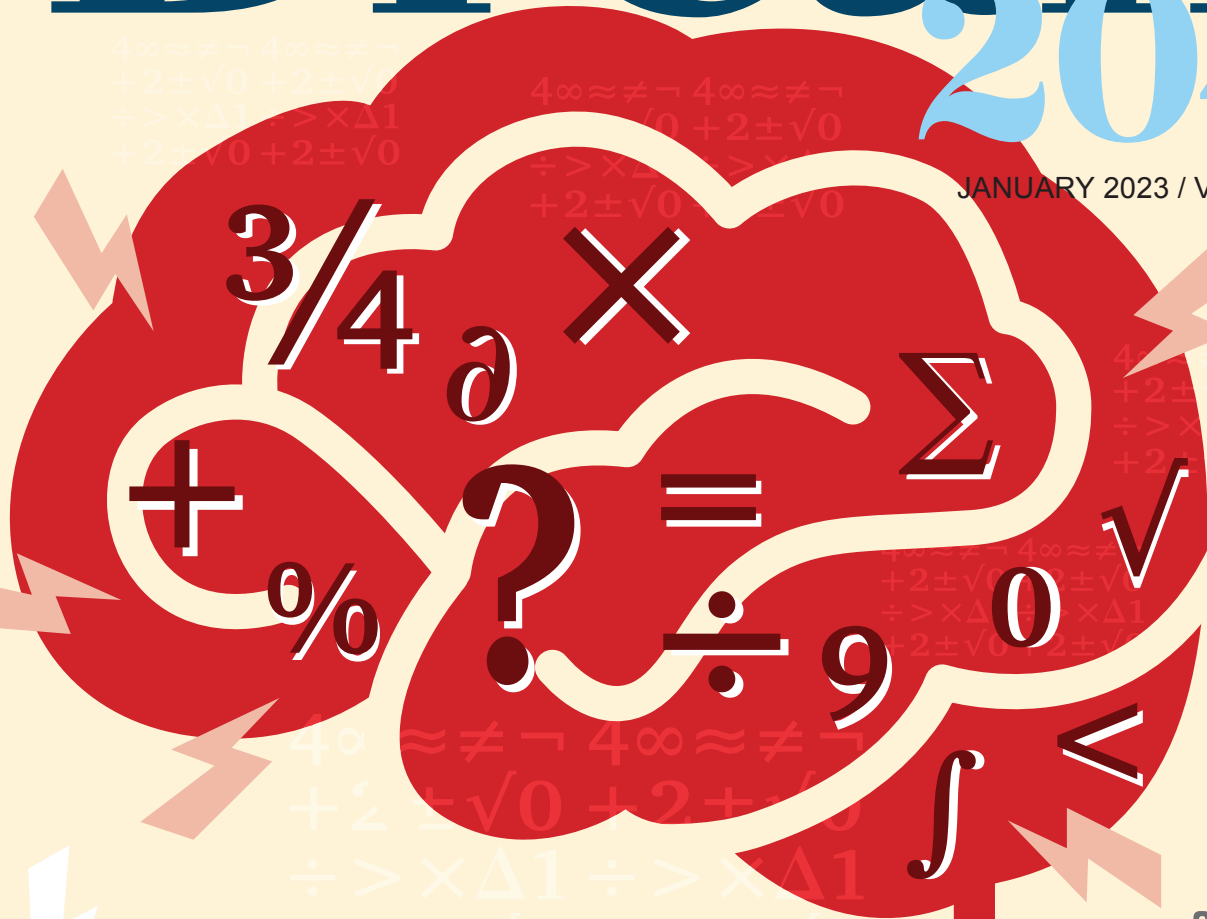


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MADHYA PRADESH

CREATIVITY: A NOVEL APPROACH TO TEACHING MATHEMATICS

**GOODBYE INSIGHT:
THE 'MARSQUAKE'
DETECTING LANDER
FINALLY GOES TO SLEEP**

**SOFTWARE AS A MEDICAL
DEVICE: HEALTHCARE
GETS SMARTER!**



Editor-in-Chief

Nakul Parashar

Editor

Rintu Nath

Language Editor

Sophiya Sheikh

Production

Pradeep Kumar

Bipro Kumar Sen

Ganesh D. Kalghuge

**Address for
correspondence**

Vigyan Prasar, A-50,
Institutional Area, Sector-62,
Noida-201 309, U.P., India

Tel: +91-120-2404430, 35

e-mail

dream@vigyanprasar.gov.in

website

<http://www.vigyanprasar.gov.in>



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EDITORIAL

Dr Nakul Parashar

New Frontiers New Year

WISHING ALL

of you a very happy new year.

Amidst encouraging news of emerging new frontiers of science & technology, like the final arrival of nuclear fusion for energy generation, the next generation of quantum computers, a nasal vaccine for COVID-19, the launch of the James Webb Telescope and much more, news of resurgence of COVID in some parts of the world lately is a matter of concern. Whether severe or not, scars of the past continue to hound. Thus, we all must stay safe and follow the basic rules of the community and personal hygiene.

While all this happens, the northern hemisphere is witnessing a harsh winter and a significant change in climate all over the place. Like past summer, where unexpected temperatures were a point of worry, blizzards in the upper reaches of the globe have sent people living there to go tizzy. More than conferences and discussions, I guess action on the ground is something we all are anxiously looking for. Applying science & technology is the only solution other than asking citizens of the world to change their lifestyles and bring in much closer to nature and natural ways of living. For decades there has been an outcry to conserve natural resources like water and forests. But what have we done? Our country's population still requires awareness about water, forest conservation, and exploitation of other natural resources. For this, at Vigyan Prasar, we plan to create a nationwide series of seminars and webinars on environmental issues and their remedies. We plan to do this in various Indian languages—Kashmir to Kanyakumari and Kutch to Kamrup.

While we talk about the geographical stretch of the nation, Vigyan Prasar plans to cover four major Indian languages that have been left behind so far. These include Malayalam, Odiya, Nepali and Bodo. In the recently concluded national meeting of stakeholders of SCoPE-in-Indian languages

at Chennai, it was decided to spruce up the popular science book production in every Indian language. Similarly, dubbing some of the most popular films of IndiaScience (the nation's only S&T OTT channel) in Indian languages is also on the anvil. We have so far met and discussed expanding the scope of SCoPE-in-Indian languages in major cities. As another new year resolution, we plan to move to B- & C-cities to enhance our outreach. From school to higher education and beyond, our effort in the coming year would be to ensure that our publications become completely holistic from a family standpoint. Whilst all this, we have been combatting the circulation of our magazines due to printing and distribution challenges. We hope the new year will bring hope for the revival of printing & subsequent distribution.

I somehow missed thanking and expressing my gratitude to all those who made a distinct mark in 2022 in the domain of SCoPE. Shri Kollegala Sharma in Mysuru single-handedly converted the much-talked idea of science communication through theatre into reality. Prof Shahid Rasool from the Central University of Kashmir brought a sea change to our Kashmiri and Urdu monthlies from a design and content standpoint. Down south, Shri Srikumar Balakrishnan managed to get our Tamil monthly penetration into the Government schools, with a whopping 6500 copies a month to be distributed in TN schools. The list is, of course, long; thus, I want to thank every coordinator of SCoPE-in-Indian languages for their remarkable contribution. Kudos to all of you.

Wishing all the readers once again a very happy new year.

