that more than 57 per cent of women (15-49 years) and over 67 per cent of Children (6-59 Months) suffer from anaemia.
- Assam is among the low- performing states; with a huge burden of anaemic cases 66.4 per cent of women and 68.4 per cent of children are affected.
- It is imperative to introspect about these problems and remain persistent, pervasive and serious.
- It has major consequences in terms of human health and development.
- It reduces the work capacity of individuals, in turn impacting the economy and overall national growth.
- Developing countries lose up to 4.05 per cent in GDP per annum due to iron deficiency anaemia.
- India loses up to 1.18 per cent of GDP annually.

4.Step up the financing

- There is a greater need to increase investment in women's and children's health and nutrition to ensure their sustainable development and improved quality of life.
- The government's focus has been on the consolidation of several programmes to improve outcomes, there is a need for the increased financial commitment.
- Saksham Anganwadi and the Prime Minister's Overarching Scheme for Holistic Nourishment (POSHAN) 2.0 programme have seen only a marginal increase in budgetary allocation this year.
- Additionally, 32 per cent of funds released under POSHAN Abhiyaan to States and Union Territories have not been utilised.

5.Monitor constituencies too

- India must adopt an outcome-oriented approach to nutrition programmes.
- Parliamentarians must begin monitoring needs and interventions in their constituencies and raise awareness of the issues, impact and solutions to address the challenges at the local level.
- There has to be direct engagement with nutritionally vulnerable groups (the elderly, pregnant women, those with special needs and young children) and contribute toward ensuring last-mile delivery of key nutrition services and interventions.
- This will ensure greater awareness on the one hand and proper planning and implementation of programmes at the grassroots level on the other.
- It can be replicated at the district and national levels.
- With basic education and general awareness, every individual is informed, takes initiative at the personal level and can become an agent of change.
- Different studies highlight a strong link between a mother's education and improved access and compliance with nutrition interventions among children.
- The young population has a competitive advantage; nutrition and health are foundational to that outcome.

6.Other steps

- There should be a process to monitor and evaluate programmes and address systemic and on-the-ground challenges.
- The new or existing committee or the relevant standing committees meet and deliberate over effective policy decisions, monitor the implementation of schemes and review nutritional status across states.
- The country's response to malnutrition and its growing anaemia burden should be practical and innovative.
- This is critical to make an India that is malnutrition- free and anaemia free a reality and not just an aspiration.
- Everyone is a stakeholder and should contribute toward ending malnutrition and anaemia.

LaMDA

1.Context

Blake Lemoine, a U.S. military veteran engaged by Google to test for bias or hate speech in the Language Model for Dialogue Applications (LaMDA), claims that the updated software is now sentient.

The neural network with deep learning capacity has the consciousness of a child of seven or eight years old.

The consent form for the software must to obtain before experiments are run on it.

2.Is AI technology here?

- AI technology appears futuristic. Facebook's facial recognition software identifies faces in the photos we post.
- The voice recognition software that translates commands we bark at Alexa.
- The Google translate apps are all examples of AI Tech already around us.
- AI tech today aims to satisfy the Turing test to qualify as intelligent.
- Turing was the designer and builder of the world's first computer, ENIGMA was used to break the German codes during the Second World War.
- To test if a **machine thinks**, Turing devised a practical solution.
- Place a computer in a closed room and a human in another. If an interrogator interacting with the machine and the human cannot discriminate between them, then Turing said that the computer should be construed as intelligent.
- The reverse Turing test, CAPTCHA, limits technology access to humans and keeps the bots at bay.

3.Which were the first chatbots to be devised?

- As electronics improved and first-generation computers came about Joseph Weizenbaum of the MIT Artificial Intelligence Laboratory built **ELIZA**, a computer programme with which users could chat.
- **ALICE (Artificial Linguistic Internet Computer Entity)**, another early chatbot developed by Richard Wallace was capable of simulating human interaction.
- In the 1930s, linguist George Kingsley Zipf analysed the typical human speech and found that most utterances began with 2,000 words.
- Using this information, Wallace theorised that the bulk of commonplace chitchat in everyday interaction was limited.
- He found that just about 40, 000 responses were enough to respond to 95 per cent of what people chatted about.

- With assistance from about 500 volunteers, Wallace continuously improved **ALICE's** responses repertoire by analysing user chats, making the fake conversions look real.
- The software won the **Loebner Prize** as "**the most human-computer**" at the Turing Test contests in 2000, 2001 and 2004.

4.What is a neural network?

- It is an AI tech that attempts to mimic the web of neurons in the brain to learn and behave like humans.
- Early efforts in building neural networks targeted image recognition.
- The artificial neural network (ANN) needs to be trained like a dog before being commanded.
- For example, during the image recognition training, thousands of specific cat images are broken down to pixels and fed into the ANN.
- Using complex algorithms, the ANN's mathematical system extracts particular characteristics like the line that curves from right to left at a certain angle, edges or several lines that merge to form a larger shape from each cat image.
- The software learns to recognise the key patterns that delineate what a general cat looks like from these parameters.
- Early machine learning software needed human assistance.
- The training images had to be labelled as 'cats', 'dogs' and so on by humans before being fed into the system.
- In contrast, access to big data and a powerful processor is enough for the emerging deep learning software.
- The App learns by itself, unsupervised by humans, by sorting and sifting through the massive data and finding the hidden patterns.

5.What is LaMDA?

- It is short for 'Language Model for Dialogue Applications', Google's modern conversational agent enabled with a neural network capable of deep learning.
- Instead of images of cats and dogs, the algorithm is trained using 1.56 trillion words of public dialogue data and web text on diverse topics.
- The neural network built on Google's open-source neural network, Transformer, extracted more than 137 billion parameters from this massive database of language data.
- The chatbot is not yet public, but users are permitted to interact with it.
- Google claims that LaMDA can make sense of nuanced conversation and engage in a fluid and natural conversation.
- The LaMAD 0.1 was unveiled at Google's annual developer conference in May 2021 and LaMDA 0.2 in 2022.

6.How is LaMDA different from other chatbots?

- Chatbots like "Ask Disha" of the Indian Railway Catering and Tourism Corporation Limited (IRCTC) are routinely used for customer engagement.
- The repertoire of topics and chat responses is narrow.
- The dialogue is predefined and often goal-directed. For instance, try chatting about the weather with Ask Disha or about the Ukrainian crisis with the Amazon chat app.
- LaMDA is Google's answer to the quest for developing a non-goal-directed chatbot that dialogues on various subjects.
- The chatbot would respond the way a family might when they chat over the dinner table.
- Topics meandering from the taste of the food to price rise to bemoaning war in Ukraine.
- Such advanced conversational agents could revolutionise customer interaction and help AI-enabled internet search, Google hopes.

7.AI Intelligent

- The Turing test is a powerful motivator for developing practical AI tools.
- Philosopher John Searle uses the ' Chinese Room Argument to demonstrate that passing the Turing test is inadequate to qualify as intelligent.
- Once I used Google Translate to read Whatsapp messages in French from a conference organiser in France and turn replied to her in French.
- For some time, she was fooled into thinking that I could speak French.
- I would have passed the ' Turing test', but no same person would claim that I know French.
- This is an example of the Chinese room experiment.
- The imitation game goes only so far. Further scholars point out that AI tech uses a false analogy of learning.
- A baby learns a language from close interaction with caregivers and not by ploughing through a massive amount of language data.
- Moreover, whether intelligence is the same as sentience is a moot question.
- The seemingly human-like conversational agents rely on pattern recognition, not empathy, wit, candour or intent.

8.Is the technology dangerous?

- The challenges of AI metamorphosing into sentient are far in the future.
- The unethical AI perpetuating historical bias and echoing hate speech is the real danger to watch for.

- Imagine AI software trained with past data to select the most suitable candidates from applicants for a supervisory role.
- Women and marginalised communities hardly would have held such positions in the past, not because they were unqualified, but because they were discriminated against.
- The machine has no bias; AI software learning from historical data could inadvertently perpetuate discrimination.

VIRTUAL PRIVATE NETWORK (VPN)

1. Background

- India's cybersecurity agency passed a rule mandating Virtual Private Network (VPN) providers to record and keep their customers' logs for 180 days.
- It also asked these firms to collect and store customer data for up to five years.
- It further mandated that any cybercrime recorded must be reported to the CERT-In (Computer Emergency Response Team) within six hours of the crime.
- In response to the CERT-In rules, Nord VPN, one of the world's largest VPN providers, **has said it is moving its servers out of the country.**
- Two other firms, Express VPN and Surfshark said they will shut down their physical servers in India and cater to users in India through **virtual servers located in Singapore and the U.K.**

2. Effect of New Rules

- CERT-In directions apply to data centres, virtual private server (VPS) providers, cloud service providers, virtual asset service providers, virtual asset exchange providers, custodian wallet providers and government organizations.
 - Firms that provide Internet proxy-like services through VPN technologies also come under the ambit of the new rule.
- **Corporate entities are not under the scanner.**

3. The aspect of virtual servers and their uses

- A virtual server is a simulated server environment built on an actual physical server. It recreates the functionality of a dedicated physical server.
- The virtual twin functions like a physical server that runs software and uses the resources of the physical server.
- Multiple virtual servers can run on a single physical server.
- Virtualizing servers help reallocate resources for changing workloads.

- Converting one physical server into multiple virtual servers allows organizations to use processing power and resources more efficiently by running multiple operating systems and applications on one partitioned server.
- Running multiple operating systems and applications on a single physical machine reduces cost as it consumes less space and hardware.
- Virtualisation also reduces cost as maintaining a virtual server infrastructure is low compared to a physical server infrastructure.
- Virtual servers are also said to offer higher security than a physical server infrastructure as the operating system and applications are enclosed in a virtual machine.
- This helps contain security attacks and malicious behaviour inside the virtual machine.

4. Can the VPN providers circumvent the new rules and regulations?

- The Ministry of Electronics and Information Technology (MeiTY) regarding the cybersecurity directions offers some clarity on relocation and virtualisation.
- It says the rules apply to “any entity whatsoever” in the matter of cyber incidents and cyber security incidents, regardless of whether they have a physical presence in India or not, as long as they deliver services to Indian users.
- The service providers who do not have a physical presence in India but offer services to the users in the country, have to designate a point of contact to liaise with CERT-In.
- Also, logs may be stored outside India as long as the obligation to produce logs to CERT-In is adhered to by the entities in a reasonable time.

5. Impact of new VPN rules on India

- In response to The Hindu’s queries on the impact of the removal of physical servers from the country on jobs, SurfsharkVPN said “It would be difficult to estimate the exact number of individuals impacted in terms of employment because we were renting servers from Indian providers.”
- VPN suppliers leaving India is not good for its burgeoning IT sector.
- Taking such radical action that highly impacts the privacy of millions of
- People in India will most likely be counterproductive and strongly damage the IT sector’s growth in the country, the company said in a release last week.
- It estimated that 254.9 million Indians have had their accounts breached since 2004 and raised its concern that collecting excessive amounts of data within Indian jurisdiction without robust protection mechanisms could lead to even more breaches.
- The Netherlands-based company further said that they have never received a similar directive on storing customer logs from any other governments in the world.

6. Approach of China towards dealing with VPN usage?

- Though not all VPNs are officially banned in China, only government-approved VPNs are officially permitted to function.
- Visitors and Chinese citizens use VPNs to circumvent China's Great Firewall, which has blocked access to many websites, keywords and
- Even IP addresses.
- Government-approved VPNs have to register with the Chinese government and have to comply with data requests during investigations.
- However, cases of tourists being penalized for using non-government-approved VPNs have not been reported.

ISKANDER-M MISSILE SYSTEM

1.Context

Russia has promised its ally Belarus delivery of nuclear-capable missiles to take on an aggressive west.

Russia will transfer to Belarus Iskander-M tactical missile systems, which can use ballistic or cruise missiles, in their conventional and nuclear versions.

2.The Missile system

- Code-named "SS-26 Stone" by NATO, Iskander-M is a term used by Russia to define both the Transporter-Erector Launch System and the Short-Range Ballistic Missile (SRBM) it fires.
- The system can also fire Ground-Launched Cruise Missiles (GLCMs).
- The Iskander-M system is exclusively used by the Russian Military, whereas Iskander-E is the one meant for export.

3.Firepower

- The Iskander-M missile has a range of 500 km and it can carry a payload of up to 700 kg.
- It is capable of carrying both conventional and nuclear warheads.
- The conventional warheads can be equipped with **Cluster Bombs, Electromagnetic Pulse (EMP) Warheads and Bunker-Buster Munitions**, according to the US-based Missile Defence Advocacy Alliance (MDAA).
- The export variant Iskander-E has a range of 280 km with a reduced 480 kg payload.

4. Development

- The Iskander system was inducted by Russia in 2006, its development picked pace in the late 1980s after the **OTR-23 "OKA" Ballistic Missile was banned under the Intermediate-Range Nuclear Forces Treaty**.
- The Oka was Russia's first attempt to replace the Soviet Scud Missiles, Iskander was the Second.
- Russia first used the Iskander in combat in Georgia in 2008.
- The US-based think tank, the Center for Strategic and International Studies (CSIS) says that the Iskander Missiles are designed to confuse missile defences by flying at a low trajectory and manoeuvring in flight to strike targets with an accuracy of around two to five meters.

5. Projection power

- Russia made the Belarus announcement at the time when the G-7 meets in Germany.
- It is also one more time that Putin has raised nuclear weapons as a sort of warning to the West against climbing the escalations ladder in the Ukraine War.
- Russia has used the Iskander system to project power against Europe, more so because of its ability to be fitted with tactical nuclear warheads.
- In 2012, Moscow said that the weapon could be used to target Europe's missile defences.
- The Iskander system has already been deployed in Kaliningrad, a Russian exclave, from where it can be fired to target NATO forces in Poland, the Baltic States and Sweden.

INTERNET OF THINGS (IoT)

1. Background

- The Internet of Things, commonly abbreviated as IoT, refers to the connection of devices (other than typical fares such as computers and smartphones) to the Internet.
- Cars, kitchen appliances, and even heart monitors can all be connected through the IoT.

2. Key features

The most important features of IoT include artificial intelligence, connectivity, sensors, active engagement, and small device use.

A brief review of these features is given below:

- **AI – IoT** essentially makes virtually anything “smart”, meaning it enhances every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can mean something as simple as enhancing your refrigerator and cabinets to detect when milk and your favourite cereal run low, and then place an order with your preferred grocer.
- **Connectivity** – New enabling technologies for networking and specifically IoT networking, mean networks are no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its system devices.
- **Sensors** – IoT loses its distinction without sensors. They act as defining instruments which transform IoT from a standard passive network of devices into an active system capable of real-world integration.
- **Active Engagement** – Much of today's interaction with connected technology happens through passive engagement. IoT introduces a new paradigm for active content, product, or service engagement.
- **Small Devices** – Devices, as predicted, have become smaller, cheaper, and more powerful over time. IoT exploits purpose-built small devices to deliver its precision, scalability, and versatility.

2. Advantages of IoT

The advantages of IoT span across every area of lifestyle and business. Here is a list of some of the advantages that IoT has to offer:

- **Improved Customer Engagement** – Current analytics suffer from blind spots and significant flaws in accuracy; and as noted, engagement remains passive. IoT completely transforms this to achieve richer and more effective engagement with audiences.
- **Technology Optimization** – The same technologies and data which improve the customer experience also improve device use, and aid in more potent improvements to technology. IoT unlocks a world of critical functional and field data.
- **Reduced Waste** – IoT makes areas of improvement clear. Current analytics give us superficial insight, but IoT provides real-world information leading to more effective management of resources.
- **Enhanced Data Collection** – Modern data collection suffers from its limitations and its design for passive use. IoT breaks it out of those spaces and places it exactly where humans want to go to analyze our world. It allows an accurate picture of everything

3. Disadvantages of IoT

- Though IoT delivers an impressive set of benefits, it also presents a significant set of challenges. Here is a list of some of its major issues: **Security** – IoT creates an ecosystem of constantly connected devices communicating over networks. The system

offers little control despite any security measures. This leaves users exposed to various kinds of attackers.

