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THE TAL PALM/ PALMYRA PALM

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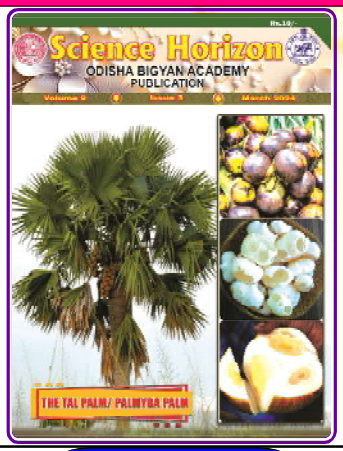

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Cover Design : ***Kalakar Sahoo***

Editorial

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ROOFTOP SOLAR POWER PLANT

Electricity is one of the important infrastructures for industry and economy of the country. Further, due to rising of population in the country, electricity demand is increasing by about 8 to 10 percent every year. In our country share of thermal power in terms of installed capacity is more than 50 percent and in term of energy generation it is more than 75 percent. Thermal power causes air pollution and it emits carbon dioxide which is responsible for global warming and climate change. Therefore, all the countries have agreed to reduce thermal power generation and adopt renewable sources of energy which do not emit carbon dioxide. India has pledged to generate 500 GW from non-fossil fuels (about half of total consumption) by 2030 and to be net carbon -zero by 2070.

One of the promising alternative sources of energy is solar power. India is blessed with 300 days of sunshine. Till now total solar energy installed capacity of India is 70 GW and is ranked fourth globally. National Institute of Solar Energy has assessed India's solar energy potential as 748 GW which means India has harnessed only about ten percent of the potential. The mode of solar energy production is solar photovoltaic method which uses small solar cells made of silicon in different arrays.

One of the major problems of development of solar power is that it requires lot of space, approximately 10 square meter area for one kilowatt of installation. If cultivated lands are used for this purpose, then the benefit of solar power will be lost. As a result, it is being installed mostly in arid lands of Madhya Pradesh, Rajasthan and Gujarat.

One solution for this problem is rooftop solar plants. There are lot of large buildings where these can be installed in small capacities. These plants can cater to the demands of the house owner and if there will be any surplus power it can be fed to the local grid. For this, net-metering system has been introduced. There are three types of rooftop solar power plants. One is stand-alone i.e. not connected to the grid. It can supply to the house where it is installed and it uses a battery to store the excess energy generated and to use it when there is no generation. The second is the grid-connected system which does not require a storage battery as it can draw power from the grid when required. The third system is hybrid

one which is a grid-connected system along with the battery. In this system one can continue to get electricity without disruptions even during grid power outage. The most preferred one is grid-connected power plant.

The Council on Energy, Environment and Water has estimated that India has an opportunity to generate about 637 GW from rooftop solar. In 2015, the government set a target of 40 GW by 2022 for rooftop solar and at the end of 2023, it is only 12.7 GW out of which industrial buildings share 6.8 GW, commercial buildings share 3.1 GW and residential buildings share 2.7 GW.

Now, again the attention is back on rooftop solar. In the last week of January 2024, the Prime Minister has announced the Pradhan Mantri Suryodaya Yojana (PMSY), promising installation of rooftop solar systems in ten million homes. Finance Minister, while presenting the interim budget 2024 had spoken about the scheme that one crore households will receive free electricity up to 300 units every month through rooftop solarisation. The government has allocated Rs.10,000 crore for the scheme. It will be a great relief on the power generating companies and also towards achieving net carbon-zero. India has a population of about 1400 million and if we consider at an average of five persons per family, then there are 280 million households. As per Central Electricity Authority report, India's households consume around 330,809 GWh of electricity. In India, the average per capita consumption is 1255 kWh. Further, the consumption is more in urban area compared to rural areas. Also the roof space available is more in urban areas and more people are taking interest for rooftop solar in the cities.

European countries have mandated a renewable energy component for new and existing buildings by 2028. In our country, government should do the same for rooftop solar for new residential and commercial buildings. Indian government is giving subsidy for installation of grid-connected solar power. Under the scheme, the government will provide a 40% subsidy for the first 3 kW of solar panel capacity and a 20% subsidy for capacity above 3 kW and up to 10 kW of solar panel capacity.

Of course there are some bottlenecks for the rooftop solar system. First is the shadow effect. The rooftops are not custom made for the installation of solar plants and the design becomes a challenge. Secondly, rooftop solar power plants are mainly installed in the cities with pollution and not so open areas leading to high temperature and low irradiation for solar panels. Thirdly, the rooftops do not always allow the most favourable direction for solar plant installation, i.e. South. Lastly, the rooftop solar power plants are of miniscule sizes when compared with the utility scale solar power plant which are in MW scale and hence the cost becomes higher. With such difficulties, the rooftop solar power plants in India can grow with the incentives of the government.

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Er. Mayadhar Swain
Editor

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QUANTUM ARTIFICIAL INTELLIGENCE: THE FUTURE REALITY

Dr. Bibhuti Narayan Biswal

Introduction

The world has witnessed several industrial revolutions to augment human needs. We are at the threshold of the 5th Industrial Revolution (5IR) that demands for larger harmonious human–machine collaborations, and sustainable interaction as part of the latest technological revolution. This 5IR revolution is in contrast to the Fourth Industrial Revolution that witnessed extensive use of Artificial Intelligence, big data analytics, the Internet of Things (IoT), machine learning, robotics, smart systems, and virtualisation, etc.

In the realm of technology world fascinating development is gaining momentum between the ground-breaking intersection of quantum physics and artificial intelligence, which holds the promise to revolutionize technology and our understanding of computation. This has augured convergence of Quantum Computing and Artificial Intelligence (AI) to give rise to an evolving field known as Quantum AI. With the advancement of AI and Quantum computing technology with respect to its real-life applications, many sectors of our country are being impacted. These sectors are Manufacturing and supply chain, Healthcare, Agriculture, Financial Services, Education Consumer and retail, Accessibility technology for the differently abled, National security and defence, Public and utility services, Environment, etc. Even the impact on these sectors is more formidable with each passing day. Our country needs a cutting-edge discipline that holds the promise of transforming our world of work and life in the form of Quantum AI which will affect all of us in unprecedented ways.

What is Quantum Computing?

Unlike classical computers, which operate using bits (0 and 1), quantum computers utilize quantum bits or *qubits*. Qubits exist in superposition, allowing them to represent both 0 and 1 simultaneously. Therefore, they exhibit entanglement, a phenomenon where the state of one qubit instantaneously influences another, regardless of distance. This is the core of quantum computing which provides impeccable speed to our complex calculations and operations.

What is AI?

Artificial intelligence (AI) is the most significant general-purpose technology of our

era that is capable of ingesting large amounts of data into machines to analyse for correlations and patterns. This is in contrast to free human intelligence, which requires more time to process the same. There were days when human beings took a long time to connect and conclude on any issues but the advent of AI has bridged the pace and scale. For instance, more personalized search results on the web, app-based cab services, faster networking across the globe, spotting the location through GPS, suggestions about online shopping, traffic-less driving, restaurants, movies and entertainment, etc. In addition, AI is moving from hype to reality and is increasingly cementing its importance as a building block for modern software and applications.

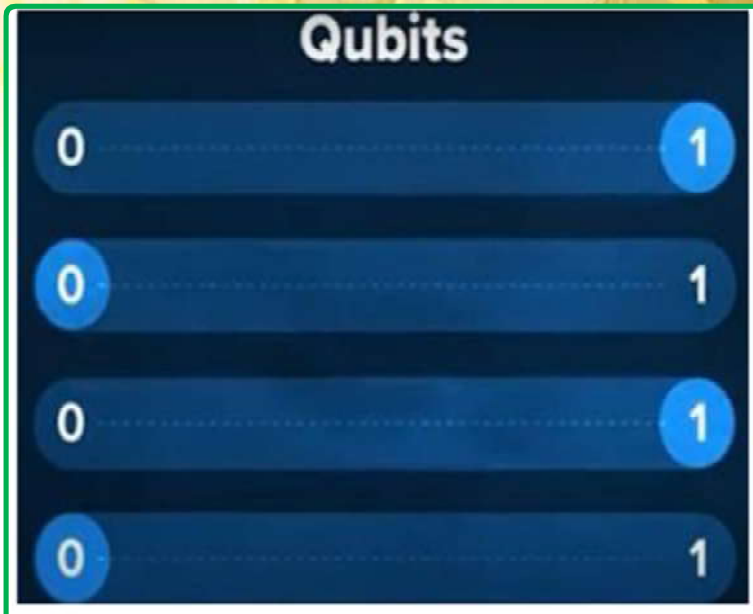

Figure 1 Qubits in QAI
:https://www.youtube.com/watch?v=dEXXAvkFsTU&t=237s

Quantum AI (Q-AI)

Quantum AI, also known as Quantum Machine Learning (QML), is a type of artificial intelligence that is able to make decisions faster and smarter than conventional AI. Q-AI does this by taking advantage of quantum computing technology that uses qubits rather than bits which helps it process data much more quickly. Rather than having to process all information one bit at a time like conventional computers, Quantum AI is able to read qubits in parallel (which means it can find different solutions simultaneously). This helps speed up the learning and decision-making processes exponentially!

Today Quantum computers are also able to access different layers of data, which makes deep learning easier for them. For example, conventional AI can process thousands of images in a second whereas Quantum AI can analyze millions at the same time. This has resulted in Q-AI more faster, less time-consuming, and fewer resources for consumption than traditional AI.

How it Works

Quantum AI uses quantum machines or computers. Unlike classical computers that use bits to represent information as either a 0 or a 1, quantum computers use quantum bits, or qubits, which can exist in multiple states simultaneously through a phenomenon known as superposition. A typical Qubits is given in Fig.1.This superposition needs faster machines such as quantum computers. Quantum machine leverages the information processing power of quantum technologies to enhance and

speed up the work performed by the machine. Even quantum machines perform faster than supercomputers.

Applications of Quantum AI

Quantum AI harnesses the potential of quantum computing to advance the capabilities of artificial intelligence. One of its most significant advantages lies in solving complex problems at an unparalleled speed. Quantum algorithms can outperform classical algorithms in certain tasks, such as optimization, cryptography, and machine learning. Some of the striking applications of QAI are-

- ***Drug Discovery:*** With the growing population and diseases, the healthcare industry needs the development of new medications. Quantum AI can expedite the process of drug discovery by simulating molecular interactions and predicting molecular structures with remarkable accuracy.
- ***Systems Optimization***: Quantum AI algorithms excel in optimizing complex systems, from logistics and supply chains to financial portfolios. They can efficiently solve optimization problems that are impractical for normal computers due to their low computational intensity.
- ***Secure Communications:*** Quantum AI contributes to developing quantum-resistant cryptography through Quantum Keys to ensure robust and secure communication channels in the face of evolving cyber threats and make the machines theoretically unhackable.
- ***Visualizing Quantum Concepts:*** Visual aids can simplify complex quantum concepts for better comprehension. Imagery demonstrating qubit superposition and entanglement can illustrate the foundational principles of quantum computing.

Quantum AI & Future Road Ahead

Despite its immense potential, Q-AI faces innumerable challenges. Building and maintaining stable qubits remain a hurdle due to quantum decoherence, which causes qubits to lose their quantum state. Moreover, scaling quantum computers to handle practical problems without errors is a significant obstacle. Ethical considerations are other aspects of the development of Q-AI.

As of now, the area of Q-AI is in its infancy, ongoing research and advancements hold the promise of overcoming current limitations. As technology evolves, it is conceivable that quantum computers equipped with AI capabilities will become integral in various industries, transforming how we approach scientific research, cybersecurity, finance, marketing, and many more.

Recent Developments in Quantum AI

The Pace of research in the field of Quantum AI is rapidly taking place all over the world. Some of the cutting-edge research is revolutionizing the spread of Quantum AI. A few such areas are Google's Quantum Supremacy, Quantum Machine Learning Algorithm, Quantum-Safe Cryptography, Error Correction in Quantum Computers, etc.

Recent research in Q-AI has manifested in many ways, which are discussed in threadbare.

a) A new and more faster operating System aimed at running the futuristic superfast quantum computers is developed by Cambridge Quantum Computing Limited (CQCL). Similarly physicists at the universities of Bonn and Cambridge have succeeded in linking two completely different quantum systems to one another in line with human teamwork.

b) Recent research reveals the development of quantum algorithms for machine learning tasks. For example, Algorithms like Quantum Support Vector Machines and Quantum Neural Networks are being explored for their potential to process and classify data faster and more efficiently than classical algorithms.

c) To mitigate the vulnerability of traditional cryptographic methods, researchers are working on developing quantum-resistant cryptographic techniques that can withstand attacks from quantum computers. Quantum key distribution is a notable example that ensures secure communication channels even in the face of quantum threats.

d) Researchers have made strides in developing error correction codes to mitigate quantum decoherence. That causes errors, making quantum computations more reliable and stable.

e) Google's quantum computer, Sycamore, achieved a milestone called quantum supremacy. For example in 2019, Sycamore solved a specific problem in 200 seconds that would take the world's fastest supercomputer over 10,000 years to solve.