Email: nakul.parashar@vigyanprasar.gov.in

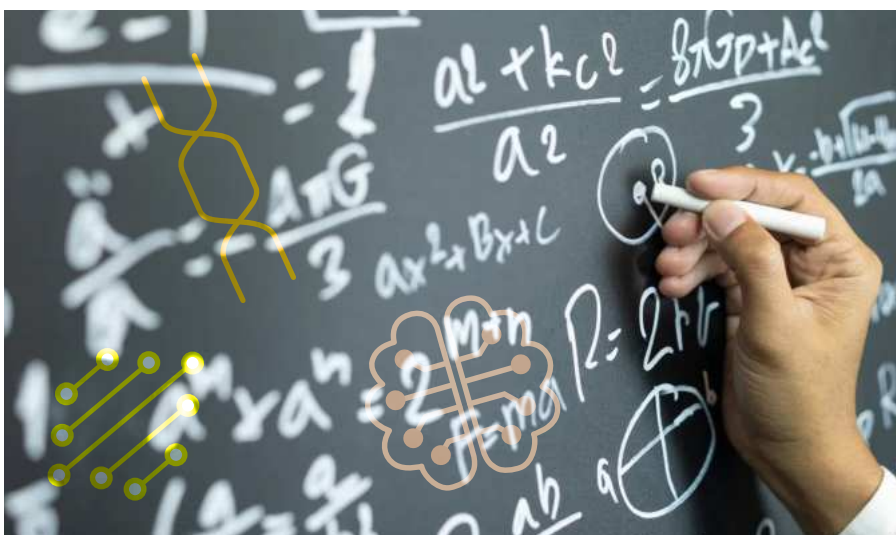
Creativity: A Novel Approach to Teaching Mathematics

Bimal Sengupta

Part I

The social and cultural revolutions over the centuries have resulted in an enormous development of science and technology, and human endeavor to overcome nature has extended in such a rapid pace that the human brain is becoming more curious, inquisitive, intellectual, and dynamic to face the growing demands and challenges of a changing society and culture. The success of mankind in this respect depends, to a great extent, on his creative ability to discover new ideas, thoughts, and practices, and such pedagogical ideas require information. Creativity in a young pupil - though to a great extent is an inborn faculty - can be developed and increased substantially by careful nurture of the same. No discipline reflects this stark contrast better than the study of science & mathematics.

Mathematics and scientific reasoning as taught in the present-day schools not only burrs whatever innate psychophysical disposition the child has towards creative thinking but also discourages any training the child is in need to accept mathematics as a challenging and growing subject. The capacity of students to learn mathematics is very seriously restricted by the teacher's capacity to teach and arouse creativeness in his pupils. To do so the curriculum should not only be well balanced and sensible but there should be an attitudinal change on the part of the teacher, especially in relation



to teaching methodology, instructional techniques, teaching aids and activities.

In the past special attention was given on the 'theory of formal discipline' and 'transfer of training' in forming a curriculum. Ancient educationalists gave much more value to the specific abilities of the pupil, and arithmetic and geometry were primarily taught to increase the analytic and reasoning capacity of the child. But the development of psychological research in the field of education has made scholars realize that in forming a successful curriculum stress should not only be given on the aims and objectives of education depending on the demand of the society, but proper weight should be given on the child's interest, aptitudes, and ability as well. In a curriculum that is suited to the needs of today and of the future, there must be a definite bias towards creative activities. To realize and enjoy the beauty of mathematics pupils must be given sufficient opportunity for free,

playful, creative activity, where each can bring out his or her own measure of wit, taste, fantasy, and personality. In a nutshell the program should aim at discovery approach, creative work by students, inquiry training of mind and "do it yourself and learn" attitude should be emphasized.

Blending old and new

Towards the end of the nineteenth century the educationalists of the West, especially the neo-Harbartians realized the demerits of compartmentalization of the subject matter and suggested education by the method of correlation and integration. The Secondary Education Commission of 1964-66 (Kothari Commission) seriously criticized the anachronistic attitude of separating various mathematical disciplines from one another in the school timetable. As a result various mathematical disciplines like geometry, arithmetic, and algebra were integrated

holistically in the academic curriculum.

In the child-centric education system, teachers are not just an informer of knowledge; he/she should rather act as stimuli in the learning process of the child. It is the teacher whose initiative, insight into the structure and new concept of mathematics, flexibility of ideas, devotion to duty and dedication that will determine how successfully he can make mathematics and science interesting and challenging to his pupils, encouraging them in rational thinking depending on their own resources and environmental situations. The new style of teaching advocates to puzzle the young pupil, to get them confused repeatedly from mathematical point of view. Paradox and puzzlement can be strong stimuli to interest, which is likely to encourage pupils not only in independent and systematic thinking but also to be empirical and inductive in their approach to problems of.

Psychology of learning mathematics

Mathematics as a subject often fails to arouse the interest of the young pupil and motivate them in learning the subject. One of the main challenges in motivating a child towards learning of mathematics is its abstract and symbolic nature. The children in general are devoid of abstract thinking and incapable of anticipating symbolic approach. Therefore, learning situations should be so designed and presented as to meet the demand of the child. At the onset the formal mechanical approach just to acquire mathematical skill often discourages and makes the students passive to the study of the subject. To motivate the child the contents must be sequentially arranged and presented as to enable mental and intellectual development and to arouse the discovery attitude in the young pupil, forming a foundation for abstract thinking and logical reasoning in the young learners.

The experience of mathematics teachers and educationists have led to the definition of certain classroom conditions favourable for the learning of mathematics. For example, Willy Servais and Tamás Varga—the Belgian-Hungarian duo—influenced

how mathematics were taught in European schools in the 1970s. Their recommendations presented at the International Symposium on School Mathematics Teaching in Budapest were to rely on the natural intelligence of the student and not to be limited to the acquisition of purely routine techniques which are quickly forgotten and are not very suitable for adaptation or transfer. The efficacy of learning is greater if the teacher presents pedagogical situations familiar to the student.

We are mostly inclined to teach in the way we were taught ourselves. However, teaching should neither be teacher centric nor child centric but mathematics centric. The main problem in teaching mathematics to the young pupil is due to the ignorance of what mathematics is and what it is about. Unless the child understands the relationships between symbols and their underlying structures it is impossible for the child to appreciate the reason for his/her errors. Mathematics without proper understanding usually betrays the previous rote learning and pupils are bewildered when confronted with something new. Even if students manipulate symbols mechanically, teachers should ensure they understand the meaning of the symbol. Most of the young pupils hardly pause to see whether their solution to a physical problem obtained by mere substitution of numerical information into a mathematical formula is physically plausible or not.

To overcome this difficulty we have to ask why we teach mathematics. And instead of asking how to teach mathematics, we should put more stress on how the children learn mathematics. This will help in finding the methods of expressing the subject to teach children to the highest level of their capabilities, without which they are likely to be bored and frustrated in the long run. But the answer to all such questions requires both mathematical and psychological knowledge.

In the concluding part of this article, we will discuss the general problems of creativity and its techniques and strategies.

Part II

The development of a country depends not only on its natural resources but also on the utilization of its manpower, where schools need to set up a climate that stimulate the creative potential of our children. It is therefore important to understand what creativity means, how it develops in a child, and the constraints for creativity in an organization or institution.

