Innovations

Yamanaka genes:

- Pro-inflammatory molecule called interleukin-6 (IL6) responsible for reducing the efficiency of the Yamanaka genes.
- The introduction of these genes can convert adult cells into pluripotent stem cells.
- Can be used for RBC generation from iPSC
- OSKM: 4 essential genes can reprogramme cells, regenerate old cells or grow new organs.

Scientists bring 'limitless' blood supply closer to reality

- For the first time, scientists have generated blood-forming **stem cells** in the lab
- May help create immune-matched blood cells, derived from patients' cells, for treatment purposes.
- Although the cells made from the pluripotent stem cells are a mix of true blood stem cells and other cells known as blood progenitor cells, they are capable of generating multiple types of human blood cells
- This step opens up an opportunity to take cells from patients with genetic blood disorders, use gene editing to correct their genetic defect, and make functional blood cells

Nobel prize in physiology or medicine

- Yoshinori ohsumi, a japanese for "his discoveries of mechanisms for autophagy".
- Autophagy is a greek term for "self-eating".
- It is a fundamental process for degrading and recycling cellular components
- This will aid in the fight against diseases such as cancer, parkinson's

Nobel prize in physics 2016:

- David j. Thouless, f. Duncan m. Haldane and j. Michael kosterlitz for "theoretical discoveries of topological phase transitions and topological phases of matter."
- Topology refers to the study of geometrical properties and spatial relations unaffected by the continuous change of shape or size of figures.

Nobel prize in chemistry 2016:

- Frenchman jean-pierre sauvage, british-born fraser stoddart and dutch scientist bernard "ben" feringa for "developing miniscule machines at the molecular level."

A quantum step to a great wall for encryption

- Quantum mechanics deals with subatomic particles
- China has combined satellite technology and QM to demonstrate how secret information can be transmitted over a thousand kilometres
- Quantum cryptography: designing 'keys' using polarized photons, i.e. spin of photons
- Pairs of photons share their quantum properties no matter how long they are separated or how far they have travelled.
- These can even be created in a laboratory and are called entangled photons.
- Modern, electronic secrecy works by two parties encrypting the messages they want to exchange and sending each other 'keys'. The trouble is that a third eavesdropper can intercept these keys.
- It has been hard to transmit entangled photons because they are extremely fragile and can disintegrate through contact with other particles in the air.
- China transferred entangled photons through a satellite, Micius, between ground stations that were 1,200 km apart.
- Russian Quantum Center is ready to offer QC that could propel India to the forefront of hack proof communication in sectors such as banking and national and homeland security.

‘Thubber’ for use in soft, stretchable electronics

- In a breakthrough for creating soft, stretchable machines and electronics, scientists have developed a novel rubber with thermal conductivity and elasticity.
- Thubber exhibits metal-like conductivity, elasticity similar to soft tissue and can stretch over six times
- Apps: athletic wear, sports medicine, advanced manufacturing, energy, and transportation
- The key ingredient is a suspension of non-toxic, liquid metal micro-droplets. The liquid state allows the metal to deform with the surrounding rubber at room temperature.

New Wi-Fi system to offer super-fast connectivity

- Current Wi-Fi uses radio signals with a frequency of 2.5 or 5 gigahertz.
- New system uses infrared light with wavelengths of 1,500 nanometers +. 100 times faster, 40 GB/Sec
- Does away with the need to share Wi-Fi as every device gets its own ray of light.
- The antennas radiate light rays of different wavelengths at different angles (‘passive diffraction gratings’). Changing the light wavelengths also changes the direction of the ray of light.

Charting the fascinating path that robots have taken over the years

- 16th century spurred the creation of mechanical devices.
- Automaton monk from 1560 could pray and walk across the table, moving its lips and raising its crucifix.
- Silver swan from the 18th century with ability to elegantly sway and pick up ornamental fish
- However it wasn’t till the 20th century that the word “robot” was coined: derived from the Czech word “robota” which means forced labour, and which was used by Karel Čapek
- Robots began to take shape—metallic, humanoid figures ex ‘Maria’ and ‘Eric’ ran on batteries and radio control
- 1950s: robots with intelligence and the ability to operate without remote control began. Example cybernetic tortoise
- However challenges remain, like efforts to create robots that are able to learn from humans and its surroundings.
- There’s Lucy, a British robot with 50,000 artificial neurons that over a period of years has learned to distinguish bananas and apples, and icub Italian robot that mimic toddlers, as they learn to discover the world around them
- Software is way ahead but the biggest challenge is mechanical.
- We are yet to have a robot capable of replicating the preciseness of human beings, or the strength of our muscles.

What is hyperloop? When can we see it?

- Elon Musk came up with the idea for a hyperloop.
- Magnetically levitating capsules are sent at high speeds through low-pressure tubes, thereby potentially reducing transport time — of people and goods — by more than 80%.
- Such a system is now being developed to connect Abu Dhabi and Dubai.
- Hyperloop One has begun an online vote for people to suggest and choose the best route to deploy a hyperloop
- The route choices for India are: Bengaluru-to-Chennai (334 km in 20 minutes), Bengaluru-to-Thiruvananthapuram (736 km in 41 minutes), Delhi-to-Mumbai via Jaipur and Indore (1,317 km in 55 minutes), Mumbai-to-Chennai via Bengaluru (1,102 km in 50 minutes)
- Hyperloop One has announced its intentions to begin operations in India by 2021.
- It has a lower right of way problem thus simplifying the land acquisition for this transport.
- It also has a lower carbon footprint & noise pollution
- It would also promote MII and technology transfer related to the hyperloop pods.
- It requires heavy investments (about $100 million) and therefore private sector partnership is needed.
- It may prove to be non-inclusive way of transport as its cost of travel may be prohibitive
- High-power consumption, accidents and technical challenges have hampered its progress.

- When railway infrastructure is abysmal and airline industry is priced, hyperloop only perceives to be futuristic idea

A method to efficiently get potable water from seawater

- Producing potable water through desalination may become more efficient and less energy-intensive if researchers at the University of Manchester are able to successfully use graphene oxide membranes to filter common salts
- GO membranes have a tendency to slightly swell when immersed in water and this results in increased spacing between successive sheets allowing smaller salts to flow through the membrane along with water
- Researchers were able to achieve a certain interlayer spacing by storing the membranes in high humidity and then physically restraining them from swelling

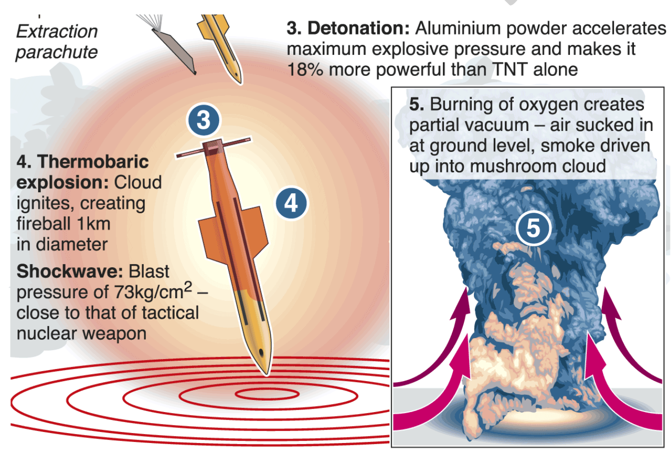
Why we should be proud of quantum healing

- One of the recent trends in health is rise of quantum healing, a combination of Ayurveda and quantum theory.
- Schrodinger, Heisenberg and other pioneers of quantum theory were inspired by the Upanishads
- According to quantum theory, everything is uncertain, leaving practitioners unconstrained by the shackles of logic.
- Quantum healing is the ability of one mode of consciousness (the mind) to spontaneously correct the mistakes in another mode of consciousness (the body)

Big data, big dangers

- Corporations have always been interested in understanding consumer behavior, improve products or services
- What is unique about Big Data Technology (BDT) is the scale at which this data collection can take place.
- Data is available also to governments of nations where these companies are based; could prove detrimental
- Ex Russian interference in the U.S. election
- Potential drain of economic wealth of a nation.
- Sadly, BDT is a tiger the world is destined to ride. It is no longer possible to safely disembark, but staying on is not without its perils.
- China has encouraged the formation of large Internet companies such as Baidu and Alibaba and deterred Google
- We should encourage overseas MNC such as Google to build data centres and retain data collected in India
- We should also build research and development activities in Big Data Science