India and AI

To invigorate the use of AI towards India's economic transformation, the Ministry of Commerce and Industry, Government of India has constituted Artificial Intelligence Task Force and provided financial support for AI programmes. Similarly, the Ministry of Electronics and Information Technology (MeitY), Government of India, has been funding projects by educational institutions in the areas of computing and wireless sensor networks for the promotion of artificial sensing, and perceptual robotics). MeitY is also operating a Technology Incubation and Development of Entrepreneurs (TIDE) scheme for facilitating technology innovation over the last decade.

Conclusion

With the emergence of Q-AI researchers and scientists continue to push the boundaries of innovation, that will shape a future where the unimaginable becomes achievable. Even Quantum AI can transform the shape of future Technologies and industries such as healthcare and finance to cybersecurity and logistics, shaping a future where complex problems are solved efficiently and securely. It is an opportune time for our country to

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DEATHLY BOTTOM

Prof. (Dr.) Ajay Kumar Patra

How one can forget the day on 26th April, 1986? It was night. All of a sudden an explosion causing terror took place in an atomic energy centre established in Chernobyl city of Ukraine. With combustion producing light and heat as well as incandescence, the fire extended in all directions. In the very night shift, it was well-planned to investigate whether the emergency reactor cooling water system of atomic energy centre is functioning properly or not at the time of energy conservation. For the reason of experimentation, the automatic safety arrangement of the plant was shut-down. However, at the time of experimentation, because of certain unknown error, irregular reaction occurred inside the reactor. As a result of which a terrific explosion took place after having heavy pressure. Because of shut-down, the automatic safety arrangement of fire-alarm didn't work at all. Within a second, a huge amount of explosive radioactive substances along with contaminated burnt ashes and gleam of fire spread hither and thither, everywhere and soon got into the environment.

Ukraine Chernobyl Disaster in 1986

The officers and workers of fire brigade without knowing its corrosive impact tried hard to extinguish the fire. While doing so, they could feel the bursting of metals or pins on their faces.

The numberless ignorant local families gathered together on the nearby river bridge to see, out of curiosity the colourful fire produced from explosion. There too children started playing merrily with the pieces of burnt flying radioactive substances looking like white ice. But they didn't know that they were caught by death-trap and death penalty was awaiting them. It was later on known from reliable sources

that the members of all families and all children who were present there on the bridge of that deathly night died within few days because of radiation producing from contaminated radioactive substances. After the intervening time, all officers and workers of fire brigade engaged in extinguishing fire and all the workers of the plant on night duties also died untimely. This historical atomic accident could cause deaths of about 1,25,000 persons suffering from cancer, especially the cutaneous cancer as well as leukaemia. From that terrible night, the bridge was given a name, "The bridge of death."

The next mission of total destruction or disposal of radioactive burnt ashes of Chernobyl Atomic Energy Centre was a very difficult task. For this purpose the staff engaged were entering with full precautions into the core area of the plant for a few seconds only by putting on anti hazardous material suits. An alarm was cautioning them to come out of the plant and second group of staff were sent to clean the core area of the plant.

The mad fire of this rare explosion was calmed down to normal condition after two weeks by using huge amount of sand, lead, nitrogen and boron. The harmful iodine 131, cisium 137, plutonium and strontium 90 along with enough radioactive isotopes had entered the environment uncontrolled for continuously ten days and had also affected the neighbouring nations.

Because of life risk from radiation a safe shelter house was set up near a small town named "Preepayat". All the families living nearby were shifted soon into that shelter house. To stop further radiation of dangerous radioactive substances, the army killed all the animals and birds of that affected area. Though it was an inhuman task, but they were compelled to perform this in order to prevent the environment from harmful radiation.

Since there was a fear of radiation from dead bodies, the same were placed deep in the tombs inside the concrete coffins. Also all the useful cultivating lands and cereals were burnt into ashes. The area of about 1600 km around the Atomic Energy Centre was declared as "Chernobyl Exclusive Zone". This affected area such as river water, the forest trees, shrubs and herbs as well as cultivating lands were not at all favourable for human habitation till 2400 years or so. In order to hold the harmful radiation of damageable reactor, an iron and cement concrete carcophogus have been constructed which have covered the whole damageable reactor. This airproof and waterproof box can stop radiation for about 100 years.

There is no end to this sad story. In 1979, in the month of March a similar kind of terrific accident happened in the Atomic Energy Centre located in the Three Mile island of Pensilivania of USA. In this accident too widespread damages were occurred. Again in Japan March, 2011, because of earthquake and tsunami, hydrogen explosion occurred in Nuclear Plant of Fujiama Daechi. In this inhuman accident, a great deal of damage was done and the most harmful radioactive gas escaped accidently through an opening into

the atmosphere. The quantities of contaminated radioactive water have been raised to ten lakh tons. This harmful water after careful collection has been kept safely in several storage tanks. Having shortage of places to place these risky storage tanks, the government of Japan is thinking to throw those tanks into the depth of pacific ocean which in future for sure can cause extreme harmful impacts on aquatic biota bringing about immature deaths in crores. However, the Japanese scientists were trying to their best to separate the radioactive isotopes, tritium of hydrogen from that harmful water.

Furthermore, in the Second World War, on 6th and 9th August, 1945, two atomic bombs named, "Little Boy" and "Fat Man" were dropped on Hiroshima and Nagasaki cities by America. In this terrible bombardment, history had never seen witnessed the instant death of about two lakh and fifty thousand people. Many more died afterwards due to cancer as a consequence of the explosion of atom bombs. Yet several Japanese are struggling for life in different hospitals of Japan.

Conclusion

The endless damages already done due to atomic disaster may not be altered, but all the people of Earth must learn a lesson about the horrid impacts of harmful radiation of radioactive substances. Today most of the nations instead of looking after the welfare of their people, are more interested in producing deathly atom bombs. The total amount expended in one five-year plan of a nation is equal to the production of a single atom bomb. The Earth today sits on fire. And the deathly bottom of atomic bomb lies at the feet of the top leaders' sitting place. That means the destiny of the whole mankind lies at the mercy of deathly bottom.

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delve into the infinite possibilities of Q-AI through research and exploration whose time has come.

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4 THE TAL PALM/ PALMYRA PALM

Bikash Mohanty

Botanical Name - Borassus flabellifer,

Family - Palmae/Arecaceae.

Introduction

This palm is indigenous to India.The palmyra palm is found in most parts of our country. It is a perennial crop.This palm can grow up to 100 to 150 feet in height. A strong central upright stem is a special character. The trunk is about 61cm thick, robust with distinct leaf scars.The leaves are fan shaped, broad. Leaves are borne in clusters at the top and folded along the midrib. The petiole or leaf stalk is stout, 60-100 cm long. The leaf sheath has a distinct cleft at its base, through which inflorescenses appear. Plant is dioecious with male and female flowers on separate plants.The inflorescence of both male and female flowers is enveloped in a large bract or sheath which is boat -like in shape. Flowers bloom in March and April.The fruit requires about one year to ripen. Fruits are oval or spherical and contain three nuts.The nuts have a white, soft, jelly like fleshy portion which is edible and is very refreshing in the hot summer. Fruit has laxative effect. Palm grows in fallow lands and in all soil types. Palms are propagated through seeds. The Palmyra palm is one of the most useful trees of India.

Uses of Palmyra Palm

The tree starts filling up with sap when it is seven to ten years old. Floral branches are supplied abundantly with sap.The sap is sweet and tasty. Fermented sap is the Toddy. To extract toddy, an incision is made into one of the flower-laden branches, and a pot is hung below to collect it. The juice keeps dripping and collecting in the pot. The unfermented sap 'Neera' is a refreshing and nourishing drink. If the toddy to be drunk as Neera, the pot has to be taken down before the sunrise. Neera which

Palm Tree

is rich in minerals, vitamins, carbohydrates, protein can meet the daily requirement of man. After sunrise it ferments due to heat and becomes intoxicating.Toddy can be converted into vinegar. Birds particularly crow and a type of small parrot are fond of the juice. Birds drink the juice and get intoxicated.They are known to sit motionless for hours on the tree in a state of intoxication.

Palm Fruit

Jaggery is obtained by boiling the unfermented juice in to a syrupy consistency and then allowing to cool and harden. Jaggery made out of palm juice is considered good for health and it is used as a household remedy for Bronchitis.Palm gur is very popular in West Bengal.

Palmyra leaves are used mainly for making fans, mats, baskets, sandals and umbrellas. The leaves are utilized for production of a host of artistic and useful leaf articles. Palm leaf boxes are used in Lord Jagannath Temple at Puri for packaging *Prasad.* In villages leaves are also used for thatching houses. The ribs of the leaves and the fibres are used for making brooms and brushes.

The black timber is hard, heavy and durable and highly valued for construction work. Its wood does not warp nor it is easily attacked by white ants. It is, therefore, often used as a rafter or pillar in the construction of houses. The palmyra wood is stronger than even the teak or Sal. The trunk is often used as a pipe after removing the central core; split into halves, it is used as a drain-pipe for conveying water. All parts of the tree make good but fast burning fuel.The young seedlings are used as vegetables. This palm is planted as a wind break on the plains.These trees also protect coastal areas from storms and cyclones. It is also used as a natural shelter by birds, bats.

Palm leaf (*TalPatra*) is considered to be the earliest writing material used by man. Quite a few Sanskrit and Pali books written on palm leaves are still preserved in different libraries and in the houses of Sanskrit scholars. Paintings too were done on palm leaves.

The Palmyra palm is considered sacred both by Hindus and Buddhists. This may be due to the palmyra leaves having been used for writing sacred scripts in ancient times. The leaves and fruits are used for decorating marriage pandals. The palmyra tree may attain 100 years of age and more.

Palmyra Palm and Lightning

On 02nd September 2023, in Odisha due to lightning 12 persons lost their lives, 14 persons were injured and 8 cattle died as per the report published in Sambad dated 06.09.2023 based on report of SRC, Odisha dated 03.09.2023. There were total 39392 lightning on 02.09.2023 in Odisha.In Khurda District there were maximum lightnings (4852 times).

In Odisha from 2001 to 2021, 5164 persons lost their lives due to lightning as per report published in Sambad dated 04.09.2023 based on Annual Lightning report of 2022-2023 of Climate Resilient Observing Systems Promotion Council. In case of death due to lightning Odisha stands in third place. Maximum people in village area are dying due to lightning.

In 2021-22, 281 lightning deaths were reported in our state particularly in rural areas. Environmentalists have expressed concern over rampant felling of Palm trees that protect against lightning.

Experts say that lightning usually hits the tallest object first. Palm trees being the tallest, they work as a lightning conductor. While working as a lightning conductor, the palm tree is reducing the chances of people getting struck by lightning strikes. The practice of planting palm trees in villages has been discontinued due to urbanization and infrastructural development.

Considering frequent lightning, Government of Odisha has decided to promote massive palm tree plantation. In the rainy season, ripened palm fruit is the best food for the elephant since there is food scarcity during rainy season. So, Palm tree cutting is also linked to man elephant conflict as in the absence of Palm trees, elephants face difficulties in getting food.

Therefore, we have to protect the existing palm trees and we have to use seeds of palm fruit and bury them in reserve forests for the elephants and along the cultivable lands and farms to protect people from lightning.

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INDIA'S ADULT OBESITY NEEDS URGENT ATTENTION

Prof. Raj Kishore Panda

India has been going through a rapid epidemiological transition-from a land of under-nutrition and underweight population to a country of over-nutrition and overweight/ obese population. Data showing nutritional status of adults by the National Family Health Survey-5 (2019-21) indicate that the percentage of overweight/ obese individuals (15-49 years) in the country outweighs the underweight ones.

Gender-wise 24 percent women and 23 percent men aged 15-49 are found overweight or obese in the country as against 19 percent women and 16 percent men in the underweight category. Besides, between 2015-16 (NFHS-4) and 2019-21 (NFHS-5) obesity has shown a 4 percent point rise (4.3 points among men and 3.4 points among women).

Generally overweight/obesity is a condition characterized with an increase in size and amount of fat cells in the body. It is seen when a person is too heavy for his/her height. Overweight/obesity results from an imbalance between energy consumed and energy expended. Commonly assessed on the basis of Body Mass Index (BMI) it is defined as the ratio of weight (in kilograms) to squared height (in metre) and thus expressed as kg/m^2.

Based on WHO standard of BMI, any individual having 25 kg/m^2 or above is considered as overweight, 30 kg/m^2 or above as obese and more than 40 kg/m^2 as sever obese (normal individual having between 18.5 kg/m^2 to 24.9 kg/m^2 and underweight below 18.5 kg/m^2). Overweight/ obesity is a chronic disorder in an individual that increases his/her risks to several non-communicable diseases (NCDs) such as; diabetes, hypertension, strokes, certain cancers etc.

