You & Technology Oct-2019

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S&T

(OCTOBER-2019)

You & Technology Oct-2019

General Studies Paper-3 – S&T – October 2019

1) All you wanted to know about Nobel Prizes

The 2019 Nobel Prize in Medicine has been awarded jointly to William G. Kaelin Jr, Sir Peter J. Ratcliffe and Gregg L. Semenza "for their discoveries of how cells sense and adapt to oxygen availability."

Why does this matter?

• The oxygen-sensing ability of the body has a role in the immune system and the earliest stages of development inside the womb.

• If oxygen levels are low, it can trigger the production of red blood cells or the construction of blood vessels to remedy this.

• More red blood cells mean the body is able to carry more oxygen and is why athletes train at altitude.

• So, drugs that mimic it may be an effective treatment for anaemia.

• Tumours, meanwhile, can hijack this process to selfishly create new blood vessels and grow.

• So, drugs that reverse it may help halt cancer.

Nobel Prize- overview: Alfred Nobel, a Swedish chemist, engineer, industrialist, and the inventor of dynamite, in his last will and testament in 1895, gave the largest share of his fortune to a series of prizes in Physics, Chemistry, Physiology/Medicine, Literature, and Peace, to be called the "Nobel Prizes".

In 1968, the sixth award, the Prize in Economic Sciences was started. The Nobel Prize consists of a Nobel Medal and Diploma, and a document confirming the prize amount.

Between 1901 and 2018, the Prizes have been awarded 590 times, the recipients during this period being 908 Laureates and 27 organisations.

How candidates are nominated?

1. The Nobel Committees of four prize-awarding institutions every year invite thousands of members of academies, university professors, scientists, previous Nobel Laureates, and members of parliamentary assemblies among others to submit candidates for the Nobel Prizes for the coming year.

2. The nominators are selected in such a way that as many countries and universities as possible are represented over time.

3. One cannot nominate himself/herself for a Nobel Prize.

The institutions that choose winners: The Nobel Committees of the prize-awarding institutions are responsible for the selection of the candidates, the institutions being:

1. Nobel Prize in Physics, Nobel Prize in Chemistry: The Royal Swedish Academy of Sciences

2. Nobel Prize in Physiology or Medicine: The Karolinska Institutet

3. Nobel Prize in Literature: The Swedish Academy

4. Nobel Peace Prize: A five-member Committee elected by the Norwegian Parliament (Storting)

5. Prize in Economic Sciences: The Royal Swedish Academy of Sciences

The following Indians (or individuals of Indian origin) have been honoured with the Nobel:

Rabindranath Tagore (Literature, 1913),

C V Raman (Physics, 1930),

Hargobind Khorana (Medicine, 1968),

Mother Teresa (Peace, 1979),

Subramanian Chandrashekhar (Physics, 1983),

the Dalai Lama (Peace, 1989),
Amartya Sen (Economics, 1998),
Venkatraman Ramakrishnan (2009), and
Kailash Satyarthi (Peace, 2014).

2) NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE

The Nobel Prize in Physiology or Medicine has been awarded to William Kaelin, Peter Ratcliffe and Gregg Semenza for discovering the complex processes behind how human cells respond to change in levels of oxygen.

• The research has tried to explain how cells adapt to higher or lower amounts of the molecule in the atmosphere. • When the body detects that less oxygen is present, the kidneys release a hormone called erythropoietin, or EPO, which tells the body to make more red blood cells to carry more oxygen around.

• They found that a protein called hypoxia-inducible factor, or HIF, rises when there's less oxygen around. o HIF then bonds to sections of DNA near the gene that produces EPO.

o Extra HIF protein around the EPO gene acts like a turbo charge for the hormone's production, which is how the body knows to make more red blood cells.

o When there's sufficient oxygen available again, HIF levels drop, as do red blood cell counts.

Significance

• Understand body functioning- This research can help understand the processes behind the generation of new blood vessels, the production of red blood cells, certain immune system functions and even fetal and placenta development.

• Tackling diseases- Much more information can be obtained about the diseases arising from these pathways, such as cancers that proliferate using the oxygen-sensing system to grow tumors.

o The new knowledge would help to treat major diseases like cancer and anaemia.

• Formulation of drugs- Already, a number of drugs have been developed on the back of the understanding of this oxygen-sensing pathway. More experimental drugs on blocking blood vessel formation, aiming to prevent tumor growth in some cancers can be introduced.

3) NOBEL PRIZE IN CHEMISTRY

The 2019 Nobel Prize in Chemistry was awarded to John D. Goodenough, M. Stanley Whittingham and Akira Yoshino for their roles in the development of lithium-ion batteries.

• M. Stanley Whittingham: laid foundations of Lithium (Li) ion batteries in 1970s, when he used titanium disulphide as cathode and metallic lithium, which is highly reactive, as anode.

• John B. Goodenough: In 1980s, he replaced titanium disulphide with cobalt oxide as the cathode doubling the battery's potential. However, the use of reactive lithium remained a concern.

• Akira Yoshino: The first commercially viable lithium-ion battery was developed by him in 1991. He replaced lithium anode with petroleum coke anode, which drew Li-ions towards it from the Lithium Cobalt oxide cathode.

About Lithium ion batteries

• A lithium-ion battery is a type of rechargeable battery.

• Lithium-ion batteries are commonly used for portable electronics (smartphones, laptops etc) and electric vehicles and for military and aerospace applications.