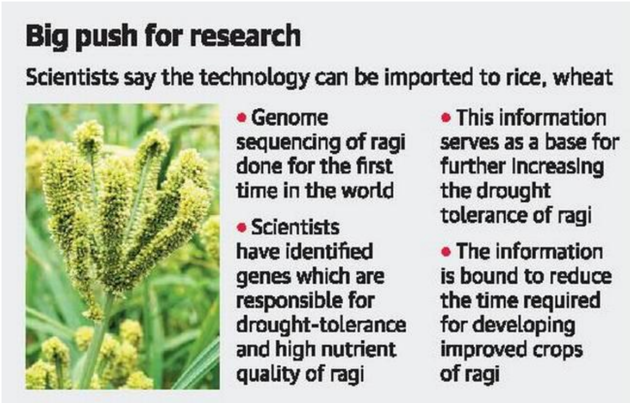
Massive ordnance air blast bomb kills 36 suspected IS militants



Sources: CNN, IHS Janes 360, Federation of American Scientists

- 36 suspected IS militants were killed in Afghanistan
- United States dropped the "mother of all bombs", one of the largest non-nuclear devices
- 9,797-kg GBU-43 bomb, was dropped from aircraft in Achin district of the eastern province bordering Pakistan
- GPS-guided munition

A hardy millet yields its genetic code



Medical science – drugs - crops

When hospitals infect you

- According to WHO 1.4 million people across globe suffer from noso-comial or hospital-acquired infection
- Improve hygiene practices and implement SOP
- Most common types: blood infection, pneumonia, urinary tract infection and surgical site infections.
- Markedly higher in India than in the United States.
- Administrative and financial support in public hospitals is insufficient, problem of overcrowding of hospitals

Potent malaria vaccine on the anvil

- The candidate drug, called pfspz
- It uses a live, immature form of the malaria parasite, sporozoite, to stimulate an immune reaction in humans.

India to frame policy on synthetic biology

- Synthetic biology is an emerging science by which new life forms can be made in labs and existing life forms tweaked to produce specific proteins or chemically useful products.
- SB in microbial systems holds promise for production of drugs, vaccines, fuel; act as sensors that can detect toxin
- The **Environment Ministry** will be convening a group of experts on biodiversity and biotechnology, to assess synthetic biology work pursued in Indian labs, potential benefits and risks
- India, so far, has no policy on synthetic biology

Role of toxins in causing litchi mystery disease

- Lancet published a study connecting consumption of the lychee to the deaths of children in Bihar's Muzaffarpur
- Consumption of litchi, which has the methylene-cyclo-propyl-glycine (MCPG) toxin, and skipping the evening meal, result in very low blood glucose levels and acute encephalopathy (brain damage) and causes death in many cases.
- A new study maintains pesticides — including endosulfan —caused the brain damage among children.

Milk revolution-The future of white gold

- India is the world's largest producer of milk, partly due to importing European cows and cross-breeding them
- However, milk productivity, 2-4 kg a day, is lower than the 25-38 kg a day yielded by cattle in the United States
- National Institute of Animal Biotechnology Hyderabad — DBT-funded— would sequence the genome of 40 strains of cattle and then take steps to ensure that these cattle were bred and popularised.
- CCMB, Hyderabad, ability to introduce the necessary genes into the local breeds, without the necessity to cross-breed, which is relatively more uncontrolled
- A1 beta-casein in the milk of several European breeds linked to a risk of diabetes, ischemic disease and heart disease

- Beta-lactoglobulin is a protein in cow's milk that triggers an allergic reaction in many infants. Absence of iron in beta-lactoglobulin which led to allergies.

Are genomewide disease studies worth it?

- Genomewide association studies or GWAS: Compare the genomes of enough people with and without a disease and genetic variants linked to the malady should pop out.
- Studies turn up more and more genetic variants — or "hits" — that have minuscule influences on disease and wouldn't serve as good drug targets.

MITOCHONDRIAL GENE THERAPY:

- UK allowed mitochondrial replacement therapy by allowing creation of a "three-parent baby" — a child in which the vast majority of DNA comes from the mother and father and small amount from female donor.
- MRT helps in preventing genetic mitochondrial diseases
- The procedure was done through the Pronuclear transfer technique.
- The process can be done by two methods - Pronuclear transfer and the Spindle transfer.
- Pronuclear transfer has a couple of drawbacks - Ethical grounds because it is seen as destroying two embryos
- Scientists worry because a bit of cytoplasm is usually transferred along and disease carrying mitochondria may also get transferred. To remove the above drawbacks spindle transfer technique is used.

Space ISRO – Indian Science

ISRO to develop full-fledged EOS

- A new set of future satellites called hyper spectral imaging satellites (HySIS) using a chip, optical imaging detector array (OIDA), ISRO has developed.
- India will be seen from about 600 km in space
- It can be used for: monitoring the environment, crops, looking for oil and minerals, military surveillance
- About a decade ago, ISRO added EOS niche with microwave or radar imaging satellites RISAT-1 and 2 that could 'see' through clouds and the dark
- 'Hyspex' imaging is said to enable distinct identification of objects, materials or processes on earth by reading the spectrum for each pixel of a scene from space.

2 space scientists dead

- U.R. Rao & Yash Pal
- Built the first Indian satellite, along with its smaller size models, within 36 months and within budget.
- Bhaskara 1, 2, Rohini and the communication satellite called Ariane Passenger Payload Experiment or APPLE.
- Yash Pal worked on cosmic rays at TIFR, headed SAC at Ahmedabad, launched educational programme called Satellite Instructional Television Experiment or SITE.
- Devised programmes on education, agriculture, health and hygiene and related topics. These were uploaded on the satellite ATS-6 and broadcast across over 2400 TV sets across urban and rural India.
- Chairmanship of UGC, Secretary of DST, gave fillip to Educational Media Research Centres, using Doordarshan to broadcast regular programmes from them, called "Countrywide Classrooms"

Saraswati, a supercluster of galaxies

- India discovered a massive supercluster of galaxies and named it Saraswati
- 4 billion light years away and spreads over 600 million light years across.
- Inter-University Centre for Astronomy and Astrophysics, IISER, NIT, Jamshedpur and Newman College
- First supercluster of galaxies, Shapley, was discovered in 1989. 2ND Sloan Great Wall in 2003.
- Milky Way galaxy is part of the Laniakea Supercluster, which was discovered in 2014.
- The structure of the universe is not a homogeneous distribution of matter. It is clumpy with galaxies forming clusters and these in turn forming superclusters.
- There are thin "filaments" that connect galaxies, forming a cosmic web, and there are large voids in between.
- The current belief is that infant galaxies form in these filaments and then drift to the intersections of the filaments where they grow.
- Saraswati supercluster could challenge this premise, because it had formed so early and building such a big structure far back might have been difficult.
- Dark matter, being massive, binds together the universe while dark energy drives it apart; the balance of the two effects helps in maintaining the universe in its present form.

India's first private moon mission:

- Team Indus, a private aerospace company will send a spacecraft to Moon in December aboard an ISRO rocket.
- Aim to land this aircraft on moon, have it travel at least 500m, beam HD videos, images and data back to the Earth.
- The space craft would land on Mare Imbrium, a region in the North western hemisphere of the moon.

India gets a sharper eye in the sky

- Cartosat-2E is third IRS or EOS that can send 60-cm resolution pictures from an orbit 500 km above earth
- Useful for town planners, creators of urban infra, agriculture, project monitoring, for Smart City and AMRUT
- Would drive down import of remote sensing imageries from foreign EO satellites.
- Cartosat-2E is last of the second generation cartography themed series, which started in 2007
- The last three are said to be exclusive for defence and security agencies.

ISRO launches 104 satellites in one go, creates history

- C-37 was a largely commercial flight as all but 3 nanosats belonged to 6 other countries. (US, Israel, UAE, Netherlands, Kazakhstan and Switzerland (SINKUU)).
- 96 were from the U.S. and one each from the other five countries
- 38 successful missions in a row out of a total of 39 flights.
- The first time it carried a multiple satellite payload was in 1999
- PSLV has totally launched 46 Indian spacecraft, most of them IRS satellites and 180 satellites of foreign customers
- With the focus on ensuring that no two satellites collided with each other, the satellites were injected in pairs in opposite directions once the vehicle rotated by a few degrees, thereby changing the separation angle and time of separation to prevent any collision.
- After separation ISRO Telemetry, Tracking and Command Network (ISTRAC) at Bengaluru took over the control
- It is a technology demonstrator for a new class of satellites called ISRO nano satellites (INS).
- INS will be launched with bigger satellites, platform for payloads up to 5 kg from universities and R&D labs
- EU, Japan, Canada, Russia and USA jointly operate International Space Station, a habitable artificial satellite.
- China sent its first astronaut into space in 2008. Neither the European Space Agency nor the Japan Aerospace Exploration Agency have independently sent humans into space.
- ISRO reports to PM and his office rather than a line ministry. This autonomy has been critical to its success.