Studies report rising burden of NCDs surpassing the burden of communicable diseases (CDs) in India. The WHO study on the rise of NCDs in 2017 has estimated nearly 5.8 million deaths occurring in India annually. A report of Ministry of Health and Family Welfare, Government of India accounting the burden of NCDs has stated that between 1990

and 2016 while death due to NCDs has increased from 37% to 61%, disability due to NCDs has increased from 30% to 55%.

For India, obesity trend has posed serious challenges. Between 2006-16 while India experienced rapid decline in child and adult under-nutrition, during this period adult overweight/obesity has doubled. Besides obesity is no more a problem of urban well-to-do in India. In recent years it has increasingly entered into the villages and among middle-class households.

Between 2015-16 and 2019-21 obesity growth in rural areas is found higher than that in urban areas. During this period, while obesity among rural men and women increased by 5 and 4.6 percent points respectively, among the urban men and women it increased by 3.2 and 0.8 percent points. Faster rise in incidence of rural obesity is largely attributed to changes in the nature of work in rural areas. As the Indian economy has been going through the process of structural transformation it has led to increasing movement of labour away from physically strenuous farm-based employment.

Overweight/ obesity besides associated with life-threatening diseases have serious economic consequences at the individual, household and state level. Not only it affects the medical cost of an individual but also it entails a productivity cost to the household and state in the form of absenteeism, premature mortality, disability etc.

A study (2022) on the average obesity cost at the all-India level works out to be Rs.2.8 lakh crore per annum. Based on the exercise it is estimated that if the spread of obesity is not controlled, India would incur a loss of nearly Rs 69 lakh crore amounting 2.5 percent of its GDP in 2060.

Obesity, no doubt has now emerged as a potential threat to public health in India. Since the country is going through a demographic transition characterised by declining birth and death rates and an increasingly ageing population, obesity is bound to rise.

This combined with rising income due to considerable economic growth will further increase average calorie intake per individual in middle and high income households enhancing obesity concern. Studies have shown rise in people's habit in taking food away from home and the country is experiencing reversal in the declining trend in per capita calorie intake in recent years.

The existing public policies and interventions largely emphasize on the programmes of ameliorating poverty, hunger

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HOW SAFE IS SILICONE COOKWARE?

Dr. Jyotshna Mahapatra

Now-a-days we find things made up of silicone much use in cookware etc. Now the question is how safe it is? Many experts and authorities consider silicone completely safe for food use in the kitchen. For example Health Canada states, "There are no known health hazards associated with use of silicone cookware. Silicone rubber doesn't react with food or beverages, or produce any hazardous fumes."

While the main chain of common organic synthetic polymers consists of repeating carbon (C) atoms, silicone is an "inorganic synthetic polymer" whose main chain is made of polysiloxane, which is the repetition of silicon (Si) and Oxygen (O) atoms.

Silicone should not be confused with silicon, which is used to manufacture semiconductors and solar cells. The term 'silicone' refers to a family of manmade compounds, of which silicon (Si) is a key element. Shin-Etsu Handotai (part of the Shin-Etsu Group) produces semi conductor-grade silicon, and is the World's leading producer.

The question arises; Is silicone made of plastic? The short answers is yes, it is a plastic polymer, although it may be referred to be as a synthetic rubber.

A silicone of polysiloxane is a polymer made up of siloxane. They are typically colourless oils or rubber like substances. Silicones are used in sealants, adhesives, lubricants, medicine, cooking utensils, thermal insulation and electrical insulation. Some common forms include silicone oil, silicon grease, silicone rubber, silicone resin and silicone chaule.

Silicone is considered chemically stable. Silicone isn't the most environment friendly material in the market. Silicone production uses hydrocarbons derived from petroleum which isn't sustainable. It is difficult to recycle and most facilities won't accept it. We can say silicone is a suitable alternative to plastic - it is just not the best.

Though it is not a 100 percent natural material like rubber, food-grade silicone is a non-toxic polymer mostly made from silica (sand). It can withstand heating and freezing without leaching or off - gassing hazardous chemicals – unlike plastic which contaminate food in these environments.

It doesn't contain BPA, latex, lead and other harmful by- products which by the way, should be nowhere near your baby's mouth.

Silicone like other human-created compounds doesn't biodegrade because it is a new material. They haven't existed long enough for natural processes that break down other materials, like yeasts, bacteria, fungi and enzymes to evolve to degrade them.

Silicone is a versatile polymer used in elastomers, oils, greases and chalks, among other materials. Its primary ingredient is silica – one of the most commonly occurring forms of sand. Silicon is chiefly obtained from quartz which is not much difficult to mine than scooping up sand, also obtained from the silicate minerals, mica and talc.

Silicones don't absorb microwaves, but like all microwave – safe utensils they can get hot in the microwave oven from contact with the heated food. Because silicones are chemically inert the pans and dishwashes are safe; caustic detergents can't touch them.

All silica minerals have a basic three-dimensional microscopic structure composed of tetrahedral arrangements of oxygen atom about a central silicon atom, with each oxygen atom shared with a neighbouring tetrahedral group. The packing of the tetrahedral vary among the silica minerals, with the most common form of silica-quartz-exhibiting a relatively dense packing. Two other forms of silica-cristobalite and tridymite have a much more open framework, easily accommodating small amounts of impurities within the three-dimensional structure. The gem opal contains cristobalite, tridymite or mixture of these two silica minerals. Because the structure of opal is not crystalline but amorphous (lacking in a periodic three dimensional arrangement of atoms), opal is often considered a mineraloid (a naturally occurring "mineral" lacking a cryotalline structure). Due to its varying water content, opal is also described as hydrated silicon dioxide or a hydrate of silica with a general formula of $SiO_2\ nH_2O$. The iridescent colours associated with opal arise from a semi-periodic arrangement of uniform microspheres with hydrated SiO_2 that are spaced at about the wavelength of visible light. These microspheres range in from 200 to 300 nanometres in diameter and serve as a diffraction source for refracted and reflected light.

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7 RAMAJUNJAN'S NESTED RADICALS

Er. Mayadhar Swain

Srinivas Ramanujan (1887-1920) was one of the famous mathematicians of the world. Born in a poor family of Kumbakonam in Tamilnadu, he became world famous in mathematics due to his inherent talents. He was a child prodigy. From early childhood, his mathematical abilities were known. While studying in school, he mastered the advanced trigonometry book written by S. L. Loney without anybody's help. He also came about the book *A Synopsis of Elementary Results in Pure and Applied Mathematics* by G. S. Carr. This book has more than 5000 formulas and theorems without proof. Ramjanujan found out many proofs himself without knowing that some of these had already been discovered earlier.

Srinibas Ramanujan

Ramanujan passed matriculation examination with good marks and got admission to the college with scholarship. But in college, he spent almost all his time to do mathematics and thus neglected other subjects. As a result, in the F.A. examination he failed in those subjects. Due to his complete devotion to mathematics and negligence of other subjects, he could not get a college degree. Then he started searching for a job. He had only one asset i.e. his notebook containing more than 500 mathematics formula and theorem. But to get a government service, college degree was essential. Luckily for him some benevolent persons helped him. Among them were Ramachandra Rao, Collector of Nellore, Ramaswamy Aiyer, Deputy Collector of Gooty, Sir Francis Spring, Chairman of Madras Port Trust, S. Narayan Iyer, Accountant Head of Madras Port Trust. With this help, he was appointed to a Class III post in Madras Port Trust. At that time, nobody in India could understand his mathematics. So with the suggestion of his mentors, he wrote a letter to G. H. Hardy, Professor of Mathematics in Cambridge University. This letter sent on 16 January, 1913 with enclosure of nine pages of

mathematics was a historic one as this paved the way for his exposure to world mathematics.

With Hardy's help Ramjanujan went to Cambridge University in 1914 and studied at Trinity College. Within a span of four years he published a number of research papers on mathematics, some in collaboration with Hardy. Based on his research works Trinity College conferred him with B.A. degree. He was elected as member of Royal Society and also got the Fellowship of Trinity College. Due to his illness he was forced to return to India in 1919 and died at the age of only 32 years.

Before getting the appointment at Madras Port Trust, Ramanujan was searching for a job but in vain. During that time he came in contact with V. Ramaswamy Aiyar who was a member of Indian Mathematical Society. On his insistence, Ramjanujan started writing in the monthly *Journal of the Indian Mathematical Society (JIMS)*. Most often he was asking some questions and inviting the readers to send the answers.

One such question Ramjanujan asked in the journal in 1911 is the nested radical problem. For two months nobody gave its solution and then he gave it himself in the journal. He has also entered the problem in his now famous Note Books. This is question No.289 of the JIMS. He had made 58 such contributions to JIMS, including the famous Rogers- Ramjanujan identities.

Ramjanujan posed the following as question 289, in the JIMS: Find the value of :

i) $1+\sqrt{\left(1+2\sqrt{\left(1+3\sqrt{\left(1+\&c\cdots\right)}\right)}\right)}$

ii) $1+\sqrt{\left(6+2\sqrt{\left(7+3\sqrt{\left(8+\&c\cdots\right)}\right)}\right)}$

Ramjanujan also provided the following solution to this Q.289:

(i) Notice that $n(n+2)= n\sqrt{1+(n+1)(n+3)}$. Let $f(n)=n(n+2)$, then,

$$f(n)=n\sqrt{1+f(n+1)}$$

$$=n\sqrt{1+(n+1)\sqrt{1+f(n+2)}}=\cdots,$$

that is,

$$n(n+2)=n\sqrt{1+(n+1)\sqrt{1+(n+2)\sqrt{1+\cdots}}}.$$

Putting n = 1, we have $\sqrt{1+2\sqrt{1+3\sqrt{1+\cdots}}}=3.$

(ii) In a similar manner: $n(n+3)=n\sqrt{(n+5)+(n+1)(n+4)}.$

Supposing $f(n) = n\,(n+3)$, we have

$$f(n)=n\sqrt{(n+5)+f(n+1)}$$

$$=n\sqrt{(n+5)+(n+1)\sqrt{(n+6)+f(n+2)}\cdots}=\cdots$$

thus

$$n(n+3)=n\sqrt{(n+5)+(n+1)\sqrt{(n+6)+(n+2)\sqrt{(n+7)+\cdots}}}$$

Putting n = 1, we have $\sqrt{6+2\sqrt{7+3\sqrt{8+\cdots}}}=4.$

Ramanujan noted down the general result as Entry 4, in Chapter XIV of his first Notebook and as Entry 4, in Chapter XII of his second Notebook, which reads

4. $x + n + a =$

$$\sqrt{ax+(n+a)^2+x\sqrt{a(x+n)+(n+a)^2+(x+n)\sqrt{\&c}}},\ (*)$$

e.g. (i) $3=\sqrt{1+2\sqrt{1+3\sqrt{1+4\sqrt{1+\&c}}}}$,

(ii) $4=\sqrt{6+2\sqrt{7+3\sqrt{8+4\sqrt{9+\&c}}}}$.

The examples are obtained from (*) by putting x = 2, n = 1 and a = 0 and 1, respectively.

Bruce C. Berndt, in his work on Ramanujan's Notebooks, writes down this Entry 4 as Entry 4. Let a, n and x denote arbitrary complex numbers. Then

$f(x) := x + n + a$

$= (ax + (n + a)^2 + x\,(a(x + n) + (n + a)^2 + (x + n)\,(a(x + 2n) + (n + a)^2 + (x + 2n)(\ldots)^{1/2})^{1/2})^{1/2})^{1/2}$.

Proof. By successively substituting, we find that

$f(x) = (ax + (n + a)^2 + xf\,(x + n)^{1/2}$

$= (ax + (n + a)^2 + x\,(a(x + n) + (n + a)^2 + (x + n)\,f\,(x + 2n)^{1/2})^{1/2})$

$= \ldots,$

and therefore we obtain the proposed formula.

Examples. We have

(i) $3 = (1 + 2\,(1 + 3\,(1 + 4\,(1 + \ldots)^{1/2})^{1/2})^{1/2})$

and

(ii) $4 = (6 + 2\,(7 + 3\,(8 + 4\,(9 +)^{1/2})^{1/2})^{1/2})$.

A simplified version ofthe Ramanujan's solution is given here to capture the gist of his solution.