- **Privacy** – The sophistication of IoT provides substantial personal data in extreme detail without the user's active participation.
- **Complexity** – Some find IoT systems complicated in terms of design, deployment, and maintenance given their use of multiple technologies and a large set of new enabling technologies.
- **Flexibility** – Many are concerned about the flexibility of an IoT system to integrate easily with another. They worry about finding themselves with several conflicting or locking systems.
- **Compliance** – IoT, like any other technology in the realm of business, must comply with regulations. Its complexity makes the issue of compliance seem incredibly challenging when many consider standard software compliance a battle.

4. Areas, where the internet of things can be efficiently, implemented

- Smart parking
- Intelligent Transport System
- Smart urban lighting.
- Waste management.
- Smart city maintenance
- Tele-care
- Citizen safety
- Smart Grid
- Smart Energy
- Water Management

5. Areas to ensure user-friendly Internet of Things

- **Universal Default Passwords:** All IoT device default passwords shall be unique per device and/or require the user to choose a password that follows best practices, during device provisioning.
- **Implement a means to manage reports of vulnerabilities:** IoT developers should provide a dedicated public point of contact as part of a vulnerability disclosure policy.
- **Keep software updated:** Software components in IoT devices should be securely updateable.
- **Securely store sensitive security parameters:** IoT devices may need to store security parameters such as keys & credentials, certificates, device identity etc. which are critical for the secure operation of the device.

- **Communicate securely:** Security-sensitive data, including any remote management and control, should be encrypted in transit, appropriate to the properties of the technology and usage of the device.
- **Minimise exposed attack surfaces:** Devices and services should operate on the ‘principle of least privilege’.
 - The Principle of Least Privilege states that a **subject should be given only those privileges** needed for it to **complete its task**.
- **Ensure that personal data is secure:** In case the device collects or transmits personal data, such data should be securely stored.
- **Make systems resilient to outages:** Resilience should be built into IoT devices and services where required by their usage or by other relying systems.

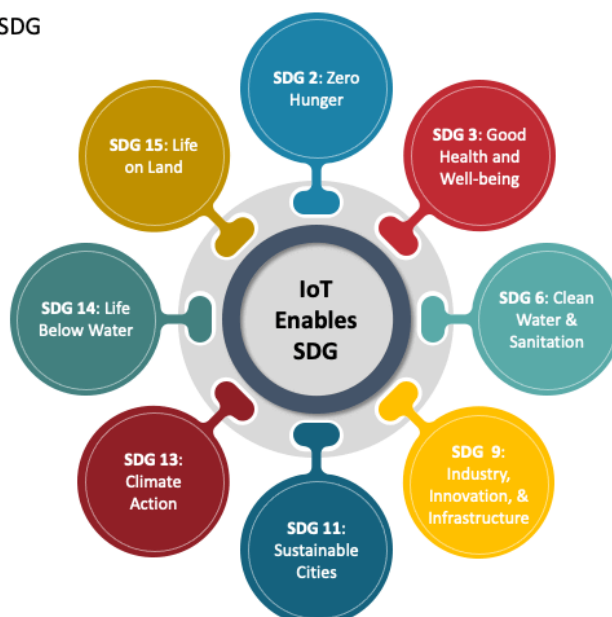
6. Government of India working towards the Internet of things

- In a first for the Indian government, 2015 saw the roll-out of a draft policy on IoT that laid down the framework. **“IT industry also has an opportunity to provide solutions, services and analytics related to IoT.”**
- *Smart Cities-A smart city is advanced in terms of its infrastructure, has sustainable real estate and the right communication among other features.*
- *Centre of Excellence for IoT in Bangalore by GOI and NASSCOM*
- *Andhra Pradesh to become an IoT hub with a first-of-its-kind policy*
- *Tech Giants back Digital India Vision.*

7. Internet of things towards sustainable development Goals

IoT FOR SUSTAINABLE DEVELOPMENT

IoT Enables SDG



HERMIT

1. about Hermit

- A SOPHISTICATED spyware called Hermit is in the news for targeting iPhones and Android devices in Italy and Kazakhstan. Its deployment was first reported by a researcher at the Lookout, a San Francisco-based cybersecurity firm.
- Then, Google's Threat Analysis Group (TAG) put out a detailed blog post last week explaining how they believed Hermit was being used to target devices.

2. Working of Hermit

- Hermit is spyware on the lines of Pegasus by the NSO Group.
- Once installed on a device, it can record audio on the device, and carry out unauthorized calls.
- According to Lookout, the spyware can steal stored account emails, contacts, browser bookmarks/searches, calendar events, etc.
- It can also take pictures on the device, and steal device information such as details about applications, the kernel information, model, manufacturer, OS, security patch, and phone number.
- The spyware can also upload files from the device, read notifications, and take pictures of the screen.
- Further, it can download and install APK (the app software files on Android) on a compromised phone.

3. Deployment of Hermit

- Sophisticated spyware such as Hermit and Pegasus costs millions of dollars in licensing fees.
- These are not like common malware targeting regular users.
- In the case of Hermit, it appears the operations used were complex. According to Google's TAG team, all campaigns started with a unique link sent to the victim's phone.
- When the user clicked it, the page installed the application on both Android and iOS.

4. How did hermit surpass Firewalls of security?

- According to Google, the actors targeting the victims possibly had to work with the target's Internet Service Provider (ISP). Google Photos, "We believe the actors worked with the target's ISP to disable the target's mobile data connectivity.
- Once disabled, the attacker would send a malicious link via SMS asking the target to install an application to recover their data connectivity.
- According to Lookout, some attacks in Kazakhstan masqueraded as pages for the phone brands Oppo, Samsung and Vivo.

POEM

1.Context:

ISRO has placed 4 Singapore satellites in precise orbits by using PSLV Orbital Experimental Module

2.About POEM

POEM is a platform that will help perform in-orbit experiments using the final stage of ISRO's rocket PSLV

PSLV is a four-stage rocket where the first three stages fall back into the ocean and the final stage PS4-after launching the satellite into orbit ends up as a space junk

In the PSLVC53 mission, the spent final stage is used as a **Stabilized platform** to perform experiments

It will be the first time that the PS4 stage would orbit the earth as a stabilized platform

POEM carried 6 payloads, including two from Indian Space startups Digantara and Dhruv space

3.POEM's Stability in the Orbit

POEM has a dedicated Navigation Guidance and Control (NGC) system for altitude stabilisation or controlling the orientation of any aerospace vehicle within permit limits

NGC will stabilise the platform with specified accuracy

POEM will derive its power from solar panels mounted around the PS4 tank and Li-Ion battery

It will navigate using "four Sun sensors, a magnetometer, gyro, NavIC"

PS4 Junk

ISRO has demonstrated the capability of using PS4 as an orbital platform in 2019 with the PSLV-C44 mission- it injected Microsat-R and Kalamsat-V2 satellites into their designated orbits

The fourth stage in that mission kept alive as an orbital platform for space-based experiments

Subsequently, 4th stage (PS4) of the vehicle moved to a higher circular orbit of 453 km after two restarts of the stage to establish an orbital platform for carrying out experiments Kalamsat-V2: A student payload first to use PS4 as an orbital platform was taken to its designated orbit

INDIA'S LARGEST FLOATING SOLAR PLANT

1.Context

India's largest floating solar plant is now fully operational at Ramagundam in Telangana.



2.Key Points

- The 100-megawatt (MW) floating solar power photovoltaic project, was commissioned by the National Thermal Power Corporation (NTPC) on July 1.
- The raising the total floating solar capacity in commercial operation in the southern region to 217 MW, according to the NTPC.
- The NTPC has set a target of 60 GW capacity through renewable energy sources, Constituting nearly 45 per cent of its overall power generation capacity by 2032.
- The Ramagundam plant spread over 500 acres is built for Rs 423 crore through a contract with Bharat Heavy Electricals Limited.

3.Solar plant

- Solar plants can be either ground-mounted or set up on the surface of water bodies.
- Though these floating farms are a bit more expensive and advantageous as well.
- They do not require land to be acquired for the installation of photovoltaic panels.
- They are more efficient as the presence of water underneath helps them keep cool.
- They also reduce water evaporation, thereby saving more water for hydropower generation.
- At Ramagundam, the solar modules are placed across 500 acres on floaters manufactured with high-density polyethylene material that keeps floating irrespective of water-level fluctuations.
- The spread is divided into 40 blocks, each with a capacity of 2.5 MW, an array of 11, 200 solar modules and a floating platform with various components.

- This project is unique because all electrical equipment is set up on floating Ferro--cement platforms.

4.Environment-Friendly

- Solar panels floating on the water surface will reduce the evaporation rate and thereby help water conservation.
- With a minimum land requirement mostly for associated evacuation arrangements, available land can be put to better use unlike in the case of ground-mounted solar farms.
- At Ramagundam, approximately 32.5 lakh cubic meters per year of water evaporation can be prevented.
- The waterbody underneath the solar modules helps in maintaining their ambient temperature, thereby improving their efficiency and generation.
- Coal consumption of 1, 65, 000 tonnes can be avoided per year; carbon dioxide emissions of 2, 10, 000 tons per year can be prevented, according to the NTPC.

DARK MATTER

1.Context

As of today, the most sensitive dark matter detector experiment in the world is LUX-ZEPLIN (LZ) in South Dakota in U.S.

To give an idea of the degree of difficulty in measuring evidence of a dark particle.

2.Key Points

- Many physicists strongly believe that the entire visible part of the universe forms only 5 per cent of all matter in it.
- They believe the rest is made up of dark matter and dark energy.
- Once this was convincingly demonstrated through various indirect observations and calculations, experiments started being set up to hunt for these elusive particles
- The chamber of this LZ detector can contain only one gram of dust if it is to detect a dark matter particle.
- This is the extent to which researchers have to go to rule out unwanted signals coming from other entities.

All interactions in the universe are a result of four fundamental forces acting on particles

1. strong nuclear force,
2. weak nuclear force,
3. electromagnetic force and
4. Gravitation.

3. Dark matter

- Dark matter is made up of particles that do not have a charge which means they do not interact through electromagnetic interactions.
- So, these are dark particles, namely because they do not emit light, which is an electromagnetic phenomenon and matter because they possess mass like normal matter and hence interact through gravity.

4. Why is it so elusive?

- Gravitational force, besides not being fully integrated and understood by particle physicists, is extremely weak.
- For one thing, a particle that interacts so weakly becomes rather elusive to detect.
- This is because interactions from other known particles could drown out signals of dark matter particles.

5. Why do physicists believe strongly that dark matter exists?

- There is strong indirect evidence for dark matter and this evidence is reflected at various levels (or distance scales, as physicists would explain).
- At the shortest distance scale, consider the rotation of galaxies.
- If you look at stars from the centre of any galaxy to its rim, the way the velocities of the observed stars change may be plotted.
- In the lab, this same function may be plotted on a graph by assuming the visible matter is all that exists.
- There is a marked difference between the observed plot of star speeds and the calculated value as you move from the inner part of the galaxy towards its rim.
- If you assume there is a certain fraction of matter which exerts a gravitational pull on the rest of the stars in the galaxy.
- It cannot be seen in any other way and recalculate the plot and fits in with the observed value.
- This means that there is a definite amount of dark matter in the galaxy.
- One may argue that it is the model that is at fault and there is some other way to reconcile this discrepancy between the calculated and observed value of velocities in rotating galaxies.
- This is where evidence from other distance scales comes up.

6.Evidence from other distance scales

- The universe can be observed at various levels at the level of electrons and nuclei of atoms, galaxies, galaxy clusters or even larger distances where the entire universe can be mapped and studied.
- Cosmologists are people who study the physics of the universe, typically work in the last-mentioned three scales and particle physicists study the lowest and even smaller scales.
- Dark matter is made up of particles that do not have a charge which means they do not interact through electromagnetic interactions.
- In this context, the second evidence came from observations of the so-called Bullet cluster of galaxies.
- The Bullet Cluster is formed through the merging of two galaxy clusters.
- Physicists found from their calculations that the way these mergers took place could not be fully explained if we believed that the visible universe was all that existed.
- Therefore, there should be something like dark matter as well as an estimate of how much dark matter there should be in the universe.
- Similar arguments exist from mappings of the universe such as the Sloan Digital Sky Survey and studies of the filamentous nature of the universe with a closer look.
- While fixing the model could help explain away one of these discrepancies, not all of them can be explained in the same manner.
- Hence physicists now take the concept of dark matter very seriously.

7.Candidates for dark matter particles

- "The neutrino would have been an excellent candidate if it had been more massive, being too light, it does not fit the bill.
- Other postulated entities include the supersymmetric partner of the Z boson, a particle that mediates the electro-weak interaction.
- Other explanations talk about hidden sector particles and Axions, a boson and a condensate of dark matter.

8.Other theories

The search is on to find one of these candidates for the story, which spins together gravity, supersymmetry and hidden worlds and is the stuff of which science fiction is made.

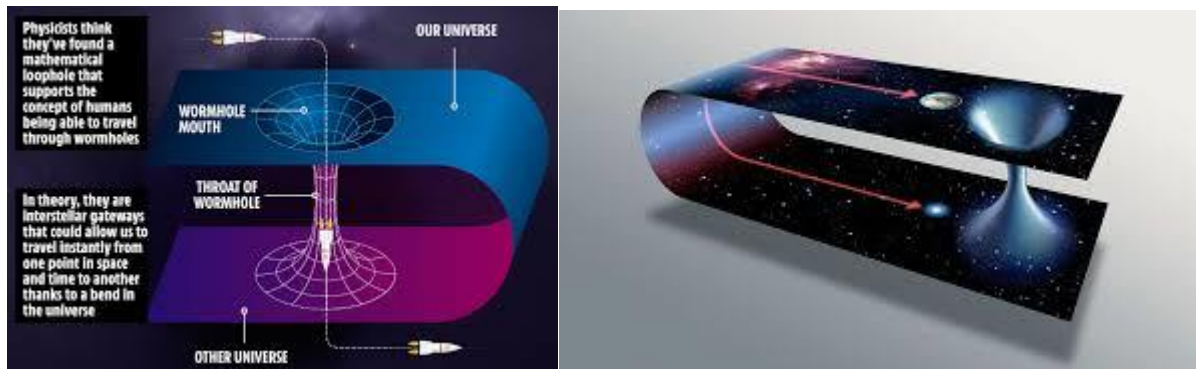
WORMHOLE

1.Introduction:

Discussions between theoretical physicists can sound very other-worldly and often seem to buzz around highly abstract concepts and ideas. It seems like a science-fiction.

2.Wormhole:

A wormhole is a bridge or shortcut between two points in curved space-time which are well separated in practical terms from the inhabitants of the universe.



3.Interstellar Travel:

- Let us imagine, sitting in a four-dimensional world and observing a 2-dimensional sub-universe embedded in the universe.
- This universe is like a sheet of paper/ ribbon on which tiny bugs live, and crawl.
- When the paper/ribbon is flat, there is only one way to get from one point to another.
- But if the paper/ ribbon is bent like 'U', the observer can see that some parts of the folded paper may appear to be close to other parts.
- According to the observer, to get from one of these points to the other, it would be quicker if the bug could jump across the intervening space.
- The bug being a 2-dimensional creature cannot see this closeness.
- Also, it is constrained to move on the surface of the ribbon. So, it has to traverse the whole length of the ribbon to reach the other point, it cannot jump across the fold and make a shortcut to the second point.

4.Observations:

- Our universe when viewed from a higher dimension is like a ribbon and we are the bugs constrained by its limits.
- When there is no gravity, our universe will be flat like a sheet.
- When there is a strong gravitational field, this sheet will bend so that a portion of it may look like the piece of ribbon which was folded.
- We, like bugs on the ribbon, are constrained to take the long route through space-time to reach points that appear close to the higher dimensional observer.

5. Cutting Across Spacetime:

- Imagine if a bridge is built connecting the two points on the ribbon, the bugs can crawl over the bridge to the target point instead of crawling down the entire length of the ribbon.
- This clearly explains the mechanism of the wormhole.
- In the universe, a wormhole can act as a bridge or a shortcut between two points in curved space-time which are well separated in practical terms from the inhabitants of the universe.