• **Advantages**:

o It is light weight and has high energy density (i.e. stores more energy per unit of weight when compare to other kind of batteries.) It is able to store 150 watt-hours electricity per kg of battery.

o Li-ion battery cells can deliver up to 3.6 Volts, 3 times higher than technologies such as Nickel Cadmium (Ni-Cd) batteries.
o Rechargeable lithium-ion batteries have 5000 cycles or more compared to just 400-500 cycles in lead acid batteries.
o Li-ion batteries are also comparatively low maintenance, and do not require scheduled cycling to maintain their battery life.
o Li-ion batteries have no memory effect, a detrimental process where repeated partial discharge/charge cycles can cause a battery to 'remember' a lower capacity.
o Li-ion batteries also have low self-discharge rate of around 1.5-2% per month.
o They do not contain toxic cadmium, which makes them easier to dispose of than Ni-Cd batteries.

• Limitations of Li- ion batteries:

o They have a tendency to overheat, and can be damaged at high voltages. In some cases this can lead to combustion. This can cause transportation restrictions on large quantities of Li- ion batteries.
o Li-ion batteries require safety mechanisms to limit voltage and internal pressures, which can increase weight and limit performance in some cases.
o Another factor limiting their widespread adoption is their cost, which is around 40% higher than Ni-Cd.

4) NOBEL PRIZE IN PHYSICS

The Nobel Prize in Physics 2019 was awarded to three scientists- James Peebles, Michel Mayor and Didier Queloz "for contributions to our understanding of the evolution of the universe and Earth's place in the cosmos".

• James Peebles was awarded for "theoretical discoveries in physical cosmology".
• Peebles' theoretical tools are the foundation of our modern understanding of the universe's history, from the Big Bang to the present day. His theoretical tools and calculations helped interpret traces from the infancy of the universe.
• Michel Mayor and Didier Queloz were awarded for discovering "an exoplanet orbiting a solar-type star".
• They discovered the first planet outside our solar system, an exoplanet, named 51 Pegasi B orbiting a solartype star in our home galaxy, the Milky Way, in 1995.
• It started a started a revolution in astronomy as more than 4,000 exoplanets have since been discovered in the Milky Way since then.
• These discoveries challenged the world's existing ideas about planetary systems and building up on them in the future might just help find answer humanity's eternal quest about whether life exists outside of the earth and the solar system.

5) The Nobel Prize in Literature 2019

Polish author Olga Tokarczuk and Austrian novelist Peter Handke would receive 2018 and 2019 Nobel Prize for Literature. The prize was postponed in 2018 after the academy was hit by a sexual assault scandal. Peter Handke "for an influential work that with linguistic ingenuity has explored the periphery and the specificity of human experience"

6) The Nobel Peace Prize 2019

Abiy Ahmed Ali (PM of Ethiopia) "for his efforts to achieve peace and international cooperation, and in particular for his decisive initiative to resolve the border conflict with neighbouring Eritrea"

History of the Ethiopia-Eritrea conflict:

• In April 1993, Eritrea broke from its federation with Ethiopia, becoming an independent country that was located strategically at the mouth of the Red Sea on the Horn of Africa, in close proximity to one of the world's most crucial shipping lanes. Independence was the outcome of a 30-year war by Eritrean liberation fighters against Ethiopia, which had annexed the small multiethnic territory to its north in 1962.

• Just over five years after Independence, however, war broke out between the two countries over the control of Badme — a border town of no apparent significance, but which both Addis Ababa and Asmara coveted.

7) The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2019

Abhijit Banerjee, Esther Duflo and Michael Kremer "for their experimental approach to alleviating global poverty". Esther Duflo has become the second woman to win prize after Elinor Ostrom (2009) of US. This year's Laureates have introduced a new approach to obtaining reliable answers about the best ways to fight global poverty. In brief, it involves dividing this issue into smaller, more manageable, questions – for example, the most effective interventions for improving educational outcomes or child health. They have shown that these smaller, more precise, questions are often best answered via carefully designed experiments among the people who are most affected.

8) Facebook's new cryptocurrency- Libra

Despite several high-profile defections and intense criticism from US regulators and politicians, Facebook officially launches Libra. The Libra Association, the nonprofit that will govern the currency, officially signed on 21 charter members at the organization's inaugural meeting in Geneva.

What is Libra?

Facebook says Libra is a "global currency and financial infrastructure". In other words, it is a digital asset built by Facebook and powered by a new Facebook-created version of blockchain, the encrypted technology used by bitcoin and other cryptocurrencies.

Who is in charge of Libra?

The currency will be serviced by a collective of companies called the "Libra Association". It functions as what is known as a "stablecoin", pegged to existing assets like the dollar or euro, in the aim of making it less subject to the volatility that many cryptocurrencies experience. The Libra Association is described by Facebook as an independent, not-for-profit organisation based in Switzerland.

Privacy concerns surrounding cryptocurrencies:

1. Cryptocurrencies allow anonymous funding potentially acting as conduits for money laundering and terror financing.
2. The anonymity of cryptocurrency has made way for cybercriminals to hold victims hard drives hostage to extort payment from them in terms of bitcoins.
3. Since cryptocurrency is borderless, it can be really attractive for terrorist finances as they can transfer funds across countries in a cheap way.
4. Certain characteristics of cryptocurrency like speed, cost, security make it a lucrative source to finance such activities
5. Cryptocurrency is being used to fund child pornography, sexual exploitation, and human trafficking
6. Most new users know close to nothing of the technology, or how to verify the genuineness of a particular crypto currency.