ISRO, lifeguard agency collaborate to study killer rip tides

- Rip-ex 2017 is being conducted by a team of scientists at SAC along with Drishti Lifesaving, a private agency appointed by the state tourism ministry to maintain a lifeguard force.
- Rip tide is strong sea current which pulls the water away from the shore, often dragging unaware swimmers into sea

NAVIC and atomic clock
- NavIC is Indian satellite-based positioning system to provide position, navigation and timing services over India and its neighbourhood.
- NavIC relies on rubidium clocks. Atomic clock uses resonance frequencies of atoms as resonator as atoms resonate at extremely consistent frequencies.
- Rubidium clocks were the previous standard in accurate clocks and most organizations need cesium clocks.
- NAVIC consists of 7 satellites in orbit and 2 as substitutes. 3 in geostationary orbit and 4 in a geosynchronous
- Each satellite has a life span of 10 years.
- Clocks on the first satellite, IRNSS-1A had failed
- Applications of IRNSS are: terrestrial, aerial and marine navigation, vehicle tracking and fleet management, terrestrial navigation for hikers/travelers, disaster, integration with mobile phones, mapping, visual/voice navigation for drivers
- Three more clocks failed later across the fleet of seven satellites, which together had 21 atomic clocks.
- Clocks for NavIC and European Space Agency's Galileo came from same Swiss company and developed similar problems around the same time.
- ISRO: Basically four geosynchronous satellites are sufficient for our functions. Within the 1,500 km range it makes no difference except in the case of satellites put in geostationary orbits
- In a step towards self-reliance, NavIC will synchronise its clocks to time provided by NPL, CSIR; not US' GPS

Satellite built by ISRO-industry partnership set for launch
- Until now, public and private sector have only supplied satellite parts, hardware or material required by ISRO
- With 1H, they are being readied to build satellites too.
- ISRO, which says it has only half the satellites it needs, has been trying in recent years to quickly make more satellites and now wants to prepare domestic industry to produce them, as also its launch vehicles.

AstroSat rules out afterglow in black hole merger
- Recently US-based LIGO group announced having detected gravitational waves emanating from the merger of two massive black holes located nearly 3 billion light years away.
- ATLAS identified a fading glow from the part of the sky where these black holes were
- AstroSat, however, has, with measurements, ruled out the possibility that this has any connection with merger.
- In collaboration with the GROWTH observatories, AstroSat concluded that this event is due to a gamma ray burst.
- A gamma ray burst is light emanating from a bursting star, for example, an exploding supernova
- There are two types of Gamma Ray Bursts: short, hard and long, soft.

LIGO-GW
- With this discovery emerges a pattern among black holes, possibilities of GW astronomy, detection of new heavenly bodies and gaining a better understanding of theory of relativity and force of gravitation.
- 67 Indians from 13 institutions across the country taking part in the theory and experiment
- There will still remain some blind spots which can be overcome if the LIGO-India project enters the fray
- Challenges ahead in building up this fourth player in the gravitational wave-detection game.
- Its experimental requirements will spearhead the evolution of many new research areas like the study of squeezed light, mirror surface physics and fibre-based laser
- Assembling parts to form a mature scientific enterprise will be an enormous challenge.

'Vampire' star caught in the act

- ASTROSAT has captured the rare phenomenon of a small "vampire" star "preying" on a bigger celestial body.
- Scientists say the smaller star, also called a "blue straggler," feeds off its companion star by sucking out its mass and energy, causing its eventual death.
- The small star becomes bigger, hotter and bluer, which gives it the appearance of being young
- ASTROSAT is India's first dedicated multi wavelength space observatory to observe the universe in the Visible, Ultraviolet, low and high energy X-ray regions
- Only the United States, European Space Agency, Japan and Russia have such observatories in space.

GSLV F05 AND INSAT 3DR:

- GSLV F05 spacecraft placed INSAT 3DR advanced weather satellite which continues the mission of INSAT-3D
- Imaging in Infrared band to provide night time pictures of low clouds and fog, estimation of SST, vertical changes of humidity, temperature and ozone
- It was the first operational flight of GSLV Cryogenic Upper Stage.

PSLV SUCCESSFULLY LAUNCHES 8 SATELLITES:

- SCATSAT-1 will now succeed the now defunct Oceansat-2 and provide weather forecasting services.
- PRATHAM from IIT Bombay and Pisat from PES University, Bangalore.
- The main challenge was to shut down and restart the fourth-stage engine called multiple burn technology.

GSLV's MK III cryogenic upper stage C-25 tested successfully by ISRO

- Powered by indigenous CE-20 engine.
- Cryogenics is the study of substances at very low temperature – at minus 150 degrees Celsius and less
- Cryogenic engines are called so because they use liquid oxygen and liquid hydrogen as fuel.
- First stage comprises solid propellant, second stage liquid. The third stage is the C25 LOX/LH2 cryo stage.
- Mk-III can launch satellites weighing up to four tonnes, which almost doubles India's current launch capacity.
- GSLV Mk III to make ISRO self reliant in launching heavier communication satellites
- Because of the launch schedules of foreign space agencies the pace at which we did our projects was getting affected.
- Cost was another deterrent
- Last year, we tried out the RLV-TD experiment [Reusable Launch Vehicle Technology Demonstrator]. We got a small, plane-like model to vertically land on water. Next we will look at landing it on the ground

India successfully fires its heaviest launch vehicle GSAT-19

- GSAT-19 carries Ka/Ku band high throughput communication transponders.
- It carries a Geostationary Radiation Spectrometer (GRASP) to monitor and study the nature of charged particles and the influence of space radiation on satellites and their electronic components
- For the first time there will be no transponders on the satellite. It will be using a new way of beaming data down using multiple frequency beams. It is therefore called HTS
- The indigenous batteries developed can also be used to power electric vehicles in India.

	Satellite Launch Vehicle-3 (SLV-3)	Augmented SLV	Polar SLV	GSLV Mk II	GSLV Mk III
First flight	1980	1987	1993	2001	Jun 5 2017

- It would boost India's communication resources and adds to the GSLV's reliability. But ISRO needed this achievement at least a good decade ago
- India should focus on expanding the technology to carry out a payload of about 6-7 tonnes (many developed countries have this capacity).
- The size that it can lift is out of fashion and does not make economic sense.
- Wake-up call for China's space industry.

- China's probs: inability to access components and parts from USA, cost of putting satellites into orbit.

'Lost' Chandrayaan-1 found orbiting Moon by NASA

- India's first lunar probe is still orbiting the moon 200 km above surface, NASA scientists have found by using a new ground-based radar technique.
- Used 70-metre antenna to send out a powerful beam of microwaves towards the moon. Radar echoes bounced back from lunar orbit were received
- The ISRO lost communication with Chandrayaan-1 in 2009, almost a year after it was launched
- Chandrayaan-1 is very small and cuboid in shape, about 1.5 metres in length on each side.
- Finding a derelict spacecraft is tricky because the moon is riddled with mascons (regions with higher-than-average gravitational pull) that can dramatically affect a spacecraft's orbit, and even cause it to have crashed into the moon.
- Chandrayaan-1 completes one orbit around the moon every 2 hrs and 8 mins.

Electric propulsion

- Capability for larger payloads is vital. This can be done by switching over to electric propulsion for orbit rising, right position and orientation
- Would reduce weight of vehicle as it can do away with nearly two tonnes of propellants and carry heavier sats.
- GSAT-9 used EP, an indigenously developed lithium-ion battery to power the satellite.
- Satellite will be flying with around 80 kg of chemical fuel or just about 25% of what it would have otherwise
- With fewer propulsion stages and control systems, the Mk-III is far more reliable than the GSLV and the PSLV.
- Countries will soon turn to ISRO for the launch of heavier satellites at a lower cost.
- Ability to carry 10 tonnes into a LEO, Mk-III can be considered for human-rating certification (to transport humans)
- Compared with the two-member crew capacity of the GSLV, the Mk-III can carry three astronauts
- GSAT-20 is planned as the first fully EPS-enabled satellite

ISRO APPROVED USE OF LITHION-ION BATTERY

- Commercial use of lithium-ion battery technology.
- Battery makers will be required to pay Rs 1 crore as a one-time technology transfer fee to ISRO.
- Could save 10-15 per cent of the cost of e-vehicles in National Electric Mobility Mission Plan 2020.
- Lithium-ion batteries are one-third the weight of lead acid batteries.
- Lithium-ion batteries are nearly 100% efficient in both charge and discharge while the lead batteries are 70%
- Rechargeable lithium-ion batteries cycle 5000 times or more
- Despite the higher upfront cost of lithium-ion batteries, the true cost of ownership is far less
- Lithium-ion batteries are a much cleaner technology and are safer for the environment.