Creativity is a complicated function of the intellect that involves thinking on multiplane of experience. Attempts of many psychologists and philosophers gave rise to different theories of creativity. Some considered it as divine inspiration, some as madness. German philosopher Immanuel Kant in his classical work 'The Critique of Pure Reason' considered it as intuitive genius to explain the creative power of a genius like Leonardo da Vinci. Darwin's Theory of Evolution considers human creativity as nothing but manifestations of creative force inherent in life. At the other extreme is Freudian view that creativity is an outcome of inner conflicts of the unconscious mind. If the solution reinforces an activity intended by the ego, then creativity emerges, and if not, then neurosis develops.

In early childhood creative imagination takes place with geometrical



shapes, usually circles and squares. During preschool, imaginative behavior increases with age. Reasoning on the other hand starts a bit later and rises slowly, though after a certain period reasoning supersedes imagination. During the high school period the child exhibits more adventurous thinking, questioning adult regulations, but also adjusts to social pressures, worries about adult acceptance of his ideas or reactions to his unusual answers. Towards the end of the high school period emotional energy of the pupil can be used to solve problems that need creative applications of principles and skills they have learned.

The renowned American psychologist Dr. Calvin Taylor summarized the characteristic features of creativity in a classroom setting in 12 Golden rules that included productive thinking, communication, planning, decision making, and predictions. Assuming only one academic (or intelligence) type of talent, discouraging or condemning free thought, failing to try new opportunities, and continuing to do what was done before are examples of how such creativity is hindered. Parent's often resist maintaining creativity in school by expecting their child to be well adjusted normal individuals rather than understanding their divergence or outstanding talents. Teachers too, at times, restrict providing opportunities to creative children, by trying to reduce variations in a classroom setting. Creative children have tendency to handle so called difficult problems and prefer learning on their own, and without these allowances, their creativeness and great ideas are quite likely to be nipped in the bud.

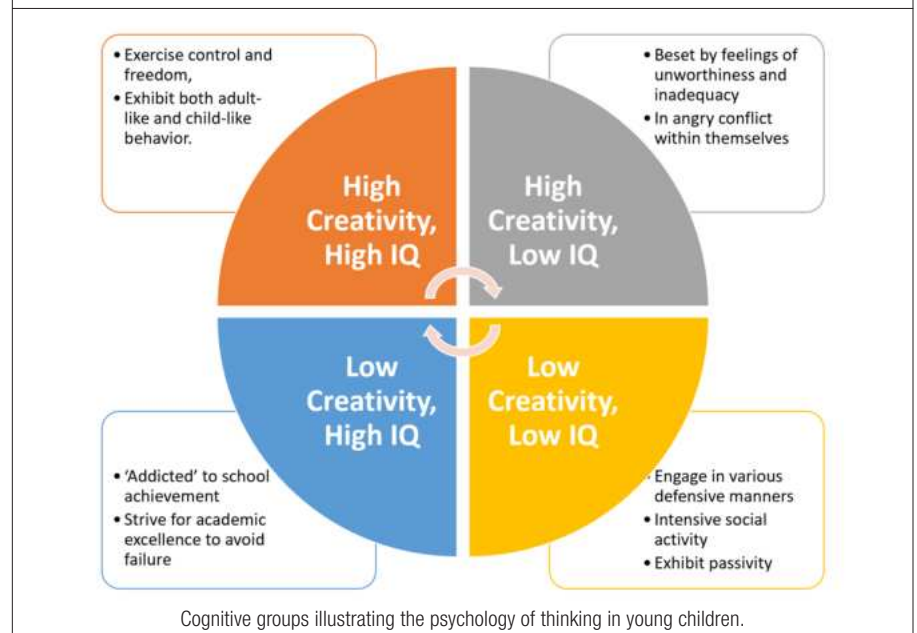
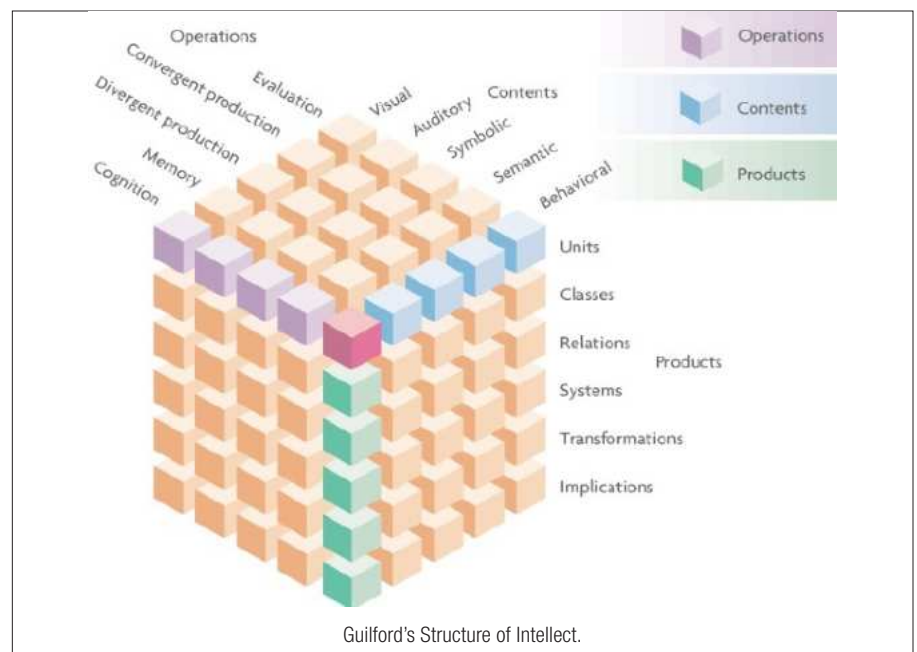
Since creativity involves independence of mind, non-conformity to group pressures, or breaking out of the mould, it is inevitable that highly creative individuals experience some unusual problems of adjustment. Students should be encouraged to be more active and responsive than being passive listeners, and not be rebuked if they happen to express views or opinions different from that of teacher, and their curiosity should not be killed.

Creativity is not intelligence

Joy Paul Guilford was a US psychologist who studied human intelligence. Guilford's three-dimensional geometric model, referred to as the "Structure of Intellect", maps 150 cognitive skills to three different factors that influence creativity: mental operations (process of thinking), content (what we think about), and product (result of our thinking).

Research and comparative studies conducted between subjects scoring high on IQ (and not on creativity) and subjects scoring high on creativity (but not on IQ) reveals that a considerable

proportion of creative students are likely undetected if we solely rely on traditional measures of intelligence. Several factors like fluency, flexibility, originality, redefinition, elaboration, motivation, and temperament influences creative thinking in an individual. A comparative study using Guilford's Structure of Intellect performed on two groups of high school students categorized by 'high-creative group' and 'high-intelligence group' found that the high I.Q. pupils tend to converge upon stereotyped meanings, to perceive personal success by conventional standards, to move



toward the model provided by teachers, whereas the highly creative tend to diverge from stereotyped meanings, to produce original fantasies, to perceive personal success by unconventional standards.

So how can we foster creativity?