7. Intense volatility of cryptocurrency.

9) NATIONAL DIGITAL HEALTH BLUEPRINT

J. Satyanarayana committee has recently submitted its report named National Digital Health Blueprint (NDHB) to Ministry of Health.

About NDHB

• NITI Aayog mooted the idea of National Health Stack (NHS) last year. NDHB is the architectural document for the implementation of the NHS.

• **Vision**:

o To create a National Digital Health Eco-system that supports Universal Health Coverage in an efficient, accessible, inclusive, affordable, timely and safe manner.

o Ensuring the security, interoperability, confidentiality and privacy of health-related personal information.

• Institutional Framework: envisages a specialised organisation, National Digital Health Mission (NDHM), that can drive the implementation of the blueprint, and promote and facilitate the evolution of a national digital health ecosystem.

• Standards and Regulations: Interoperability is possible only if all the building blocks and the digital systems are built using the defined standards. So, standards related to exchange of healthcare data, data privacy and patient security are given.

• Action Plan: Expected outcomes like access to Electronic Health Records, continuum of care etc have been outlined.

Methods needed for systematic implementation of the blueprint include:

o a Federated Architecture

o Unique Health Id (UHID)

o Data Analytics o EHR (Electronic Health Record)

o multiple access channels like call centre, Digital Health India portal and MyHealth App.

o Legislation and Regulations on Data Management, with focus on Privacy and Security

o Directories of Providers, Professionals and Para-medicals

Benefits of digital healthcare ecosystem

• At Citizen level-

o Citizens should be able to access their health records speedily or store them conveniently.

o Continuum of Care- as it supports information flow across primary, secondary and tertiary healthcare.

o Shift focus from Illness to Wellness to drive down future cost of health protection.

o Cashless Care to ensure financial protection to the poor

• At the level of service providers-

o Medical history of a person can help a medical practitioner to accurately determine the cure needed.

o Enhanced Trust and Accountability

o Timely Payments to service providers that is crucial to participate in government-funded healthcare programs.

• At administration level-

o Central and State governments should have reliable and complete data for policy analysis and evidence-based interventions.

o Robust Fraud Detection to prevent funds leakage.

o Convergence of schemes- apart from Ayushman BharatPradhan Mantri Jan Arogya Yojana, there are many secondary and tertiary care schemes running in the states — such as Swasthya Sathi in West Bengal, Aarogyasri in Telangana etc. So, to prevent drain of resources and duplication, inter-operability of various health schemes is required.

Concerns related to NDHB

• There is currently no direct law on data protection and privacy that spells out responsibilities and deterrents.
• No clarity on the amount of patient data that will be disclosed to private players in the system, such as insurers, pharmacies, and hospitals, among others.
• Document says that data disclosure will require explicit consent of the patient, however there are a large number of illiterate patients, patients can be unconscious, or can be children.

10) EDGE COMPUTING

According to a research, by 2025 companies will generate and process more than 75% of their data outside of traditional centralised data centres — that is, at the "edge" of the cloud.

What is Edge computing?

• Edge computing enables data to be analysed, processed, and transferred at the edge of a network. Meaning, the data is analysed locally, closer to where it is stored, in real-time without latency.

• How it differs from cloud computing?

o The basic difference between edge computing and cloud computing lies in where the data processing takes place.
o In simple terms, cloud computing means storing and accessing data and programs over the Internet instead of your computer's hard drive.
o Currently, the existing Internet of Things (IoT) systems perform all of their computations in the cloud using data centres.
o Edge computing, on the other hand, manages the massive amounts of data generated by IoT devices by storing and processing data locally.

Benefits of edge computing

• **Speed**: The most important benefit of edge computing is its ability to increase network performance by reducing latency (ability to process very high volumes of data with minimal delay). It allows for quicker data processing and content delivery.
• **Security**:
o Centralized cloud computing architecture is vulnerable to distributed denial of service (DDoS) attacks and power outages.
o Edge computing distributes processing, storage, and applications across a wide range of devices and data centers, which makes it difficult for any single disruption to take down the network. o Since more data is being processed on local devices rather than transmitting it back to a central data center, edge computing also reduces the amount of data actually at risk at any one time.
• **Scalability**:
o Expanding data collection and analysis no longer requires companies to establish centralized, private data centers, which can be expensive to build, maintain, and replace when it's time to grow again.
o Edge computing offers a far less expensive route to scalability, allowing companies to expand their computing capacity through a combination of IoT devices and edge data centers.
• **Versatility**: The scalability of edge computing also makes it incredibly versatile. By partnering with local edge data centers, companies can easily target desirable markets without having to invest in expensive infrastructure expansion.
• **Reliability**: With IoT edge computing devices and edge data centers positioned closer to end users, there is less chance of a network problem in a distant location affecting local customers. This increases reliability.

11) GEMINI

Recently, the Government of India has launched the Gagan Enabled Mariner's Instrument for Navigation and Information (GEMINI) device, a satellite-based advisory service for deep-sea fishermen.

• In an effort to achieve Blue Revolution, to enhance the country's marine resources management and utilisation, the Meena Kumari Committee had recommended optimum utilization of the Exclusive Economic Zone (EEZ)— sea between 22 and 370 km from the coast.