Note that for any non-negative real number x, we have –

$$x+1=\sqrt{(x+1)^2}$$
$$\Rightarrow x+1=\sqrt{1+2x+x^2}$$
$$\Rightarrow x+1=\sqrt{1+x(x+2)}$$

Now, $(x + 2)$ can again be written as $((x + 1) + 1)$, to get -

$$x+1=\sqrt{1+x((x+1)+1)}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{((x+1)+1)^2}}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{1+2(x+1)+(x+1)^2}}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{1+(x+1)+(x+3)}}$$

Carrying on with the process and writing $(x + 3)$ as $((x + 2) + 1)$, we get

$$x+1=\sqrt{1+x\sqrt{1+(x+1)((x+2)+1)}}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{1+(x+1)\sqrt{((x+2)+1)^2}}}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{1+(x+1)\sqrt{1+2(x+2)+(x+2)^2}}}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{1+(x+1)\sqrt{1+(x+2)(x+4)}}}$$
$$\Rightarrow x+1=\sqrt{1+x\sqrt{1+(x+1)\sqrt{1+(x+2)\sqrt{((x+3)+1)^2}}}}$$

The pattern is pretty visible by now. It's clear that if we carry on this process infinitely, we'd land at –

$$x+1=\sqrt{1+x\sqrt{1+(x+1)\sqrt{1+(x+2)\sqrt{1+(x+3)\sqrt{1+\ldots}}}}}$$

Now comes the magic! Plugging in $x = 2$, we get –

$$3=\sqrt{1+2\sqrt{1+3\sqrt{1+4\sqrt{1+5\sqrt{1+\ldots}}}}}$$

It's hard not to wonder at the remarkable stroke of genius at the heart of this solution. Who would have thought that representing a number as the square root of its square could lead to such a beautiful identity?

Also, the above serves as an excellent example of a broader category of problems – wherein the problem posed is a particular case of more general identity. In such cases, we discover the general identity first and then

plug in suitable values to get the desired result. For example, we can now easily say that –

$$125 = \sqrt{1+124\sqrt{1+125\sqrt{1+126\sqrt{1+127\sqrt{1+\ldots}}}}}$$

So, that was Ramanujan's solution to the problem.

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Ramanujan's Magnificent Formula for Pi

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801}\sum_{n=0}^{\infty}\frac{(4n)!\,(1103+26390n)}{(n!)^4 396^{4n}}$$

$$\pi = \frac{9801}{1103\sqrt{8}}$$

.....Continuing from Page No.-111

and under-nutrition. A few years ago there was a discussion of a 'Sin Tax' to raise prices of unhealthy food and drink to discourage their consumption but it did not work out. Time has come to adopt strategy to discourage the consumption of unhealthy foods. Similar to the mandatory warning on cigarette packets, the packets of unhealthy foods and drinks should contain pictorial warning to deter people from consuming the products.

With under-nutrition prevailing at a high level, increased prevalence of adult obesity puts India in a challenging situation. Health care being a state government area of making policies it is difficult to manage the double burden of malnutrition (under-nutrition and obesity) at the state level due to paucity of resources. Both central and states have to rise to the occasion. Sooner they rise to the occasion, the better.

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8

CARBON FOOTPRINT: A COMPONENT OF ECOLOGICAL FOOTPRINT FOR ENVIRONMENT SUSTAINABILITY

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An ecosystem maintains a functional balance among various components through the carrying capacity of its environment and recycling wastes. Biocapacity represents potential of a given area to provide ecosystem services such as resource production and waste assimilation. Human beings share a single planet where resources are available in a limited amount. Resources are being consumed at very faster rate than it is renewed. Urbanization and industrialization are main factors for ecological disturbances. Due to anthropogenic activities, greenhouse gasses like carbon dioxide, methane, CFCs increase in the atmosphere and consequently cause global warming. It gradually increases the earth's temperature. It creates threat to the ecosystem and leads to changes in the climatic conditions.

Ecological footprint is a measure of the burden produced by a given population on nature. It checks the consumption pattern of resources and lifestyles of the society against the biocapacity of our planet in a sustainable way. Thus, it is an important computational tool to understand carrying capacity of our planet and to calculate the ecological requirements for sustainability (Goldfinger & Wackernagel, 2007). Sustainability finds the ways to fulfil the needs of current generation without compromising needs of future generation. Carbon footprint are a component of ecological footprint. The carbon footprint serves as an indicator of total amount of greenhouse gasses emissions from direct and indirect activity of an individual, organization or product.

It deals with the direct emissions within the boundaries and indirect emissions such as from travel, transportation of materials, emissions from electricity, waste generation management by other bodies. For example - A person uses car and emissions from it coming under direct emission and emission during production of cars and extraction of fuel by industry coming under indirect emissions. The concept of footprint was proposed by Rees. Mathis Wackernagel is the founder of global footprint network. It calculates the overshoot day of earth. It marks the date where human beings use more earth's ecological resources than the planet can renew in entire year. In 2023, earth overshoot day was on 2nd August. Human society face an ecological deficit from

this date to until the end of year.

Carbon footprint expressed as carbon dioxide equivalent (CO_2 eq) whereas ecological footprint expressed in global hectares. Carbon footprint is also known as greenhouse gasses footprint. It is expressed in units of CO_2- metric ton, million tons or gigatons on a national or global scale. In 2020, India's CO_2 emission is 2411.73 Mt and Carbon dioxide emission per capita is 1.74 tonnes (https://Worldpopulationreview.com).

There are many significances to study of Carbon footprint such as:

(a) Identify main sources of emissions

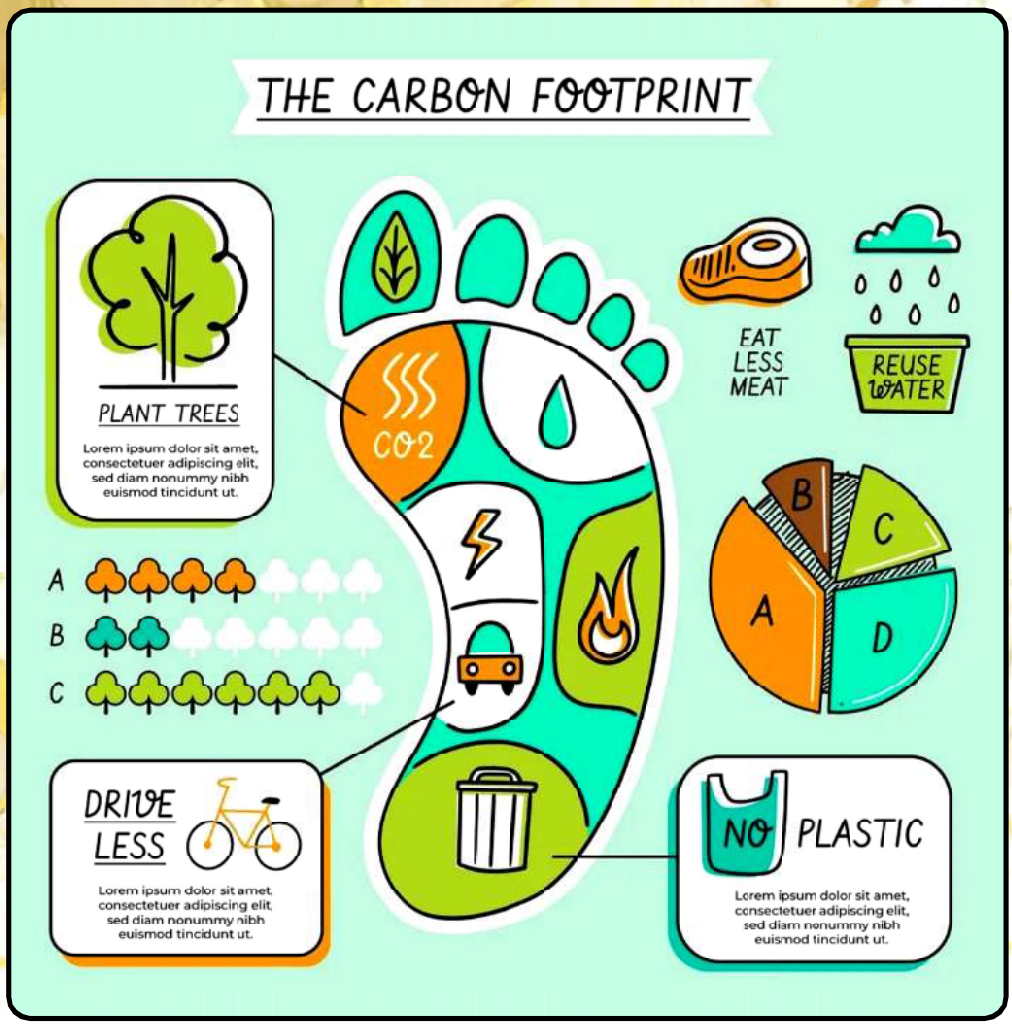
(b) Plan to curb the reduction of emission

(c) Policy making to cut down emissions

(d) Personal lifestyle management.

Measurement of Carbon Footprint

We can calculate footprint of individuals, nations and organizations by available methods. Carbon footprint can be calculated for academic institutes, cities, nations, individuals. Life cycle assessment method is used for measurement of footprint. Another method is ISO14064. It is an international standard to determine the boundaries and quantification of GHG emissions. ISO14067 is a standard for carbon foot printing of products under development. Sangwan *et al.*, 2018 studied carbon footprint of Birla institute of Technology and Science, Pillani, India, using life cycle assessment method. Pathak *et al.*,2010 calculated carbon footprint of Indian food items and considered GHGs emissions at 4 stages production, processing, transportation and final preparation. They revealed that non-vegetarian diet has high carbon footprint than vegetarian diet. Carbon footprint from fossil fuels has been increasing



every day. The estimated carbon footprint release from all major fossil fuels used in India mounted to 1,209,243 gigagram in 2005-06 and 1,768,057 gigagram in 2013-14 (Maheshwari *et al*., 2017).

There are also many web-based sites which can easily calculate the footprint of individual. We are mostly acquainted with mobile phone or android applications which can inculcate the carbon footprint calculation on daily basis in our hand. One such app developed by Chandigarh named as Carbon watch. It focuses on individual actions and ask questions on basis of transport, energy, waste and water consumption. DOGAN *et al*., 2019 used World wide fund (www.org.in) and developed ecological footprint calculation tool (ekolojikayakizim.org) for calculation of footprints of academicians working at a state university in southeast of Turkey. It asked 23 multiple choice questions in total; on food, travel, home and other services, demographic data such as gender, age, academic unit.

Steps to Reduce Carbon Footprint

1) Incorporate walking or cycling for short trip destination and less use of fossil fuel

.....To be Continued at Page No.-125

9

COGNITIVE DEVELOPMENT

Dr. (Mrs.) Pritishri Parhi

Jean Piaget and his co-worker conducted researches on the development of cognition in children for more than the last forty years. His theory of cognitive development explains the qualitative development in the intellectual abilities. Generally cognition can be explained as the process of gaining knowledge about the world through perception, memory and thought. Cognitive development involves the orderly changes that take place in the way children understand the world and solve problems. Jean Piaget developed a very influential theory of cognitive development and divided the development of cognition in four periods which are interdependent to each other.

Stage I - The sensory –motor stage i.e. birth to 2 years.

Stage II - Pre-operational stage (2-7 years)

Stage III - Concrete operational stage (7-11 years)

Stage IV - Formal operation (11 to adulthood)

Stage I-The Sensory–Motor Stage

This period is from birth to 2 years of age. The child since his birth starts interacting with his environment and through the process of constant interaction he gets knowledge of the world. It is sensori – motor stage because the behavior of the child operates on sensori-motor level. This period is very crucial for laying the foundation to understand the world. Babies at this stage organize their physical action called schemes such as sucking, grasping and betting for dealing with the immediate world. Piaget divided this period into further 6 sub stages.

The use of Reflexes

When Piaget talked about the infant's action structures, he used the term scheme or schema. A scheme can be any action for dealing with the environment such as looking, grasping, hitting or kicking. The most prominent reflex is sucking reflex. Babies automatically sucked whenever their lips are touched. This stage lasts for birth to one month.

Primary Circular Reactions (One to 4 months)

A circular reaction occurs when the baby acts upon a new experience and tries to repeat it. For example, a child puts his finger in his mouth accidentally and tries to repeat it again. It is known as primary circular reaction

because they involve the co-ordination of parts of the baby's own body.

Secondary Circular Reactions:- (4 to 10 Months)

These reactions occur when the baby discovers and reproduces an interesting event outside himself or herself. For example – a child lying in a cradle hits the toy hanging on it with his leg. The child observes it moving and then repeats it and observe it moving again and become happy.

The Co-Ordination of Secondary Reaction (10 to 12 Months

In this stage, the infant's actions become more differentiated. The infant learns to co-ordinate two separate schemes to get a result. For example- A child wants to grab an object and there is an obstacle i.e. an adult puts his hand over it. The infant at this stage can think of striking the hand out of the way and grab the toy. So here the child co-ordinates two separate schemes- striking and grabbing to obtain the goal.

Tertiary Circular Reactions (12 to 18 Months)

At this stage, children experiment with different actions to observe the different outcomes. For example- A year old boy was sitting in the bath tub, watching the water pour down the faucet. He puts his hand under the faucet and notices how the water sprayed outward. He repeats this action twice, making the interesting sight last. But he shifted the position of his hand sometimes nearer; sometimes further away from the faucet, observing how water spray out at different angles. He varies his actions to see what new different results would follow.

