You & Technology April-2020

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GOOD MORNING TIMES S&T (APRIL-2020)

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General Studies Paper-3 – S&T – April 2020

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1) Novel blood plasma therapy for COVID

India has taken a bold step to provide innovative treatment to patients suffering from COVID-19 disease- plasma therapy. Technically called "convalescent-plasma therapy", the treatment aims at using the immune power gained by a recovered person to treat a sick person.

But, before understanding more about the therapy, let's see how our immune system works? When a pathogen like novel coronavirus infects, our immune systems produce antibodies. Like the police dogs, the antibodies span out to identify and mark the invading virus. White blood cells attach the identified intruders, and the body gets rid of the infection.

But, what are antibodies?

Antibodies are one of the front-line immune response to an infection by a microbe. They are a particular type of proteins secreted by immune cells called B lymphocytes when they encounter an invader, such as a novel coronavirus. The immune system designs antibodies that are highly specific to each invading pathogen. A particular antibody and its partner virus are made for each other.

How plasma therapy works?

1. Blood is drawn from a person who has recovered from COVID-19 sickness.
2. The serum is separated and screened for virus-neutralizing antibodies.
3. Convalescent serum, that is the blood serum obtained from one who has recovered from an infectious disease and especially rich in antibodies for that pathogen, is then administered to a COVID-19 patient.
4. The sick acquires passive immunisation.

When was it previously used? How effective has it been?

We have effective antibiotics against bacterial infection. However, we do not have effective antivirals. Whenever a new viral outbreak takes places, there are no drugs to treat it. Hence, the convalescent serum has been used during past viral epidemics.

- 2009–2010 H1N1 influenza virus pandemic.
- The Ebola outbreak in 2018.

How long the antibodies will remain in the recipient?

After the antibody serum is given, it will stay on the recipient for at least three to four days. During this period, the sick person will recover. Various studies have confirmed this.

Difference between this therapy and vaccination?

This therapy is akin to passive immunization. When a vaccine is administrated, the immune system produces the antibodies. Here, the effect lasts only up to the time the antibodies injected remain the bloodstream. The protection given is temporary. Whereas, Vaccination provides lifelong immunity. For example, the mother transfers antibodies through breast milk to an infant before the child could build her own immunity.

Related fact: In 1890, Emil von Behring, a German physiologist, discovered that the

serum obtained from a rabbit infected with diphtheria was effective in preventing the diphtheria infection. Behring was awarded the first-ever Nobel prize for medicine in 1901.

2) CollabCAD

Atal Innovation Mission, NITI Aayog & National Informatics Centre (NIC) jointly launched CollabCAD in ATL schools.

What is CollabCAD?

• It is a collaborative network, computer enabled software system, providing a total engineering solution from 2D drafting & detailing to 3D product design.

• The aim of this initiative is to provide a great platform to students of Atal Tinkering Labs (ATLs) across country to create and modify 3d designs with free flow of creativity and imagination.

• This software would also enable students to create data across the network and concurrently access the same design data for storage and visualization.

Tinker from Home campaign:

• In light of the current situation, the ATL program has launched a 'Tinker from Home' campaign to ensure that the children across the county have access to useful easy-to-learn online resources to keep themselves fruitfully occupied.

• The objective of the initiative is to harness the creativity and innovativeness of children by encouraging learning through self-initiation.

What are ATLs?

With a vision to 'Cultivate one Million children in India as Neoteric Innovators', Atal Innovation Mission is establishing Atal Tinkering Laboratories (ATLs) in schools across India.

Objective: The objective of this scheme is to foster curiosity, creativity and imagination in young minds; and inculcate skills such as design mindset, computational thinking, adaptive learning, physical computing etc. Financial **Support**: AIM will provide grant-in-aid that includes a one-time establishment cost of Rs. 10 lakh and operational expenses of Rs. 10 lakh for a maximum period of 5 years to each ATL.