• The committee's recommendations on allowing large trawlers in this zone invited protests from several fishermen bodies, as it would negatively impact large number of small fishermen.

o However, there have been two issues in deep-sea fishing for fishermen- location of potential fishing zones and disaster forecasts.

• So far, communication with fishermen has been limited to mobile networks and very high frequency (VHF) radio which does not range over 20 kilometres, while fish shoals in the Arabian Sea, Bay of Bengal and the Indian Ocean are as far away as 150 kilometres from the coast.

o At such distances, it becomes impossible to provide timely warnings of sea storms and cyclones to fishermen. This lacuna was severely felt during theOckhi cyclone in 2017, when fishermen went out, for deep-sea fishing before the onset of the cyclone and could not be informed about the developing cyclone.

o It resulted in loss of life, serious injuries to those rescued and severe damages to fishing boats and fishing gear.

• To overcome this difficulty, Government has developed the GEMINI device to disseminate seamless and effective emergency information and communication on disaster warnings, Potential Fishing Zones (PFZ) and Ocean States Forecasts (OSF) to fishermen.

o It has been developed by the Indian National Centre for Ocean Information Services (INCOIS), an autonomous body under the Ministry of Earth Sciences (MoES) and Airports Authority of India (AAI).

• This device receives and transfers the data received from GAGAN satellites to a mobile through bluetooth communication.

• Ocean State Forecasts (OSF)- They will have many ocean related advisories, providing details on the accurate state of the ocean. It will include forecasts on winds, waves, ocean currents, water and temperature at every six hours on daily basis for next five days.

GAGAN

• It stands for GPS Aided GEO Augmented Navigation.

• Developed by- Airports Authority of India (AAI) and Indian Space Research Organization (ISRO).

• It is a system to improve the accuracy of a global navigation satellite system (GNSS) receiver by providing reference signals.

• It is the first in the world, which has been certified for approach with vertical guidance operating in the equatorial ionospheric region.

• It consists of three geosynchronous satellites (GSAT-8, GSAT-10 and GSAT-15), and covers the entire Indian Ocean round the clock. It covers entire area from Australia to Africa.

12) MICROBIAL FUEL CELLS

Zoological Society of London (ZSL) scientists used plants to power sensors in the wild by installing microbial fuel cells.

About Microbial fuel cells

• A microbial fuel cell (MFC) is a bio-electrochemical device that harnesses the power of respiring microbes to convert organic substrates directly into electrical energy.

• It transforms chemical energy into electricity using oxidation reduction reactions

• It relies on living biocatalysts to facilitate the movement of electrons throughout their systems instead of the traditional chemically catalyzed oxidation of a fuel at the anode and reduction at the cathode.

• It has various application especially where there is low power requirement where replacing batteries may be impractical, such as wireless sensor networks, biosensors etc.

How do Microbial Fuel Cells Work?

• Microbial fuel cells work by allowing bacteria to oxidize and reduce organic molecules.

• Bacterial respiration is basically one big redox reaction in which electrons are being moved around.

o An oxidation-reduction (redox) reaction is a type of chemical reaction that involves a transfer of electrons between two species.

• Whenever you have moving electrons, the potential exists for harnessing an electromotive force to perform useful work.

• A MFC consists of an anode and a cathode separated by a cation specific membrane.

• Microbes at the anode oxidize the organic fuel generating protons which pass through the membrane to the cathode, and electrons which pass through the anode to an external circuit to generate a current.

• The trick of course is collecting the electrons released by bacteria as they respire.

13) GLOBAL TUBERCULOSIS REPORT

World Health Organization released its annual Global Tuberculosis Report for 2019.

Major findings of the report

• The world is not on track to reach the 2020 milestones of the End TB Strategy.

For instance:

o The END TB strategy by the WHO aimed to reduce TB by 20 per cent from 2015-18. However, between 2015 and 2018, only 6.3 per cent TB cases showed a cumulative decline. o The End TB Strategy milestone of 35 per cent decrease by 2020.

• Funding challenges:

o In 2019, the low- and middle-income countries, accounting for 97 per cent of reported TB cases, received a global funding of $6.8 billion. This amount is $3.3 billion less than the $10.1 billion estimated to be required in the Stop TB Partnership's Global Plan to End TB 2018–2022. o Also, it is only just over half of the global target of at least US$ 13 billion per year by 2022 that was agreed at the UN high-level meeting on TB. o Funding gap for TB research was US$ 1.2 billion in 2017.

• Under reporting of the cases: Of the 10 million new cases worldwide, 3 million cases went unreported to the authorities. In India 1.99 million of the 2.69 million in India were reported.

• Globally, TB claimed 15 lakh lives in 2018, including 2.51 lakh with HIV. The 15lakh included 4.49 lakh deaths in India (9,700 lakh had HIV), down from over 6 lakh in 2000.

• 66 per cent of that burden came from eight countries: India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (6%), Nigeria (4%), Bangladesh (4%), and South Africa (3%).

• Based on survey conducted in 14 countries the percentage facing total costs that were

catastrophic ranged from 27% to 83% for all forms of TB, and from 67% to 100% for drug resistant TB.

• Key five risk factors attributable to new cases of TB: undernourishment, smoking (especially among men), alcohol abuse, HIV infection, and diabetes.

Other findings with respect to India

• 26.9 per cent of the global TB burden in 2018 was from India. In 2017, the figure was 27 per cent.