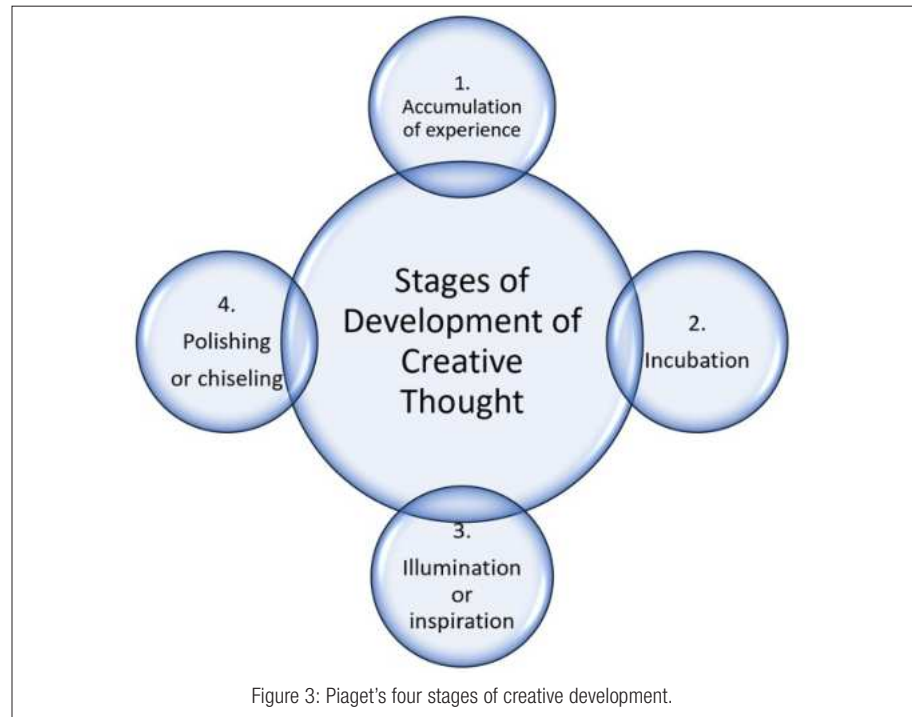
Creativity is enhanced significantly with openness to experience. There needs to be a feeling of unconditional worth, empathetic understanding from others, and an external evaluation-free (but not reaction free) climate. Pressure of external evaluation often inhibits experiential openness and generates a defensive attitude and non-admittance of personal likings and dislikes of the individual. Having psychological safety and freedom of expression in thoughts, perceptions, and feelings, along with the freedom to bear the consequences of one's failures as well as achievements fosters constructive creativity.

Over the decades various methods such as word building, picture writing, puzzles, and drawings have been used to test for creativity and to assess the inventive and imaginative power in young people at the elementary- and high-school level. In India, the NCERT's Scientific Creativity Test, developed by S. K. Majumder was based on Guilford's Structure of Intellect. While these tests measured flexibility, fluency, and originality, studies show very low correlation between the creativity tests and traditional measures of intelligence (IQ). Further, assessing creativity or intelligence is not a one size fits all exercise. An intelligence test or a test on creativity constructed for one culture may not fit well in a different culture or country.

Albert Einstein once said, "Imagination is more important than knowledge". Jean Piaget, the Swiss psychologist, applied this idea to the dormant creative potentialities of the human brain that can be explored through free and open education, and mapped them to four stages of development of creative thought. Creativity does not mean merely problem solving and novel solutions, but it is the sum total of personality orientation. It is

the actualization of one's potentialities. A good reading motivated by the spirit of enquiry can be creative. An exploration of scientific experiment that helps in the development of scientific attitudes, however less it may be, is creative. A lecture or a demonstration can be creative if it is inspiring and stimulating.

effective germination depends on the fertility of the social, cultural, and educational environment. A creative education system is one where instead of trying to cram a lot of facts into the minds of the children and making them scientific encyclopedias, we ask what kind of children they are becoming. What



Divergent and convergent thinking are complementary aspects or different styles of intellectual functioning. Formal education often fails to develop divergent thinking abilities, as compared to an informal education system that provides an environment for such development, and natural method of learning. To help creative children maintain and continue their creativity, the learning environment should genuinely recognize and respect their creativity. Their unusual questions and answers should not be considered crazy or silly. Like most behavior, creative activity represents many learned skills, and research shows that proper education, leads to substantial improvement in quantitative and qualitative ideas, for all categories of students in general, irrespective of their initial creative abilities and intelligence level. Environment plays a vital role as well. The innate creative potentialities of an individual are the seeds, but their

kind of thinking do they do? Are they learning to give thoughtful explanations of the things they do and see? Do they believe their own ideas to be of value? Do they relate similar experience together to draw conclusions? Do they do some thinking for themselves?

Having a general knowledge of the distinction between the high-creative and the high-intelligent while supporting convergent and divergent thinking abilities combined with inner and outer conditions fostering 'constructive creativity' in children, should help us build a better and new model of teaching, learning, and understanding of science and mathematics.

Bimal Sengupta is a retired Mathematics teacher, a lifetime member of All India Science Teachers' Association, and an award winner from Bose Institute, Kolkata for his work on Transformation Geometry.
Email: bimal.sujata@gmail.com

Goodbye InSight: The ‘Marsquake’ detecting lander finally goes to sleep

Atin Sharma

The beginning of the summer of 2019 sent a wave of excitement among space scientists and enthusiasts. The first-ever ‘Marsquake’ – an earthquake on Mars – was detected by the NASA InSight lander, confirmed by the space agency on April 23rd, 2019. A little less than four years later, the lander has quietly said goodbye. NASA reported earlier in December 2022 that they were unable to contact the lander and finally, on December 22nd, after two unsuccessful attempts at contacting the lander, the mission was declared over. The last successful contact with InSight was made on December 15th, 2022.

An attempt to understand the rocky foundations of Mars

InSight, short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, landed on Mars in November 2018 as the first robotic device to study the crust, core, and mantle of Mars. It was designed to provide data that would be critical to unlocking the mystery of the formation of rocky planets in our solar system. According to NASA, the lander was equipped with instruments that would allow it to go beyond the surface of the planet to sense activities that may have led to the formation of the red planet about 4.5 billion years ago. The lander would track the ‘vital signs’ of the planet – its ‘pulse’ (seismic activity) and ‘temperature’ (thermal activity).

Built by Lockheed Martin Space, InSight was managed by NASA’s Jet Propulsion Laboratory (JPL) with a majority of instruments built by



Big chunks of ice located by NASA’s Mars Reconnaissance Orbiter, directed by the meteorite impact detected by InSight. (Credits: NASA/JPL-Caltech/University of Arizona.)

European agencies. The two main scientific instruments on the lander were a seismometer, Seismic Experiment for Interior Structure (SEIS), which was designed to measure seismic activity, and a thermal probe, Heat Flow and Physical Properties Package (HP3), to measure the internal heat transfer. The

data from InSight was expected to reveal more details of the internal structure of Mars by determining the composition of the planet’s surface, the size of the core, the structure and thickness of the crust, the composition of the mantle, and the warmth of the internal core. The lander was also expected to study the tectonic

SPACE EXPLORATION

activity on Mars by determining the origin and intensity of 'Marsquakes'. It could also detect the frequency of meteorite impacts and the seismic movement caused by volcanic activity.