Final Stage i.e. The Beginnings of Thought (18 Months to 2 Years)

At this stage, children seem to think out situations more internally before they act. The most widely known example is lucience and a match box. Piaget placed a chain in the box, which lucience immediately tried to recover. She possessed two schemes: turning the box over and sticking her finger in the box's slit. None of the schemes were successful. She then stopped her actions and observed the slit very carefully. Then, several times opened and closed her mouth wider and wider. After this she promptly opened the box and obtained the chain. Children at this stage are also capable of deferred imitation i.e. the imitation of absent models. By the end of sensori–motor stage, children develop the capacity to recognize that objects continue to exist even when they are not seen or perceived. This ability is known as object permanence. The child becomes capable of representing things mentally. For example=-somebody says the word 'dog', the child gets a mental picture of an object which makes a 'bow bow' sound. The child's mental development can be influenced by providing adequate stimulation i.e. Visual, sound, play materials, books etc.

Stage-II Pre-Operational Stage- (2-7 Years)

During this period, the child uses language and images with certain facility. The child engages what is called as "symbolic play" i.e. a wooden block may be considered

as a car, a round ring as steering wheel, a round bead as a chocolate etc. During this stage, the child's thinking is basically unsystematic and illogical. True thought and operations do not yet exist. Children do not have the ability to engage in a discussion but they take part in collective monologues. Preoperational children believe that everyone else thinks as they do. The child's thoughts are still limited to the perceptual and motor characteristics of the objects or the situations. Perceptual characteristics are those which are quite visible. For example- Size, texture, colour etc. The motor activities are whether the object is manipulated, turnable, throwable etc., he cannot think beyond what he sees. This period is marked by some attainments. For instance, language is acquired very rapidly. Behavior in the early part is egocentric but by the age of 6 or 7 years children become communicative and social. Now he can solve some small problems of his own initiative.

Limitations of The Pre-Operational Child

Since the thinking of the child is highly influenced by the perceptual characteristics, i.e. what he sees in terms of colour, size, length, shape etc,. the child is unable to understand that since nothing has been added or subtracted from the objects, there should be no difference in the original quantity or number.

The Other Limitations of the Pre-Operational Child Are

1. Pre-operational thinking ends to be egocentric that is the child at this age cannot understand the other's point of view. In the sense the child in this age group tends to think that what he thinks and understands is the understanding all have and that there can be no other view to this.
2. Pre-operational thinking tends to focus on only one aspect or dimension of a problem at a time. For example –while looking at the height of an object, the child is unable to consider any changes undergone in its width. The child is unable to handle multiple characteristics.
3. **Pre-operational thinking tends to involve transductive reasoning.** The pre-operational child reasons from one specific to another specific event, as opposed to inductive and deductive reasoning, i.e. in other words, the child cannot think from particular to general or general to particular. Like for instance, the child knows all birds but will be unable to conclude that all birds have feathers.
4. The pre-operational child cannot understand relational terms such as larger than, darker than etc. For exm-coming back to those, two boys in this age group, know who is 'good' and who is 'bad' or who is the hero and who is the villain. The young child cannot appreciate that people cannot always be categorized like that and there could be characters in the story or the film which may have shades of good and bad in them.

5. Class inclusion which means that he cannot reason between part and whole simultaneously.

6. The child at this stage is not able to understand how things operate internally or how things relate to one another.

These limitations make the pre-operational child's thinking illogical and inconsistent.

Stage-III The Concrete Operational Stage (7-11 Years)

Here the first mental operation exists. The ability to conserve volume develops in children i.e. the amount of substance may remain the same even though the shape of the material or size of the container has changed. A child during this stage acts directly or concretely on objects. Children become less egocentred. They experience differences between themselves and other's behavior. Children become more social and cooperative. They follow rules and orders faithfully. They form more complex mental actions on concrete elements of their world. They develop the ability to classify; i.e. the ability to sort out objects on the basis of common features like colour, size or shape. A child begins to classify objects into three or more categories only by the age of eight or nine.

The older child can understand the gradation but the younger child cannot. This is so because the older child has the ability to see the relational merit or demerits of a set of object. Like they have the basic understanding that A is larger than 'B', 'B' is larger than 'C' then 'A' is the largest. They are able to perceive the shades of differences and place the objects in an orderly series.

This process by which the child observes the relational difference in set of objects and organizes them in a series on the basis of these differences is called seriation.

Now children can reason about things with which they may have had direct personal experience. But they are limited to thinking about what is 'reality' and cannot deal with what might be 'potentiality'. The child therefore may not be able to think the aspects like-democracy, religion, morality etc.

The concrete-operational child lacks the ability of Hypothetico-Deductive thinking. That is the child is unable to logically think of different possible aspects of a problem and thinking out the irrelevant and selecting that is most appropriate.

Stage-IV The formal operational stage (11 years to adult):- During formal operations, thought processes can be made at hypothetical and abstract level. The capacity for abstract reasoning can be seen. For example- If Shyam is shorter than Sunil and Shyam is taller than Ravi, who is the tallest? At the level of formal operative however adolescents can order their thoughts in their minds alone. Now, thinking reaches its highest degree of equilibrium. When adolescents think about the various possibilities inherent in a situation before hand and then systematically test them, they are working like true scientists.

According to **Flavell (1977)**, adolescents engage in meta-thinking i.e. they

develop the capability of thinking about the thinking process rather than merely thinking about the content of their thoughts. They engage in both hypothetic deductive and empirico-inductive reasoning. The concrete operation is limited only to empirico-inductive reasoning.

Formal thought is flexible and effective. Adolescents are able to deal with complex and highly abstract problems of reasoning. At concrete operational stage, child works with the actual, the formal operational adolescent sees possibility as well as actuality. The adolescents when confronted with a problem consider all the alternatives.

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.....Continuing from Page No.-120

2) Use of reusable or disposable items and stop use of plastics
3) Turn off lights and unplug electrical devices when not using them
4) Using solar, wind energy use as alternative energy source
5) Change in choice of diet. Meat and packaged foods have high carbon footprint
6) Recycling the waste products
7) Plant more trees

"Reduce, Reuse and Recycle" habit can reduce the carbon footprint. It emboldens our responsibilities for creating a sustainable world. Each one can develop their management plan to reduce the carbon dioxide emissions. Changes in lifestyle have already started by everyone and this habit should continue for long term. BMC collect dry and wet waste and regenerate it. Use of CNG bioenergy vehicles use is also a significant step for reduction of carbon dioxide gasses. We are aware at personal level about using android app. One day a habitat will develop where we breath fresh air and live a healthy life.

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10

MAKE YOUR TOY ASTRONOMICAL TYPE TELESCOPE

Nikunja Bihari Sahu

Telescope (Refracting Type)

A telescope is a device that shows a distant object in magnified form. The telescope was first invented by a Dutch lens-maker Hans Lippershey in 1608. He believed that the telescope can be potentially used as a spy glass to detect pirates in the ships going along the seas. However, it was the Italian astronomer Galileo who first pointed his telescope skyward for astronomical investigations in 1609.

A telescope primarily consists of two lenses; i.e. an Objective Lens and an Eyepiece Lens. The Angular Magnification of a Telescope is the ratio of the focal length of the Objective lens to the focal lens of the Eyepiece lens. The Angular Magnification of a Telescope is defined as the ratio of the angle subtended at the eye by the final image formed by the optical instrument to the angle subtended at the eye by the object when not viewed through the instrument. This is given by the following formula:

$M = f_o/f_e$

Where

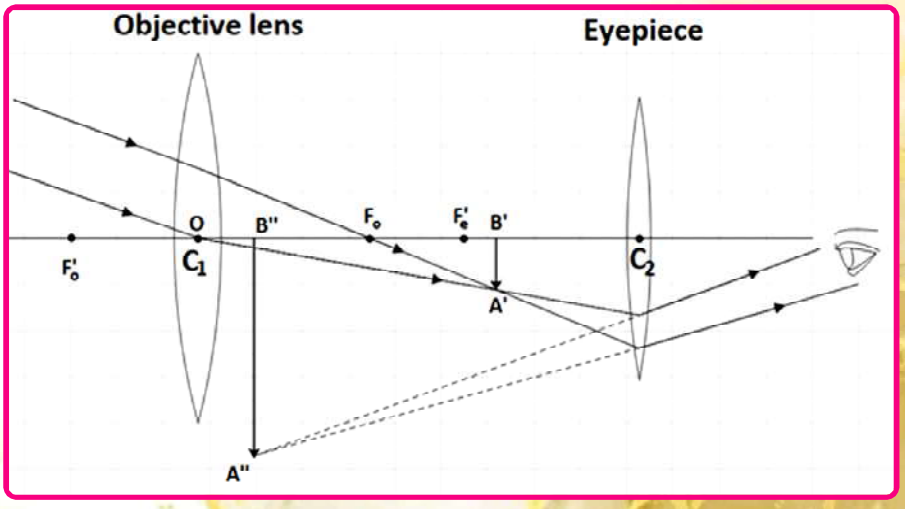
M= Angular Magnification of the Telescope

f_o = Focal length of the Objective Lens, and

f_e = Focal length of the Eyepiece Lens

For a telescope, the focal length of the Objective lens is fixed and, hence, cannot be changed. However, a telescope's Magnification can be changed by using eyepieces with different focal lengths: the shorter the focal length, higher is the Magnification.

The Tube length (L) of the Telescope



Ray diagram for an Astronomical telescope

(when the Object distance for the Eyepiece matches with its focal length) is given by the formula:

$L = f_o + f_e$

We will make a small Refractive telescope having 3x Magnification. An astronomical telescope always produces inverted image, as there is no harm in viewing a celestial object like a star or a planet or the Moon upside down.

A girl testing her telescope by adjusting the distance between the two lenses in a Telescope Making Workshop

Materials Required

1. Double Convex Lens (f = 30 cm, Dia= 50 cm) to serve as the Objective
2. Double Convex Lens (f= 10 cm, Dia= 50 cm) to serve as the Eyepiece
3. Black Cardboard Paper
4. Cellotape

Construction

Roll the Cardboard sheet to form a cylinder of 50 mm in diameter and glue the edges with the help of cellotape so that the tube remains sturdy in shape. Fit the Objective lens at one end of this cylinder with the help of cellotape. Prepare a second cylinder using the same cardboard sheet by rolling it over the first cylinder so that the first cylinder can be tightly pushed into it and slide freely to and fro. Attach the Eyepieces lens at one end of this second cylinder again with the help of cellotape. Now, push the Eyepiece cylinder into the Objective cylinder so that the Eyepiece lens remains outside for the observer to place his/her eyes to view. Our kit is now ready for operation. Care should be taken to keep the lens surface free from any dust, oil or dirt and, hence, direct contact of the lens surface with hand should be avoided.

How does it Work

The Objective lens produces a real, inverted and diminished image of a distant object in its focal plane. The position of the Eyepiece lens is adjusted so that the image is formed within the focal length of the Eyepiece. The image produced by the Objective lens acts as an object for the Eyepiece lens which magnifies the image to produce a final image. The final image produced after the light rays refracted from the Eyepiece lens is Inverted, Virtual and Magnified.

How Do You Go

Point the telescope to a distant object so that the Objective lens remains towards the object and look through the Eyepiece. Slide

A 4" astronomical telescope is used to view the four Galilean moons of Jupiter using an Objective lens of focal length 660 mm and an Eyepiece having focal length 25 mm, adjusted to yield a Magnification of 26.4

the Eyepiece cylinder over the Objective cylinder to and fro so as to vary the distance between the two lenses till the image looks sharper. The final image will be virtual, inverted and magnified.

Caution

Never look to the Sun with telescope. It might permanently impair your vision by damaging the eyes!

Further Scope

You will soon realize that this telescope is not free from various optical aberrations like Spherical aberration and Chromatic aberration. Spherical aberration arise due to the fact that the Paraxial rays and the Marginal rays, after refraction through the lens, don't come to the focus at the same point on the Principal axis of the lens. This aberration can be minimized by using an Aperture Stop for the Objective Lens. In this arrangement, a black coloured Paper ring can be put over the Objective lens reducing its aperture to only one-third. This results in the fact that most of the marginal rays are blocked allowing only paraxial rays to pass through the Objective lens. In this case, although the image will be fainter, it will be much clearer.

Similarly, the telescope also suffers from Chromatic aberration and the final image is bordered by coloured fringes. Chromatic aberration arises because of the failure of all the wavelengths of the visible light to come to a common focus, as the Refractive Index of lights of different colours are different for a given refracting medium like glass. In professional telescope, an Objective lens incorporating an Achromatic doublet is generally used to minimise the effects due to Chromatic aberration which is a complicated technology beyond the reach of common people. Hence, in our telescope, the Chromatic aberration cannot be eliminated in part or full and, hence, the final image will look surrounded by coloured spectrum.

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11 THE STORIES OF GENES:6 GENOME PACKAGING: A WONDER OF THE NATURE

G.B.N. Chainy

Presence of an extraordinarily long genomic DNA molecule into a tiny nucleus of a cell is one of the greatest unsolved mysteries of nature. The Stories of Genes would fall short without discussing it. Genetic information of all species is imbedded in their genomic DNA which is thousands of times finer than a human hair with a length of several millimetres to a metre. The packaging of around one-meter-long human genomic DNA molecule in a tiny cell nucleus (average diameter between 10 and 100 µm), is analogous to stuffing several metres long, single thread from a sewing machine spool inside a mustard seed.