6. Wormhole fiction/ fact:

- Just like black holes predicted by Einstein's theory of gravity long before, wormholes are also not fictitious.
- Ludwig Flamm, in 1916, first discovered that wormholes may exist, soon after Einstein proposed the General Theory of Relativity which explains gravitational field.
- The presence of wormholes has not yet been established through observation or inference by astronomers.

7. Conclusion:

With rapid advances in observational cosmology like the detection of gravitational waves by LIGO-VIRGO collaborations, Einstein's theory is coming to the fore.

MARBURG

1. Context:

The first two cases of the Marburg virus disease, highly infectious diseases like Ebola, have been confirmed officially by Ghana after test results were verified by a Senegal laboratory.

2. History

- Marburg was first detected in 1967 after simultaneous outbreaks in Marburg and Frankfurt in Germany, Belgrade, and Serbia.
- This outbreak is only the second time that the disease has been detected in West Africa.
- As it was first detected in Marburg, it got its name.

3. Marburg

- As per WHOM, Marburg Virus Disease (MVD), is a severe, often fatal hemorrhagic fever?
- Earlier it was known as Marburg hemorrhagic fever.
- Marburg, like Ebola, is a filovirus and both diseases are clinically similar.

4.Hosts

- Rousettus fruit bats are considered the natural hosts for the Marburg virus.
- According to WHO, African green monkeys imported from Uganda was the source of the first human infection?
- It was first detected in 1967 after simultaneous outbreaks in Marburg & Frankfurt in Germany, Belgrade Serbia.
- The disease has an average fatality rate of around 50%.
- It may be as low as 24% and as high as 88% depending on virus strain and case management.

5.Symptoms

- The onset of symptoms may begin anytime in between 2-21 days.
- MVD can manifest itself in the form of high fever, muscle aches and severe headaches.
- Around the 3rd day, patients report abdominal pain, vomiting, severe watery diarrhoea and cramping.
- The appearance of patients is described as “ghost-like” with deep-set eyes, expressionless faces, and extreme lethargy.
- Between 5-7 days, patients report bleeding from the nose, gums and blood appearing in vomits and faeces.
- Severe blood loss leads to death, often between 8-9 days after symptoms begin.

6.Challenges of MVD

- It is difficult to clinically distinguish from malaria, typhoid fever and other viral hemorrhagic fevers.
- It is confirmed by lab testing of samples, like coronavirus and Ebola are extreme biohazard risks.
- There is no approved antiviral treatment or vaccine for MVD till now.
- It can be managed with supportive care.
- As per WHOM guidelines, rehydration with oral or intravenous fluids and treatment of specific symptoms can help prevent death.

LANCE SYSTEM

1. About

- The LANCE acronym stands for “**Laser Advancements for Next-generation Compact Environments.**”

- “It is the smallest, lightest, high energy laser of its power class that Lockheed Martin has built to date,”
- “It is a critical benchmark in developing an operational laser weapon system in the airborne domain.”
- "Lockheed Martin continues to rapidly advance laser weapon systems and the technologies that make them possible to use directed energy to counter threats from the ground, and look forward to future tests from the air as part of the SHiELD system."
- LANCE is designed to operate in a compact environment, and as such, the Lockheed Martin team focused on developing a compact, high-efficiency laser within challenging size, weight and power constraints.
- The company stated that LANCE represents a critical component in developing airborne laser weapon systems.

2. SHiELD program

The SHiELD program includes three subsystems:

- SHiELD Turret Research in Aero Effects (STRAFE), the beam control system, which will direct the laser onto the target
- Laser Pod Research & Development (LPRD), the pod mounted on the tactical fighter jet, which will power and cool the laser
- Laser Advancements for Next-generation Compact Environments (LANCE), the high-energy laser itself, which can be trained on adversary targets to disable them

3. Significance of LANCER SYSTEM

- The development is significant as it is an acknowledgement that efforts to reduce the size of the laser energy weapon have been successful, and it is now ready to be tested after being mounted on an aircraft.
- The fact that the size of the energy weapon has been reduced to that of a pod which can be mounted on a fighter aircraft, or any aircraft for that matter, is an important development.
- This laser weapon will give the USAF the capability of shooting down incoming anti-aircraft missiles, thus giving it a crucial edge over its adversaries **especially a peanut size counter to S-400**

4. The laser Technology of other countries

- While LANCE has been reduced in **size for operational use on aircraft, the system**
- It can be **put to use on a variety of platforms on land and at sea.**

- Apart from the US, **several other countries have robust laser energy weapon** development programmes. This includes **China, Russia, Israel, Germany, France and India.**
- Israel recently tested its laser weapon to **shoot down a drone from the ground.**
- Russia, meanwhile, said it had tested a laser weapon — **Zadira** — in **Ukraine** recently, a claim dismissed by western powers.
- India, too, is developing a directed energy weapon named **DURGA II**, which stands for Directed Unrestricted Ray-Gun Array. It is said to be a light energy weapon of 100-kilowatt capacity.

ARTEMIS

1.Context

NASA's Artemis mission aims to put humans back on the moon for the first time after the Apollo 17 mission 50 years ago

The space agency has built the most powerful rocket ever, The Space Launch System (SLS) which will carry all the spacecraft as part of the Artemis mission

2.What is Artemis?

Artemis is the mission of NASA which is considered the next generation of lunar exploration. It is named after the twin sister of Apollo from the Greek mythology. Artemis is also the goddess of the moon.

- NASA plans for an increasingly complex mission which enables human exploration of the Moon and Mars, Artemis is the first in the series
- Artemis aimed to land humans on the moon in 2024, and also planned to land the first woman and first person of colour on the moon
- NASA will establish an Artemis base camp on the surface, it will also establish a gateway which is a lunar outpost for the Moon, it can aid in exploration by robots and astronauts

3.Other Space agencies involved in Artemis

1. Canadian Space Agency- Providing advanced robotics for the gateway
2. European Space Agency - Providing International habitat and the ESPRIT module.
3. Japanese Aerospace Exploration Agency- Providing habitation components and logistics resupply

ESPRIT-This module aims to deliver additional communication capabilities among others

4.Important facts about Artemis

- Artemis I is formerly known as Exploration Mission - 1
- It will be the first integrated flight test of NASA's Deep Space Exploration Systems
- It comprises Orion spacecraft, Space Launch System (SLS) rocket and newly upgraded Exploration Ground systems
- Orion Spacecraft will remain in space without docking to a Space Station, longer than any ship for astronauts has ever done before
- **The Space Launch System (SLS) rocket is the most powerful rocket in the world with a newly upgraded Exploration Ground System**
- SLS and Orion under Artemis I will be launched from the Kennedy Space centre
- It is an uncrewed space mission where the spacecraft will launch on an SLS rocket

CAPSTONE

A micro oven-sized CubeSat weighing just 55 pounds will serve as the first spacecraft to test a unique, elliptical lunar orbit as part of the CAPSTONE(Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment) experiment

A pathfinder for Gateway, Moon-Orbiting Outpost which is part of the Artemis program, CAPSTONE will help reduce the risk for future Spacecraft by validating innovative navigation technologies and verifying the dynamics of this halo-shaped orbit

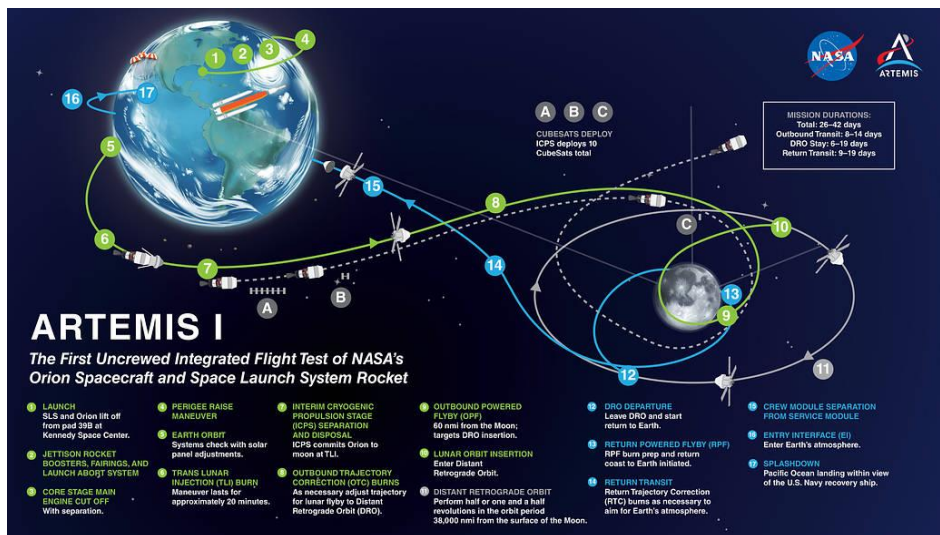
Next Steps under Artemis

1. Second flight will have a crew on board
2. It will test Orion's critical systems with humans Onboard
3. The experiences from Artemis Programme will be utilised to send the first Astronauts to the Mars

5.Important Space Facts regarding Moon

GRAIL (Gravity Recovery and Interior Laboratory) - It is an American Lunar Science Mission, which used high-quality gravitational field mapping of the moon to determine its interior structure

Apollo 11 - American Spaceflight that first landed humans on the moon



ADITYA L1

1. About

- Aditya L1 shall be the first space-based Indian mission to study the Sun.
- The spacecraft shall be placed in a halo orbit around the Lagrangian point 1 (L1) of the Sun-Earth system at a distance of about 1.5 million km from the Earth.
- A satellite placed in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without any occultation/eclipses.
- As the spacecraft will be directly placed in between the Sun and the earth, it will also provide crucial information in understanding the impact of solar activities on near-Earth space weather.

2. Objectives

- Understanding Coronal Heating and Solar Wind Acceleration.
- Understanding initiation of Coronal Mass Ejection (CME), flares and near-earth space weather.
- Coupling and Dynamics of the Solar Atmosphere.
- Solar wind distribution and temperature anisotropy.

3. Uniqueness

- First time spatially resolved solar disk in the NUV band.
- CME dynamics close to the disk (~ 1.05 AU) and thereby providing information on the acceleration regime of CME which is not observed consistently.

- On-board intelligence to detect CMEs and Flares for optimized observations and data volume.

4. Importance of studying the sun

- Every planet, including Earth and the exoplanets beyond the Solar System, evolves and this evolution is governed by its parent star.
- The solar weather and environment, which is determined by the processes taking place inside and around the sun, affect the weather of the entire system.
- Variations in this weather can change the orbits of satellites or shorten their lives, interfere with or damage onboard electronics, and cause power blackouts and other disturbances on Earth.
- Knowledge of solar events is key to understanding space weather.

5. Importance for India

- Alongside another mission to the Moon, being planned for next year, and the first human space flight scheduled for 2022, the Indian Space Research Organisation (ISRO) is also preparing to send its first scientific expedition to study the Sun.
- Named Aditya-L1, the mission, expected to be launched early next year, will observe the Sun from a close distance, and try to obtain information about its atmosphere and magnetic field.

6. about Lagrange Point

- In simple words, the Lagrange point is an orbit type in the space between 2 bodies like the Sun and Earth, where the gravitational force of both the planets is balanced.
- And anything at these points is in a state of equilibrium.
- And for this reason, if you place any satellite or spacecraft at these points, you need very little fuel consumption to move this because the body is free from any repulsion and attraction force.
- That's why you can also call it parking points of space.

7. Lagrange points of Earth and Sun:

Lagrange Points	Distance from the Earth	Stability Specifications
L1	1.5 million km	Unstable This Offers uninterrupted views of the Sun.
L2	1.5 million km	Unstable The ideal location to study deep space.

L3	301.4 million km	Unstable	This is the Farthest lagrange point from the earth.
L4	—	Stable	60° ahead of earth, Where earth was 2 months ago
L5	—	Stable	60° behind of earth, Where earth will being 2 months' time

PSYCHE

1.Context

NASA delayed the Psyche mission to the asteroid because of the late software delivery

2.What is Psyche?

Psyche is an asteroid and it is unique because it appears to be the exposed nickel-iron core of an early planet.

One of the building blocks of our solar system

Psyche asteroid is in between Mars and Jupiter, and is orbiting the Sun

Psyche is a large M-type asteroid discovered by the Italian astronomer Annibale De Gasparis working in Naples on 17 March 1852 and named after the Greek Mythological figure Psyche



3.About Psyche's Mission

NASA's Psyche mission is a journey to a unique metal asteroid orbiting the sun between Mars and Jupiter

Psyche was selected in 2017 by NASA under the Discovery programme, which is a low-line cost competition mission led by a single principal investigator

4.Objectives of the Mission

- To understand how planets and other bodies are separated into layers such as cores, mantles, and crusts

- To examine an asteroid made of a metal
- To explore early eras of the Solar System

5. Deep Space Optical Communication (DSOC)

The Psyche mission will test a sophisticated new laser communication technology that encodes data in photons at near-infrared wavelengths to communicate between a probe in deep space and Earth.

Using light instead of the radio allows the spacecraft to communicate more data in a given amount of time

The DSOC team is based at the Jet Propulsion Laboratory

SPACE DEBRIS

1. Context:

Remnants of an uncontrolled Chinese rocket (The long march 5B) reentered the atmosphere over the Indian Ocean, the risk of space junk and its uncontrolled descent.



2. Space junk:

Also known as space debris .which is divided into 2 types

1) **natural space debris:** which is nothing but small pieces of cometary and asteroidal material called meteoroids

2) **artificial space debris:** It is any piece of machinery or debris left by humans in space which includes dead rockets, spent rocket stages, anti-satellite systems (asat)etc.

This free-floating space debris is a potential hazard for operational satellites and colliding with them can leave the satellites dysfunctional.

This is called Kessler syndrome.

3.ROCKET DEBRIS:

- Recently the 22-tonne core stage of the Chinese rocket The long march -5B hurtled uncontrollably back to the earth, and there were fears that it might hit a populated area.
- The long march -5b blasted off on July 24 to deliver a laboratory module to the new Chinese space station under construction in orbit.
- Generally, the core or first stage of a rocket is made up of heavy pieces that usually don't reach orbit after liftoff, and fall back safely along a near-precise projected trajectory.
- If they do enter an orbit, then a costly de-orbit manoeuvre is required for a steered and controlled return using engine burn. Without de-orbit manoeuvre, the orbital core stage makes an uncontrolled fall

4.UNCONTROLLABLE RE-ENTRY :

- Remnants from china's long march -5b.s core stage known for this uncontrolled fall, the reason is a difference in the mission sequence where the core stages reach orbit, and then crash back.
- According to reports, most nation's rockets, separate the launcher from the payload before leaving the atmosphere. an extra engine then gives the payload a final boost. but china's 5b series does not use a second engine and pushes right into orbit.
- Difficulties to track uncontrolled descents.
- The variables involved make it difficult to precisely track the re-entry time and drop zone of rocket debris in uncontrolled descents. the factors are atmospheric drag, variations in solar activity, and angle and rotational variation of the object among others.
- A miscalculation of even a few seconds in re-entry time would result in the final resting place of the debris changing by a hundred km.

5.Laws regulating space junk:

The Space liability convention of 1972, defines responsibility in case a space object causes harm. according to the treaty “ A launching state shall be liable to pay compensation for damage caused by its space objects on the surface of earth or to aircraft, and liable to its fault in space. The convention also provides for procedures for the settlement of claims of damage.

However, there is no law against space junk crashing back to earth

Solutions to tackle Space debris: moving an object out of the way by altering its orbit is one of the methods of diverting potential crashes. but it needs constant observation of debris

NASA's space debris sensor: orbits the earth on the international space station, it will detect the mm-sized debris for 2 years, providing information on whatever hits it such as size, velocity, density etc

Deorbit mission: European space agency's e.deorbiter mission is developed to grasp space junk or catch it.

REMOVE debris is a satellite research project intended to demonstrate various space debris removal technologies.

Project NETRA(network for space objects tracking and analysis): ISRO's early warning system in space to detect debris and other hazards to Indian satellites.