• Fall in total TB incidence rate: The total TB incidence rate in India has decreased by 50,000 patients over the past one year. In 2017, India had 27.4 lakh TB patients, which came down to 26.9 lakh in 2018.

• TB incidence rate in India dropped from almost 300 per lakh population in 2000 to 199/lakh in 2018, as compared to a global decline from 170/lakh to 132/lakh.

• Increased diagnosis: The number of patients being diagnosed for resistance to rifampicin (one of the frontline TB drugs) increased from 32 per cent in 2017 to 46 per cent in 2018 due to mandatory testing for resistance.

• The number of drug-resistant cases detected increased from 38,000 in 2017 to 58,000 in 2018. This is good because these cases would normally go undetected and continue to spread drug-resistant TB.

• Treatment success rate increased to 81 per cent for new and relapse cases (drug-sensitive) in 2017, which was 69 per cent in 2016.

• Children below 14 years comprised 6 per cent of patients and women were 34 per cent.

About TB

• TB is communicable infectious disease caused by the bacillus Mycobacterium Tuberculosis.

• TB is one of the top 10 causes of death worldwide and the leading cause of death from a single infectious agent (ranking above HIV/AIDS).

• It typically affects the lungs (pulmonary TB) but can also affect other organs (extrapulmonary TB).

• Drug Resistant TB: o Multidrug Resistance TB (MDR): It is TB that does not respond to at least isoniazid and rifampicin (2 of the most powerful first line drugs). o Extensively drug-resistant tuberculosis (XDR-TB): It is resistant to at least four of the core anti-TB drugs. It involves multidrug-resistance (MDR-TB), in addition to resistance to any of the fluoroquinolones (such as levofloxacin or moxifloxacin) and to at least one of the three injectable second-line drugs (amikacin, capreomycin or kanamycin).

o Totally drug-resistant tuberculosis (TDR-TB): TB which is resistant to all the first- and second-line TB drugs.

Global Efforts for TB

• SDG Target 3.3 includes ending the TB epidemic by 2030.

• Moscow Declaration to End TB: It is the outcome of first global ministerial conference on ending TB, in 2017.

• The first UN General Assembly high-level meeting on TB was held in New York in September 2018, titled United to End TB: An Urgent Global Response to a Global Epidemic. The outcome of this meeting was declaration having following global targets.

o Treat 40 million people for TB disease in the 5-year period 2018–2022;

o Reach at least 30 million people with TB preventive treatment for a latent TB infection in the 5-year period 2018– 2022;

o Mobilize at least US$ 13 billion annually for universal access to TB diagnosis, treatment and care by 2022; and

o Mobilize at least US$ 2 billion annually for TB research.

• WHO- End TB Strategy o Vision: A world free of TB with zero deaths, disease and suffering due to TB.

o It has three high-level, overarching indicators and related targets:

✓ 95% reduction by 2035 in number of TB deaths compared with 2015.

✓ 90% reduction by 2035 in TB incidence rate compared with 2015.

✓ Zero the level of catastrophic costs for TB-affected families by 2035.

14) LYMPHATIC FILARIASIS

Recently, Union Minister for Health & Family Welfare inaugurated National Symposium on the theme 'United to Eliminate Lymphatic Filariasis' and signed the 'Call to Action to eliminate Lymphatic Filariasis by 2021'.

About Lymphatic Filariasis

• Lymphatic filariasis, commonly known as elephantiasis, is globally considered as a neglected tropical disease.

• It is a parasitic disease caused by microscopic, thread-like filarial worms.

• There are 3 types of these threadlike filarial worms of which Wuchereria bancrofti is responsible for 90% of the cases.

• Infection occurs when filarial parasites are transmitted to humans through mosquitoes such as Culex, Anopheles, and Aedes.

• Infection is usually acquired in childhood causing hidden damage to the lymphatic system.

• It impairs the lymphatic system and can lead to the abnormal enlargement of body parts, causing pain, severe disability and social stigma.

• Repeated mosquito bites over several months to years are needed to get lymphatic filariasis thus people living for a long time in tropical or sub-tropical areas where the disease is common are at the greatest risk for infection. Short-term tourists have a very low risk.

Lymphatic Filariasis in India

• Lymphatic Filariasis (LF) is one of the biggest public health challenges that India faces today. In India, 650 million Indians across 21 states and union territories are at risk of lymphatic filariasis.

• Infection levels have been reduced to below the threshold level for further transmission in almost 37 percent of districts. However, active transmission persists in 160 districts.

• Steps taken:

o India is the first country in southeast Asia to adopt a drug regime to prevent LF.

o Since 2004, India has adopted a twin pillar strategy - prevention through Mass Drug Administration (MDA) using a combination of 2 anti-filarial drugs (DEC and Albendazole) and providing Morbidity Management and Disability Prevention (MMDP) services to those affected by the disease.

o The Government launched the Accelerated Plan for Elimination of Lymphatic Filariasis (APELF) in 2018, and as part of intensifying efforts towards elimination later rolled out IDA (triple drug therapy) treatment in a phased manner.

o The triple drug therapy that administers a single dose of three anti-filarial drugs: Ivermectin, Diethylcarbamazine and Albendazole (IDA), is a radical step towards intensifying LF prevention efforts.

o India is set to scale-up the use of Triple Drug Therapy (IDA) in a phased manner from-November 2019 and working with state governments and other partners to ensure high level of compliance to these drugs by communities living in endemic districts.