A challenging mission

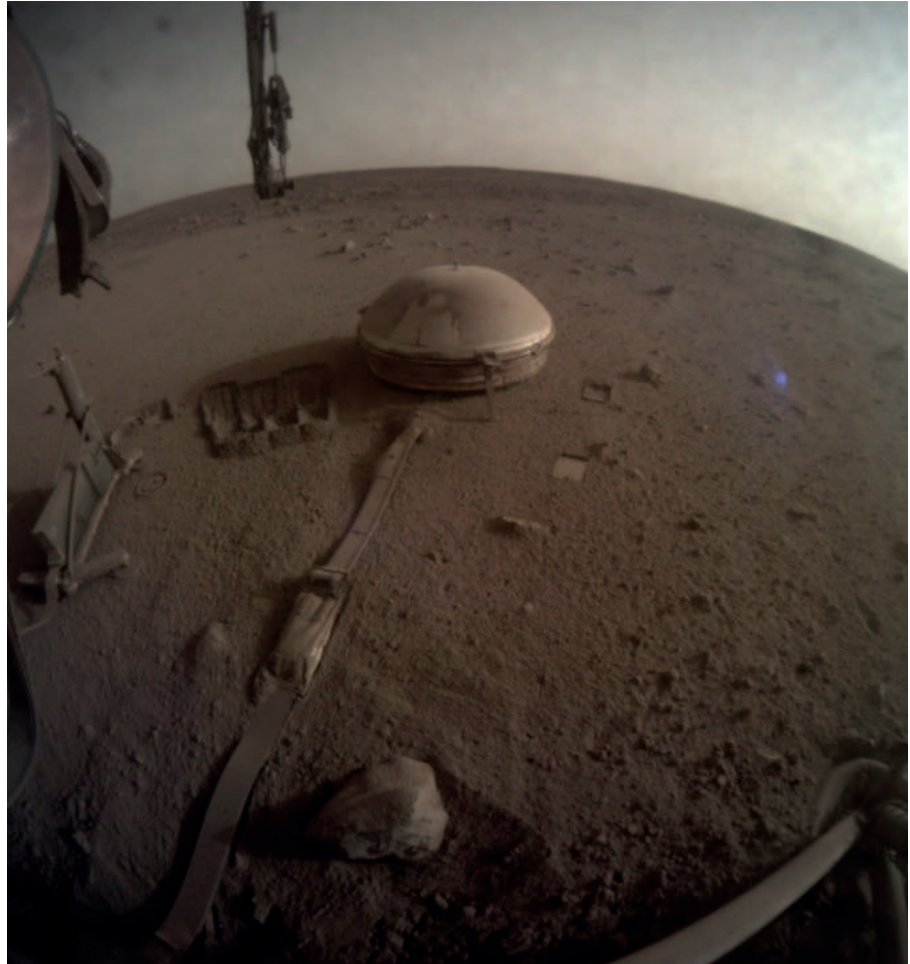
The InSight mission suffered troubles even before it began its voyage to the red planet. Despite being scheduled to be launched in March 2016, troubles with vacuum leakage in SEIS led NASA to delay the launch till May 2018. Once on the surface of Mars, the lander was to be powered using solar panels. However, the Martian dust build-up on the panels proved to be a major hindrance. NASA expected winds to clean the panels but there was lower-than-expected wind activity at the landing site. InSight had to work on a low-power mode for most of the time but was still able to make important measurements. However, the surface of the planet also provided another insurmountable obstacle. The HP3 probe was supposed to be buried 3 meters under the surface but the Martian soil could not provide the necessary friction for drilling and digging. Eventually, the probe managed to bury itself under the surface but only 2-3 cm which was not optimal but better than nothing.

Beating the odds to provide important data

In the face of all the challenges that troubled the lander, InSight was able to provide a plethora of new information and set many records. In addition to recording the first seismic activity on a planet other than earth, it also recorded the sound of the Martian wind for the first time.

It revealed that the crust of the planet was thinner (25-40 Km) than expected. The core of the planet consists of molten iron fused with lighter elements and has a radius of about 1800 Km, larger than previously believed to be. This important geological information is a step further in understanding the ability of Mars to support life.

The lander also identified meteorite impacts, one of which led NASA's Mars Reconnaissance Orbiter to find



One of the last images from InSight. Captured on Dec. 11, 2022, the 1,436th Martian day, or sol, of the mission. (Credits: NASA/JPL-Caltech)

buried ice reserves on Mars exposed to the surface. This was a breakthrough discovery as this ice can serve as a source of water for future missions. InSight was also the first Mars lander to carry a magnetometer and found strongly magnetized rocks, 10 times stronger than expected. It also provided unique insights (pun intended) into the Martian weather. The sensors mounted on the lander detected thousands of dust devils and other atmospheric features.

A poignant goodbye

After about four years of providing new unique information about Mars, NASA said a poignant goodbye to InSight. The mission is a great exhibit of the unforeseen challenges space exploration poses and of the relentless human ingenuity that is always up to the task.

"InSight has more than lived up to its name", commented Laurie Leshin, director of JPL. "As a scientist who's spent a career studying Mars, it's been a thrill to see what the lander has achieved, thanks to an entire team of people across the globe who helped make this mission a success."

The mission's principal investigator Bruce Banerdt said that it was hard to say goodbye but stated that InSight had earned its richly deserved retirement.

"Yes, it's sad to say goodbye, but InSight's legacy will live on, informing and inspiring", Laurie added.

Atin Sharma obtained a PhD in molecular biology from IIT Roorkee. He is a researcher and a science communicator. In addition to writing, he draws funny science comics on Instagram and Twitter @FridgeComics.

Email: atins88@gmail.com

Software as a Medical Device: Healthcare gets Smarter!

Vibha Saklani

Software as a medical device (SaMD), a term referred to a software with a medical purpose that is capable of functioning in an effective manner without the need of being a part of a hardware medical device. It is also referred to as standalone medical software. Software has gained huge popularity in our day-to-day activities and is rapidly evolving through continuous innovations as per the requirement. In addition, the realization of the importance of online/virtual platforms amid the novel coronavirus pandemic situation has further strengthened the call for software as a medical device (SaMD) technology to boom today and in the upcoming years. Everyone in the present tech era comes across the utilization of softwares that assist in making our lives easier to function, even if in our home environment. Starting from MS windows to surfing the internet, playing games from the cloud, or software that helps in the assessment of our health parameters, all are examples of software. However, there is a slight distinction between different softwares available. Some software requires hardware to carry out its function (software integral to a device or software used for manufacturing or maintenance of a device), while some function even without the need of the utilization of hardware. Such software, themselves serve as a device too. In the case of software as a medical device (SaMD), the standalone software capable of making well-

informed clinical decisions unlike other standalone software without a medical purpose is gaining momentum with advancements in healthcare technology. The use of software in healthcare is further attributed to the multiple tech platforms that consist of personal computers, smartphones, and network servers. Additionally, with growing access and penetration of internet and cloud platforms, software for making clinical decisions is becoming doctors' or



medical/biomedical professionals' best friends with time.