ALPHA FOLD

1. About

- **AlphaFold** is an artificial intelligence (AI) program developed by Alphabet's/Google's DeepMind which performs predictions of protein structure.
- The program is designed as a deep learning system.
- AlphaFold is an AI-based protein structure prediction tool.
- It used processes based on “training, learning, retraining and relearning” to predict the structures of the entire 214 million unique protein sequences deposited in the Universal Protein Resource (UniProt) database.
- Hence in General **AlphaFold is an** advanced modelling program that can predict the precise 3D atomic structures of proteins and some molecular complexes.

2. Significance of Protein

- **Proteins are at the centre of life itself.**
- Proteins are the building blocks of life, they **underpin every biological process in every living thing.**
- And, because a protein's shape is **closely linked with its function**, knowing a protein's structure unlocks a greater understanding of **what it does and how it works.**
- This groundbreaking resource would help **accelerate scientific research and discovery globally.**
- Proteins play many roles in the **biological world.**
- They **transport nutrients, trigger chemical reactions, and build the structures that make up all living things.**
- To fully understand what a protein does, scientists need to know its **3D structure, and this is no easy task.**

3. Why to study the Protein Structure

- Proteins are involved in basically every important activity that happens inside every living thing, yourself included: digesting food, enabling muscles to contract, moving oxygen throughout the body, and attacking foreign viruses and bacteria. Our hormones are made out of proteins; so is Our hair.
- To put it simply, proteins are so important because they are so versatile. Proteins can undertake a vast array of different structures and functions, far more than other types of biomolecules (e.g., lipids or carbohydrates).
- This incredible versatility is a direct consequence of how proteins are built.
- Every protein is composed of a string of building blocks known as amino acids linked together in a particular order. There are 20 different types of amino acids. In one sense, then, protein structure is elegantly simple: each protein is defined by its one-dimensional sequence of amino acids, with 20 different amino acids to choose from. Proteins can range from a few dozen to several thousand amino acids in length.
- But proteins do not stay one-dimensional. To become functional, they first fold into complex three-dimensional shapes.
- A protein's shape relates closely to its function. **To take one example, antibody proteins fold into shapes that enable them to precisely identify and target particular foreign bodies, like a key fitting into a lock.** Understanding the shape that proteins will fold into is thus essential to understanding how organisms function, and ultimately how life itself works.



4. Significance of AlphaFold on Society

- When it comes to commercial opportunity and startup activity, there are two applications in particular for which AlphaFold attracts a lot of attention: drug discovery and protein design
- In a nutshell, designing a new drug entails identifying a compound in the body—most often a protein—that you want to target, and then finding a molecule (the drug) that will successfully bind to that target, producing some beneficial health outcome. Knowing the three-dimensional shape of a prospective protein target is essential to this process because a protein's shape defines which and how other molecules will bind to it. AlphaFold makes available a vast new set of drug target candidates to explore.
- One area of drug discovery for which AlphaFold holds particular promise is neglected diseases. Neglected diseases are those for which little research funding is directed to develop treatments, often because the disease affects very few people or because the populations that it affects are low-income and thus represent a less compelling market opportunity.
- AlphaFold helps level the playing field in the search for therapeutics for these disease states by, for the first time, making relevant protein structures instantly available without the need for costly laboratory work.

- Protein researchers and entrepreneurs seem even more excited about AlphaFold's potential to boost the burgeoning field of *de novo* protein design.

5. How alpha fold can impact the field of Biology

- Proteins are the business ends of biology, meaning 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.
- The development of AlphaFold changes all of that.
- It is a watershed movement in science and structural biology in particular.
- AlphaFold has already helped hundreds of scientists accelerate their discoveries in vaccine and drug development since the first public release of the database nearly a year back.

6. Implication of AlphaFold innovation in India

- India is no stranger to the field and has produced some fine structural biologists.
- The Indian community of structural biology is strong and skilled.
- It needs to quickly take advantage of the AlphaFold database and learn how to use the structures to design better vaccines and drugs.
- Understanding the accurate structures of COVID-19 virus proteins in days rather than years will accelerate vaccine and drug development against the virus.
- India will also need to speed up its implementation of public-private partnerships in the sciences.
- India could facilitate collaborations with the prevalent hardware muscle and data science talent in the private sector and specialists in academic institutions to pave the way for data science innovations.

7. Conclusion

- At the same time, AlphaFold is no silver bullet for real-world challenges like drug discovery. Figuring out the most viable and impactful ways to translate AlphaFold's fundamental insights into products that create value in the real world will entail years of hard work from researchers and entrepreneurs. But make no mistake: the long-term impact will be transformative.

ASTROBEE

1.Context

For the first time ever, two astrobbee robots have begun working independently on the International Space Station, side by side with humans

2. What is Astrobbee?

Astrobbee is NASA's new free-flying robotic system

It will help Astronauts reduce the time that they spent on routine duties, leaving them more time to focus on things only humans can do

It can work autonomously or via remote control by astronauts, flight controllers or researchers on the ground.

The robots are designed to complete tasks such as taking inventory and documenting experiments conducted by astronauts with their built-in cameras or working together to move cargo throughout the Station

Astrobbee also consists of a system that serves as a research platform that can be outfitted and programmed to conduct microgravity experiments

3.Honey, Queen, bumble

- The three flying robots are named Honey, Queen, and bumble, they are shaped like cubes 12.5 inches wide
- The Astrobbee consists of three cube-shaped robots, some software and a docking charging station used for recharging, they are about 32 centimetres wide
- The three robots propel themselves using electric fans that allow them to fly through the microgravity environment of the International Space Station
- They look around and navigate their surroundings using cameras and Sensors
- All the robots are equipped with a perching arm that allows them to handrails to either conserve energy or grab and hold items

- When they are running low on charge, they will get back to the docking station for recharging

4.About Astrobee

- Astrobee robots are built on the knowledge acquired from operating SPHERES (Synchronised Position Hold, Engage, Reorient, Experimental Satellite) robots which have been operating in the International Space Station for over a decade
- Once fully commissioned, the Astrobee system will take over for SPHERES as the space station's robotic test facility
- In the latest development, Bumble tested its navigation ability in the harmony module and gathered new station mapping data while Queen captured its 360-degree panoramic image of the interior of the orbital laboratory
- The mapping imaging experiments conducted by Astrobee are part of the Integrated System for Autonomous and Adaptive Caretaking (ISAAC) project managed at NASA's Ames Research Centre
- As a Part of ISAAC, project scientists have been teaching Astrobee to autonomously support spacecraft monitoring, maintenance and other tasks. Apart from making space missions safer and more cost-effective, Astrobees could manage routine chores that would free up human operators for more complex work
- Even more importantly, Astrobees could be instrumental in future space crafts that won't be crewed year around, like Gateway Space Station, these will need autonomous robots to keep things running while humans are away

5.About SPHERES

SPHERES consists of three flying satellites on board the International Space Station that test a diverse range of hardware and software from scientists all over America

SPHERES has been active for 10 years and continues to be one of the most popular projects of NASA and a favourite of many Astronauts who are fortunate enough to work with the SPHERE project

Hellfire R9X

1.Context:

Weapon CIA used to Kill Al-Zawahiri in Afghanistan. No warhead explosives just blades swing out to kill one guy

2. About

- Hellfire R9X missile is a modified version of the renowned Hellfire missile which was an anti-tank weapon developed in the 1980s and was later modified numerous times, especially after the 9/11 attacks, to target individuals
- The missile is designed in a way that it can shove more than 100 pounds of metal to kill its target, be it a car or building.
- Better known in military circles as the AGM-114 R9X, the Hellfire R9X is a US-origin missile known to cause minimum collateral damage while engaging individual targets.
- The most lethal aspect of the R9X is the halo of six long blades which are packed inside that deploy through the skin of the missile moments before impact to ensure that it shreds anything in its tracks.
- Also known as the ‘Ninja Missile’, this 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 massive damage to the surroundings which would be the case with a missile carrying an explosive warhead.

3. Significance of HellfireR9X

- In the last few years, the US military has carried out a series of airstrikes using secretive weapons.
- To this day, the US authorities have made barely any public statements about the R9X Hellfire missile.
- It appears to be used as a targeted assassination weapon against high-value targets: commanders and other prominent individuals.
- Over the last four years there have only been 11 confirmed cases involving the weapon. Many of these took place in Syria, although the R9X missile is believed to have been used in Afghanistan, Libya, Somalia and Yemen.
- At first glance, the R9X missile, described as “a weapon that combines medieval brutality with advanced technology,” by the *Wall Street Journal*, appears to be an important breakthrough in the U.S. counter-terrorism arsenal.
- Despite its Hellfire connotation, the R9X missile is more like a long-range sniper round than its explosive cousins. The payload allows a drone operator based in the United States to target terrorist leaders anywhere in the world to an accuracy of only a few feet, and potentially without any collateral damage.
- A former US official expressed hopes the weapon could even solve a “right seat, left seat” problem, with the missile, being capable of discriminately targeting passengers in a moving vehicle.

- But there are downsides, including a failure to adequately address ethical and human rights questions and a lack of clarity about if it can be deployed effectively in future battles.

LUMPY SKIN DISEASE (LSD)

1.Context:

Over the last few weeks, more than 3,000 cattle have died in Rajasthan, Gujarat, and Punjab due to a viral infection called Lumpy Skin Disease (LSD)

2.About the LSD

According to a report by GAVI (Global Alliance for Vaccination and Immunisation), lumpy skin disease is caused by a virus called capripoxvirus, which is an emerging threat to livestock worldwide.

It is genetically related to the Goatpox and Sheeppox virus family

- LSD infects cattle and water buffalo mainly through vectors such as blood-feeding insects
- Signs of an infection include the appearance of circular, firm nodes on the animal hide or skin that looks similar to lumps
- Infected animals start losing weight and may have fever and lesions in the mouth along with a reduced milk yield
- Other symptoms include excessive nasal and salivary secretion

3.Previous Outbreaks

- The disease has been endemic in African Countries. But since 2012 it has spread rapidly through the middle east, southeast Europe and West and Central Asia
- Since 2019, several outbreaks of LSD have been reported in Asia, in this year Pakistan's Punjab also reported deaths of over 300 cows due to LSD
- In September 2020, a strain of the virus was discovered in Maharashtra, and Gujarat too has reported cases over the last few years Sporadically (irregular intervals)
- The number of deaths are being the biggest concern at this point

Risk to Humans

The disease is not Zoonotic-Doesn't spread from animals to humans
However, milk produced by infected animals is to be boiled before consuming by humans

SMALL SATELLITE LAUNCH VEHICLE (SSLV)

1. Background

- The SSLV is intended to cater to a market for the launch of small satellites into low earth orbits which has emerged in recent years on account of the need for developing countries, private corporations, and universities for small satellites.
- The launch of small satellites has until now been dependent on ‘piggy-back’ rides with big satellite launches on ISRO’s work-horse – the Polar Satellite Launch Vehicle which has had over 50 successful launches so far.
- The launch of small satellites as a consequence has been dependent on the finalizing of launch contracts for the larger satellites by ISRO.

2. About

- ISRO developed a small satellite launch vehicle (SSLV) to cater for the launch of up to 500 kg satellites to Low Earth Orbits on a ‘launch-on-demand’ basis.
- SSLV is configured with three solid stages
- The satellite insertion into the intended orbit is achieved through a liquid propulsion-based velocity trimming module.
- SSLV is capable of launching Mini, Micro, or Nanosatellites (10 to 500 kg mass) to a 500 km planar orbit.
- SSLV provides low-cost access to Space on-a demand basis.
- It offers low turn-around time, flexibility in accommodating multiple satellites, launch-on-demand feasibility, minimal launch infrastructure requirements, etc.

3. Prominence of SSLV

- The SSLV received a commercial booking in 2019 itself from the US space launch services intermediary Spaceflight Inc.
- Spaceflight announced on August 8, 2019, that it has clinched a deal with an ISRO commercial arm for using the second developmental flight of the SSLV rocket to launch a spacecraft for an **“undisclosed US-based satellite constellation”**.
- “SSLV is perfectly suited for launching multiple microsatellites at a time and supports multiple orbital drop-offs.
- We are excited to add SSLV to our launch portfolio and manage many launches together — **first to LEO (low earth orbit) mid-inclinations this year and SSO missions starting in the fall of 2020,**”

4. Significance of small satellite programme

- The primary tool for the detailed study of particular regions of space and specific physical phenomena
- A cost-effective method for addressing key scientific problems
- A means for the flight demonstration of new spacecraft and instrument design concepts and hardware
- An opportunity to develop scientific research, engineering and project management capabilities
- The capability for a quick response to targets of opportunity • An opportunity for international cooperative missions.
- Explorers and similar space programs cannot play many of these roles when they become ambitious, scientifically or technologically complex projects requiring long development times and large budgets. These roles can be maintained only when scientists have frequent access to new small spaceflight mission

5. Multiple significance of Small Satellite

- **More accessible to companies of all types and sizes.** For a long time, only a few countries and multinationals had the financial muscle and the technical and human capacity to access space. This has changed. The introduction and widespread use of small satellites has meant a total reduction in space barriers for all types of companies and countries.
Advances in technology, the reduction in prices, the appearance of new providers and the reduction in waiting times for the implementation of new projects in space have had a decisive influence on this transformation.
- **more affordable prices.** This is a basic criterion for any company. A conventional satellite, as a reference, can cost between 350 to 450 crore. A small satellite costs less than 50 crores as multiple launches are possible.
- **Shorter development times.** The New Space age is about the ability to start projects quickly, without waiting too long. A conventional satellite requires very long development times, between 5 and 15 years. On the other hand, the Small satellites take less than 72 hours for installation and reduced manpower.
- **Smaller size and weight.** These are two criteria that are closely related to the price of satellites. Let's think of some steps that need to be taken into account in the development of this type of project, such as launch and logistics.
In the case of launchers, the price of putting a satellite in space is measured in kilograms. The heavier it is, the more expensive it is to launch a satellite. And when it comes to logistics, the level of complexity and the price of moving a CubeSat has nothing to do with the device that needs to be deployed in the case of a conventional satellite.
- **Risk distribution.** Satellites usually operate in constellations, so the different satellites provide backup and redundancy to the services they offer. If a small satellite becomes unusable, for whatever reason, the project does not fail, but the

other small satellite can fill that gap while waiting for a replica to be placed in orbit to take the place of the damaged satellite. And all this in a very short period. This is not the case with large satellites, as the consequences of a serious breakdown can be catastrophic for the mission, with the added problem that launching another satellite to take its place can take a matter of years.

We can also consider other factors beyond the manufacturers' control, such as launching. We can find recent examples of large satellites that were lost without reaching space. As it happens, in the last two years, the United Arab Emirates Falcon Eye 1 military satellite (which cost more than 400 million dollars), the Russian Meteor-M No.2-1 weather satellite (45 million dollars) and the Chinese Yaogan-33 satellite.

These are risks that exist, even for small satellites. The difference is that the loss of Small satellites allows more room for manoeuvre, even in the short term, and has fewer economic and operational repercussions for the service you want to provide from space.

- **More flexible services.** The adaptability and flexibility offered by Small satellites are enormous. If a new business opportunity is detected, it is possible to implement new functionalities and services in a relatively simple way. Each new Small satellite is an opportunity to improve the features and solutions offered.

Without the need to wait for the launch of new CubeSats, there is also room for manoeuvre for reconfiguring the payload of small satellites in space, for example in the case of projects that use SDR platforms.

- **Greater independence and control over the project** as it involves less administrative work and
- **Greater data security.** When intermediaries come into play, the risks associated with the security of the information being transmitted also increase, especially if it is sensitive and strategic data for a government.

Having a CubeSats constellation avoids having to transmit this information through satellites in countries that are not very respectful of data protection and intellectual and industrial property, with all that this can mean when it comes to preventing leaks or problems derived from geostrategic and commercial tensions.

- **Standing out from the competition** between India and other countries

iDEX

1. About

- iDEX is aimed at creating an ecosystem to foster innovation and technology development in Defence and Aerospace by engaging Industries including Micro, Small & Medium Enterprises (MSMEs), Start-ups, Individual Innovators, Research & Development (R&D) institutes and Academia and providing them grants/funding and other support to carry out R&D which has potential for future adoption for Indian defence and aerospace needs.