SAARC minus Pak satellite

- GSAT 9, Cuboid in shape, mission life of over 12 years.
- New face of cooperation in space for common good of the neighbourhood.
- Ashraf Ghani said, "If cooperation through land is not possible, we can be connected through space."
- GSAT-9 will support communication, broadcasting, Internet, disaster management, tele-medicine, tele-education, weather forecasting, land monitoring and resource mapping
- Neighbours use its applications free of charge.
- Carrying 12 Ku band transponders
- The latest F09 was the 11TH GSLV flight and the 5TH flight to use the indigenous cryo stage.
- The message is equally strong to China, when it is preparing to demonstrate its global clout at the BRI

- India is the only country in South Asia that has independently launched satellites on indigenously developed vehicles.
- Pakistan and Sri Lanka have launched satellites with assistance from China, while Afghanistan, the Maldives and Nepal are also understood to have discussed satellite projects with China.
- Bangladesh, which will launch its first satellite Bangabandhu-1 this year, is working with a European agency.

ISRO plans complex manoeuvres

- Shutdown and re-ignition of rocket engines in space in a bid to master the technique that will enable ISRO to inject satellites into different orbits in a single launch
- PSLV is capable of launching satellites into different types of orbits like Sun Synchronous Polar Orbit, LEO, GTO
- 200 students contributed to development of nano-satellite NIUSAT for disaster management and crop monitoring
- Cartosat-2 IRS is the sixth in the series, the main payload and another Indian satellite, NIUSAT
- It will be used for cartographic applications, coastal land use and regulation, road network monitoring, water distribution, land use maps, Land Information Systems and GIS

ISRO may use semi-cryogenic engine for heavy lift rockets

- Project codenamed SCE 200, semi-cryogenic engine uses a combination of liquid oxygen (LOX) and refined kerosene

Telescope grapes-3 upgrade to snipe out solar storm

- Gamma Ray Astronomy PeV Energies Phase-3 is a muon telescope observation unit, located in TN, established with the collaboration of TIFR and Japan. 1955 GRAPES-1 by TIFR
- Giant cloud of magnetized plasma was ejected from the Sun and slammed into Earth's magnetosphere, triggering a severe geomagnetic storm. This incident called for more robust preventive scientific measures for solar storm.
- Solar Flares, Coronal Mass ejection, and sunspot activities are the indicators of solar storm.
- It is an eruption in the form of electrically charged particles, GXU
- To study cosmic rays, air shower detectors and muon detectors from galaxy.
- To study the sun and its energetic particles and its effects on the Earth.
- It will act as an early warning system for solar storms and will measure the intensity of coronal mass ejection.

FOVEA

- Indian scientists found that a small depression in the retina near the optic nerve called "Fovea" plays a crucial role in helping humans read the text, recognize faces, colours, focus on computer screens
- Fovea is unable to process rapidly changing visual signals because of slow response of its cone-photoreceptors
- This inability let the humans see continuous motion in movies/flipbooks.

Time is money, insists National Physical Laboratory

- NPL-CSIR is host of the most accurate clocks in country and only agency in India authorised to maintain IST.
- NPL maintains accuracy of ±20ns through five cesium clocks and one hydrogen maser.
- NPL decided to start charging for this service. Its parent, the CSIR, has a funds crunch.
- IST can be sourced from similar United States but with varying degrees of accuracy.
- NPL asked government to mandate that Indian organisations exclusively set their time to NPL's clocks.

CSIR-Tech shut down for lack of funds

- CSIR Pvt. Tech Ltd., a company affiliated to CSIR, formed to commercialise technology developed by CSIR's 37 labs, ToT to small and medium enterprises, invest in science-based start-ups and laboratory spin-offs.
- CSIR-Tech was to be an autonomous company that would hold CSIR's patent portfolio and earn CSIR revenues

CSIR faces fund crunch, asks its 38 labs to look outside

- Most of CSIR's revenues are derived from consultancy, projects for India's defence and space activities. CSIR-Tech was conceived to address this problem.
- The crunch was primarily due to increased salary outgo from recommendations of SPC and pension requirements.
- CSIR decided, as part of a Dehradun Declaration to generate about 50% of its budget through external sources.
- Some scientists described the funds crunch a result of move to scrap the Planning Commission (which allowed the CSIR to access budget research money for a 5-year period) and replace it with a yearly-accounting system.

TKDL faces grim future

- Traditional Knowledge DB Library, organisation of CSIR that has fought bio-piracy for decades, will cease to exist in its current form due to no committed funds
- TKDL is an online repository of about 3Lformulations from Ayurveda, Siddha and Unani.
- It scouted for IPR infringements by Indian and foreign companies on traditional knowledge.
- It translated, scanned and digitised texts from their Sanskrit, Arabic and Urdu originals. This was then made searchable, allowing patent offices to check if patent applicants of herbal creams and drugs were basing their claims on available patents.
- It made it hard for companies to develop formulations and there was lobbying against it

Green nod for India Neutrino Observatory suspended by NGT

- INO was to come up in Theni
- Shola National Park in Idukki, Kerala was just about 4.9 km from project site making it Category 'A'
- MoEF had called it a Category 'B' project, for which an EIA is not necessary
- Since it was near a national park, the INO was also asked to get clearance from NBW

INO related benefits and doubts

- Neutrinos are tiny particles, almost massless, that travel at near light speeds.
- Born from violent astrophysical events such as exploding stars and gamma ray bursts
- It is a fact that neutrinos from sun are falling on us by trillions every sec. Being the lightest matter particles, the neutrinos do not decay into any other particles. It does not create a radiation hazard
- Questions of safety, questionable potential for application of neutrino physics.
- Allegations such as neutrinos being radioactive particles and that the INO will double up the storage of nuclear waste
- INO involves constructing an underground lab. Explosives used are a threat to the highly sensitive ecology of WG
- The proposed excavation is planned to be carried out by a controlled blast, limiting the impact of vibrations
- Kalam had written how neutrinos could be used to sniff nuclear proliferation from a remote location.
- Also, with respect to dark matter he guessed how neutrinos could help in this search.
- There are also anti-neutrinos that INO can observe.
- Unravel the secrets of the ultimate laws of physics & neutrino astronomy.
- INO would house the largest magnet in the world, four times more massive than CERN's CMS
- In the 1960s and 1970s, a group of scientists led by the TIFR detected some unusual observations; Kolar events
- Communication between the scientific community and the public needs to be more basic and democratic.

Bionic hand

- Hand that can "see" objects enabled by a camera affixed to the hand's knuckles and reacts by grabbing the object
- The engineers trained a neural network structure with pictures of about 500 objects that can be grasped.
- Objects were classified into four different classes of grasps
- Could pave the way to much more advanced breakthroughs in prosthetic limbs

Trai recommends shutting down of analog transmission by 2023

- Recommended introduction of digital terrestrial transmission for broadcast services in a phased manner
- DTT can provide a rich bouquet of SDTV, HDTV, UHTV, mobile TV channels, radio service and other services.
- The platform is content agnostic and can be adapted to handle new forms of content.
- Frequency use is much more efficient, allowing for the transmission of 20 to 30 SD channels in the spectrum occupied by a single television channel in an analog signal.
- DTT offers better quality of images and sound as compared to analog signals.
- The DTT transmitters have lower power requirements than traditional analog transmitters.

New system to catalogue library books

- In a decision which may adversely affect the marketing of Indian books in other countries, the Ministry of Culture has decided to merge the functions of the Central Reference Library with the National Library.
- The CRL is responsible for the publication and sale of the Indian National Bibliography (INB) list of all books published in India annually and is the key source for foreign libraries to know about the books published in India.
- Will reduce duplicity and speed up the process of accession.
- It may become difficult for foreigner to search for books published in India as they may not be having ISBN number.