Software as a medical device includes an in-vitro medical device in the form of software that is capable of examining fluid or body tissue samples in a laboratory environment for providing information related to diagnostic, monitoring, or compatibility motives. Additionally, SaMD holds suitability to run on a general-purpose non-medical computing platform without being its integral part for the achievement of an intended medical purpose. Furthermore, a SaMD can be utilized in conjunction with other products that include medical devices and may interface with other medical devices that include other SaMDs, hardware medical/general-purpose devices, and

general-purpose software. Mobile apps capable of performing functions with a medical purpose are also listed under the definition of software as a medical device. However, software with an intended motive to drive a hardware medical device is not considered a SaMD. The need for smart technologies (like artificial intelligence, augmented reality, cloud computing, etc.) in the field of healthcare requiring minimum human interaction is serving as a strong driver for software as a medical device to sustain. This need is further supported by the requirement of software in medical devices for performing the following functions namely, monitoring, assistance in interoperability, for making efficient preventative practices, for smooth remote diagnosis, and for ensuring data accuracy and consistency. The medical purpose served by a SaMD involves diagnosis, treatment, monitoring, disease alleviation, investigation, modification, replacement, or supporting the anatomy or a physiological process, to help in life support or sustenance, conception control, and disinfecting medical devices.

Harmonization

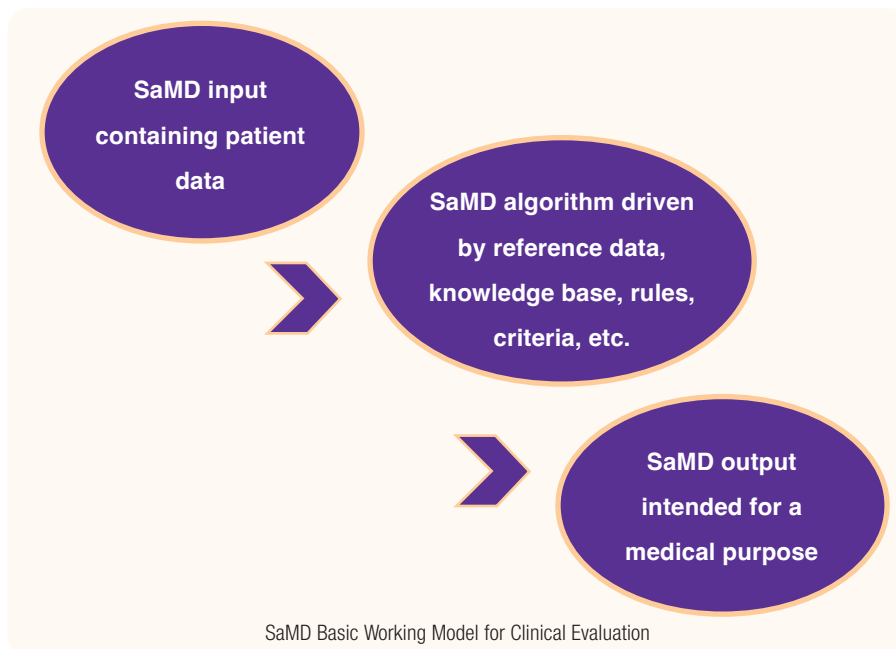
For a technology to be well accepted among a range of consumers depends on how well it is being regulated along with the harmonization of regulations. Harmonization of regulations refers to a process of creation of the common standards throughout the internal market. Harmonization leads to the creation of consistency of laws, standards, practices, and regulations in order to smoothen the

functioning of businesses across varied geographical boundaries. Also, through harmonization, it is taken care that businesses of one state do not attain an unnecessary economic advantage over other businesses due to different rules. Furthermore, harmonization leads to the reduction of compliance and regulatory burdens for business operations at the local or international level. In spite of the fact that harmonization aids in the establishment of the admitted levels of unification of laws at the international level, this, however, does not necessarily mean achieving the vision of complete

for topics related to medical devices. IMDRF, in 2013, formed a group, software as a medical device working group (WG) for the development of guidance motivating innovation and well-timed access to the safe and effective SaMD internationally. Under the control of the FDA, i.e., U.S. Food and Drug Administration, the SaMD working group consented to certain parameters including key definitions, the framework for risk categorization, quality management system (QMS), and clinical evaluation for software as a medical device.

status. With growing health awareness among individuals worldwide along with technological advancements in healthcare, people hope that the current healthcare system will definitely cure their chronic diseases. Hence, SaMD fits well in the fulfilment of the criteria where smart and intelligent systems with technologies like artificial intelligence (AI) are capable of making predictive analyses of the severity of a patient's health condition. Thus, providing preventive measures before the disease turns severe.

Furthermore, with remote healthcare in vogue, patients through health apps are capable of being well-connected to their doctors for receiving effective treatment, thus strengthening the utilization of software as a medical device. The SaMD technology can hence prove to be of immense help as the mobile health industry continues to grow at a significant pace, and will keep on increasing. With the increase in mobile health apps, the USFDA is paying much more attention so that it is well utilized. There is a distinct difference between a health app and a wellness app. A wellness app is capable of keeping a track of the overall health of the user, on the other hand, a health app is basically a mobile software (created to be run on a mobile device) that holds the capability in diagnosing, tracking/monitoring, and treating disease. Hence, a health app falls under the category of software as a medical device that helps physicians or medical/biomedical professionals in making clinical decisions. As it has been observed that most of the health apps have a serious consequence on a patient's health condition, FDA has taken the responsibility of the scrutinization and regulation of all these apps. The organization believes in adopting a well-balanced approach for all the mobile medical apps that aim to support continuous innovation, in addition to offering assurance of complete patient health protection.



uniformity. Realizing the distinct features of the software as a medical device (SaMD) that stretches beyond the conventional medical device, it has been observed that regulators at the global level have recognized the requirement of converging on a common regulatory framework. This has further enabled all the stakeholders involving regulators for promoting safe innovation along with the protection of patient safety. The International Medical Device Regulators Forum, abbreviated as IMDRF, a medical device regulators group around the globe, volunteered for reaching harmonization on medical device regulation. The forum is responsible for the development of combined agreed-upon documents at the global level

Healthcare 1.0 And Beyond

Healthcare has evolved with the way a patient is being treated along with the utilization of healthcare systems. The working of a healthcare system slowly evolved from a method where a healthcare system included loads of documentation on papers to the adoption of a digitized way of patient care. SaMD is enabling the healthcare 3.0 and healthcare 4.0 revolution that is an amalgamation of human and technology. This has further led to entering the era of the internet of things (IoT) that include the internet of medical things (IoMT) for the management of smart healthcare systems and services and aim to satisfy human quest regarding their improvement in health

Ms. Vibha Saklani is a passionate science communicator, currently serving Vigyan Prasar in the capacity of a Project Associate.

Email: saklanivibha@gmail.com

“Moringa”-The Miracle Tree

G.S.Unnikrishnan Nair

Do you realize that a tree we used to grow in our backyards has emerged as a global Super Food? It is the Moringa (*Moringa oleifera*); known in Hindi by the name –Shahjan. Originated in India, Moringa trees are cultivated and used here since very ancient time. Moringa leaf and drumstick remain an integral part of the traditional south Indian cuisine. Now the whole world has accepted Moringa as a functional food ingredient for human health promotion.

Ancient Tree

Nutritional and medicinal properties of this tree were recognized by Indians thousands of years ago. Roman historians recorded that the ancient Maurya warriors of India drank the leaf extract of Moringa daily. This gave them great strength. These warriors needed less sleep and hardly got sick. They repeatedly attacked King Alexander's armies in over 60 battles in a span of two years. Thus Alexander's unstoppable conquests ended with the Moringa drinking warriors of India. Even before the Maurya dynasty, curative properties of Moringa were realized by ancient Indian systems of medicine.