Eligibility:

• Schools (minimum Grade VI – X) managed by Government, local body or private trusts/society can set up ATL.

• The applicant school would have to provide at least 1,500 Sq. Ft. of built up space. Applicant schools from hilly / Himalayan and island states, UTs would have to provide atleast 1,000 Sq. Ft. of built up space.

3) Software Technology Parks of India (STPI)

In light of the current coronavirus pandemic, the Ministry of Electronics and Information Technology (MeitY) has decided to provide rental waiver to IT companies housed in STPI premises in the country from March to June, i.e., for 4 months period as of now.

About Software Technology Parks of India (STPI):

It is an autonomous society under Ministry of Electronics and Information Technology (MeitY), Govt. of India. It was established in 1991 with the objective of encouraging, promoting and boosting the export of software from India. The STPI's Governing

Council's Chairperson is the Union Minister for Electronics & Information Technology.

The objectives of the Software Technology Parks of India are:

1. To promote the development and export of software and software services including Information Technology (IT) enabled services/ Bio- IT.
2. To provide statutory and other promotional services to the exporters by implementing Software Technology Parks (STP)/ Electronics and Hardware Technology Parks (EHTP) Schemes, SEZ scheme and other such schemes which may be formulated and entrusted by the Government from time to time.
3. To provide data communication services including value added services to IT / IT enabled Services (ITES) related industries.
4. To promote micro, small and medium entrepreneurs by creating conducive environment for entrepreneurship in the field of IT/ITES.
5. To establish and manage infrastructure resources such as Datacom facilities, Project Management and Consultancy and IT support facilities.

4) TriboE masks and triboelectricity

A team of researchers at the Centre for Nano and Soft Matter Sciences (CeNS), Bangalore, an autonomous institute of the Department of Science and Technology (DST), have come up with a recipe for making face masks, termed as TriboE Mask, that can hold electric charges to restrict the entry of infections but interestingly, without any external power.

How they operate or work?

It relies on electrostatics. When two non-conducting layers are rubbed against each other, the layers develop positive and negative charges instantly and continue to hold the charges for some time. This electric field, quite strong at proximity, is used to deactivate or possibly even kill the germs.

Key features of these masks:

1. The mask is three-layered –a layer of nylon cloth sandwiched between polypropylene layers, the latter sourced from commonly used non woven grocery bags.
2. In place of nylon, silk fabric from an old saree or shawl may also be cut and used.
3. When layers are rubbed against each other, the outer layers develop negative charges, while nylon will hold the positive charges.
4. This will act as double electric wall protection against the infectious entities crossing.
5. As the mask is made out of commonly available fabrics, it can be washed just like any other cloth and can be reused.

What is triboelectric effects?

Also known as triboelectric charging, it is a type of contact electrification on which certain materials become electrically charged after they are separated from a different material with which they were in contact. Rubbing the two materials each with the other increases the contact between their surfaces, and hence the triboelectric effect.

Examples: A very familiar example could be the rubbing of a plastic pen on a sleeve of almost any typical material like cotton, wool, polyester, or blended fabric used in modern clothing. Such an electrified pen would readily attract and pick up pieces of paper less than a square centimeter when the pen

approaches. Also, such a pen will repel a similarly electrified pen.

5) SunRISE mission

NASA has selected a new mission to study how the Sun generates and releases giant space weather storms – known as solar particle storms – into planetary space.

Overview of the mission- the Sun Radio Interferometer Space Experiment (SunRISE): It is an array of six CubeSats operating as one very large radio telescope. NASA has awarded $62.6 million to design, build and launch SunRISE by no earlier than July 1, 2023.

Objectives of the mission:

1. To study how the Sun creates and releases giant solar particle storms.
2. To help scientists understand the workings of the Solar System.

How it works?

The mission design relies on six solar-powered CubeSats to simultaneously observe radio images of low-frequency emission from solar activity and share them via NASA's Deep Space Network.

• The constellation of CubeSats would fly within 6 miles of each other, above Earth's atmosphere, which otherwise blocks the radio signals SunRISE will observe.