VAJRA: Visiting Advanced Joint Research faculty scheme

- To enable NRI, PIO, OCI, overseas scientists to participate and carry out R&D, teaching/mentoring for 1-3 months
- Public funded institutions and national labs are allowed to host the VAJRA faculty.
- Science and Engineering Research Board (SERB), a statutory body will implement the Scheme.
- India has moved from brain drain to brain gain
- Over 1,000 Indian scientists working abroad have returned to India in the last two-three years
- Opportunities in India are better through several scholarships and fellowships, such as the Ramanujan fellowship.
- Not everyone who wishes to come back is accepted. Those interested are put through an evaluation process

DST'S NIDHI (National Initiative for Development and Harnessing Innovations):

- Technological solutions to the pressing needs of the society
- Nurturing innovations into successful start-ups.
- It connects all the links of the innovation chain- scouting, sustaining, securing, scaling and showcasing.
- The key stakeholders of NIDHI includes various departments and ministries of the central government, state governments, academic and R & D institutions, mentors, financial institutions, angel investors, private sectors.
- Components: PRAYAS (Promoting and Accelerating Young and Aspiring Innovators & Start- ups)
- Seed Support System

DRDO inks deal to make key alloy

- Technology transfer agreement with Jindal Stainless for manufacturing High Nitrogen Steel (HNS)
- The alloy has significant applications in the defence sector, but currently the country is largely dependent on imports.
- Higher ballistic strength than normal steel, non-magnetic and corrosion-resistant, cost is about 40% less
- HNS technology would further the Army's quest for lighter armouring material

India building a supercomputer juggernaut

- If its processors operate at the full capacity of 10 petaflops, among the world's top 10 fastest supercomputers.
- Held top 10 spot only once, 2007, thanks to the EKA built by Computational Research Lab, part of Tata
- Colleges and other research institutions can log in and harness its power

- Machine's computing power will help in monsoon forecasting, using a dynamical model.

Reviving Assam's ancient herbal ink 'mahi' used in manuscripts

- Linked to the marketing of heritage tourism and the development of eco-friendly technologies in the digital age.
- A cocktail of fruit pulp and barks such as haritaki, amla, bibhitakhi or bhomora, mango, jamun —— often infused with the blood of eels or catfish —— Mahi was extracted using cow urine. Rust were also added
- Mahi was used in early and medieval Assam for writing on Sancipat (folios made of bark of the sanci tree)
- Herbal concoction's resistance to aerial oxidation and fungal attacks and its non-corrosiveness.

DST kicks off programme on cyber physical systems

- CPS is an interdisciplinary field that deals with computer-based systems that do things in physical world
- Autonomous vehicles, robot-executed surgeries, smart grids (electricity distributed on basis of calculations in real time by micro-processors), UAV, AI, Internet-of-Things
- Would take root in some of IITs, there would be dedicated courses
- PM: potential to pose unprecedented challenges and stresses to our demographic dividend.

A half-kilometre manned sea dive in the making

- Mission to send a researcher in a spherical submersible vehicle, 500m deep into Indian Ocean.
- Will pave the way for a bigger mission to send a three-member team in a titanium sphere, 6,000 metres into the sea to scout for little-known life-forms and precious metals.
- Talks were on with BHEL to fabricate the submersible vehicle.
- Titanium can withstand the enormous pressure of water at great depths.
- Discussions with ISRO also because many aspects of the design are common to space missions.

IISc researchers' ecofriendly way of recycling e-waste

- Crushing e-waste into nanosize particles using a ball mill at very low temperature ranging from -50 to -150 degree C.
- Different classes of materials — metals, oxides and polymer — get physically reduced into their constituent phases, which can then be separated without using any chemicals.
- The use of low-temperature grinding eliminates noxious emission.
- The behaviour of individual materials is different when they are pulverised at room temperature. While metal and oxides get mixed, the local temperature of polymer increases during grinding and so the polymer melts and starts reacting with the rest of the components and forms a chunk.
- The deformation behaviour at low temperature: The polymer material breaks
- There is also a lower limit to which materials can be broken into when e-waste is milled at room temperature. But in the case of low temperature ball milling the size can be reduced to 20-150 nanometres.
- The cryo-mill grinding chamber is cooled using liquid nitrogen and a small hardened steel ball is used for grinding the material in a controlled inert atmosphere using argon gas to keep interface clean

IISc designs a novel graphene electrical conductor

- Produced a new type of electrical conductor that was theoretically predicted nearly 20 years ago.
- Graphene that is single- or a few-layers thick to conduct current along one particular edge, zigzag edge.
- The zigzag edge allows flow of charge without any resistance at room temperature and above.
- Can lead to realising power-efficient electronics
- Many groups over the world have been trying to access these edges since the emergence of graphene in 2004, but have been largely unsuccessful because when current flows through graphene, it flows through both edge and bulk.

- We succeeded in this endeavour by creating the bulk part of graphene **extremely narrow** and hence highly resistive, thus forcing the current to flow through the edge alone
- Use of chemicals destroys the edges. So the IISc team resorted to mechanical exfoliation

National large solar telescope

- Government cleared a proposal for diversion of forest land from the Changthang, Cold Desert WS in Ladakh
- It will be a 2-m class, multipurpose, state-of-the-art largest solar telescope in the world
- Capable of doing both day and night astronomy because of unprecedented high spatial resolution.
- It will fill the longitude gap between Japan and Europe.
- High spatial resolution would provide crucial information on the nature of magnetic fields in the solar atmosphere.
- It will help in understanding the formation and decay of sunspots by using Helioseismology
- High altitude, prolong sunshine, clear sky, high visibility, low seasonal variation will enhance the NLST capacity
- Low concentration of aerosol and dust particles in sky.

Mango leaves to make fluorescent graphene quantum dots (nanocrystals of semiconductor material)

- IIT Bombay have been able to produce cheap probes for bioimaging and for intracellular temperature sensing.
- Unlike the currently used dyes, quantum dots synthesised from mango leaves are biocompatible, have excellent photostability and show no cellular toxicity.

FIRST AUGMENTED REALITY (AR) INSTITUTE:

- AR superimposes a computer-generated image on a user's view of real world, thus providing a composite view.
- AR augments sound, video, graphics etc on real world objects, using your device's camera.
- India's first AR education and training institute will be set in Varanasi by centre in partnership with Eon Reality
- Augmented reality is seen as next big thing in Internet revolution especially in learning and practical training
- It will be a virtual manufacturing shop that will provide students "hands-on training" on high value machines that are beyond the budgets of institutions.

NANOGENERATOR:

- Pune based IISER developed a nanogenerator that could produce power when thumb pressure is applied.
- Electrospun a piezoelectric polymer onto a flexible carbon cloth.
- To develop flexible or wearable devices which should be powered by harvesting easily available mechanical or vibration energy, making battery or related wiring redundant.
- Piezoelectricity is the electric charge that accumulates in certain solid materials (such as crystals, certain ceramics, and biological matter such as bone, DNA and proteins) in response to mechanical stress/ pressure.

FAST NEUTRON REACTOR:

- Russia has invited India to join it in developing the 4TH generation reactors (MBIR) and fast-reactor project
- A fast neutron reactor is a type of reactor in which nuclear fission chain reaction is sustained by fast neutrons.
- Such a reactor does not need any neutron moderator such as water
- Fast reactors can help in reprocessing and deactivation of radioactive waste material and produce energy
- Transitioning to closed fuel cycle which is based on fast neutron reactors can solve five essential problems: safety, competitiveness, shortage of fuel, reprocessing and refabricating the used nuclear fuel and radioactive waste.
- Advanced Heavy Water Reactor is the latest Indian design
- Russia has also offered India a new breed of reactor units – the VVER-Toi for 3rd/4th units of Kundakulam.

Reform in science set-up sought

- Heads of India’s top scientific, administrative bodies conveyed to PM that science in India needs a major revamp.
- They have proposed an over-arching SNT body that marries research and industry and will report directly to PM
- Though scientific departments were headed by scientists, they were frequently not independent to take key decisions, such as filling vacancies and deciding how budgets to various projects within a Ministry ought to be allotted.
- SPARK (Sustainable Progress through Application of Research and Knowledge), as it is tentatively called
- The report laid out a broad map on how India ought to prepare itself to be among the top three countries in science and technology by 2030 and ensure that 10 of the top 100 leaders in scientific fields are Indians.
- Vigyan 2030: SNT as the Pivot for Jobs, Opportunities and National Transformation.
- SPARK will have 2 arms; Discovery arm that can organise the expertise of various organisations.
- Delivery arm that will closely work with industry and evolve PPP
- The existing systems of science governance are robust with departments reporting to ministers who in turn report to Cabinet. There is no lack of sound advisory bodies and committees within these departments.
- As for overarching bodies, we already have the Scientific Advisory Committee to PM and the Principal Scientific Adviser to Government
- The science departments are too different from one another to come under the purview of one body like SPARK.
- CSIR directly reports to PM and has an independent governing council.
- Department of Atomic Energy to the Department of Science & Technology, have bureaucracies of their own.