Neglected tropical diseases (NTDs)

• These are a diverse group of communicable diseases that prevail in tropical and subtropical conditions in 149 countries.

• They are neglected in the pharmaceutical industry's research and development efforts due to their limited geographical incidence, small market size of drugs for such diseases.

• These affect more than one billion people and cost developing economies billions of dollars every year.

• Populations living in poverty, without adequate sanitation and in close contact with infectious vectors and domestic animals and livestock are those worst affected.

• Indian government has pledged to ensure that diseases such as Lymphatic Filariasis (Hathi Paon) and Visceral Leishmaniasis (Kala-Azar) are eliminated from India.

• The Sustainable Development Goals (SDGs) provide an effective framework for successful elimination of NTDs.

15) India Innovation Index 2019

NITI Aayog with Institute for Competitiveness as the knowledge partner has released the India Innovation Index (III) 2019.

Key findings:

1. Karnataka is the most innovative major state in India.

2. Others in top 10: Tamil Nadu, Maharashtra, Telangana, Haryana, Kerala, Uttar Pradesh, West Bengal, Gujarat, and Andhra Pradesh.

3. The top ten major states are majorly concentrated in southern and western India.

4. Sikkim and Delhi take the top spots among the north- eastern & hill states, and union territories/city states/small states respectively.

5. Delhi, Karnataka, Maharashtra, Tamil Nadu, Telangana, and Uttar Pradesh are the most efficient states in translating inputs into output.

About the index: The index attempts to create an extensive framework for the continual evaluation of the innovation environment of 29 states and seven union territories in India and intends to perform the following three functions:

1. Ranking of states and UTs based on their index scores.

2. Recognizing opportunities and challenges.

3. Assisting in tailoring governmental policies to foster innovation.

The Index is calculated as the average of the scores of its two dimensions - Enablers and Performance.

1. The Enablers are the factors that underpin innovative capacities, grouped in five pillars:

(1) Human Capital,

(2) Investment,

(3) Knowledge Workers,

(4) Business Environment, and

(5) Safety and Legal Environment.

2. The Performance dimension captures benefits that a nation derives from the inputs, divided in two pillars:

(6) Knowledge Output and

(7) Knowledge Diffusion.

Significance of the index: India has a unique opportunity among its myriad challenges to become the innovation leader in the world. Cluster-based innovation should be leveraged upon as the focal point of competitiveness. The index is a great beginning to improve the

environment of innovation in the country as it focuses on both the input and output components of the idea. The index is a good effort to benchmark the performance of the state with each other and promote competitive federalism.

16) Air-independent Propulsion

DRDO is a step closer to boosting endurance of submarines with the indigenous Air Independent Propulsion (AIP) System. It has successfully tested the operation of the indigenous land-based prototype.

What is Air-independent propulsion?

It is any technology which allows a non-nuclear submarine to operate without the need to access atmospheric oxygen (by surfacing or using a snorkel). It can augment or replace the diesel-electric propulsion system of non-nuclear vessels. It is based on the combustion of stored oxygen and ethanol to augment battery-powered propulsion.

Significance of AIP:

• AIP significantly improves stealth because it enables a submarine to generate electricity for services and battery charging and propulsion while completely submerged.

• AIP systems also generate electricity, powering a submarine to operate and also generate oxygen, lighting and amenities for crew.

• The Non-nuclear submarines running on battery power or AIP can be virtually silent.

17) Deep Carbon Observatory

Deep Carbon Observatory (CDO) has released a report on Carbon, it's emissions and availability. The study's results are concerning due to past extinction events linked to the mass release of atmospheric CO2.

Key findings:

1. Less than one percent of the planet's carbon is found above surface.
2. The rest of the carbon – about 1.85 billion gigatonnes – is trapped in the planet's crust and mantle.
3. The carbon that is found in the oceans, the land and the atmosphere, for the most part, appears to be disturbed by human activity.
4. Human emissions of the greenhouse gas are 100 times greater than all of Earth's volcanoes.
5. Human activity contributes about 10 gigatonnes of CO2 into the atmosphere each year. Natural geological process underground, for comparison, release about 10 times less of the global warming gas.
6. Carbon dioxide emissions into the atmosphere and oceans from volcanoes account for about 280 to 360 million tonnes.
7. The burning of fossil fuels, deforestation and other human actives contribute between 40 and 100 times the amount of CO2 into the atmosphere.

About Deep Carbon Observatory (DCO): It is a global community of more than 1000 scientists on a ten-year quest to understand the quantities, movements, forms, and origins of carbon in Earth.

Why study carbon in Earth?

Carbon plays a fundamental role on Earth. It forms the chemical backbone for all essential organic molecules produced by living organisms. Carbon-based fuels supply most of society's energy. Atmospheric carbon dioxide affects Earth's climate. Yet despite its importance, remarkably little is known about the physical, chemical, and biological behaviour of carbon in the vast majority of Earth's interior.

18) NASA ICON Mission

National Aeronautics and Space Administration (NASA) has launched a satellite ICON to detect

dynamic zones of Earth's Ionosphere. The satellite Ionosphere Connection Explorer (ICON) was launched from an aircraft over the Atlantic Ocean near the Florida coast.

About ICON Mission:

1. The ICON satellite will study the Earth's Ionosphere. It includes various layers of the uppermost atmosphere where free electrons flow freely.