• Together, the six CubeSats will create 3D maps to pinpoint where giant particle bursts originate on the Sun and how they evolve as they expand outward into space.

• This, in turn, will help determine what initiates and accelerates these giant jets of radiation.

• The six individual spacecraft will also work together to map, for the first time, the pattern of magnetic field lines reaching from the Sun out into interplanetary space.

Why study solar particle storms?

This information will help improve understanding of how our solar system works. It can help protect astronauts traveling to the Moon and Mars by providing better information on how the Sun's radiation affects the space environment they must travel through.

Background: NASA had chosen two missions in August 2017 for its Mission of Opportunity program, a part of its Explorers Program, to conduct an 11-month concept study. The SunRise mission was one of the two missions.

6) GRACE-FO mission

New satellite-based, weekly global maps of soil moisture and groundwater wetness conditions were developed by US space agency National Aeronautics and Space Administration (NASA) and the University of Nebraska-Lincoln (UNL) on March 31, 2020.

How were these maps produced?

Data available from NASA and German Research Center for Geosciences' Gravity Recovery and Climate Experiment Follow On (GRACE-FO) satellites was used to derive these global maps.

• The satellite-based observations of changes in water distribution were integrated with other data within a computer model that simulated water and energy cycles.

• The model then produced — among other outputs — time-varying maps of the distribution of water at three depths: Surface soil moisture, root zone soil moisture (roughly the top three feet of soil) and

shallow groundwater. • The maps have a resolution of up to 8.5 miles, providing continuous data on moisture and groundwater conditions across the landscape.

Why do we need these data?

The scientific community believes data available through this project would fill existing gaps in understanding the full picture of wet and dry conditions that can lead to drought. These tools are absolutely critical to helping us address and offset some of the impacts anticipated, whether it is from population growth, climate change or just increased water consumption in general. The data would also help in managing the selection of appropriate agricultural crops and predicting yields.

About GRACE- FO mission:

The Gravity Recovery and Climate Experiment Follow-on (GRACE-FO) mission is a partnership between NASA and the German Research Centre for Geosciences (GFZ). GRACE-FO is a successor to the original GRACE mission, which began orbiting Earth on March 17, 2002. The GRACE missions measure variations in gravity over Earth's surface, producing a new map of the gravity field every 30 days.

• GRACE-FO will continue the work of tracking Earth's water movement to monitor changes in underground water storage, the amount of water in large lakes and rivers, soil moisture, ice sheets and glaciers, and sea level caused by the addition of water to the ocean.

• These discoveries provide a unique view of Earth's climate and have far-reaching benefits to society and the world's population.

7) INDIAN INITIATIVE ON EARTH BIOGENOME SEQUENCING (IIEBS)

Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) is selected to take part in Indian Initiative on Earth BioGenome Sequencing (IIEBS).

• JNTBGRI is selected as one of the Biological Knowledge and Resource Centres for the IIEBS.

• Department of Biotechnology has allotted ₹143.89 lakh for JNTBGRI to take up the project.

About Indian Initiative on Earth BioGenome Sequencing (IIEBS)

• This project aims to decode the genetic information of all known species of plants and animals in the country.

• The National Institute of Plant Genome Research, New Delhi is the coordinating centre involving a total of 24 institutes.

• The whole genome sequencing of 1,000 species of plants and animals will be taken up in the initial phase of IIEBS to be completed over a period of five years at an estimated cost of ₹440 crore.

• The project is part of the Earth BioGenome Project.

Significance of the project

• The project will enable collection and preservation of endangered and economically important species.

• The decoded genetic information will also be a useful tool to prevent biopiracy. o Biopiracy is exploitative use of genetic code of plants or animals, without compensating the countries from which the material or relevant knowledge is obtained.

• India's participation in the EBP would provide a boost for the field of genomics and bioinformatics within the country.

About Earth BioGenome project

• It is a global effort launched in 2018, involving scientific partners and funders from around the globe.