Hyderabad team grows miniature eyes using stem cells

- Stem cells of a healthy eye have been used for restoring vision when only one eye is damaged.
- But when the damage is present in both eyes, the only way to restore vision is by using the healthy cells taken from a related or unrelated donor.
- Patients have to be on immunosuppressants lifelong when cells are transplanted from donors.
- However, immunosuppressants are not required when corneal cells grown using the patient’s own skin cells are used

Indian researchers develop 3D bioprinted cartilage

- Millions of people around the world suffer from degenerative joint diseases such as arthritis.
- Cartilages that are molecularly similar to the ones seen in human knees, 3D bioprinted using a bioink.
- The bioink has high concentration of bone-marrow derived cartilage stem cells, silk proteins and few factors.
- Bioink supports cell growth and long-term survival of the cells.
- While the cartilage found in the knee is an articular cartilage that is typically sponge-like and has a huge load-bearing capacity, the ones produced in the lab so far are transient cartilage.
- Unlike articular cartilage, transient cartilage becomes bone cells and brittle within a short time.

IISER Pune: Novel drug delivery system to kill cancer cells

- Cancer drug delivery system using graphene oxide nanoparticles
- When a FDA-approved anticancer drug cisplatin was added, the graphene oxide sheets self-assembled into spherical nanoparticles enclosing the drug within (shape-shifting transformation), a kind of ‘molecular stitching’
- Nanoparticle containing cisplatin was able to kill cancer cells.
- The drugs bind to the DNA strands and break the strands so cell division does not happen

Soon, doctors can ‘see’ a fever

- Visual monitoring of body temperature may become a reality soon, thanks to team of scientists at IGCAR
- The concept is based on ferro fluid emulsion contained in a thin film that changes colour with rise in temperature within a narrow range — 30-40° C.
- The emulsion has iron oxide nanoparticles containing oil droplets dispersed in water.

- In the presence of a temperature-sensitive polymer the ferrofluid emulsion can be used to produce different colours

Global collaboration project Belle-II moves a step forward

- High Energy Accelerator Research Organisation (KEK) Belle-II experiment in Japan.
- This experiment is designed to study violations of the Standard Model of particle physics.
- A grand collaboration of 700 scientists from 23 countries, Indian participation on experimental and theoretical sides.
- Electron-positron beams will be made to collide and B-mesons (a boson containing the B, or beauty, quark) produced.
- The fourth layer of the six-layer, highly sensitive particle detector has been built by Indian scientists led by **TIFR**
- The highly miniaturised sensor and the "origami chip-on sensor", which improves the signal to noise ratio, are novel and highly complex aspects.
- This experiment has the same aim as the LHCb experiment at CERN

MCR-1 ISOLATED IN INDIA:

- Scientists have isolated resistance causing mcr-1 gene in a strain of E.coli, responsible for resistance against the antibiotic, Colistin- the last mile antibiotic, termed "critically important by WHO.
- Mcr-1 has already been detected in China, USA and Brazil.
- Colistin is used rampantly for non-therapeutic purposes such as growth promotion and disease prevention in poultry, farming and aquaculture in India which makes the situation all the more vulnerable.

INDIA JOINS CERN:

- CERN is based in Geneva. It was founded in 1954. It has 22 member states and four associate member states
- India was inducted as an 'Observer' in 2004. India recently became an associate member
- India can choose to apply for full membership after 2 years or continue with this status for 5 years.
- India will now have to contribute 11.5 million Swiss francs every year to the capital or to the operating costs
- Indian industries, now, can bid for tenders and procurements.
- "Observer" status allows states to attend council meetings, receive council documents without taking part in the decision-making.

PRETERM BIRTH MYSTERY UNLOCKED:

- Indian researchers have made a major discovery by understanding the mechanisms by which preterm births (between 28 and 32 weeks of gestation) occur.
- Group B Streptococcus bacteria are found in human vagina and their numbers can shoot up in some pregnant women.
- GBS produce small balloons called membrane vesicles, which contain toxins that kill both foetal and maternal cells and destroy the collagen that binds the cells together.

A data glove for the speech-disabled

- A data glove, which measures the individual joint angles of all the five fingers to understand the activity of daily living, developed by Nayan Bhatt, IIT Madras, won the Budding Innovators Award given by National Research Development Corporation.
- The data glove has 15 sensors that help in gathering information about kinematics or hand motion.
- Sensors are placed directly on each segment of the finger to avoid any deformation.
- Data glove can help speech-disabled people to communicate. Can use speech synthesizer & speaker to generate sound

Gas leak: CM promises 'strict action' cutting chloro methyl pyridine

CRISPR (clustered regularly interspaced short palindromic repeats)

- Gene altering technology which can be used to target specific stretches of genetic code and to edit DNA at precise locations, possibly correct disease-causing mutations
- The majority of non-communicable diseases are caused by DNA mutations in the functional gene.
- Fatal mutations passing to the next generations can be prevented or detected as early as tenth week of pregnancy.
- CRISPR/Cas9 has been tested across an array of domains, such as human health and agro biotech
- A team of researchers from China has successfully utilized CRISPR to insert a new gene into the cow genome
- It's already been done with pigs, fish, mice, and mosquitos, as well as human embryos.
- Designer babies: Can we also alter genes to make us look more attractive? Smarter? Stronger? Fairer? In other words, can we beautify the babies of tomorrow?
- Prevent the purely cosmetic in baby design, while paving the way for life-saving medical interventions.
- Data from gene trials should be open to the wider public for greater transparency and abundant caution India
- PROB: side effects, regulatory steps, efficacy of these techniques?
- Genetic changes and alterations take years to manifest and side effects perhaps even more so.
- Can sometimes lead to nearby, off-target genes also getting altered (**mosaicism**).

The lowdown on genome editing

- Researchers repaired a mutation in human embryos by using a gene-editing tool called CRISPR-Cas9.
- The mutation seen in the MYBPC3 gene causes heart condition called hypertrophic cardiomyopathy
- Gene editing tool has two components — a single-guide RNA (sgRNA) that contains a sequence that can bind to DNA, and the Cas9 enzyme which acts as a molecular scissor that can cleave DNA.
- The genetic sequence of the sgRNA matches the target sequence of the DNA that has to be edited.
- Clinical trials are under way in China and in the U.S. to use this tool for treating cancer. In May this year, it was shown in mice that it is possible to shut down HIV-1 replication and even eliminate the virus from infected cells.
- In agriculture, a new breed of crops that are gene-edited will become commercially available in a few years.

GIS-enabled portal maps land-related information

- Centre has brought out an online database of more than half a million hectares of land assisting industry.
- DB has details of industrial parks/clusters, agricultural/horticultural crops, mineral production, information on warehouses, power-grid, financial institutions, demand for industrial infrastructure
- The exercise is to eliminate the information asymmetry that is affecting country's industrial policy-making and investments in the manufacturing sector.
- The development comes in the backdrop of the Centre firming up a new industrial and manufacturing policy to push up the contribution of the manufacturing sector in India's GDP to 25% by 2020
- The database is being developed by DIPP and National e-Governance Division (MEITY), BISAG

India's first uterine transplant begins

- Only a handful of these operations have met with success in other countries, primarily in Sweden.
- The operations are meant to help women who cannot conceive because they were born without a uterus, suffered damage to it or had to have it removed.
- Organ rejection in which the patient's immune system attacks the organ; an infection of the organ; or problems with the organ's blood supply.

U.R. Rao, genial genius of ISRO

- Former chairman of ISRO, acknowledged as father of Indian satellite technology
- He finalised, shaped, refined or designed the Chandrayaan-1; Mars Orbiter Mission; and upcoming Chandrayaan-2
- One of unfinished projects is Aditya L1 mission - India's upcoming solar observatory

- Aditya was earlier planned as a near-Earth mission looking at Sun. Rao convinced ISRO to greatly enlarge its feature and scope. Spacecraft must gaze at Sun from an apparently stable point called L1 or Legrangian point.
- He presided over the fruition of the ASLV early rocket, much of the development of the now-famous PSLV.
- Laid foundation for GSLV by pact with Russia in 1991 for the cryogenic engine technology for its third stage.
- Dr. Rao's joy was blunted as the PSLV clicked after his tenure while the Russians reneged on the cryogenic pact.