2. The ICON mission is the 39th successful launch and satellite deployment by Pegasus rocket. This mission is operated by the University of California.

3. It was originally planned to launch in late 2017 but delayed due to the problems with the Pegasus XL rocket. It is equipped with 780-watt solar arrays to power the instruments.

Earth's Atmospheric Layers:

Troposphere: It starts at the Earth's surface and extends 8 to 14.5 kilometers high (5 to 9 miles). This part of the atmosphere is the most dense. Almost all weather is in this region.

Stratosphere: It starts just above the troposphere and extends to 50 kilometers (31 miles) high. The ozone layer, which absorbs and scatters the solar ultraviolet radiation, is in this layer.

Mesosphere: The mesosphere starts just above the stratosphere and extends to 85 kilometers (53 miles) high. Meteors burn up in this layer.

Thermosphere: It starts just above the mesosphere and extends to 600 kilometers (372 miles) high. Aurora and satellites occur in this layer. Ionosphere: It is an abundant layer of electrons and ionized atoms and molecules that stretches from about 48 kilometers (30 miles) above the surface to the edge of space at about 965 km (600 mi), overlapping into the mesosphere and thermosphere. This dynamic region grows and shrinks based on solar conditions and divides further into the sub-regions: D, E and F; based on what wavelength of solar radiation is absorbed. The ionosphere is a critical link in the chain of Sun-Earth interactions. This region is what makes radio communications possible. Exosphere: This is the upper limit of our atmosphere. It extends from the top of the thermosphere up to 10,000 km (6,200 mi).

19) Copernicus Programme

Data from the Sentinel-3 World Fire Atlas have been released. Data have been recorded under the Copernicus Sentinel-3 mission.

• There were almost five times as many wildfires in August 2019 compared to August 2018- 79 000 fires in August this year, compared to just over 16 000 fires detected during the same period last year.

• 49% of fires were detected in Asia, around 28% were detected in South America, 16% in Africa, and the remaining were recorded in North America, Europe and Oceania.

About Copernicus programme:

1. Copernicus is the most ambitious Earth observation programme to date.

2. It will provide accurate, timely and easily accessible information to improve the management of the environment, understand and mitigate the effects of climate change and ensure civil security.

3. Copernicus is the new name for the Global Monitoring for Environment and Security programme, previously known as GMES.

4. This initiative is headed by the European Commission (EC) in partnership with the European Space Agency (ESA). 5. Services provided by Copernicus: land management, the marine environment, atmosphere, emergency response, security and climate change.

6. Sentinel: ESA is developing a new family of satellites, called Sentinels, specifically for the operational needs of the Copernicus programme. The Sentinels will provide a unique set of observations, starting with the all-weather, day and night radar images.

Way ahead:

One of the biggest problems during and after fires is obtaining an overall view of the fires evolution and potential damage. With fires seen from space, Earth observation is also being used to detect and monitor the active spots over affected areas. Quantifying and monitoring fires is important for the ongoing study of climate because they have a significant impact on global atmospheric emissions, with biomass burning contributing to the global budgets of greenhouse gases, like carbon dioxide.

20) Project Soli

Recently launched Google Pixel 4 uses a radar-based Soli chip to introduce Motion Sense, a feature that provides similar touchless gesture-based controls.

What is Project Soli?

Google announced Project Soli in 2015. Since then, Google's ATAP (Advanced Technology and Projects) division has been developing the technology, which can be used in wearables, phones, computers, cars and IoT devices.

What is Google's Soli chip?

The Soli radar chip works on the 60 GHz spectrum frequency as it has the least interference for the kind of minute movements Google wants to track. However, the 60 GHz spectrum is not commercially usable in India. The 60 GHz band is also known as V-band or WiGig band (Wi-Fi at 60 GHz) using IEEE 802.11ad protocol.

21) Nanopharmaceuticals.

Guidelines Released for Evaluation of Nanopharmaceuticals in India. Guidelines are developed by DBT, ICMR and Central Drugs Standard Control Organization (CDSCO).

Developed in line with the provisions of Schedule Y of Drugs and Cosmetics Rules, 1945 as well as Second Schedule of the New Drugs and Clinical Trials Rules, 2019 with specific requirements for nanopharmaceuticals.

Need for these guidelines: Nanocarrier based targeted drug delivery is an emerging field with introduction of nanopharmaceuticals in the market. These nanoformulations have higher efficacy, lower toxicity and are safer than the conventional drugs. Therefore, to provide transparent, consistent and predictable regulatory pathways for nanopharmaceuticals in India these guidelines were necessary.

Application of these guidelines: The guidelines apply to the nanopharmaceuticals in the form of finished formulation as well as Active Pharmaceutical Ingredient (API) of a new molecule or an already approved molecule with altered nanoscale dimensions, properties or phenomenon associated with the application of nanotechnology intended to be used for treatment, in vivo diagnosis, mitigation, cure or prevention of diseases and disorders in humans.

Significance:

• These guidelines mark one of the most important steps for delineating quality, safety and efficacy assessment of the novel nanoformulations.

• The guidelines will pave the way for significant benefits through such cutting edge technology and contribute to the mission on “Affordable Health Care for All”.

• Private investments would also be attracted since these guidelines would strengthen the regulatory system.

What are Nanopharmaceuticals?

They are a relatively new class of therapeutic-containing nanomaterials that often have unique " nanoproperties" (physiochemical properties) due to their small size (compared with their bulk-phase counterparts) a high surface-to-volume ratio and the possibility of modulating their properties.