Species	Genome size (no. of bp in millions)	Genomic DNA length (Meter)
Bacteria	4.6	0.001
Fruit fly	180	0.06
Rice	430	0.15
Human	3200	1.0
Lung fish	43000	14.0

Table 1. Approximate Genomic DNA length in various species

How is Length of a DNA Molecule Calculated?

An approximate length of genomic DNA of various species depicted in table 1. The distance between two base pairs in a DNA molecule is 0.34 nm. Therefore, the length of the DNA molecule can be calculated by multiplying 0.34 nm to the number of base pairs present in a genome. The approximate number of total base pairs present in two sets of DNA molecule of 46 chromosomes of a diploid human cell is approximately 6 billion (6×10^9 bp). Therefore, the length of the DNA molecule of a human diploid cell is equal 2.1 metre (6×10^9 bp x 0.34 nm). Human chromosome 1(the largest chromosome) contains around 249 million base pairs (Mb). Therefore, the length of DNA measures 85000 micrometres as per the above calculation but it measures only 10 micrometres at metaphase stage (the most condensed stage). So, the DNA molecule is folded approximately 8500 times in the case of human chromosome 1. The smallest human chromosome is

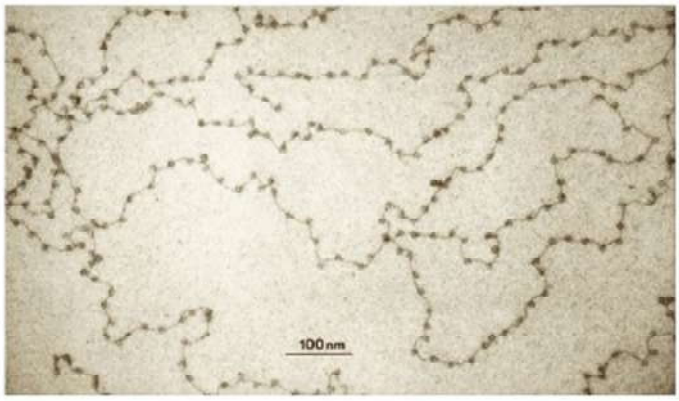

Figure 1. DNA picture in electron microscope (beads on a string)

chromosome 21. At the metaphase stage, it measures 1.6 micrometre in length. The DNA of it has 48 million base pairs (Mb). Can you calculate how many times DNA has folded in? The mechanism by which a long DNA molecule is folded in chromosomes will be discussed in the following sections.

Beads-on-a-String

American scientists Don Olins and Ada Olins reported that electron microscopic images of spread isolated eukaryotic nuclei of different eukaryotic species (chicken blood, rat, and calf thymus) looked like beads- on- a- string in 1974 (Figure 1). The beads are named as ν (nu) because they were new structures. The finding suggested that chromatin is present as a repeating unit. The repeating units of chromatin was named as "nucleosomes" by a French scientist P. Oudet in 1975.

Structure of Nucleosomes

In the same year 1974, the structure of repeating units of chromatin (nucleosomes) was deciphered by American biochemist Roger Kornberg. Each nucleosome is the smallest structural part of the chromatin. They are found in all types of animal and plant cells, which proves their universal nature. Each nucleosome consists of two components, a nucleosome core and a DNA molecule that wraps the core 1.75 times. The average length of the DNA strand that wraps the core is 146-200 bp. (Figure 2). Adjacent nucleosomes are

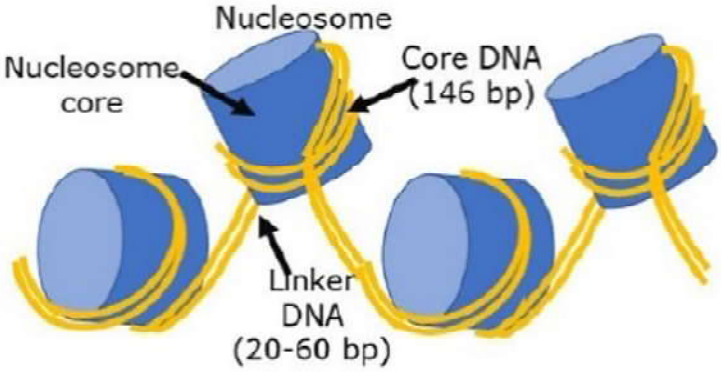

Figure 2 Wrapping of DNA around histone octamers.

connected by DNA strand known as linker DNA. Linker DNA is 20-60 bp long. Nucleosome core is an octamer because it is assembled from two copies of each of the four types of histones (H2A, H2B, H3, and H4) (Figure 3).The octamer forms a spool for rapping DNA. The ends of DNA wrapped strands are sealed off by H1 molecules. Structurally, nucleosomes look like an oval disc with a diameter of about 11 nm and a height of 5.7 nm. Histones are highly conserved and positively charged proteins

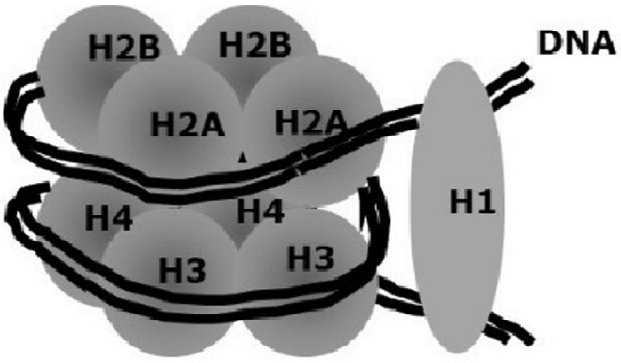

Figure 3. Structure of a nucleosome

(rich in basic amino acid residues such as lysine and arginine).

Various Levels of Folding

The folding of chromatin fibre is expressed as a packing ratio. Packing ratio is used to describe the degree to which DNA is condensed. Researchers have shown that the chromatin fibres go through several hierarchies of folding in order to fit inside the nucleus to form chromosomes. The levels of folding can be expressed as primary level, secondary level, tertiary level, and so on. Till date, the mechanism of folding of DNA is comprehended up to secondary level and research is going on to unveil the mysteries of folding at higher levels.

The formation of nucleosomes is the primary level of folding of the DNA molecule where DNA is condensed into an 11 nm fibre of nucleosomes due to approximately six-fold folding. A secondary level of chromatin condensation arises from interaction between nucleosomes. The secondary level of chromatin organization leads to a 30-nm fibre, which is packed helical arrays of nucleosomes. The secondary level of chromatin is explained by either solenoid or zigzag model. The solenoid model consists of tightly wound nucleosomes in a regular, spiral configuration with six nucleosomes per turn. In the zigzag model, nucleosomes are arranged loosely with irregular configuration. The DNA molecule folds forty times in its secondary level structure. The 30 nm fibre chromatin further condenses and forms 300 nm fibre (tertiary level structure) which coils around each other and forms 700 nm fibre (quaternary level structure), which is one arm of the 1400 nm metaphase chromosome. From formation of nucleosome to metaphase stages of the chromosomes, the DNA molecule is folded around 10000 times. Till date, exact

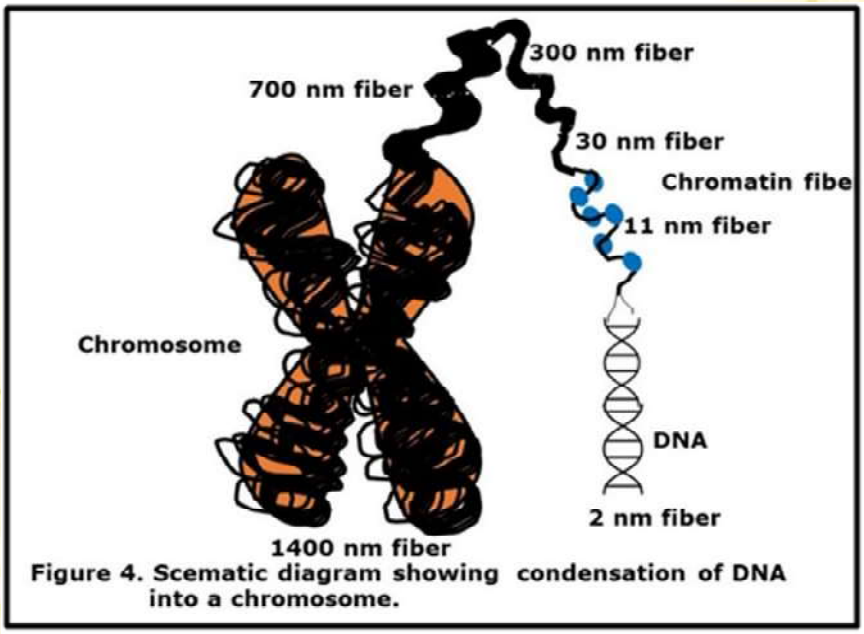

Figure 4. Scematic diagram showing condensation of DNA into a chromosome.

mechanism of folding has not been understood(Figure 4).

How are Nucleosomes Formed?

Cells have evolved efficient nucleosome disassembly and assembly machines, which are composed of several proteins. These proteins, in a coordinate manner, disassembles nucleosomes during DNA replication of a cell division and reassembles histones and DNA strands (both daughter and parent strands) to form new nucleosomes. Nucleosomes are formed in a systematic step. In the first step, DNA interacts with newly synthesized tetramer (2H3-2H4). Both histone proteins that are acetylated form subnucleosomal particles. In the second stage, addition of two H2A and H2B proteins to subnucleosomal particles completes the formation of nucleosomes. Some proteins facilitate wrapping of DNA around it. Finally, the H1 histone binds to entry and exit sites of DNA on the surface of nucleosome core particle and completes the formation of the nucleosomes. The exact mechanism of nucleosome assembly is not known and calls for further study.

It is crucial to understand the mechanistic features of genomic DNA condensation not only for academic purposes in biology but also for potential uses in the medical field. It will help in understanding how various chemical modifications of regulatory proteins influences their binding to genomic DNA and, thereby, influences gene expression. A thorough comprehension of genomic DNA folding thought to be clinically relevant in future to figure out the molecular causes of uncommon genetic illness, cancer, and aging.

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12 ENVIRONMENT, MAN AND DEVELOPMENT

Dr. Bijay Ketan Patnaik

The word "Environment" is defined in the Chamber's dictionary as 'surround'. According to Webster's dictionary Environment is the aggregate surrounding things, conditions or influences ie; the air, water and other natural resources and all other external factors surrounding and affecting a given organism at any time. Environment (Protection) Act, 1986 (EPA) defines the word as: " Environment includes water, air and land and the inter relationship which exists amongst them and human beings, other living creatures, plants, microorganisms and property.

In the Universe our Earth is only planet so far which is known to sustain life. The life support system which is responsible for sustaining life on Earth, is what we term as "Environment". This concept was very much there in a more subtler form in our ancient scripture, which clearly stated that five elements that are basic ingredients responsible to sustain life on earth are; Kshiti[Earth or Soil], Aap [Water], Tej [Fire or Sunshine], Marut [Air], and Byoma [Sky, Space]. All these constituents are now showing signs of strain for their use, reuse or overuse. In the middle of twentieth century, we saw our planet from space for the first time. From space we could see a small and fragile ball dominated by a pattern of clouds, ocean, greenery and soil. Humanity's inability to fix its doings into that patterns is changing planetary systems fundamentally. It is an

admitted fact that the planetary ecosystem, whether terrestrial or marine is continuously degrading inspite of our best efforts. A break down has occurred in the relationship of human system and natural system.

Nature and natural system is resilient enough to rebuild itself if disturbance is of limited order. If the deterioration in any element is for a short term, the life support system repairs itself and reverts to the original state. However, if deterioration continues beyond the limit of recuperation, the whole system, including all life it sustains is thrown out of gear.

Environment is where we all live and development is what we all do in attempting to improve our lot within that abode. The environment cannot exist in isolation, separate from human action, ambitions and needs; and hence both are inseparable, and both are intricately linked. Development cannot subsist upon a deteriorating environmental resource base. Similarly, environment cannot also be protected when growth and development becomes static. The origin of this concept of linking ' Man, Environment and Development 'refers to the Stockholm Conference on Environment held in 1972 by United Nations. This U N conference brought the developed and developing nations together to delineate the "Rights" of the human family to a healthy and productive environment.

One of the basic characteristics of development is that, it should be sustainable. The word sustainable development first appeared in United Nations' report titled " Our Common Future", also called as Brundtland Report in 1987. It connotes the idea of development that meets the need of present without compromising the ability of future generation to meet their own needs. That means whatever benefits our generation has achieved, posterity should also get that much, if not more. Though this definition strangely leave out any mention of development, it is clear that the commission is explicit about environmental protection as the core of any potential definition of sustainable development. According to the New Oxford American dictionary, "Sustainable Development refers to economic development that is conducted without depletion of natural resources. It puts several core goals to be adopted on development policy; (a) to protect ecosystem (b) preserve genetic diversity (c) sustainably utilize species and ecosystem.