Don't stop driverless cars

- Gadkari's justification for opposing the entry of driverless cars into India is to protect jobs
- Economists have used term 'lump of labour fallacy' to characterise belief that there is only a limited amount of work to be done in an economy.
- The reality, of course, is that technology has caused massive job losses for centuries, yet new forms of work have always cropped up to absorb the displaced labour.
- Such thinking goes against one of the hallmarks of sound policymaking, which is to focus on what's good for the consumer instead of what saves the producer from bankruptcy.

When silver 'grows' in paddy fields

- Garib-sal rice plants capable of absorbing silver found naturally in soil and accumulating it in the grain
- Possibility of commercial extraction of the metal through farming.
- Once polished, the silver in the grain is reduced significantly.

The march from yesterday

- A global movement called March for Science was held in different places in the world
- Science in India is facing the danger by unscientific beliefs, religious bigotry, reduction of funding
- Suggestions: allocate a certain percentage of the GDP for science and education, "stop propagation of unscientific, obscurantist ideas and religious intolerance", insist that education should only impart "ideas that are supported by scientific evidence", and finally, "enact policies based on evidence-based science".
- Researchers from a CSIR lab were explicitly warned by its director from participating in it.
- Scientists were barred from going because participation posed "potential security risk".

Bilateral catalyst

- India-US Partnerships: Clean Energy, Proton Accelerator, TMT, LIGO, NISAR, SNT Endowment Fund
- Integrating American technologies with Indian innovations will enhance value of the latter and make them scalable, affordable and marketable.
- A database of U.S.-based inventors, their inventions and technologies relevant to India needs to be created.
- Partnerships- university-to-university, university-to-industry, industry-to-industry, and consortia-to-consortia levels.
- Joint incubators, to enable Indian start-ups to introduce products in the U.S. market and to facilitate U.S.-based start-ups to enter India with inflow of technologies, mentors and best business practices

Claims on Bt cotton need to be probed, says panel

- Parliamentary panel headed by Renuka Chowdhury
- Yields increased by 69% in the five years (2000-2005) when Bt Cotton was less than 6% of total cotton area, but by only 10% in the 10 years from 2005-2015 when Bt Cotton grew to 94% of the total cotton area
- Ministry of Agriculture conceded to the committee that herbicide-tolerant gene may escape through pollen into nearby farm and fields, to another GM or non-GM crop.
- Unless bio-safety and socio-economic desirability studies are done through a participatory, independent and transparent process, the committee has recommended that no GM crop should be introduced.

GM MUSTARD:

- GEAC has concluded that DMH-11 (Dhara Mustard Hybrid 11) did not raise any public health or safety concerns
- Barnase and Barstar genes are used for engineering male sterility in plants. Targets the TA29 gene.
- Barnase and Barstar are at negligible levels in the edible parts and have been derived from commonly occurring non-pathogenic bacteria.
- GEAC's recommendation will have to be approved by the environment minister whose decision will be final.
- In 2014-15, India imported 14.5 million tonnes of edible oils valued at $10.5 billion.
- Country's cotton production has gone up more than 2½ times since Bt hybrids were first planted in 2002.
- Impacts GM crops have on the environment and wildlife are not researched properly.
- Insect resistant crops may affect non-target and helpful insects like butterfly, honey bee etc
- There is also a chance that herbicide resistant plants produce uncontrollable weeds or so called "super weeds"
- They increase the yield but there are concerns about GM crops increasing input costs
- Biotech companies (despite a global moratorium via CBD) can resort to the Genetic Use Restriction Technology (GURT) and produce the terminator seeds which makes crops die off after one harvest without producing offspring. This would force the farmers to buy new seeds for each planting
- The farmers also oppose the 'seed monopolies', which are causing price distortion
- GM crops effect on soil health and soil organisms is not known.
- By inserting genes from organisms which have never been eaten as food, new proteins are introduced into the human and animal food chains.
- Many GM crops contain genes which provide resistance to commonly used antibiotics such as ampicillin.

DESI GM ALTERNATIVE TO MONSANTO:

- DU Centre for Genetic Manipulation of Crop Plants (CGMCP) developed two new sets of indigenous transgenic events in cotton cultivation for insertion of the cry1ac gene that is a potential alternative to Mosanto seeds.
- Cry1ac gene isolated from a soil bacterium Bt and is toxic for American bollworm insect.
- The other promising indigenous GM event is whitefly-resistant cotton developed by the National Botanical Research Institute (NBRI), Lucknow.
- The levels of cry1ac protein expression is known to be much higher than that of Monsanto

GM mustard basics

- In 2009 the GEAC approved Bt brinjal for commercial release and environment Minister overruled the GEAC clearance and changed its status from an approval committee to an 'appraisal' committee.
- It involved technology developed by the multinational Monsanto. On the other hand, GM mustard (DMH-11) was developed by a team of scientists at Delhi University
- It uses three genes from soil bacterium that makes self-pollinating plants such as mustard amenable to hybridization with custom traits such as higher oil content and pest resistance.
- Years of field tests on transgenic corn, soyabean and brinjal in other countries have shown no health risks

GM mustard pro

- Better yields, resistant to pests and diseases, Address threats from CC, investment and growth in the biotechnology, indigenously developed, reduce imports

GM mustard fears

- Opposition to GM crops is driven by fears of harm to health, environmental impact, socio-eco-pol factors, precautionary principle, lack of transparency in the regulatory process, lack of trust in government and industry

- Report from Argentina found a fourfold increase in birth defects and childhood cancers in HT soya areas.
- All the safety tests for regulatory approvals are typically conducted by same party that applies for commercialization
- Refusal of GEAC to publicly release the safety testing data submitted for regulatory approval
- The highest yields in mustard are from the five countries which do not grow GM mustard — U.K., France, Poland, Germany and Czech Republic — and not from the GM-growing U.S. or Canada
- GEAC had itself rejected a similar HT GM mustard proposal by Bayer in 2002.

GM mustard solution

- Successive governments have failed to move on the draft National Biotechnology Regulatory Bill, 2008. Sans such legislation, issues to be decided on the basis of science will be at the mercy of political expediency.
- Government should adopt a participatory approach to bring together all stakeholders to develop regulatory protocols
- Precautionary principle suggests that we wait until a broader scientific consensus is achieved. For example, regulations in Europe explicitly invoke the precautionary principle as the basis for deciding
- Adopt system of Mustard Intensification, for which successful trials have been done in Bihar through a World Bank project. Results showed higher yields and better income.

Panel for action against farmers using herbicides on GM mustard

- Apprehension that farmers may use herbicides to kill weeds that grow in crops of herbicide-tolerant GM Mustard.
- Proposal for legal action on farmers unless otherwise approved by CIBRC
- Glufosinate-based herbicides act as a neurotoxin and have adverse impacts on humans
- Centre submitted to SC that it would file its affidavit on its preparedness for commercial release of GM Mustard on July 29. SC asked the government to stay the commercial release of GM mustard until it does so.

From green to 'yellow' revolution

- Canola is the international trade name for mustard carrying lower levels of erucic acid — less than 2% —and is considered as one of the healthiest options.
- Scientists believe that canola is one of the best possible options available to lead a "yellow revolution" in Punjab
- Canola business holds good potential since edible oil is needed in every household.
- With increasing health awareness, most people are ready to pay for quality products.
- Mustard farming is labour intensive, especially for weeding during harvest.
- Punjab Agricultural University is pushing farmers to adopt canola farming by developing "canola villages"
- Canola villages would have production of canola crop, extraction of canola oil within the village itself.
- Canola cultivation would be a benefit to decrease dependence of oilseeds imports.
- It has a relatively shorter duration of crop. It is also a livestock feed and is light cooking oil too.
- Canola cropping would also be a step towards diversification of crops that is badly needed in Punjab
- Canola crops can also lead to halting the reduction of groundwater table
- PROBS: absence of assured market, assured price, farmers have reservations, cost prohibitive (expensive oil)

SUPERCONDUCTIVITY FOUND IN BISMUTH:

- Researchers at TIFR discovered superconductivity in bismuth at a fraction of degree above absolute zero (-273.16° C)
- The current theory of superconductivity says that superconducting material must be abundant in free mobile electrons.
- However, Bismuth has only one mobile electron for every 100,000 atoms
- It invalidates the Bardeen-Cooper-Schrieffer Theory of Superconductivity. According to which, bismuth can only achieve superconductivity at a much lower temperature

SCIENTIFIC SOCIAL RESPONSIBILITY

- PM advocated scientific social responsibility on the lines of CSR at 104th Indian Science Congress.
- Encouraging innovation and scientific models for the benefit of society, promoting greener options, climate friendly innovations, scientific excellence in all stakeholders including educational institutions.