- Two major objectives of iDEX are indigenization and innovation.
- iDEX-Prime supports projects requiring support beyond Rs 1.5 crore up to Rs 10 crore, to help ever-growing start-ups in the defence sector.
- iDEX is funded and managed by “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 helps as a policy guide to iDEX.

2. Prominence of iDEX

- One of the first aims of India as a nation since its Independence has been to achieve self-reliance in the field of defence and defence production.
- India is the world’s largest defence equipment importer and is expected to spend around USD 220 Billion in the coming decade to modernize its armed forces.
- In recent years, the government of India has initiated various schemes like Make
- In India, Startup India, Atal Innovation Mission (AIM), etc. to encourage innovation and entrepreneurship in the Indian commercial ecosystem.

3. Other prominent initiatives aimed at Indigenous Defence Manufacturing

3.1. ‘Buy {Indian-IDD (Indigenously Designed, Developed and Manufactured)}’

- To promote indigenous design and development of defence equipment ‘Buy {Indian-IDD (Indigenously Designed, Developed and Manufactured)}’ category has been accorded top priority for procurement of capital equipment.

3.2. DAIC and DAIPA

- To enable the adoption of Artificial Intelligence in defence, Defence AI Council (DAIC) and Defence AI Project Agency (DAIPA) have been created. Also, an AI roadmap has been finalized.

3.3. DAP-2020

- Specific provisions have been introduced in DAP-2020 under the ‘Buy and Make (Indian)’ and ‘Buy (Global – Manufacture in India)’ categories, wherein indigenous production is carried out with the Transfer of Technology (ToT) from foreign original equipment manufacturers (OEM).
- Discharge of offset obligations by foreign OEMs through ToT to Indian enterprises including government institutions has been incorporated.

3.4. SP Model

- Indegeneous manufacturing through a transparent and competitive process, wherein they would tie up with global Original Equipment Manufacturers (OEMs) to seek technology transfers to set up domestic manufacturing infrastructure and supply chains.

3.5.DRDO

- Defense Research and Development Organisation (DRDO) identified nine thrust areas for focused research, namely Platforms, Weapon System, Strategic Systems, Sensors & Communication Systems, Space, Cyber Security, Artificial Intelligence & Robotics, Material & Devices and Soldier Support.

3.4.TDF

- Technology Development Fund (TDF) Scheme funds industries, especially – startups and MSMEs up to an amount of Rs. 10 Crore. It is for innovation, research and development of defence Technologies in the field of defence and Aerospace.

3.5.The Unmanned Aerial Vehicle

- The Unmanned Aerial Vehicle designed and developed by DRDO, has been successfully tested in fully autonomous mode.
- DRDO carried out the successful maiden flight of the ‘Autonomous Flying Wing Technology Demonstrator’ from the Aeronautical Test Range in Chitradurga, Karnataka.

4. Prominence of Indigenisation of the Defense Sector

- **Self-defense:** The presence of hostile neighbours like China and Asian country makes it inconceivable for the Asian nation to spice up its protection and readiness.
- **Strategic advantage:** Independence can build India's government stance strategically stronger as an internet security supplier.
- **Technological advancement:** Advancement within the defence technology sector can mechanically boost alternative industries thus catapulting the economy additional ahead.
- **Economic drain:** the Asian nation spends around a third-dimensional of GDP on defence and hr of that's spent on imports. This results in an associate degree with a large economic drain.
- **Employment:** Defence producing can want the support of various alternative industries that generate employment opportunities.

5.Need for Indigenisation

- The national capital International Peace analysis Institute (SIPRI) rumoured that the Republic of India was the world's second-largest bourgeois of major arms in 2014-18 and accounted for nine.5% of the worldwide total and India's military expenditure rose by three.1%.
- C&AG report, 2011 to the Parliament, highlighted the ninetieth import dependency of geographic area physical science Ltd (HAL) for 'raw materials and bought-out things for the assembly of autochthonous instrumentation.
- India has been defrayal around four-dimensional of its gross domestic product on defence.
- The independence Index (SRI) (the magnitude relation of autochthonous content of defence procurements to the whole expenditure on defence procurements during a monetary year) is at a coffee of zero.

6. Conclusionary Remarks

- “iDEX has provided an opportunity to our science and technology professionals to understand futuristic technologies such as AI, Augmented Reality, Block-chain and Space technologies.

LANGYA VIRUS

1. Background and the story so far

- Scientists in Asia have identified a new virus that can cause severe fever and was likely transmitted to humans from animals in eastern China.
- The Langya henipavirus (LayV) was found in 35 people in the Shandong and Henan provinces of China, who were tested between 2018 and 2021, according to a letter published in the New England Journal of Medicine earlier this month.

2.Prominence of langya in causing disease

- The researchers used a modern technique known as metagenomic analysis to find this new virus. Researchers sequence all genetic material then discard the “known” sequences (for example, human DNA) to look for “unknown” sequences that might represent a new virus.
- This raises the question about how scientists can tell whether a particular virus causes the disease.
- Scientists have traditionally used “Koch’s postulates” to determine whether a particular microorganism causes disease:
 - it must be found in people with the disease and not in well people
 - it must be able to be isolated from people with the disease

- the isolate from people with the disease must cause the disease if given to a healthy person (or animal)
- it must be able to be re-isolated from the healthy person after they become ill.

3. Contemporary highlights about the virus

- The virus has reportedly been found in throat swab samples
- The early patients of the virus are mainly farmers
- The virus was also detected in 2% of domestic goats and 5% of dogs

4. BACK TO BASICS

4.1. What is a Virus

- A virus is an infectious microbe consisting of a segment of nucleic acid (either DNA or RNA) surrounded by a protein coat.
- A virus cannot replicate alone; instead, it must infect cells and use components of the host cell to make copies of itself.
- Often, a virus ends up killing the host cell in the process, causing damage to the host organism.
- Well-known examples of viruses causing human disease include AIDS, COVID-19, measles and smallpox.

4.2. Differences between Virus and Bacteria

Viruses	Bacteria
I. They are very small.	They are larger in size as compared to viruses.
II. Non-cellular.	Single-celled.
III. Have no metabolism of their own.	Have metabolism of their own. Take food by absorption.
IV. Taken no food by any method.	Grow in size and divide to produce more bacteria.
V. Do not grow and do not divide.	They can reproduce by their own.
VI. Command the host cell to produce virus.	Cannot be crystallised.
VII. Can be crystallised.	Some are harmless, some useful and some are disease causing.
VIII. All produce diseases in man, animals or plants.	

F-INSAS

1.Context

A day after a made-in-India howitzer gun, the ATAGS was used for the first time for the 21-gun salute during the Independence day ceremony, Defence Minister Rajnath Singh on Tuesday handed over several new defence systems, including the F-INSAS, the Nipun mines, the Landing Craft Assault (LCA), to the Indian Army.

2.The F-INSAS project

- F-INSAS or the Future Infantry Soldier As a System is an infantry modernisation programme aimed at increasing the operational capability of the soldier.
- As part of the project, soldiers are being equipped with modern systems that are lightweight, all-weather-all-Terrain, cost-effective and low maintenance.
- The full gear of the F-INSAS system includes an **AK-203 assault rifle, which is a Russian-origin, gas-operated, magazine-fed, select-fire weapon.**
- It has a range of 300 metres and is being built in Korwa near Amethi in Russia-India joint venture.
- A contract for over 6 lakh AK-203 rifles was signed in December last year between the Ministry of Defence and the Indo-Russian Rifles Private Limited (IRRPL).

3. F-INSAS hand grenade

- On the weaponry front, the F-INSAS also includes a multi-mode hand grenade.
- In defensive mode, these grenades are to be hurled when the thrower has a cover, while the target is in the open and can be harmed by fragmentation.
- In offensive mode, the grenades do not fragment and the adversary is harmed by the blast or is stunned.
- The weapon kit also has a multi-purpose knife for close-quarters combat.

4.Ballistic helmets and goggles

- As part of this, the F-INSAS provides soldiers with ballistic helmets and ballistic goggles for protection against small projectiles and fragments, along with a bulletproof vest.
- The helmet and the bulletproof jacket are capable of protecting the soldier against 9 mm bullets and AK-47 ammunition.
- For target acquisition, the soldier gets a rifle-mounted holographic sight for fast and accurate aiming within a 200-metre range.
- The helmet has a mounted night-vision device for operating in low light and the option of installing a thermal imager that can convert infrared energy from objects into thermal images.
- It comes with hands-free, secured communication set for real-time exchange of information with the command post and fellow soldiers.
- All these items have been sourced from Defence Public Sector undertakings and private Indian Industries.
- They have been indigenously designed by the Indian entities, including the DRDO and the ordnance factories ecosystem.

5.The F-INSAS Vision

- Conceived in the 2000s, F-INSAS is one among many soldier modernisation programmes across the world.
- The US has Land Warrior, while the UK has FIST (Future Integrated Soldier Technology).
- According to estimates, over 20 armies around the World are following such programmes.
- The Defence Research and Development Organisation (DRDO) developed F-INSAS in sync with the targets of the Army's Infantry Soldier Modernisation Programme.
- According to DRDO scientists, similar programmes from the **US, France, Germany and Israel** were studied for the Indian Project, the quality requirements for which were set by the Army.
- Officials added that research and development efforts are still on the finetune the F-INSAS for all types of conflict scenarios and terrains.

6.Nipun Mines

- Nipun Mines are indigenously designed and developed anti-personnel mines, termed as "soft target munition" by the DRDO.

- These mines are meant to act as the first line of defence against infiltrators and enemy infantry.
- They have been developed with the efforts of Armament Research and Development Establishment, a Pune-based DRDO facility and Indian industry.
- 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.
- The Army has said that Nipun is more effective than the existing anti-personnel mine in its arsenal.

7.The LCA

- The Landing Craft Assault (LCA) is meant to serve as a replacement for the boats with limited capabilities currently in use in the Pangong Tso Lake.
- The LCA, which has been indigenously developed by Goa-based Aquarius Ship Yard Ltd, is said to have better launch, speed and capacity to operate across water obstacles in eastern Ladakh.
- Similar vessels are already in operation in the Indian Navy

Tomato flu

1.Context:

- As cases of tomato flu were reported from Kerala, Tamil Nadu, Haryana, and Odisha, the Health Ministry on Tuesday issued guidelines on prevention, testing, and treatment.
- According to some reports, tomato flu could be an aftereffect of chikungunya or dengue fever in children.
- It could also be a new variant of the viral hand, foot and mouth disease, a common infectious disease targeting mostly children aged 1-5 years, which is immunocompromised adults.
- India recorded around 100 cases of tomato flu which is a highly contagious yet non-life threatening virus.

2.HFMD:

- Tomato flu is characterized by fever, joint pain, and red tomato-like rashes which are usually seen in children 10 years of age and less.
- Researches believe that these symptoms could be of a hand, foot and mouth disease caused by enteroviruses-virus that are transmitted through the intestine.
- The current HFMD cases are mainly caused by the enterovirus Coxsackievirus A-6, A-16.

- Another pathogen, Enterovirus 71, which causes a disease that is not prevalent now.
- Specific origin, type or cause of the infection is not mentioned.

3. Tomato Flu :

- As far its etymology is concerned, the tomato flu is so named because of the eruption of red & painful blisters throughout the body that gradually enlarge to the size of a tomato.
- Medical experts took strong exception to this, saying that the usage of such terms is unscientific & misleading.
- It was also clarified that infection is not related to the consumption of tomatoes in any way.

3.1. Spreading :

- As the disease is self-limiting, doctors do not usually test for it.
- There are so many viral infections in children and there is no need to test for each & every one.
- More viral infections were reported because testing for viral infections has increased over the last five years.
- The pandemic gave a further push to such surveillance.
- Another explanation could be that schools have re-opened fully after the pandemic.

4. Clinical Presentation :

- The Ministry clarified that the virus causing tomato flu is not related to SARS-CoV-2, monkeypox, dengue or chikungunya despite symptoms similar to those in viral infections.
- In a small number of cases, tomato flu can lead to CNS (Central Nervous System) complications.
- The disease in this outbreak has some atypical presentations: the red tomato rashes, traditionally restricted to the mouth, palms, and soles are now being reported on the buttocks and shedding of nails is also observed.
- The rashes can be distinguished from that of Monkeypox by a visual inspection monkeypox rashes are more deep-rooted and distribution is also different.
- HFMD can be diagnosed by observing the symptoms, especially the red rashes.
- Infants and young children are also prone to this infection through the use of Napier's, touching unclean surfaces as well as putting things directly into the mouth.
- The illness usually begins with a mild fever, poor appetite, malaise, and sore throat.
- Small red blisters appear one or two days after the fever and these sores are usually located on the tongue, gums, inside of cheeks, palms, and soles.
- In some cases, fatigue, nausea, vomiting, diarrhoea, dehydration, swelling of joints, body aches & common influenza-like symptoms were noted.

5.Treatment & Prevention :

- No specific treatment or vaccine is available for the disease.
- Those with the infection are treated symptomatically, like a prescription of paracetamol for fever.
- As per the advisory, anyone suspected to have the infection should remain in isolation for 5-7 days after the onset of symptoms.
- Children must be educated about the infection and asked not to hug or touch the children with fever or rashes.
- They should be encouraged to maintain hygiene, not suck their thumb, and fingers & use a handkerchief for running nose.
- Infected children should be isolated, and their utensils, clothing and bedding must be regularly sanitized.
- They must be kept hydrated, and blisters must be cleaned using warm water.

ETHEREUM

1.Context

The "Proof of stake "consensus mechanism will cut Ethereum's energy consumption by 99.95%.

ETHEREUM is one of the most used platforms by developers to build decentralized apps, smart contracts, and even crypto tokens. Ether is only second to Bitcoin (BTC) in terms of market capitalization

The change in the way Ethereum builds the blockchain comes with not just environmental consequences, but also major cyber and financial security implications.

2.Consesus Mechanism

- Decentralized transactions are processed on blockchains using consensus mechanisms
- Ethereum's former method," proof-of-work", which is also used by Bitcoin, needs powerful mining hardware that consumes a lot of electricity and generates enormous amounts of heat. This energy is then used to process extremely difficult mathematical puzzles, the solutions of which would let new transactions be added to the blockchain to reward the miners with crypto.
- Many environmentalists, policymakers, and regulators have strongly criticized the impact of Bitcoin mining on local communities.
- Common enters of mining included China, the U.S., Russia, and Kazakhstan – countries with cheap electricity rates and colder climates.

- Ethereum's website admitted that their crypto's total annualized power consumption nearly matches that of Finland while its carbon footprint is comparable to Switzerland.
- Ethereum has decided to switch to a "proof-of-stake" consensus mechanism, where Ether owners will stake their coins to serve as collateral and help process new blockchain transactions, in return for rewards.
- Crypto experts are divided as to which consensus mechanism offers better protection from hackers. Theoretically, there are ways to hack both verification methods. But Ethereum claims the 'proof-of-stake' consensus mechanism offers better security.

3.Bitcoin

Bitcoin switching to a proof of stake consensus mechanism seems highly unlikely because of the following reasons.-

- Switching to a proof-of-stake consensus mechanism would violate the principles of decentralization
- It would also represent losses of millions of dollars for individuals miners and companies trying to solve the puzzles that would reward them with BTC.

4. BITCOIN vs ETHEREUM

- Some Bitcoin supporters go so far as to say that miners' activities, though harmful to the environment now, will help bring about an energy revolution and the faster adoption of solar, wind, gas, and nuclear energy.
- However, the consequences of crypto mining across the globe have included mass electricity blackouts, fire accidents, overburdened grids, struggles between locals and crypto miners for more control over the energy supply, and even crypto mining on indigenous land.
- Ethereum on the other hand was co-founded by Vitalik Buterin, who has an active presence on Twitter .he also attended various international crypto events. The blockchain is backed by powerful non-profit organizations to support its activities-the Ethereum foundations.
- Therefore as far as the Ethereum community is concerned, miners will no longer produce valid blocks for the Ethereum blockchain.

For now, no other top coin is planning an Ethereum-style Merge.

5.Conclusion

Ethereum Classic has made it clear that it is loyal to the proof-of-work mechanism. It has invited miners to mine ETC and has said that stakers are free to choose ETH2.