• Nanopharmaceuticals present novel reformulation opportunities for active agents (e.g., single molecule drugs, proteins, nucleic acids, etc.) that were previously insoluble or could not be targeted to a specific site of the body where they were needed.

• Nanopharmaceuticals can also increase drug half-life by reducing immunogenicity and diminishing drug metabolism.

• With these advantages, nanopharmaceuticals have the ability to extend the economic life of proprietary drugs, thereby creating additional revenue streams.

22) Organoids

We've heard a lot in the last few years about organoids, the so-called "brains in a dish" created in labs by neuroscientists. However, experts have expressed concerns over growing mini-brains or organoids in the laboratory that can perceive or feel things.

Why worry about this?

In some cases, scientists have already transplanted such lab-grown brain organoid to adult animals.

• The transplanted organoid had integrated with the animal brain, grown new neuronal connections and responded to light.

• Similarly, lung organoid transplanted into mice was able to form branching airways and early alveolar structures. These are seen as a step towards potential "humanisation" of host animals.

What is an organoid?

Organoids are a group of cells grown in laboratories into three-dimensional, miniature structures that mimic the cell arrangement of a fully-grown organ.

• They are tiny (typically the size of a pea) organ-like structures that do not achieve all the functional maturity of human organs but often resemble the early stages of a developing tissue.

• Most organoids contain only a subset of all the cells seen in a real organ, but lack blood vessels to make them fully functional.

How are organoids grown in the laboratory?

Grown in the lab using stem cells that can become any of the specialised cells seen in the human body, or stem cells taken from the organ or adults cells that have been induced to behave like stem cells, scientifically called induced pluripotent stem cells (iPSC). Organoids of the brain, small intestine, kidney, heart, stomach, eyes, liver, pancreas, prostate, salivary glands, and inner ear to name a few have already been developed in the laboratory.

How have organoids helped in our understanding of diseases?

1. Organoids offer new opportunities to studying proteins and genes that are critical for the development of an organ. This helps in knowing how a mutation in a specific gene causes a disease or disorder.

2. For example, Researchers have used brain organoids to study how the Zika virus affects brain development in the embryo.

3. Since the organoids closely resemble mature tissues, it opens up new vistas. These include studying the complex arrangements of cells in

three-dimension and their function in detail, and understanding how cells assemble into organs.

4. Organoids can be used to study the safety and efficacy of new drugs and also test the response of tissues to existing medicines.

5. Organoids will bring precision medicine closer to reality by developing patient-specific treatment strategies by studying which drugs the patient is most sensitive to.

What are the ethical challenges of growing organoids?

Scientists argue that organoids do not have sensory inputs and sensory connections from the brain are limited. Isolated regions of the brain cannot communicate with other brain regions or generate motor signals. Thus, the possibility of consciousness or other higher-order perceptive properties [such as the ability to feel distress] emerging seems extremely remote.

23) Block Chain Technology

The Tea Board of India is keen to harness latest technologies such as blockchain to help endconsumers track the supply chain of tea of Indian origin, by digitising Indian tea marketing channels.

What are Blockchains?

They are a new data structure that is secure, cryptography-based, and distributed across a network. The technology supports cryptocurrencies such as Bitcoin, and the transfer of any data or digital asset. Spearheaded by Bitcoin, blockchains achieve consensus among distributed nodes, allowing the transfer of digital goods without the need for centralized authorisation of transactions.

How it operates?

1. The technology allows transactions to be simultaneously anonymous and secure, peer-to-peer, instant and frictionless.

2. It does this by distributing trust from powerful intermediaries to a large global network, which through mass collaboration, clever code and cryptography, enables a tamper-proof public ledger of every transaction that's ever happened on the network.

3. A block is the "current" part of a blockchain which records some or all of the recent transactions, and once completed, goes into the blockchain as permanent database.

4. Each time a block gets completed, a new block is generated. Blocks are linked to each other (like a chain) in proper linear, chronological order with every block containing a hash of the previous block.

Benefits of blockchain technology:

1. As a public ledger system, blockchain records and validate each and every transaction made, which makes it secure and reliable.

2. All the transactions made are authorized by miners, which makes the transactions immutable and prevent it from the threat of hacking.

3. Blockchain technology discards the need of any third-party or central authority for peer-to-peer transactions.

4. It allows decentralization of the technology.

Uses and possibilities of blockchain are:

1. Confidential communication of cryptocurrency.

2. Safe, cost effective and fast bank transactions.

3. Secure legal documents, health data, notaries and personal documents.

4. Distribution of land records and government financial assistance.

5. Cloudstorage, digital identification, smart communication and digital voting.

Regulation in India:

The current debate in India has, unfortunately, focused too heavily on trading and speculation, looking at cryptocurrencies as an investment tool, rather than understanding the potential of core blockchain technology and the basic role of cryptocurrencies as an incentive mechanism to secure decentralized transactions.

• Prevailing cyber laws in India touch almost all aspects of transactions and activities involving the internet, www and cyber space (IT Act 2000 and amended in 2008, section 463 of IPC, and section 420). But in today's techno-savvy environment the world is becoming more and more digitally sophisticated and so are the crimes. India's cyber laws are lacking in this respect.

• There are sufficient global examples of countries that have taken cautious steps in regulating the technology, and are focusing on stopping illegal activity without hurting innovation.

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