G-PROTEIN COUPLED RECEPTORS (GPCR)

- Researchers from IIT Kanpur have found that regulation of GPCRs by the drug molecules can be far simpler than earlier thought by simply engaging with end (tail) of receptor.
- Presently, for any drug to be effective it has to bind at two sites of receptors – at the tail, outside the cell and at the core, inside the cell.
- Receptors are found embedded in the cell membrane
- Receptors react to external stimuli by changing their shape which brings a corresponding change in the shape of receptors inside the cell. This change in shape inside the cell allows the receptor to bind to a particular protein called G-Protein triggering a specific change in the cell which brings physiological changes in our body
- This research will help in designing simple, cheaper and more efficient drugs

New human organ found by Ireland scientists: mesentery

- It's a double fold of peritoneum **-** the lining of the abdominal cavity **-** that attaches our intestine to the wall of our abdomen, and keeps everything locked in place.
- Earlier thought to be made up of fragmented structures. But research has shown that it's actually a continuous organ.
- It carries blood and lymphatic fluid between the intestine and the rest of the body.

THE GREAT RED SPOT

- NASA has released a new view of a crescent **Jupiter** which shows the iconic Great Red Spot, along with a series of storms shaped oval known as the ‘string of pearls’.
- Great Red Spot is a giant, counterclockwise rotating, persistent storm in Jupiter’s southern hemisphere
- It is more than twice the size of our planet and is observed since 400 years.
- String of Pearls are massive storms that appear as white ovals in Jupiter’s southern hemisphere.
- Juno is a NASA space probe orbiting Jupiter to measure its composition, gravity field, magnetic field.

What is DNA fingerprinting?

- Lab technique used to establish a link between biological evidence and suspect in a criminal investigation.
- A DNA sample taken from a crime scene is compared with a DNA sample from a suspect. If the two DNA profiles are a match, then the evidence came from that suspect
- To establish paternity, seed stock identification, the authenticity of consumer products, and medical diagnosis.

Regulation of DNA profiling

- LCI 271st report drafted Bill (DNA Based Technology, 2017) on use and regulation of human DNA profiling.
- DNA profiling is used for disaster victim identification, investigation of crimes, identification of missing persons and human remains and for medical research purposes.
- Privacy concerns and the ethics involved in this scientific collection of data are very serious.
- Bill provides for statutory DNA Profiling Board to spell out procedures and standards to establish DNA labs.
- Bill restricts DNA profiling to specific purpose of identification of a person and not for extracting other information.
- It provides for the creation of DNA data banks, at national and regional levels, which would be responsible for storing DNA profiles received from the accredited laboratories.
- They will also be responsible for maintaining certain indices, like crime scene index, suspects’ index, offenders’ index, missing persons’ index and unknown deceased persons’ index.

- DNA experts would be notified as government scientific experts.
- Any violation would lead to imprisonment up to three years, and a fine which may extend up to Rs. 2 lakh.

Space – rest of world

BLAZARS

- A blazar is a galaxy which, like a quasar, has an intensely bright central nucleus containing a super massive black hole
- Emitted light sometimes includes extremely high energy gamma rays

NASA PROBE TO HUNT FOR 'TROJAN' ASTEROIDS:

- OSIRIS-REx spacecraft is set to search for elusive "Trojan" asteroids, study and bring a sample of asteroid bennu.
- Trojans are asteroids that are constant companions to planets in our solar system as they orbit the Sun, remaining near a stable point 60 degrees in front of or behind the planet.
- Since they constantly lead or follow in the same orbit, they will never collide with their companion planet.
- 6 planets in our solar system with known Trojan asteroids—Jupiter, Neptune, Mars, Venus, Uranus and Earth
- Scientists have only discovered one Earth trojan asteroid—2010 TK7.

Japan's mission to clean up 'space junk' misses the mark

- Over 100 million pieces of garbage are thought to be whizzing around the planet, including cast-off equipment from old satellites and bits of rocket, which experts say could pose risks for future space exploration.
- Scientists at the JAXA were trying to test an electrodynamic 'tether'— created with the help of a fishing net company — to slow down the orbiting rubbish and bring it into a lower orbit.

Outer Space Treaty: 50 years later

- Space race intensified the Cold War rivalry as a fight for supremacy in space became a matter of pride
- Signed in 1967 through UN, ratified by 105 countries
- According to the treaty, no country can place WMD in the orbit of the Earth, Moon etc.
- However, does **not** prohibit launch of ballistic missiles **through space**.
- Celestial bodies shouldn't be subjected to weapon testing or military manoeuvring.
- The country is liable and fully responsible for any damage in the space caused by their space object.
- Challenge of 1976 Bogota Declaration: 8 countries tried to claim ownership of a segment of an orbit that was in the space situated above their land. However, this was dismissed by the international community.
- In 2007 China was thought to have violated the treaty when it shot down one of its own weather satellites with a "ground-based medium-range ballistic missile".
- Vague definition of terms like WMD, Outer Space etc. makes it liable for misuse.
- Although it bans the deployment of military technology, it allows it for research purposes
- India does not have a space law to protect sovereign, public or commercial interests.

NASA's Cassini spacecraft

- Beamed back closest-ever view of Saturn's dazzling rings of icy debris, features like "straw" and "propellers" which are caused by clumping ring particles and small, embedded moonlets, respectively
- The new images resolve details as small as 550 metres, closest-ever views of small moons Daphnis and Pandora.
- Spacecraft arrived at Saturn in mid-2004.

Spacecraft to fly near the Sun next year

- NASA plans to send its first robotic spacecraft to the Sun next year, first mission to fly to the Sun

- Surface of the Sun, called the photosphere, is not as hot as its atmosphere, called the corona.
- The scientists also want to know how solar wind gets its speed

Life elsewhere

- 7 Earth-size extra-solar planets, or exoplanets, orbiting a dwarf star about 40 light years away.
- Could have liquid water in the habitable 'Goldilocks' zone of a star — neither too close nor too far from a star
- Since the initial discovery of three planets was made using the Chile-based Transiting Planets and Planetesimals Small Telescope, the exoplanet system is called TRAPPIST-1.
- Unlike in the case of our solar system, the planets have apparently formed far away from the star and gradually migrated towards it
- Another major difference in comparison with the solar system is the tight packing of the seven planets around the star.
- The closest planet in the TRAPPIST-1 system takes just 1.5 days to complete an orbit and the farthest one takes 20

For the love of Pluto

- In 2015New Horizons spacecraft became the first to fly by Pluto, passing within 8,000 miles
- International Astronomical Union, in 2006, laid down three criteria for a rocky body to be planet: it must orbit the sun, it must be round, the body and its satellites must "orbit in a clear path around the sun".
- It's last bit that buried Pluto, as many asteroids and planets bigger than Pluto, were found in its orbit.
- Dr. Runyon and co-authors proposed that the offending third clause be deleted.
- Along with Pluto being upgraded from its current "dwarf planet" status, nearly 100 other celestial bodies in the solar system could also become planets.

SpaceX rocket makes history

- Elon Musk 's SpaceX launched and retrieved its first recycled rocket in bid to drive down costs and speed up flights.

A Saturn moon may host life

- Could icy moons like Saturn's Enceladus in the outer solar system be home to microbes or other forms of alien life?
- Data collected by NASA's Cassini spacecraft suggest the possibility.
- Plumes of gas erupting out of the small moon with an ocean of liquid water beneath its icy crust, contain hydrogen.
- There are hydrothermal chemical reactions similar to those that occur at hot fissures at the ocean bottoms on the earth.
- On the earth hydrothermal vents thrive with microbial life
- CO2, H2, CH4 in Enceladus plume could provide an energy source that organisms could tap into for food
- Similar plume rising from Europa, one of Jupiter's big moons that also possesses an ocean beneath an icy exterior.
- As hot water flows past the rocks, minerals in the rocks were grabbing the oxygen atoms and releasing hydrogen

Finally, NASA's super balloon lifts off to collect near space data

- A stadium-sized pressure balloon launched by NASA in NZ began collecting data in near space (34 km above earth), to detect cosmic particles from beyond the galaxy as they penetrate the earth's atmosphere