• It aims to sequence, catalogue and characterise genomes of all of Earth's eukaryotic biodiversity over a period of ten years.

• Vision- Create a new foundation for biology to drive solutions for preserving biodiversity and sustaining human societies.

About Genome Sequencing

• A genome is an organism's complete set of deoxyribonucleic acid (DNA).

• Sequencing a genome means deciphering the exact order of base pairs in an organism.

• The way these base pairs are arranged, or variations and mutations in their pattern, can provide clues about the individual's health or ill health, inherited or acquired.

About JNTBGRI

• It is an autonomous R & D organisation set up in 1979 in Thiruvananthapuram, Kerala.

• It is recognised as a 'National Centre of Excellence in ex situ conservation and sustainable utilisation of tropical plants diversity'.

Related Information

• Eukaryotic organisms are those whose cells contain a nucleus and organelles, and are enclosed by a plasma membrane.

• It includes protozoa, fungi, plants and animals.

• Prokaryotic cells are cells that do not have a true nucleus or membrane-bound organelles. E.g. Bacteria

8) What is geofencing?

The centre has tested an application that triggers e-mails and SMS alerts to an authorised government agency if a person has jumped quarantine or escaped from isolation, based on the person's mobile phone's cell tower location. The "geo-fencing" is accurate by up to 300 m.

Background: The States have been asked to seek the approval of their Home Secretaries under the provisions of Section 5(2) of the Indian Telegraph Act, 1885, for the specified mobile phone numbers to request the DoT to provide information by email or SMS in case of violation of "geo-fencing".

What is geofencing?

It is a location-based service in which an app or other software uses GPS, RFID, Wi-Fi or cellular data to trigger a pre-programmed action when a mobile device or RFID tag enters or exits a virtual boundary set up around a geographical location, known as a geofence. Depending on how a geofence is configured it can prompt mobile push notifications, trigger text messages or alerts, send targeted advertisements on social media, allow tracking on vehicle fleets, disable certain technology or deliver location-based marketing data.

How geofencing works?

To make use of geofencing, an administrator or developer must first establish a virtual boundary around a specified location in GPS- or RFID-enabled software. This virtual geofence will then trigger a response when an authorized device enters or exits that area, as specified by the administrator or developer.

Other applications of geofence:

1. Social networking.
2. Marketing.
3. Audience engagement.
4. Smart appliances.
5. Human Resource management.
6. Telematics.
7. Security.

9) What is pool testing of Corona?

Stating that the number of COVID-19 cases in India is rising, the Indian Council of Medical Research (ICMR) is now advising the feasibility of using pooled samples for molecular testing of patient samples. The council has said that it is critical to increase the numbers of tests conducted by laboratories. The advisory is aimed at increasing capacity of the laboratories to screen increased numbers of samples using molecular testing for COVID-19 for the purpose of surveillance.

How does it work?

A pooled testing algorithm involves the PCR screening of a specimen pool comprising multiple individual patient specimens, followed by individual testing (pool de-convolution) only if a pool screens positive. As all individual samples in a negative pool are regarded as negative, it results in substantial cost savings when a large proportion of pools tests negative.

What the ICMR has recommended?

1. As per ICMR, preferable number of samples to be pooled is five, though more than two samples can be pooled, but considering higher possibility of missing positive samples with low viral load, it is strongly discouraged to pool more than five samples, except in research mode.
2. Also, the study has recommended that it should be used only in areas with low prevalence of COVID19 (initially using proxy of low positivity of less than 2% from the existing data).
3. In areas with positivity of 2-5%, sample pooling for PCR screening may be considered only in community survey or surveillance among asymptomatic individuals, strictly excluding pooling samples of individuals with known contact with confirmed cases and health care workers (in direct contact with care of COVID-19 patients).
4. Sample from such individuals should be directly tested without pooling.

Why we need pool testing?