Ayurveda describes Moringa as a food cum medicine and Moringa is part of over 160 Ayurvedic medicinal combinations. According to Ayurveda, the plant has significant detoxifying and cleansing effects, particularly for the blood and fat tissues. In fact, in the ancient textbook of Ayurveda, *Bhava Prakash*, Moringa is described as 'Sigru', one that moves like an arrow. It is explained as deeply and rapidly penetrating tissues, even to the depth of the bone marrow for deep cleansing. Moringa has the unique and mysterious effect of being a tonic also. After cleansing, the plant strengthens the heart and blood to function optimally.



During BC 3000 the Ayurvedic Acharya 'Sushruta' wrote about the medicinal quality of Moringa oil.

Sidha is another system of medicine which evolved along with the Dravidian culture in the South Indian state of Tamilnadu. The Sage Agastya considered as the first Sidha has written a lot about Moringa tree. He stated that one who consumes Moringa will become strong as a 'Yali' (Mystical creature that ate elephants as its meal) and won't need any waling stick or support even after attaining 90 years of age. Practitioners of Sidha system consider Moringa as an elixir of life. Many medicinal uses of Moringa have been described about 7000 years back in the Sidha system. It is written in ancient Sidha texts that Moringa contains more than 500 phyto-colloids having curative properties.

Moringa: accepted by the world

Though Moringa pods and leaves are consumed in India, the world is more interested in Moringa leaf and its byproducts.

Major byproducts from the Moringa tree are ; Moringa Leaf Powder followed by Moringa Leaf Tablets, Moringa Capsules, Moringa Oil, Moringa Tea, Moringa Energy Bars, Moringa Gum Powder, Moringa Drops and Moringa Oil Cake. India is the main supplier of Moringa products worldwide, accounting for around 80% of global demand. Moringa Market Size in 2018 was worth 5.5 Billion (USD). Forecast for 2019 to 2025 is CAGR of 8.9%. Value Projection for 2025 is 10 Billion (USD). Growing incidence of obesity and increasing fondness of individuals towards fast food products are the key factors that enhance the dietary supplements market demand. Global dietary supplements market surpassed USD 125 billion in 2018. In dietary supplements, Moringa is used as an ingredient due to presence of a large number of essential nutrients that help in improving health. Growing consumer awareness and dietary supplements consumption in the U.S., Canada, India, China, UK, Germany, and Australia are the main contributing

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factors towards market growth. In many European countries consumption of Moringa tea is becoming a healthy daily habit. Other than our country; Moringa is widely grown now in Ghana, Philippines, Nigeria, Kenya, Rwanda, Niger, Mozambique, Cambodia and Haiti. Organic certified Moringa is also

15 kinds of amino acids, essential amino acids namely: Threonine, Lysine, Leucine, Isoleucine, Phenylalanine, Valine, Methionine, Tryptophan and non-essential amino acids namely: Histidine, Proline, Tyrosine, Aspartate acid, Glycine, Arginine, Alanine, Glutamate acid, Serine and Cysteine. If

If Moringa leaf soup is given to children, their body growth and brain growth will be enhanced. Moringa powder can be blended in dishes like roti, dosa and snacks or can be mixed with dal powder, ghee and given to children. In one week the fatigue will be gone and they will become healthy and energetic. Same is the case with pregnant women. Studies have made it clearer that Moringa leaves can greatly improve breast milk production. Consuming Moringa or Moringa leaf powder can benefit pregnant women. Moringa leaves have the power to stimulate breast milk and increase its quantity and quality.

MORINGA AND FIDEL CASTRO

One another country which whole heartedly accepted Moringa is the Cuba. In May 2015, when recovered from a long illness, Fidel Castro credited consumption of Moringa from India for his recovery. "Moringa, originally from India, is the only plant that has every kind of amino acid. With proper planting and management, its green-leaf production can exceed 300 tons per hectare in a year. It has dozens of medicinal properties," Castro said. According to his wish, acres of Moringa were planted in Cuba.

Good bye to Lifestyle ailments

According to Ayurveda, *M. oleifera* can prevent and cure about 300 diseases. It is capable of acting as

being produced in the island of Tenerife, which is part of the European Union.

Nutritional Powerhouse

What makes Moringa unique is this incomparable rejuvenative power resulting from the presence of nutrients in high proportion. It is a well known fact that, Moringa can provide 7 times more Vitamin C than oranges, 10 times more Vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than Yoghurt, 15 times more potassium than bananas and 25 times more iron than the 'green Iron'-Spinach.

"The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M.oleifera*. Phytochemicals in Moringa include Tannins, Sterols, Terpenoids, Flavonoids, Saponins, Anthraquinones, Alkaloids and Reducing sugar. Anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-octadecanoate are also found in Moringa leaves. Moringa leaf contain

you are consuming a Vitamin tablet or any food item there should be a nutrition management system so that it gets properly absorbed. In human body Zeatin does this role. Lot of research is going on about the benefits of Zeatin. Moringa leaves contain high quantity of Zeatin.

For the health of Women and Children

According to FAO, Moringa leaves are rich in protein, vitamins A, B and C, and minerals—highly recommended for pregnant and nursing mothers as well as young children.

Moringa has great potential to be used as a nutritional supplement for children and women. Iron folic acid supplement can effectively be replaced by Moringa leaf powder. By doing so not only the under nourished, the farmers who cultivate Moringa also will be benefitted. Countries like Zambia are giving Moringa a central place in their programs to end malnutrition.



Moringa products have antibiotic, antitrypanosomal, hypotensive, antispasmodic, antiulcer, anti-inflammatory, hypocholesterolemic, and hypoglycemic properties

cardiac and circulatory stimulants and possesses antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive, hypoglycemic, cholesterol lowering, antioxidant, antibacterial, antifungal, antidiabetic, and anti-asthmatic as well as hepatoprotective qualities. It detoxifies the body, enhances immunity and gives radiant skin and hair.

FAO describes Moringa as follows- "Moringa products have antibiotic, antitrypanosomal, hypotensive, antispasmodic, antiulcer, anti-inflammatory, hypo-cholesterolemic, and hypoglycemic properties." Moringa Leaf is having many Anti inflammatory compounds.

Moringa and Moringa products have high efficiency to fight life style diseases. Several clinical studies are going on.

In one study report in the Journal of Food Sciences and Technology, it is indicated that Moringa leaf powder possesses antioxidant and curative potential to prevent complications related to post menopause. According to Journal of American College of Nutrition, findings in human subjects indicated the lowering effect of Moringa oleifera leaves consumption on the 2 hours 'after meal BP' and showed a potential lowering effect on both Systolic blood pressure and Diastolic blood pressure despite prior high consumption of salt (7g/d).

A study by Acharya Ranga Agricultural University revealed significant reduction in the mean blood lipid levels of the subjects who were administered Moringa oleifera leaves powder. The study was designed to investigate clinically the hypoglycemic effect of seeds of Moringa oleifera and Azadirachta indica in Type 2 Diabetes Mellitus.

American Journal of Hypertension has described the clear beneficial effect of Moringa seed powder in cardiac function.

Moringa flower and stem bark also are source of valuable medical compounds. Moringa flower is a natural aphrodisiac and is also good for the eyes. Bark extract has anti inflammatory property and ability to suppress urinary tract infection. Clinical trials reveal that, Moringa bark

extract is a potential source for the treatment of different infections caused by the antibiotic resistant microbes.