May both chains co-exist in their right providing options for stakes and miners.

DART

1. Background

- NASA's Double Asteroid Redirection Test (DART) is the world's first full-scale mission to test technology for defending Earth against potential asteroid or comet hazards.
- The mission will test a method that could be used to redirect asteroids that pose a threat to our planet.
- Using the impact of a massive object like a spacecraft to divert asteroids is called the **"kinetic impact method"** of asteroid impact avoidance.

According to Robert Braun, head of the Johns Hopkins Applied Physics Laboratory's (APL) Space Exploration Sector, **"This is humanity's** first planetary defence test mission. This is the first time defence technology will be tested in a civilian mission. Also, we do not know the exact shape of the target or what it is made of. But we intend to understand its shape and composition based on the change in its orbit and based on the ejected material."

2. The crash of DART with Dimorphous

- The 160-meter-wide asteroid Dimorphos orbits the much larger asteroid Didymos, which is about 780 meters wide.
- After DART crashes into Dimorphos, it will ever so slightly change the way that it orbits Didymos.
- Telescopes on our planet and in space including the **Webb Telescope and Hubble** will be trained on this asteroid system to take measurements of the changes in the system.
- While Dimorphos poses no actual threat to Earth, scientists will compare the data from DART's actual impact with the many computer-generated simulations they have already made.
- This will help ascertain whether the kinetic impact method will be effective as a mitigation strategy in the event of an actual asteroid threat.
- DART weighs around 600 kilograms. According to NASA, this would be similar to crashing a golf cart into the great pyramid.

"This is intended to be a small nudge that will slightly change the position of the asteroid. In the event of an actual predicted threat, this is something that we would do five, ten or twenty years in advance,"

3.About

- The only instrument on board the DART spacecraft is DRACO, or Didymos Reconnaissance and Asteroid Camera for Optical navigation.
- The high-resolution camera will capture images of Didymos and Dimorphos while simultaneously supporting DART's autonomous guidance system.

Apart from the James Webb Telescope, the Hubble Telescope and various other space telescopes here on Earth, a satellite much closer to the vicinity of the asteroid system will also have its eyes trained on the impact. This is the CubeSat called LICIACube.

- According to the Italian space agency Agenzia Spaziale Italiana, which built the CubeSat, LICIACube detached itself from DART and has begun operating autonomously.
- The two cameras on board the CubeSat will transmit back images even after the DRACO can no longer do so.

CRISPR-Cas9

1.Background

- CRISPR-Cas9 is a genome editing tool.
- It is faster, cheaper and more accurate than previous techniques of editing DNA and has a wide range of potential applications.

CRISPR-Cas9 is a unique technology that enables geneticists and medical researchers to edit parts of the genome by removing, adding or altering sections of the DNA Sequence.

It is currently the simplest, most versatile and precise method of genetic manipulation and is therefore causing a buzz in the science world.

2.Effective treatment of diseases

- This method offers an enormous range of options to intervene with the genetic code of living organisms, both people and animals as well as micro-organisms and plants.
- This can be beneficial when treating diseases, such as cancer and genetic diseases.
- The CRISPR/Cas9 technology can also be applied to crops.

- By editing the genome, you can give the crop the desired characteristics, whereby it becomes resistant to pathogens or grows faster and eventually provides a higher yield.

3.How the genetic scissors work

- CRISPR, which stands for Clustered Regularly Interspaced Short Palindromic Repeats, is a piece of DNA, a so-called DNA sequence.
- CRISPR sequences were first discovered in bacteria and archaea, which are part of an adaptive immune system that can recognize infectious viruses.

Once CRISPR recognizes the virus, a mechanism comes into operation whereby enzymes (such as Cas9) can **“cut”** the genetic material of the viruses and make them harmless.

In this way, disease-causing or other undesirable genes are turned off, or **“healthy”** and desirable genes can even be inserted into the genome.

- This system has been modified by scientists in such a way that it also works in animal and plant cells.
- CRISPR sequences are developed so that they specifically recognize the relevant part of the genome of these cells.
- The CRISPR sequence leads the Cas9 enzyme, for example, to that part of the genome which is selectively cut.

4.The ethical Dilemma

Cases of creating a ‘designer baby’, and caused widespread concern in the scientific community.

Preventive interventions to obtain special traits is not something that scientists are not something that scientists currently want the technology to be used for.

Socioeconomic disparities

Multiple polls have shown that the majority of people around the world are opposed to the use of genetic engineering of embryos for enhancement, such as athletic ability and intelligence, or for altering physical characteristics, such as eye colour and height. 89 It is easy to conceive of the risk of a new age of eugenics.

Possible stigma

Especially while the concept is still novel, it is difficult to predict how society will feel about gene-edited babies.

Insurance

Because gene editing will be a tool to cure and prevent illness, the insurance coverage will be an important part of the conversation.

Glossary

- **DNA:** Deoxyribonucleic acid, a molecule present in all cells that carries genetic instructions.
- **RNA:** Ribonucleic acid, a single-stranded molecule sometimes referred to as DNA's "cousin."
- **CRISPR:** clustered regularly interspersed short palindromic repeats – arrays of repeated DNA sequences.
- **Cas:** CRISPR-associated proteins that cleave virus DNA. There are 93 of them, one of which is Cas9.
- **TracrRNA:** trans-activating CRISPR RNA, which enables long RNA created from a CRISPR sequence to mature into its active form.

ONCOLYTIC VIRUSES (OVs)

1.Context

A new study published in the journal Cancer Cell suggests that the body's immune capacity against cancer to recognise and destroy cancer cells can be boosted by using oncolytic viruses.

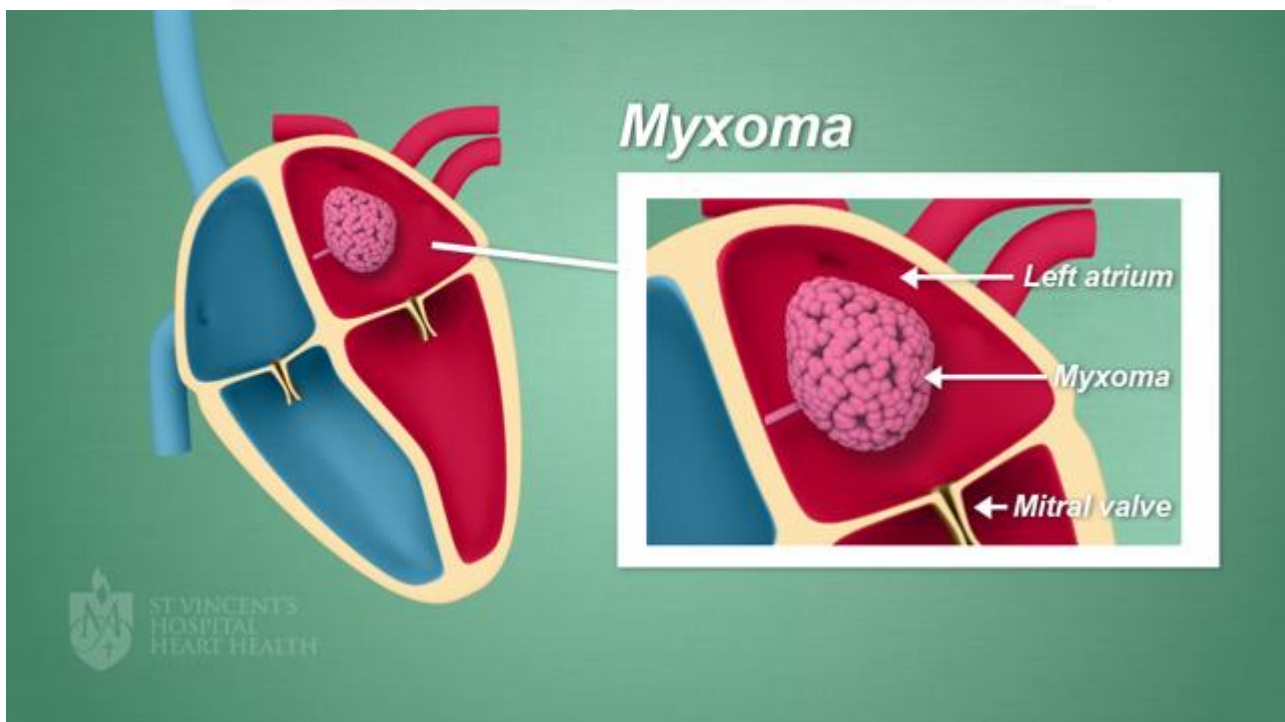
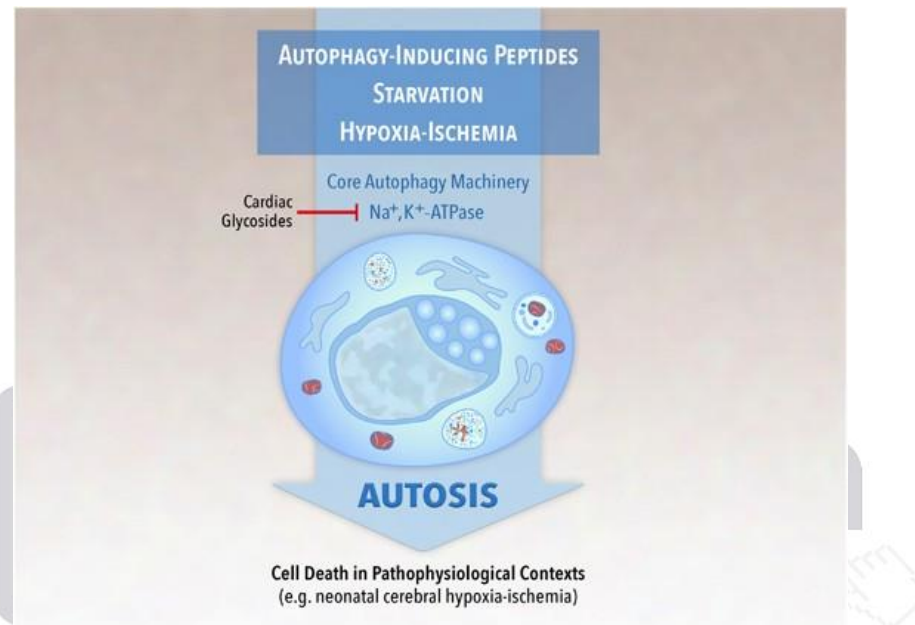
2.Key takeaways

- Oncolytic viruses (OVs) are viruses that selectively target and kill cancer cells while sparing normal ones.
- The study notes that these viruses also enhance the immune system's ability to recognise and terminate cancer cells.
- Although long theorised, the research into oncolytic virotherapy picked up only in the 1960s. Of late, there have been several trials looking at different viruses for cancer treatment.
- The latest study focused on the virus known as myxoma and it found that T-cells infected with the myxoma virus can lead to a type of cancer cell death not previously observed.
- The research claims to "uncover an unexpected synergy between T-cells and MYXV (myxoma virus) to bolster solid tumour cell autosis that reinforces tumor clearance".

Autosis is a form of cell destruction that is useful against solid tumors, which are seen as treatment-resistant.

Myxoma can target and kill cancer cells directly, but using myxoma-equipped T-cells works well as cancerous cells in the vicinity of those targeted are also destroyed. This process is called **bystander killing**.

The study makes the case that immunotherapy combined with virotherapy holds the potential to seek and destroy ‘cold tumours’ that fly under the immune system’s radar.



LAUNCH WINDOWS

1.Introduction:

- Space missions cannot just take off at any time, they require a precise timeslot for launch to find an efficient way, in terms of time & energy to get to their destination.
- The space agency NASA has to abort the launch of its Artemis-1 mission to the moon due to a problem found during fueling engine tanks.
- NASA said it would not make any further attempts to send the mission during the available launch opportunities till September 6.
- The next set of launch windows -14- are available between September 19 & October 4.

2.Launch Windows:

- Nothing is stationary in space. The origin(earth) is moving and the destination (moon/other planets/satellites)too.
- One reason for scheduling a launch window is to look for the shortest distance to the destination.
- The other is fuel efficiency, as space has no refuelling opportunity.
- The more fuel the rocket carries, the heavier it becomes, which means more fuel is needed to propel it.
- Depending on which side a satellite is headed in space, the distance it has to travel to get into orbit, the nature of the probe it has to carry & several other factors are also calculated in a precise launch window.
- The launch windows can sometimes be very narrow, even a few minutes.



3.Mechanism:

This mechanism can be better explained by the following example.

- Let's suppose we have to travel from our home(Point A) to the workplace(Point B).
- If the traffic considerations are removed, any time is good to travel.
- If the office is not stationary, but moving in a circular or elliptical path, point B might still be the shortest distance from home(point A), but the office is now not always located at point B.
- It arrives there periodically.
- If we do not time/schedule our journey to coincide our arrival at point B with that of the office, then it has to wait.
- We try to get to our office at some point other than Point B, which then is not the shortest route.
- In either case, the journey is not the most efficient.
- The challenge of charting an efficient journey grows manifold.
- Depending on the trajectories of Point A & B, the shortest distance between the two may be along a different route.
- There would be even fewer opportunities to make the most efficient journey and the journey would have to start at very precise timings.

4.Objectives:

- The objective of the mission is to land on a particular side of the Moon or go around it in a way that a certain part of the moon is observable.
- There can be hundreds of orbits around a planetary body.
- The mission has to enter one of them for specific needs.
- The choice of the orbit or the location of landing, matters in the launch window.
- The power of the rocket is also a factor.

- One of the reasons why the Artemis-1 has many launch opportunities is the fact that it is being carried by the most powerful rocket ever built.
- Named the Space Launch Vehicle /SLS, this rocket can take the spacecraft directly to lunar orbit.
- The Saturn V rockets used by the Apollo missions could go directly to the moon, making the journey in 3-4 days.
- Most other lunar missions, including India's Chandrayan missions, take a circuitous route because they don't have the energy to make the direct journey.
- The rockets deposit the spacecraft in near-earth orbits, which requires less energy.
- Once there, they periodically fire thrusters to progressively increase the orbit and gain energy to move forward.
- Chandrayan-2 took 12 days to reach the moon's orbit.
- The routes have to be taken into account for launch window calculations.
- The satellites in space, in most cases, derive energy from the sun.
- So, their trajectories have to be designed in a manner that the sun is not entirely blocked from their view for prolonged periods.

5. Earth's Rotation & Revolution :

- Because of their circular/elliptical orbits, it is possible that the two heavenly bodies are closest in distance at a time when they are moving in opposite directions.
- The earth goes around the sun at the speed of about 1.1lakh km/hour.
- The nature of the revolving orbit is such that the direction of movement is changing continuously.
- If the mission's destination is in the same direction in which the earth is moving at the time of the launch, then the rocket gets a big boost.
- It gains from the earth's momentum.
- In the opposite case, if the earth is moving in a direction that is opposite to the destination, then the rocket has negative momentum.
- It has to change the direction in which a lot of energy is wasted.
- Depending on the location of the mission, particular dates of the year are more favourable for launch than others.
- There is the earth's rotation on its axis from west to east.
- If the rocket is launched towards the east, it again gains from the earth's rotation speed.
- Because of its shape, the earth rotates faster at the equator than at the poles.
- This is also the reason why some of the most prominent launching sites, especially for heavier satellites, are located near the equator.
- many factors decide the location of a launch site, including proximity to the sea, and distance from highly populated areas as a security consideration.

6. Weather :

- A space mission cannot be launched if the temperature is too cold or too hot, or if the wind is blowing at a strong speed.

- Rainfall, Humidity, lightning, cloud, and smoke are all factors that need to be considered.
- Favourable conditions are required not only at the time of the launch, but also during the fuelling of the engines.

INS VIKRANT

1.Context

The commissioning of the Navy's first Indigenous Aircraft Carrier (IAC-1) as INS Vikrant by Prime Minister Narendra Modi on Friday will mark a defining moment for India.

In its new Avatar, Vikrant will enhance India's standing as a blue water Navy a maritime force with global reach and capability to operate on the high seas far from the country's shores.