Environment and Sustainable Development is conceived on the premise of 'One Earth Perspective'. For the last few decades, scientists, astrophysicists are constantly exploring to locate another living planet, either in our Universe or other Universe. They might succeed in their endeavor in future. But presently, what is the alternative to one planet perspective? Do we have a spare earth stashed away somewhere? Have we been able to find out another earth, another congenial, celestial planet? Where we could be able to shift our burden? Mankind is trying to colonize the red planet, i.e. Mars even with its prevailing hostile conditions. But at what cost? Will that serve the purpose?

During 1972, the world population was nearly 384 crore. But by 2023, it reached 800 crore; more than doubled. With passage of time and increase in population, our ecological foot print is also increasing. On the contrary, our earth has limited and finite natural resources. With finite and in many cases with dwindling natural resource base, it is increasingly looking like, we will not be able to provide all with food, water and energy that we need for 9 or 10 billion people in the decade ahead. This apprehension leads to another concept ie; 'Earth Overshoot Day'. It marks the day when humanity has exhausted natural budget for the whole year. For the rest of the year we are maintaining our ecological deficit by exploiting local resource stock. Further to simplify the above concept, Earth Overshoot Day is the calculated illustrative calendar date on which humanity's resource consumption for the year exceeds earth's capacity to regenerate these resources that year.

The concept of World Overshoot Day is purposefully mentioned here so as to focus on the primary reason behind coinage of words 'Sustainable Development', that was adopted during Stockholm conference of 1972. Sustainable Development gives emphasis on the word 'Need-fulfilment of the need of human being within the permissible limit of natural resource base. The satisfaction of human need and aspiration is the major objective of development. The essential needs of vast numbers of people in developing countries- food, clothing, shelter, jobs - are not being met; and beyond their basic needs these people have legitimate aspirations for an improved quality of life. As such environmental sustainability cannot be achieved without provision of social and economic sustainability. In the present day context, need of human being is a galloping horse. Once a particular need is met or fulfilled, the expectation and want goes upto the next level. The ever increasing demand multiplied with population growth factor makes it almost impossible for our finite and in many cases dwindling natural resources to cope with.

Sustainable Development, as per UNESCO's definition refers to many processes and pathways to achieve it; such as sustainable agriculture and forestry, sustainable production and consumption, good government, research and technology, education and training etc. On the start of millennium during September 2000, the Millennium Summit and UN general assembly declared 8 millennium development goals emphasizing on three areas; ie human capital, infrastructure and human rights [social, economic and political]. They are; 1. To eradicate poverty and hunger, 2. To achieve universal primary education, 3. To promote gender equality and empower women, 4. To reduce child mortality, 5. To improve maternal health, 6. To combat HIV/ AIDS , malaria and other disease, 7. To ensure environmental sustainability, 8. To develop a global partnership for development. The M D goals are supposed to be achieved by 2015. Subsequently during 2015, the U N general assembly created the SDG's as part of the post 2015 development agenda. These 17 goals are [1] No Poverty, [2]

Zero Hunger, [3] Good Health and well Being, [4] Quality Education, [5] Gender Equality,[6] Clean Water and Sanitation, [7] Affordable and Clean Energy, [8] Decent work and Economic Growth, [9] Industry, Innovation and Infrastructure, [10] Reduced Inequalities,[11] Sustainable Cities and Communities, [12] Responsible Consumption and Production, [13] Climate Action, [14] Life below Water, [15] Life on Land, [16] Peace, Justice and Strong Institutions, [17] Partnership for the Goals. These are the global agendas proposed to be achieved by 2030.

The primary thought behind these 17 sustainable development goals propagated by United Nation is to make development process ongoing and sustainable. All development processes are derived from two basic capitals-soil and water. These two are no doubt renewable resources. It may be surprising to note that the first environmental limits that we have confronted and possibly exceeded are not the limits to non-renewable resources [like forest, water, soil and ocean] and to our use of the environmental sink function-its ability to absorb our waste. These are limits related to the loss of soil, fisheries, forests, flora and fauna, water to the loss of purity of air by absorptionof carbon dioxide emission from different human activity related issues.

A thin air layer of our environment, surrounding our planet is getting studded with increase in green house gas emission, specifically carbon dioxide and methane.This phenomena of increased emission of green house gases to the atmosphere, that starts slowly but steadily after the industrial revolution during second part of eighteenth century is the root cause behind global warming which in turn is linked to climate change. Climate change is manifested in monsoon, such as heavy rainfall in a limited period leading to unexpected flood, cloud burst, land slide, cyclone, heat wave, lightening and thunder storm, soil erosion linking to decreased food production, health hazard and infant mortality etc. Since environment does not obey any geographical boundary, nor does limit itself to any particular geographic location, any disturbance in environment at any point will have spread effect.

It has now begun to be realized that the earth's resources are finite and limit to that natural environment can no more be considered a free and inexhaustible bounty. It must be utilized in such a way that these assets are not seriously damaged or destroyed. Similarly, one must realize that environmental components get polluted by discharge of waste and large scale emission of green house gas by any means such as industry exhaust, power generation, transport alike, will have consequential chain effect leading to global warming and climate change with disastrous consequences.

Subsequently in 2015, the United Nations general assembly created SDGs as part of post 2015 development agenda.

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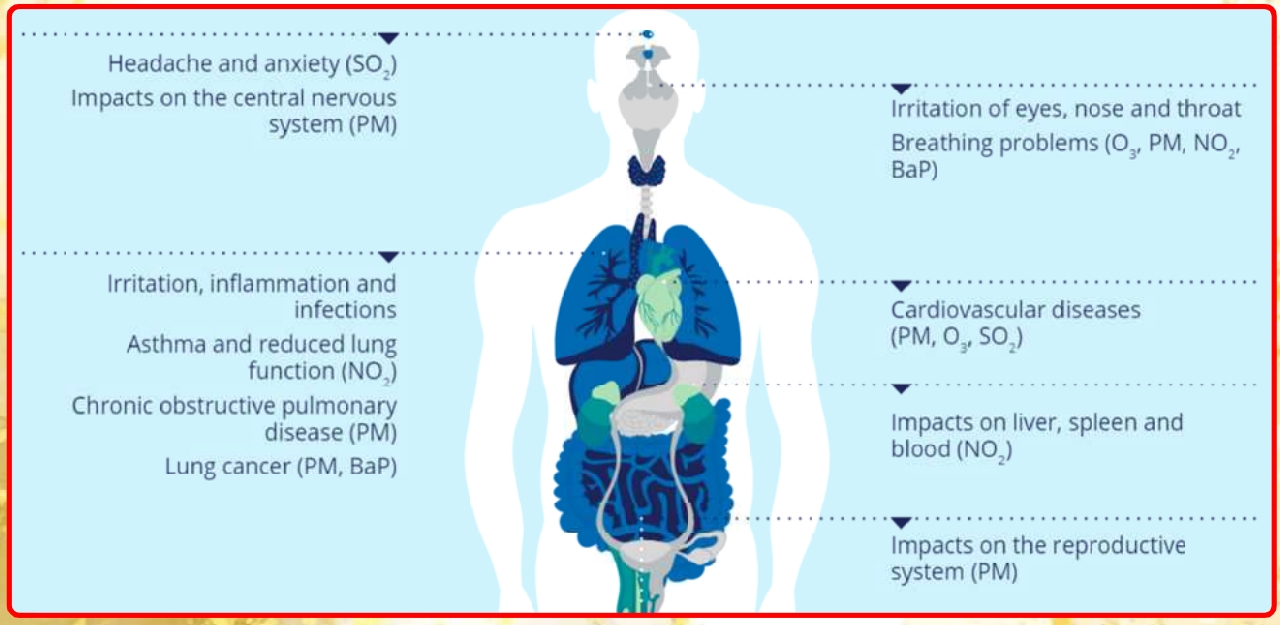
13

LIQUID TREE: A PRACTICAL SOLUTION TO COMBAT AIR POLLUTION

Prof. Madhumita Das

Pollutants in the environment create massive impact on our health. Air and noise pollution including heavy metal emissions like mercury are directly related to health issues like asthma, hearing loss, dehydration and heart diseases. Air pollution is the single most important cause of environmental health hazards affecting millions of people across the globe. Vehicle emissions, fuel oils and Natural gas to heat homes, by-products of manufacturing and power generation, particularly coal fuelled power plants and fumes from chemical industries are the primary sources of human- made air pollution.

Ambient air pollution and ozone are responsible for 40 percent of all pollution related deaths or an estimated 3.4 million deaths a year. These deaths are caused by exposure to toxic air, water, soil, and chemical pollution globally. The results are still conservative, as many known toxins are not included in the analysis. According to the IHME (The Institute for Health Metrics and



Impact of Air pollutants in our body: Particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2), *benzo*[a] pyrene (BaP) and sulphur dioxide (SO_2)

Evaluation, Seattle) Global Health Data Exchange Tool, "pollution kills three times as many people a year as HIV/AIDS, tuberculosis, and malaria combined". Cities experience more air pollution because of denser population. Much of the world's attention is focused on ambient air pollution, especially the smog that often envelops in cities like Beijing and Delhi.

Following are the three main pollutants associated with poor health condition in cities:

1.NO_2 (Nitrogen Dioxide) is present typically in areas of high vehicle traffic. Exposure to NO_2 has been associated with a range of health effects including organ and neurological problems during pregnancy, new onset asthma in children and lungs infection decline in older adults.

2.PM2.5 or, **Fine particulate matter ($PM_{2.5}$)** such as soot, smoke, dust and liquid droplets measuring less than 2.5 micrometres in diameter. These tiny particles are of particular concern to our health as they can enter the bloodstream and place deep in our organs. $PM_{2.5}$ is responsible for premature mortality. In 2021, 97% of the urban population was exposed to concentrations of fine particulate matter above the health-based guideline level set by the World Health Organization.

3.PM10 are larger particles than PM2.5 and come from similar sources. PM of all size has been linked to chronic inflammation and is associated with similar health risks affecting lungs during pregnancy and early childhood, as well as decline in lung function in older adults.

In 2021, the World Health Organization (WHO) published new air quality guidelines following a systematic review of the latest scientific evidence demonstrating how air pollution damages human health. The European Union (EU) has set a vision for 2050 to reduce air, water and soil pollution to levels no longer considered harmful to health and natural ecosystems. In addition, the zero-pollution action plan introduced targets for 2030, to reduce the health impacts of air pollution (premature deaths) by more than 55% and reduce the share of EU ecosystems where air pollution threatens biodiversity by 25%. Ministry of Environment, Forest and Climate Change (MoEFCC), India has launched National Clean Air Programme (NCAP) in January, 2019 with an aim to improve air quality in 131 cities (non-attainment cities and Million Plus Cities) in 24 States/UTs by engaging all stakeholders. The programme envisages to achieve reductions up to 40% of National Ambient Air Quality Standards for Particulate Matter10 (PM 10) concentrations by 2025-26.

Plantation in Urban Areas

Planting trees in forests is a commonly used strategy for companies and governments to lower CO_2 in the air. But what can we do in dense cities where there is barely any space for a bush? After all, these urban sites are where the pollution is concentrated. The APTI (Air Pollution Tolerance Index),a parameter which represents air pollution scavenging capacity of the plants, is based on four plant biochemical parameters: relative water content

(RWC), ascorbic acid level, total chlorophyll content (TChl), and leaf pH. Despite the identification of several plants which show higher APTI, it has not been possible to grow these plants in the crowded areas of cities due to lack of open land for plantation.

In an effort to combat this problem, scientists have developed an innovative solution, the "liquid tree," an urban photo-bioreactor that harnesses the power of microalgae to improve air quality. The liquid tree is Serbia's first urban photo-bioreactor, designed to address the issue of greenhouse gas emissions and improve air quality in densely populated areas. Dr.Ivan Spasojevic, one of the project's authors from the Institute for Multidisciplinary Research at the University of Belgrade, explains that microalgae are 10 to 50 times more efficient than trees in binding CO_2. This is equivalent to the CO_2-binding capacity of two 10-year-old trees or 200 square meters of lawn. The objective of the liquid tree, however, is not to replace forests but to fill urban pockets where there is no space for planting trees.

Evolution of Liquid Tree

Serbia, especially Belgrade, has one of the worst cases of air pollution in the world as Belgrade is home to large coal plants that further contribute to the city's severe air pollution. The air has reached a high level of pollution, 60 AQI, is unhealthy for sensitive groups. Serbia's reliance on lignite and coal-fuelled power stations is the main reason in addition to the burning of solid fuels (such as coal and wood) to heat homes. The PM2.5 concentration in Belgrade was 4.3 times the WHO annual air quality guideline value.

Tiny dirt particles come from power plants, motor vehicles, and agricultural burning. They are considered dangerous because they

Liquid Tree: A tank full of water and Micro - algae

can penetrate deep into people's lungs because of their small size. As a solution, Dr Ivan Spasojevic, specialized in Biophysical science, developed the liquid tree, popularly known as LIQUID 3. The first urban photo-bioreactor was installed in Belgrade in September 2021.