Moringa oleifera seeds are a promising resource for food and non-food applications, due to their content of monounsaturated fatty acids with a high monounsaturated/saturated fatty acids (MUFA/SFA) ratio, sterols and tocopherols, as well as proteins rich in sulfated amino acids. Moringa Seed Oil is very special as it contains Omega 3, 6 and 9 fatty acids. Moringa seed oil also contains phenols, and in particular flavonoids, with free radical scavenging activity. Moringa oil is widely used as cosmetic and medicinal oil.

A crop which require less care and management

Moringa has uniqueness as a crop also.

leaves harvested throughout the year. According to Tamil Nadu Agricultural University, Coimbatore, to increase the yield of Moringa high density planting at 1.5x1.0 m spacing with two plants per hill and plant population of 13,333 per hectare can be adapted. Pods also can be harvested year round by adapting suitable cultural practices like pruning. Emerging global demand for Moringa leaves other than pods is bringing good income to farmers. Many companies have come forward to buy pods and leaves giving reasonable price.

Moringa has emerged as a cheaply available super food which has high potential to be incorporated in such malnutrition eradication programs. For economically weaker sections of our country, Moringa tree could be made into a readily available, cheap nutritional

IFAD MORINGA PROJECT IN KANYAKUMARI

Centre for Excellence in Moringa at Kanyakumari, is implementing a special Moringa project for livelihood betterment and nutritional security of Tsunami affected coastal villagers of Tamil Nadu. Aided by International Fund for Agricultural Development (IFAD-FAO), the project was launched during 2015. Dr.P.Kamalasanan pillai, the people's Scientist who was instrumental in implementation of many Rural Development projects like Azolla project and Project for Organic farming and bio-manure production is leading the Moringa project. As part of the project, farmers have planted Moringa in 300 acres. Centre's vehicle collects Moringa leaf and pod from villagers once in 4 days. They are dried using solar driers. Moringa powder and Oil are extracted and marketed. Agencies like Accenture and Entrepreneurship Development Institute of India also help in marketing the Moringa products. The income derived out of Moringa farming has become a boon for poor coastal families.

Coastal districts of Tamilnadu have high shortage of water during summer months. Coastal soil and ground water with salt content is another issue. But even in these adverse conditions, Moringa is a boon for farmers. It requires less irrigation and can be grown with organic inputs. By adapting high density planting more trees can be grown and

source in their backyard. Moringa also has great prospective as a protective food that prevent lifestyle diseases. Let us embrace nature's panacea for lifelong health, the Moringa.

G.S.Unnikrishnan Nair is retired Additional Director of Agriculture and Science Writer.

Email: unnikrishnanbhu@gmail.com



India International Science Festival (IISF) 2022

**MARCHING TOWARDS AMRIT KAAL WITH
SCIENCE, TECHNOLOGY,
AND INNOVATION**

The 8th edition of IISF is being held in the city of Lakes, Bhopal, from January 21st -24th, 2023. The Ministry of Science and Technology (MoS&T), Ministry of Earth Sciences (MoES), Department of Atomic Energy (DAE), Department of Space (DoS), Government of India and Government of Madhya Pradesh are jointly organising IISF 2022 on the theme 'Marching towards Amrit Kaal with Science, Technology and Innovation. The Department of Biotechnology, Ministry of Science & Technology is the nodal coordinating department for organising IISF-2022. The Madhya Pradesh Council of

Science and Technology (MPCOST) is the local partner, and Vijnana Bharati (VIBHA) is Knowledge Partner for IISF 2022.

IISF 2022 is going to be held at Maulana Azad National Institute of Technology (MANIT), Bhopal, Madhya Pradesh during 21st to 24th January 2023. This year the festival will have fifteen programs, including the Mega Science and Technology Exhibition showcasing the theme of the festival. The nodal agency to organise the IISF 2022 is the Regional Center for Biotechnology (RCB), Faridabad, Department of Biotechnology.

IISF is a festival to celebrate the

achievements of India's scientific and technological advancements with students, innovators, craftsmen, farmers, scientists and technocrats from India and abroad. In simpler words, it is the celebration of science cherished by all. Celebrating IISF 2022 during India's presidency of the G20 Summit gives an additional edge to showcase Indian scientific accomplishments at the global level. The activities during the festival will foster the global theme of G20 – "One Earth, One Family, One Future".

Fifteen different events which will be conducted during the festival are as follows:-

- 01 Artisan's Technology Village - Vocal for Local
- 02 Face-to-Face with New Frontiers in Science
- 03 Guinness Book of World Records
- 04 International Science Film Festival of India
- 05 Mega Science and Technology Exhibition
- 06 National Social Organizations and Institutions Meet (NSOIM)
- 07 New Age Technologies Show
- 08 Science through Games and Toys
- 09 Startup Conclave
- 10 State Science & Technology Councils Conclave
- 11 Students' Innovation Festival (SIF)
- 12 Students Science Village 2022
- 13 VIGYANIKA – Science Literature Festival
- 14 Young Scientists Conference
- 15 Mentoring & Counselling (Scientific Discussion)

Dr Prahlad K. Seth – Footprints on the Sand of Time



DR PRAHLAD K. SETH, Former Director, CSIR-Indian Institute of Toxicology Research (CSIR-IITR), Lucknow has left for heavenly abode. He had his last breath at AIIMS, New Delhi on December 22, 2022 at 3.00 am where he was undergoing treatment for last few days.

After obtaining B.Sc and M.Sc

(Biochemistry) from Lucknow University, Lucknow Dr Seth pursued his research in the field of 'biochemical pharmacology' at King George's Medical University (Formerly King George's Medical College), Lucknow and obtained PhD in 1967. Soon after he was trained as a post-doctoral researcher at Chicago Medical School, Chicago, USA and served as Research Associate and Assistant Professor (1967-71). Thereafter, he returned India and joined CSIR-IITR (Formerly Industrial Toxicology Research Centre), Lucknow as Senior Scientist (1971) and served as its Director (1997-2003). He has been an Adjunct Professor, Department of Elementology and Toxicology, Jamia Hamdard University,

New Delhi; and Honorary Professor of Biochemistry, Department of Biochemistry, Lucknow University, Lucknow.

Dr Seth made notable contributions to molecular biology and biotechnology related to health sciences, particularly understanding the effect of chemicals and drugs on the nervous system. He introduced the concept of toxicogenomics and mechanistic toxicology for assessing risk to toxic

substances and the need to identify the target molecules to serve as markers of exposure and prediction of adverse effects of chemicals. Being an outstanding neurotoxicologist, he has contributed extensively to the growth of this important discipline and given new dimensions.

Dr Seth has been instrumental to plan and built up a state-of-the-art Biotech Park in the city of Lucknow and was his first CEO. He has been the recipient of several honours and awards and elected Fellow of premiere national and international academies. He was member of several committees of ICMR, DRDO, DST, DBT, MOEF, ILSI and their task force.

It is certainly a loss to the scientific community which is difficult to be filled up. However, his ideas and suggestions that he shared with us on several occasions will help us to move forward and make us feel the fragrance of his personality. Needless to mention, It is a great loss to his family members, friends and many of his colleagues in India and outside who will

Miss him in the coming time/years.

Director & Staff of CSIR-IITR pray that his noble soul rests in peace.



MARCHING TOWARDS AMRIT KAAL WITH
SCIENCE, TECHNOLOGY,
AND INNOVATION

For more details about the events and programmes
to be held during IISF2022, visit IISF2022 official
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