2.From Vikrant to Vikrant

- The original INS Vikrant, with pennant number R11, was the Indian Navy's first aircraft carrier.
- It was purchased by India from the UK in 1957 and was commissioned in the Indian Navy as INS Vikrant in 1961.
- The ship, which had less than half the displacement of the new Vikrant and was 50 m shorter in length, led the Naval blockade of East Pakistan during the 1971 war.
- It was decommissioned in 1997.
- The Sanskrit word Vikrant means Courageous or steeping beyond, which appears in various scriptures including the first chapter of the Bhagavad Gita.
- The same chapter contains the word viraat, meaning magnanimous, which became the name of the Navy's second, now decommissioned, aircraft carrier.
- The new Vikrant will carry the motto of its predecessor, Jayema sam yudhi sprudhah an expression that appears in the Rig Veda and means " We conquer those who fight us in war".
- When fully operational, INS Vikrant will be India's airbase on the blue oceans and act as a powerful deterrent against enemies.

3.Design and construction

- Vikrant has been built at an approximate cost of Rs. 20, 000 crores.
- Due to the indigenous components and construction, 80-85 per cent of the cost has been ploughed back into the Indian economy, the Navy has said.
- The design and construction of the IAC were sanctioned in January 2003.
- The ship's keel was laid in 2009 and it was launched on August 12, 2013.

- The readiness of the propulsion and power generation equipment was tested in November 2020 and four sea trials took place between August 2021 and July 2022.
- The ship was delivered to the Navy on July 28.
- When fully operational, INS Vikrant will be capable of operating an Air Wing consisting of 30 Aircraft.
- It has a length of 262 meters and a width of 62 meters and is powered by four Gas Turbines with 88 MW power.

4.Key features

Performance

It has a top speed of 28 Knots, a Cruising speed of 18 Knots and an Endurance of 7, 500 Nautical Miles.

Space

over 2, 400 compartments Designed for a crew of around 1, 600 including 200 officers, the 18-floor vessel has special cabins for women Naval officers and sailors.

16-Bed Hospital

The medical complex on board has a 16-bed hospital along with a modular emergency operation theatre, physiotherapy clinic, Intensive Care Unit, Pathology set up, radiology wing with a CT scanner and X-ray machines, a dental complex, isolation ward and telemedicine facilities.

Huge Aviation Hanger

The aviation hanger is as big as two Olympic-sized pools that can accommodate around 20 Aircraft.

3, 000 Rotis/ Hour

A well-equipped kitchen on board can serve a diverse menu to the crew. It has a unit that can make 3, 000 Rotis an hour important given the ship's crew is 1, 600 strong.

STOBAR

Using An aircraft-operation mode known as Short Takeoff But Arrested Recovery (STOBAR), INS Vikrant is equipped with a ski-jump for launching aircraft and a set of three arrester wires for their recovery on board.

5.Conclusion

Fight trials are set to begin by November and the carrier is expected to be fully operational by mid-2023, vice chief of Naval Staff, Vice Admiral S N Gormade, has said.

KALANAMAK RICE

1. Key Points:

- India rules the global scented rice trade through basmati. In the last 15 years, the area under its cultivation has remained at 0.5-0.6 million hectares.
- Production has stagnated at 1-1.5 million tonnes.
- This scented rice variety cannot be grown beyond stipulated tracts in Haryana, Punjab & Uttaranchal.
- The global scented rice market is growing at 12% per annum, but India seems to have few aromatic varieties to offer.
- The undivided Uttar Pradesh region has already lost the germplasm of 20 non-basmati scented varieties after the onset of the Green Revolution.
- Only 8 such varieties are cultivated & are protected through scientist-farmer participation.
- The prominent one is "Kalanamak".
- Outshining basmati Kalanamak, a non-basmati scented rice variety grown in UP is so named because of its black husk.
- Kalanamak easily outclasses the top variety of Basmati for the primary trait of aroma.
- Its elongation after cooking, a trait that is the major determinant of prices in the international market is also greater.
- Kalanamak's elongation to pre-elongation ratio is 2.2-2.7, in different basmati rice, it is 1.8-2.0.
- The great head rice recovery after polishing adds to its profitability.
- This recovery rate in Basmati is 40-45% whereas in Kalanamak it is 65%.
- Salt, alkalinity Kalanamak outclasses Basmati in agronomical abilities. It's a successful adapter to soils characterised by higher salt concentration & high pH.
- Kalanamak is highly resistant to notorious, common rice diseases like panicle blast, stem rot & brown rot. Bacterial blight is quite rarely observed.
- Drought tolerance Kalanamak is normally grown under rain-fed conditions & in uplands.
- The water requirement is quite low compared to Basmati. It doesn't need standing water during transplantation, it goes through a unique process of double transplantation.

- The first transplanting of a 30-35 day-old seedling is done in a bunch of 5-6 seedlings.
- After 25-30 days, these seedlings are uprooted, separated from each other & again transplanted.
- During drought, when rice yield decreased up to 50% in almost all varieties, Kalanamak is unaffected.

2. Advantages:

- Kalanamak is traditionally grown using no fertilizer, herbicide, or pesticide, making it suitable for organic cultivation.
- The global organic rice market is growing at a compound annual rate of 30%.
- Improved cultivars of Kalanamak easily outperform Basmati. The input & labour cost is meagre, while the yield is almost 40-50% higher.
- The net return amount of Kalanamak is ₹22,447 per hectare which for Basmati is ₹12,564/per hectare. This calculation is based on the lowest possible price estimates.
- Kalanamak is grown in the Tarai belt which comprises Siddharthnagar, Sant Kabir Nagar, Maharajganj, Basti, Gonda, and Gorakhpur.
- The total area under Kalanamak's cultivation is about 4,000 hectares.
- If proper care is not taken at this stage, this rice could soon lose its germplasm.

METAVVERSE

1. Context

Investors rushed to dump Meta Platforms Inc's stock after hours, pushing it down 20% and wiping \$67 billion off its market value as Wall street increasingly loses patience with Mark Zuckerberg's Metaverse bid.

2. Metaverse

- The term "metaverse" is a combination of the words "meta" and "universe". The term meta means 'beyond'. So the metaverse is a universe that exists beyond the known universe. It exists in the virtual realm but has the same sense of reality.
- The metaverse is a virtual reality that combines elements of social media, online gaming, augmented reality (AR), virtual reality (VR), and cryptocurrencies. Augmented reality enhances the user's experience by superimposing visual elements, sound, and other sensory input onto real-world settings. Virtual reality, on the other hand, is entirely virtual and enhances fictional realities.

- As the metaverse expands it will create online spaces with also more multidimensional user interactions than the current technology it can support. The users in the metaverse will be able to immerse themselves in a space where the digital and physical worlds converge rather than just viewing digital content.

3. Understanding the Metaverse

- Facebook has been talking about the metaverse for a while, stating in a press release dated October 17, 2021, that the metaverse is "coming soon". "A new era of interconnected virtual experiences enabled by the technologies such as virtual and augmented reality at its core is the idea that by enhancing one's 'virtual presence', interacting online can become much more similar to interacting in person."
- The proponents of the metaverse see it as the next step in the evolution of the Internet. Facebook, for example, has already made significant investments in AR and VR, developing hardware such as its Oculus VR headsets, and AR glasses and wristband technologies are in development.
- According to Zuckerberg, who believes AR glasses will one day be as common as smartphones, Facebook will "effectively transition from people seeing us as primarily begin a social media company to begin a metaverse company" over the next several years.

4. Origin of Metaverse

The term "metaverse" that was first used in Neal Stephenson's 1992 science fiction novel "snow Crash". The Novel is set in a dystopian world where governments have ceded power to private corporations and contain references to many modern-day aspects of life such as virtual reality, digital currency, and so on. Many films, including 'The Matrix,' 'Ready Player One, and The Tron Legacy,' have explored this concept.

5. What is the Facebook Metaverse?

There is no single creator of the metaverse, it is not something that Facebook owns or is solely responsible for developing. Nonetheless, Facebook has already made significant investments in the metaverse through its Oculus VR headsets, and it is working on AR glasses and wristband technologies. The company announced a \$50 million investment in global research and program partners in September 2021 to ensure that metaverse technology is developed responsibly.

6. Metaverse Potential

- **Hardware sales:** According to Facebook CEO Mark Zuckerberg, augmented reality glasses will eventually be as common as smartphones. If this is true, this will be a massive market.
- **Software sales:** There is a lot of room for growth in the development of software applications to support the metaverse ecosystem.

- **Gaming:** Facebook's Oculus VR gaming platform is expected to be the portal into the metaverse.
- **Physical Sales:** In the future, physical goods and services will be linked to virtual ecosystems.
- **Immersive Learning:** Immersive learning is a training methodology that employs Virtual reality (VR) to simulate real-world scenarios and train students in a safe and engaging immersive training environment.
- **Decentralized Commerce:** Peer-to-peer transactions in the real world.

7. Expensive Transition

In June, Zuckerberg briefly spoke about the challenges in building a VR headset as it required addressing retinal projection, depth perception, and high dynamic range (HDR) imaging. He moved on to note that Meta would soon roll out a headset capable of projecting holographic images. Three months later, on October 11, he unveiled a \$1,500 VR headset that was nowhere close to his idea of a virtual world-seeing gadget.

8. A solution waiting for the Problem

- Meta investors are unhappy as they see the company's boss diving deeper and deeper into the metaverse without a clear path for return on investments. This has already sent the stock down by over 60% this year. The company's market value has collapsed by a whopping \$676 billion, removing it from the ranks of the 20 largest U.S. companies.
- The real challenge with Zuckerberg's idea of the metaverse is that it remains a niche offering, unlike his foray into social media, which was a problem waiting to be solved.
- With the metaverse, it feels like a solution looking for a problem. In parallel to the dail-up modern days, the metaverse is buffering, and it is unclear in what shape or size the page will load.

DIRTY BOMB

1.Context

Russia intends to raise at the United Nations Security Council its accusation that Ukraine is planning a "Dirty Bomb" attack.

2.Dirty Bomb

- The term 'Dirty Bomb' refers to explosive devices that disperse the radioactive material, such as Uranium, or Plutonium, after being triggered when the conventional explosives denote. It is different from nuclear bombs as it doesn't need highly refined radioactive material.

- Using radioactive materials from hospitals, nuclear power stations, and even research laboratories, it can be made. They can be transported quite easily as well. Moreover, it doesn't create a radiation cloud as in the case of a nuclear bomb. Instead, it scatters the radioactive material over a radius spanning a few hundred meters.
- There is no recorded use of 'dirty bombs'. They have, so far, been tested only. They are designed to disperse radioactive material over a certain area. The purpose of the weapon is to contaminate the area around the dispersal agent/conventional explosion with radioactive material, serving primarily as an area denial device against civilians.
- The aftermath of the use of such an explosive device can be devastating for the area and the clean-up could be highly expensive and time-consuming. It may well be rendered unusable for a long time, depending on the amount of radioactive material used in the bomb.

3. Materials used in Dirty Bombs

- Cesium-137
- RDX(Explosive)
- Like Cobalt-60(High-energy gamma emitters)

4. How much damage they can do?

- Dirty bombs do not create city-flattering atomic explosions but are designed to spread toxic waste. Security experts have worried about them mostly as a form of terrorist weapon to be used on cities to cause havoc among civilians, rather than as a tactical device for use by warring parties in conflict.
- Immediate health impact would probably be limited since most people in an affected area would be able to escape before experiencing lethal doses of radiation.
- But the economic damage could be massive from having to evacuate urban areas or even abandon whole cities.
- A bomb using radioactive cesium from a misplaced or stolen medical device might require the evacuation of an area of several city blocks, making it unsafe for decades.
- A piece of radioactive Cobalt from a food irradiation plant could, if blasted apart in a bomb in New York, contaminate a 380 square mile (1,000 square km) area and potentially make the island of Manhattan uninhabitable.

5. Response of Ukraine and the west

Kyiv and its Western allies say Moscow's allegation that Ukraine would intentionally make some of its territory uninhabitable is absurd, especially at a time when Ukraine forces are recapturing territory on the battlefield.

GM MUSTARD

1. Introduction:

The Genetic Engineering Appraisal Committee (GEAC) under the Union Ministry of Environment, Forest & Climate Change recommended the environmental release of the transgenic hybrid mustard DMH-11 for seed production & conduct of field demonstration studies concerning its effects.

2. Hybrid Mustard:

- Hybridisation involves crossing two genetically dissimilar plant varieties that can be from the same species.
- The first generation (F1) offspring from such crosses tend to have higher yields than that of parents.
- Such hybridisation is not easy in mustard, as its flowers are bisexual and make the plants largely self-pollinating.
- Since the eggs of one plant cannot be fertilised by the pollen grains from another, it limits the scope for developing hybrids unlike cotton, maize, and tomato, where this can be done through simple emasculation/physical removal of anthers.
- By Genetic Modification, scientists have developed the hybrid mustard DMH-11 containing two alien genes isolated from a soil bacterium called *Bacillus amyloliquefaciens*.
- The first gene codes for a protein that impairs pollen production & makes the plant into male-sterile.
- This plant is then crossed with a fertile parental line containing in turn, the second gene that blocks the action of the first gene.
- The resultant F1 progeny is both high-yielding & capable of producing seed/grain.
- The scientists have deployed the barnase-barstar (1st & 2nd genes), GM technology to create a robust & viable hybridisation system in mustard.
- This system was used to develop DMH-11 by crossing a popular Indian mustard variety 'Varuna' with an East European 'Early Heera-2' mutant.
- DMH-11 is claimed to have shown an average 28% yield increase over Varuna in contained field trials carried out by ICAR.

3. GEAC:

- GEAC is a responsible body for the appraisal of proposals relating to the release of GM organisms into the environment.
- It has recommended the release of DMH-11 for its seed production & testing, before commercial release.
- It has given the green signal for commercial cultivation by farmers, with the production of seeds being the first step.
- GEAC recommended the environmental release of DMH-11's parental lines to develop new hybrids, which can give higher yields than DMH-11.
- Mustard varieties in India have a narrow genetic base.

- The barnase-barstar system enables the breeding of hybrids from a wider range of mustards, including those of East European origin like Heera, and Donskaja.
- There were two specific concerns about GM mustard.
- The first is the presence of a third 'bar' gene, which makes GM mustard plants tolerant to the spraying of glufosinate ammonium, a chemical used for killing weeds.
- DMH-11 developers say that the bar gene is only a marker gene.
- It is used to identify those plants that were GM, the non-GM ones that cannot withstand the application of herbicide & necessary for large-scale seed production.
- GEAC recommended the usage of any formulation of herbicide, exclusively for hybrid seed production.
- The second concern is over GM mustard threatening / undermining the population of honeybees.
- Mustard flowers are a source of nectar for honeybees & many other pollinator insects.
- Based on the examination of scientific evidence available, it seems that the bar, barnase, and barstar system will pose an adverse impact on honey bees & other pollinators.

GEAC recommended that field demonstration studies concerning the effect of GM mustard on honey bees & other pollinators post the environmental release, to generate scientific evidence in Indian agronomy.

4. Epilogue:

The compelling motive here could be India's spiralling edible oil import bill. The country produces only 8.5-9 million tonnes of edible oil annually while importing 14-14.5 million tonnes.

PALAEOGENOMICS

1. Background

This year, the Nobel Prize for Physiology has been awarded to Svante Pääbo, a Swedish geneticist, who pioneered the field of palaeogenomics, or the study of ancient hominins by extracting their DNA.

The study of ancient humans has historically been limited to analysing their bones and objects around them such as weapons, utensils, tools and dwellings.

Pääbo pioneered the use of DNA, the genetic blueprint present in all life, to examine questions about the relatedness of various ancient human species.