• This will reduce the total test kits used to examine patients and treat them.
• It is also expected to trim the work at the laboratories testing these samples.
• International researchers suggest that pooling test samples is cost effective, especially for the countries with limited resources.
• It can be used to prevent community spread of the disease.

10) Chitra GeneLAMP-N

What is it?

It is a diagnostic test kit that can confirm COVID19 in 2 hours at low cost. It has been developed by Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, an Institute of National Importance, of the Department of Science and Technology (DST).

How it works?

The confirmatory diagnostic test detects the N Gene of SARS- COV2 using reverse transcriptase loop-mediated amplification of

viral nucleic acid (RT-LAMP). The test kit is highly specific for SARS-CoV-2 N-gene and can detect two regions of the gene, which will ensure that the test does not fail even if one region of the viral gene undergoes mutation during its current spread.

Significance:

1. The trial tests performed show that Chitra GeneLAMP- N has 100% accuracy and match with test results using RT-PCR.
2. The detection time is 10 minutes, and the sample to result time (from RNA extraction in swab to RT-LAMP detection time) will be less than 2 hours.
3. A total of 30 samples can be tested in a single batch in a single machine allowing a large number of samples to be tested each day.

What is Reverse transcription loop-mediated isothermal amplification (RT-LAMP)?

It is a technique for the amplification of RNA. It is used in the detection of viruses. In this method, a DNA copy of the viral RNA is generated by reverse transcriptase, and then isothermal amplification is carried out to increase the amount of total DNA.

11) Berberine and Alzheimer's

What is Berberine?

Berberine is a natural and cheap product similar to curcumin, available commercially It is poorly soluble and toxic to cells.

Why in News?

Scientists from Jawaharlal Nehru Centre For Advanced Scientific Research (JNCASR) have modified the structure of Berberine into Ber-D to use as a Alzheimer's inhibitor. Ber-D is a soluble (aqueous), antioxidant. It is a multifunctional inhibitor of multifaceted amyloid toxicity of Alzheimer's disease. The structural attributes of Ber-D are such that they prevent the generation of reactive oxygen species (ROS) and rescue biomacromolecules from oxidative damage. These attributes make Ber-D a promising candidate for developing effective therapeutics to treat multifaceted toxicity of Alzheimer's disease.

Background: Alzheimer's disease is the most prevalent neurodegenerative disorder and accounts for more than 70% of all dementia. The multifactorial nature of the disease attributed to multifaceted toxicity has made it difficult for researchers to develop effective medication.

Protein aggregation and amyloid toxicity predominantly contribute to multifaceted toxicity observed in neuronal cells, including generation of reactive oxygen species (ROS), mitochondrial dysfunction, interfering with synaptic signaling, and activation of premature cell death.

What is Alzheimer's?

It is a progressive brain disorder that typically affects people older than 65. When it affects younger individuals, it is considered early onset. The disease destroys brain cells and nerves, and disrupts the message-carrying neurotransmitters. Eventually, a person with Alzheimer's loses the ability to perform day-to-day activities. Symptoms include memory loss, difficulty in completing familiar tasks, confusion with time or place, problems in speaking and writing, decreased or poor judgment, and changes in mood and personality. Alzheimer's disease is also the

most common cause of dementia — which is a syndrome and not a disease in itself, and whose symptoms include loss of memory, thinking skills, problems with language, changes in mood and deterioration in behaviour.

Treatment: There is no cure for Alzheimer's, because its exact causes are not known. Most drugs being developed try to slow down or stop the progression of the disease. There is a degree of consensus in the scientific community that Alzheimer's involves two proteins, called beta amyloids and tau. When levels of either protein reach abnormal levels in the brain, it leads to the formation of plaque, which gets deposited between neurons, damaging and disrupting nerve cells. Most existing drugs for Alzheimer's try to target these proteins to manage some of the symptoms of Alzheimer's.

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All the Best to all my Economics students…
Hope this material will help you.
God bless...JAI Hind

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All the Best
Jai Hind ☺