Functioning of Bioreactor

We can compare the liquid tree with an aquarium having microalgae in it except that it is not really a tank, but it acts as a tree. Technically termed bioreactors, these are tanks containing six hundred litres of water and microalgae which bind carbon dioxide and produce pure oxygen through photosynthesis. Because of the microalgae, the tanks emit green colour. The microalgae replace two 10-year-old trees or 200 square meters of lawn. The function of the LIQUID 3 is practically an imitation of it. Both trees and grass perform photosynthesis and bind carbon dioxide. However, the advantage of microalgae is that it is 10 to 50 times more efficient than trees. The bioreactors can be used as benches and have power outlets for charging mobile phones. The tank can survive in winter also. Dr.Ivan Spasojevic used single-celled freshwater algae, which exist in ponds and lakes in Serbia and can grow in tap water, and are resistant to high and low temperatures. The system does not require special maintenance – it is easy to remove the biomass created by dividing algae, which can later be used as an excellent fertilizer. After 45 days water and minerals are to be replaced and the algae would continue to grow indefinitely. This project aims to popularize and expand the use of microalgae in Serbia, because they can be used in wastewater treatment, as compost for green areas, for the production of biomass and biofuels, as well as for air purification from exhaust gases from the factories. Because of the creative, practical, and innovative design, the LIQUID 3 was awarded as one of the best innovative and climate-smart solutions by the Climate Smart Urban Development project, created by the UNDP, and the Ministry of Environmental Protection and sponsored by the Global Environment Facility (GEF).

This ground-breaking technology should be adopted by all the countries to combat urban air pollution that will benefit the environment and society. By engaging the civil society, the public, and businesses to implement this innovative idea, we can ensure better solutions for climate change mitigation, which will overall have a positive impact on the air quality of urban areas.

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14

QUIZ: ELEMENTS

Bibhuprasad Mohapatra

1. Name the element that becomes liquid at room temperature.
   a. Bromine b. Mercury
   c. Both a & b d. None of these
2. Which element can melt with the warmth of hand?
   a. Gallium b. Indium
   c. Germanium d. Beryllium
3. Name the rare earth element that resists corrosion in dry air but not in moist air.
   a. Vanadium b. Cerium
   b. Ruthenium d. Lutetium
4. Which is the most conductive element?
   a. Platinum b. Tin
   c. Silver d. Lead
5. Io is the innermost and 3rd largest of the 4 Galilean moons of the planet Jupiter. The most volcanically active lo appears yellow because of which element that comes from the many active volcanoes?
   a. Chlorine b. Sulfur
   c. Tungsten d. Oxygen
6. It is mainly found in our bones and teeth which is also a very essential element in biochemical reactions like cell signaling, building skeletal systems, and controlling muscle actions.
   a. Carbon b. Calcium
   c. Magnesium d. Potassium
7. Which element was considered as the 'king of poisons' as well as the 'poison of kings'?
   a. Arsenic b. Antimony
   c. Cadmium d. Germanium
8. Robert Bunsen and Gustav Kirchhoff discovered it in 1860 in Heidelberg, Germany, when they analyzed the spectrum of mineral water. It is the 1st element to be discovered using a spectroscope.
   a. Rubidium b. Cesium
   c. Francium d. Cerium
9. Marc Delafontaine and Jacques-Louis Soret observed unrecorded spectroscopic lines of the then unknown element which they termed as element 'X'. Name that element which was discovered through isolation by Per Teodor Cleve.
   a. Erbium b. Thulium
   c. Gadolinium d. Holmium
10. Swedish chemist Per Teodor Cleve found it in 1879 during analysis of the mineral erbia, which was a source of several rare

earth elements. The element is named after the early name of Scandinavia.

a. Terbium b. Promethium

c. Thulium d. Europium

11. Which element gets its name in honour of the city where it was first made?

a. Darmstadtium b. Roentgenium

c. Meitnerium d. Copernicium

12. Smithson Tenant discovered it in 1803 in London which gets its name from a Latin word which means rainbow.

a. Osmium b. Iridium

c. Rhodium d. Platinum

13. Name the element which was named after the country of its discovery and discovered by Marguerite Perey in 1939 at the Curie Institute while she was researching the radioactive decay of Actinium-227.

a. Francium b. Cesium

c. Astatine d. Radium

14. During cold war between the United States and Soviet Union, radioactive isotope of which element was used to estimate how quickly the Russian government was building nuclear weapons?

a. Argon b. Neon

c. Rubidium d. Krypton

15. Name the element which was discovered by Glenn Seabourg in 1944 and named after a double Nobel laureate and her husband. It provides power to X-ray spectrometers in Mars rovers.

a. Curium b. Americium

c. Berkelium d. Einsteinium

16. It was used from ancient times and even mentioned in the Quran. Ancient Egyptians used it in their eyeliner and mascara.

a. Tellurium b. Tin

c. Antimony d. None of these

17. An army officer and part-time chemist Carl Axel Arrhenius discovered four elements yttrium(Y), terbium (Tb), erbium (Er), and ytterbium (Yb) in Ytterby village. This most important village in chemistry is in which country?

a. Sweden b. Switzerland

c. Scotland d. Slovenia

18. Name the element which was discovered in 1996 and named after the renaissance scientist who proposed heliocentric model. It turns into gas at room temperature.

a. Nihonium b. Copernicium

c. Flerovium d. None of the above

19. Name the diamagnetic element which makes beautiful geometric crystals if you melt and cool it slowly and also used in cosmetics as a colourant.

a. Pyrite b. Technetium

c. Bismuth d. Cadmium

ANSWER

01. (c)	02. (a)	03. (d)	04. (c)	05. (b)
06. (b)	07. (a)	08. (b)	09. (d)	10. (c)
11. (a)	12. (b)	13. (a)	14. (d)	15. (a)
16. (c)	17. (a)	18. (b)	19. (c)	

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RECENT NEWS ON SCIENCE & TECHNOLOGY

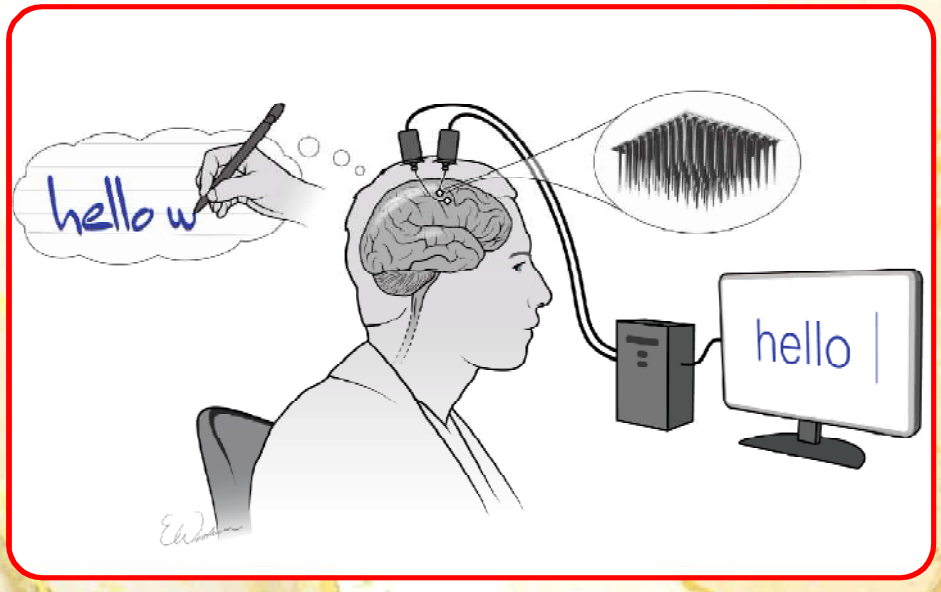
The Mars Ingenuity Helicopter Ends Its Mission After 3 Years

After three years filled with many firsts, NASA's Ingenuity Helicopter has made its final flight in January 2024. The little helicopter completed 72 flights, which far exceeded expectations. It was expected to fly only five times over 30 days. It began its mission attached to NASA's Perseverance rover and completed its first flight on April 19, 2021. In all, it flew for 128.8 minutes, covered 10.5 miles and reached 78.7 feet at its highest.

Brain–Computer Interface Tested

Neuralink, the company owned by Elon Musk has implanted a 'brain-reading' device called Brain–Computer Interface (BCI), into a person for the first time, on 28 January 2024. BCI is a device that creates a direct communication pathway between a brain's electrical activity and an external output. Their sensors capture electrophysiological signals transmitted between the brain's neurons and relay that information to an external source, like a computer or a robotic limb, which essentially lets a person turn their thoughts into actions. The Neuralink chip contains 64 flexible polymer threads, providing 1,024 sites for recording brain activity, according to the company's study brochure.

These brain chips go over the scalp in a wearable device, get surgically placed under the scalp or even get implanted within brain



tissue. Patients with paralysis, muscle atrophy and other conditions could leverage BCI to regain motor functions.

The U.S. Food and Drug Administration had given the company clearance last year to conduct its first trial to test its implant on humans, a critical milestone in the startup's ambitions to help patients overcome paralysis and a host of neurological conditions.

Japan's SLIM Spacecraft Lands on Moon, A First For The Country

Japan became the fifth country in history to reach the moon when its spacecraft the Smart Lander for Investigating Moon, or SLIM landed on the lunar surface on January 19, 2024. It is a lightweight spacecraft about the size of a passenger vehicle. While most previous probes have used landing zones about 10 kilometers wide, SLIM was aiming at a target of just 100 meters.

SLIM was launched on a Mitsubishi Heavy H2A rocket on September 6. It initially orbited Earth and entered lunar orbit on December 25.Japan follows the United States, the Soviet Union, China and India in reaching the moon.

The mission's main goal is to test new landing technology that would allow moon missions to land "where we want to, rather than where it is easy to land." The spacecraft is supposed to seek clues about the origin of the moon, including analyzing minerals with a special camera.

India Tested HAPS

India has successfully tested a High – Altitude Platform Station (HAPS) prototype. These solar powered vehicles can be used effectively for surveillance, monitoring and disaster management and enjoy many significant advantages over drones and satellites. In a major breakthrough, Bengaluru based National Aerospace Laboratory (NAL) successfully flew a prototype of new generation unmanned aerial vehicle (UAV) in the first week of February, 2024. It can fly about 20 km above the ground, runs entirely on solar power and can remain in air for months on end.

The jobs performed by HAPS are also done by UAVs and satellites. But they have certain limitations. UAVs and drones are mostly battery powered and cannot remain in the air for more than a few hours. So, they cannot do continuous monitoring effectively. In addition, they fly at relatively low heights, because of which their vision is restricted to small areas. Satellites can observe much higher areas, but the ones in low earth – orbits are continuously moving with respect to the Earth. They cannot constantly keep an eye over the target area.

Compiled by
EDITOR

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1. "SCIENCE HORIZON" aims at developing the scientific outlook of students as well as the general people and seeks to give them information on scientific developments. It is published as a monthly magazine.
2. The authors desirous of writing and contributing articles to the magazine should first assimilate the ideas of the theme and present it in simple language and popular style.
3. The authors are requested to send their articles by typing **(in MS Word)** to avoid errors in reading handwritten article and send it through e-mail given below.
4. The authors are requested to write clearly on one side of A4 size paper. The relevant pictures in 4cm X 6 cm size are welcome. **Photo copies of manuscripts are not accepted for consideration.**
5. Each article will be ordinarily of two to three printed pages in A4 size papers.
6. The article shall be profusely illustrated with pictures.
7. At the end of the article the author should give the references and suggestions for further reading.
8. The reference of books, journals, sources, ideas and essential points collected by the writer should be mentioned in the bibliography. This will enhance the quality and fidelity of the writing and give the reader an opportunity for making further studies.
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11. The writers should present difficult concepts of science through stories of everyday life, heart-rendering songs, pictures, satirical cartoons or attractive dramas.
12. All units in the articles should be given in the metric system.
13. The title of the article should be brief and attractive. Moreover, subtitles may be given in long articles. The writings should be coherent and cohesive.
14. There should not be repetition of specific words. While ensuring the contemporary spirit of the writing, it should reflect some valuable lesson for the society. It is also necessary to avoid mistakes in spelling, language use and factual details.
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The twin dust and ion tails of Comet 12P/Pons-Brooks (the so-called "Devil Comet") are visible in this image taken Feb. 14. The longer, ion tail has curves and distortions, perhaps due to interactions with coronal mass ejections from the Sun that passed by a few days prior. The image was taken with an 11-inch f/2.2 RASA telescope and four 2-minute exposures with a one-shot color camera. This comet has been exploding at regular intervals leading to the formation of so-called horns, thus giving it the nickname "Devil Comet". This comet has exploded at least four times till now. It was on July 21, 1812, that French astronomer Jean Louis Pons discovered it. It takes about 71 years to revolve around the Sun.

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