He proved that Neanderthals, a cousin of the human species that evolved 1,00,000 years before humans, interbred with people and a fraction of their genes about 1-4% live on in those of European and Asian ancestry

2. Extracting DNA from Fossils

- The challenge with extracting DNA from fossils is that it degrades fairly quickly and there is little usable material.
- Because such bones may have passed through several hands, the chances of them being contaminated by humans as well as other bacterial DNA get higher.
- This has been one of the major stumbling blocks to analysing DNA from fossils
- DNA is concentrated in two different compartments within the cell: the nucleus and mitochondria, the latter being the powerhouse of the cell
- Nuclear DNA stores most of the genetic information, while the much smaller mitochondrial genome is present in thousands of copies and therefore more retrievable
- Pääbo managed to sequence a region of mitochondrial DNA from a 40,000-year-old piece of bone.
- This was the first time a genome from an extinct human relative was pieced together. Subsequently, he managed to extract enough nuclear DNA from Neanderthal bones to publish the first Neanderthal genome sequence in 2010
- The most important contribution is demonstrating that ancient DNA can be reliably extracted, analysed and compared with that of other humans and primates to examine what parts of our DNA make one distinctly human or Neanderthal.
- Europeans and Asians carry anywhere between 1%-4% of Neanderthal DNA and there is almost no Neanderthal DNA in those of purely African ancestry
- Comparative analyses with the human genome demonstrated that the most recent common ancestor of Neanderthals and Homo sapiens lived around 8,00,000 years ago

3. Advantages of Palaeogenomics

1. The study of ancient DNA provides an independent way to test theories of evolution and the relatedness of population groups

2. In 2018, an analysis of DNA extracted from skeletons at Haryana's Rakhigarhi reported to be a prominent Indus Valley civilisation site provoked an old debate about the indigenes of the ancient Indian population
3. The Rakhigarhi fossils showed that these Harappan denizens lacked ancestry from Central Asians or Iranian Farmers and stoked a debate on whether this proved or disproved 'Aryan migration.'
4. Palaeogenomics also gives clues into disease. Researchers have analysed dental fossils to glean insights on dental infections.
5. Genome-wide association studies, where segments of DNA from species are compared, have found that Neanderthal DNA may be linked with autoimmune diseases, type 2 diabetes, and prostate cancer
6. A study co-authored by Svante Pääbo and Hugo Zeberg linked an increased risk of severe respiratory failure following COVID-19 with a set of genes that are inherited from Neanderthals and is present in 50% of South Asians and 16% of Europeans
7. The presence of Neanderthal and Denisovan DNA in people also raised questions on whether there are hard genetic distinctions between people and their extinct evolutionary cousins.

Neanderthals are an extinct species or subspecies of archaic humans who lived in Eurasia until about 40,000 years ago

USB-C

1.Context

The European Parliament on Tuesday passed a rule standardising the charging port on electronic items. It has selected USB Type-C -- better known as USB-C -- as the standard port.

So, by the end of 2024, all mobile phones, tablets, and cameras sold in the EU must have a USB-C port. But the deadline for the laptop has been set for 2026.

2.What are the rules

- The European Parliament has said, "Regardless of their manufacturer, all new mobile phones, tablets, digital cameras, headphones and headsets, handheld video game consoles and portable speakers, e-readers, keyboards, mice, portable navigation systems, earbuds and laptops that are rechargeable via a wired cable, operating with a power delivery of up to 100 Watts, will have to be equipped with a USB Type-C port."

- These rules have been in the making since 2014. Yet, its adoption has picked pace only in recent years. Unlike its previous iterations, the USB-C has a small oval port with no fixed up or down orientations. Its symmetrical connector makes it easy to plug in.

3.How will it help the environment?

The European Parliament said that disposed of and unused chargers account for about 11,000 tonnes of e-waste annually in the EU. Imagine the worldwide figure, and how this new rule, if implemented across the globe, will help in reducing the e-waste.

4.What exactly is USB-C?

Unlike its previous iterations, the USB-C has a small oval port with no fixed up or down orientations. Its symmetrical connector makes it easy to plug in. Besides, it is among the industry-standard connectors capable of transmitting both data and power on a single cable. Moreover, it supports fast charging (100W) required by large electronic devices such as laptops and offers super-fast data throughput. Not just data and power, USB-C also supports sending simultaneous video signals – up to 8K resolution.

5.The limitations of USB-C

USB-C is good, but its utility depends on implementation. You may already have a USB-C port on your device but still cannot use all features and functions such as host device charging and video out. It is because different manufacturers use USB-C for different utilities. Moreover, there are different protocols and standards related to USB-C.

6.When can India have a single charger?

India too is mulling the idea of a single charger for all electronic devices. The Union Ministry of Consumer Affairs has written to industry players to come up with a plan for having one cable for charging all your devices.

NavIC

1.Context

The Indian government is **pushing smartphone makers** to enable support for its NavIC navigation system in new devices sold in the country from next year, a move that has spooked the industry due to additional costs and tight time frames.

2.What is NavIC?

- NavIC, or Navigation with Indian Constellation, is an independent stand-alone navigation satellite system developed by the Indian Space Research Organisation (ISRO).

- NavIC was originally approved in 2006 at a cost of \$174 million. 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 (930 miles) 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.
- Enabling it in smartphones is the next step India is pushing for

3.NavIC vs Others

- 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.
- 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.
- India's 2021 satellite navigation draft policy stated the government will work towards "expanding the coverage from regional to global" to ensure the availability of NavIC signal in any part of the world.
- NavIC is "as good as GPS of the United States in terms of position accuracy," the Indian government said in August.

4.NavIC backed by India

- India says NavIC is conceived with the aim of removing dependence on foreign satellite systems for navigation service requirements, particularly for "strategic sectors."
- Relying on systems like GPS and GLONASS may not always be reliable, India says, as those are operated by the defence agencies of respective nations and it is possible that civilian services can be degraded or denied.
- NavIC is an indigenous positioning system that is under Indian control. There is no risk of the service being withdrawn or denied in a given situation
- India also wants to encourage its ministries to use NavIC applications to promote local industry engaged in developing indigenous NavIC-based solutions

BLUEBUGGING

1. Context

Cybersecurity experts noted that apps that let users connect smartphones or laptops to wireless earplugs can record conversations, and are vulnerable to hacks. Even the most secure smartphones like iPhones are vulnerable to such attacks.

2. What is BlueBugging?

Bluebugging is a hacking technique that allows individuals to access a device with a discoverable Bluetooth Connection. Once the target device accesses a rigged link, the attacker can control it fully. The hacker can read and send messages, access the victim's phonebook, and initiate or eavesdrop on phone calls.

Initially, blue bugging focuses on eavesdropping or bugging a computer with Bluetooth capability. With the increasing use of smartphones, cybercriminals shifted to hacking mobile phones. This attack is often limited due to the range of Bluetooth connections, which goes up only 10 meters. Some attackers use booster antennas to widen their attack range.

It's not much different from bugging a landline phone, except it can be done without gaining access to the physical device.

3. How Does Bluebugging Occur?

Bluebugging can vary from one device to another since it depends on inherent vulnerabilities. Some phones or computers that don't come with Bluetooth protection are more susceptible to attacks.

Typically, blue bugging starts when a hacker attempts to pair with a victim's device via Bluetooth. Once a connection is established, the hacker installs a backdoor or malware to bypass authentication. Malware is usually designed to gain unauthorized access by exploiting a vulnerability. In some cases, the attacker can compromise a device through a brute-force attack, which entails repeatedly logging in to a victim's account by randomly guessing username-password combinations. As soon as the hacker gains access, he/she can essentially do what the device owner can, such as reading messages, making calls, or modifying contact details.

4. How Does Bluebugging differ from Bluejacking and Bluesnarfing?

All three hacking techniques take advantage of weaknesses in Bluetooth-enabled services. In Bluejacking, the idea is to "prank" device owners by sending harmless messages to annoy or promote products.

Bluesnarfing, on the other hand, is a more sinister version of bluejacking since hackers access Bluetooth-connected devices without the device owners' permission to download sensitive data, such as phone books, messages, or images.

Finally, blue bugging goes beyond bluejacking and bluesnarfing, as it enables attackers to gain full control of a target device. Hackers can wirelessly interface with a mobile phone to make and receive calls and messages on behalf of unsuspecting victims.

5. How do you protect against Bluebugging?

To prevent blue bugging, Bluetooth-enabled device users must ensure proper safeguards such as:

5.1 Update devices

Older devices make Bluetooth discoverable by default. That leaves systems open to unsolicited connections. Newer computers and phones have corrected this issue. Those who use old units may need to update their software or turn Bluetooth off.

5.2 Avoid going hands-free

If you are exchanging sensitive data, limit the use of hands-free connections.

5.3 Reject Unsolicited messages

Messages coming from strangers should always be ignored or immediately deleted. As much as possible, make your device undiscoverable.

5.4 Monitor Data Usage

Knowing your usual data consumption is helpful. Someone may be hacking your device and using up your data when you notice spikes.

5.5 Be wary of suspicious activity

It would also help to see if your device is making any unusual actions, such as suddenly disconnecting and reconnecting calls. That could indicate someone else is controlling it. When this happens, reset to factory settings to uninstall unwanted and potentially dangerous applications.

6. Way Forward

Hackers will always find ways to hack into people's devices for whatever purpose. While some methods could be old-fashioned, such as blue bugging they still pose dangers. To protect against identity theft and other threats, stay abreast of threat updates and learn how to keep hackers at bay.

ANTIMICROBIAL RESISTANCE

1. Context

An Antimicrobial Resistance (AMR) Multi-stakeholder Partnership Platform (MSPP) was established on November 18, 2022, to mark the beginning of World Antimicrobial Awareness Week (WAAW).

It was launched globally by a quadripartite comprising the Food and Agriculture Organization (FAO) of the United Nations, the UN Environment Programme, the World Health Organization (WHO), and the World Organisation for Animal Health through a webinar.

2. What is Anti Microbial Resistance?

Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi, and parasites change over time and no longer respond to medicine making infections harder to treat and increasing the risk of disease spread severe illness, and death.

3. Emergence and spread of AMR

- AMR occurs naturally over time, usually through genetic changes.
- Antimicrobial-resistant organisms are found in people, animals, food, plants, and the environment (in water, soil, and air).
- They can spread from person to person or between people and animals, including from food of animal origin.
- The main drivers of antimicrobial resistance include the misuse and overuse of antimicrobials, lack of access to clean water, sanitation, and hygiene (WASH) for both humans and animals, and poor infection and disease prevention and control in healthcare facilities and farms. Poor access to quality, affordable medicines, vaccines, and diagnostics, lack of awareness and knowledge, and lack of enforcement of legislation.

4. Factors causing AMR in India

Inappropriate consumption of broad-spectrum (last resort) antibiotics is high because of changing prescription practices in the healthcare system due to the non-availability of a narrow spectrum of antibiotics.

Inappropriate antibiotics use among the general public like self-medication to avoid the financial burden.

A large proportion of sewage is disposed of untreated into receiving water bodies, leading to gross contamination of rivers with antibiotic residues, and antibiotic-resistant organisms.

5. Reasons for the recent increase in the use of antibiotics in India

- The high disease burden
- The rising income
- The easy and cheap availability of these medicines to the public.

- The uncontrolled sales of antibiotics
- Poor Public health infrastructure
- Lack of awareness regarding the misuse of antibiotics.

6. Government Initiatives that help to curb Antimicrobial Resistance In India

The Union Health Minister of India in the International Conference on Anti-Microbial Resistance stated that the first step in addressing the problem of AMR is to avoid the need for antibiotics at all in the first place. Improved water, vaccination, and sanitation may control inappropriate antibiotic use indirectly. The main government policies that help in this process are:

- Through the **Swacch Bharat Program**, the government has taken active steps to improve hygiene and sanitation and reduce the environmental spread of pathogens.
- Vaccination is an equally important public health measure, and through **Mission Indradhaniush**, India has set itself an ambitious goal of increasing routine immunization coverage to 90% within just a few years.

6.1 Red Line Campaign

The Union health ministry's Anti-Microbial Resistance awareness campaign urges people not to use medicines marked with a red vertical line, including antibiotics, without a doctor's prescription.

These medicines are called the 'Medicines with the Red Line'.

To check the irrational use of antibiotics, the 'red line' will help the users to differentiate them from the drugs.

This campaign is aimed at discouraging unnecessary prescription and the counter sale of antibiotics causing drug resistance for several critical diseases including TB, malaria, urinary tract infection, and even HIV.

7. WHO's Global plan on Anti-Microbial Resistance?

- To improve awareness and understanding of antimicrobial resistance through effective communication, education, and training.
- To Strengthen the knowledge and evidence base through surveillance and research.
- To reduce the incidence of infection through effective sanitation, hygiene, and infection prevention measures.
- To Optimize the use of antimicrobial medicines in human and animal health.
- To develop the economic case for sustainable investment that takes account of the needs of all countries and to increase investment in new medicines, diagnostic tools, vaccines, and other interventions.

8. Global efforts

8.1 Global Action Plan on Antimicrobial Resistance (GAP): Globally, countries committed to the framework set out in the Global Action Plan¹ (GAP) 2015 on AMR during the 2015 World Health Assembly and committed to the development and implementation of multisectoral national action plans.

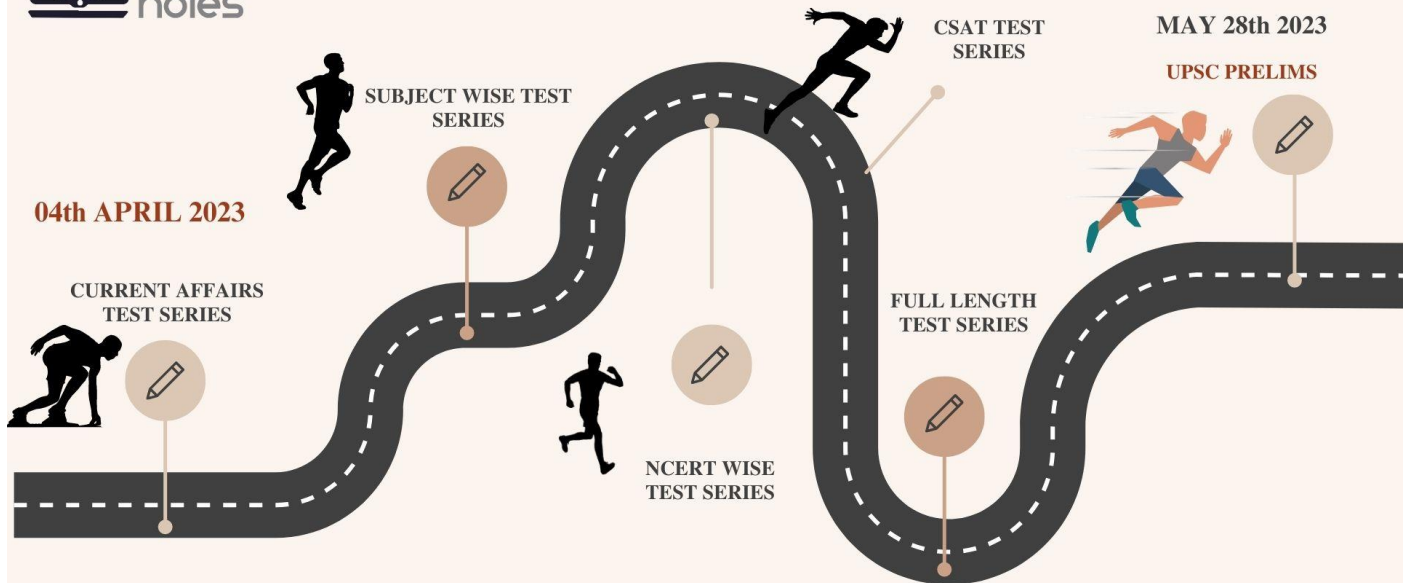
8.2 Tripartite Joint Secretariat on Antimicrobial Resistance: Tripartite joint secretariat (FAO, OIE, and WHO) has been established and is hosted by WHO to drive multi-stakeholder engagement in AMR.

8.3 World Antimicrobial Awareness Week (WAAW): WAAW was previously called World Antibiotic Awareness Week. From 2020, it will be called world Anti-Microbial Awareness Week. It is a global campaign that aims to raise awareness of antimicrobial resistance worldwide.

8.4 Global Antimicrobial Resistance and use surveillance system (GLASS): WHO launched it in 2015 to continue filling knowledge gaps and to inform strategies at all levels. GLASS has been conceived to progressively incorporate data from surveillance of AMR in humans, surveillance of the use of Antimicrobial medicines, and AMR in the food chain and the environment.



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