

VIGYAN PRASAR

HAPPY NEW YEAR

DREAM

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CORONAVIRUS: ITS HOLISTIC IMPACT ON NATURE AND SOCIETY

UNSDG GOAL 1: NO POVERTY
CAN SCIENCE AND TECHNOLOGY
HELP ACHIEVE IT?

PENDULUM TEST FOR
SENSORS IN
DRIVERLESS CAR

VALUE ADDITION THROUGH
DEHYDRATION OF
FLOWERS AND FOLIAGE

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MY WORD

NAKUL PARASHAR

Happy New Year

AT THE

outset wishing you and your loved ones a very happy new year.

Staying safe, healthy, and happy is paramount. Personal hygiene and keeping yourself fit by eating right and regular exercise have gained more prominence than ever before. Regular washing of hands, social distancing, and keeping your surroundings clean have gotten ingrained in one's mind globally. All of this learning and communication around it arrived, but late and that too, for a price. We all know that this happened due to the pandemic that shook the global economy in a big way throughout 2020, a year that no one would generally wish to remember for a good reason. Businesses were affected, the pace of research and development slowed down, and above all, in-person meetings came down to almost nil. The entire humanity thus, eagerly awaited the arrival of a vaccine against COVID-19. Finally, at the end of 2020, news started to trickle in about a few vaccines' final stages.

Good news is, not many of its side effects have been reported so far. Early days and counting. It was, and it is still, a race against time, especially in an era when we have significant automation and artificial techniques in place. Scientists and researchers involved in this research had to toil very-very hard, go through a huge repository of reported and published research papers. Sifting through a huge repository of content to get the required and relevant information is indeed a herculean task. This is where content extraction, summarisation, and classification come into play. For this, natural language processing (NLP), one of the most exciting fields of artificial intelligence, comes forward. With growing numbers of use cases, NLP techniques are finding more and more new applications in newer domains of real life. Real estate, law, education, health,

and the list of domains where NLP techniques are being applied is growing rapidly and so are the associated challenges.

Challenges remind the indomitable spirit of our researchers and scientists that has kept the flag of constant change for humanity's betterment flying high. To keep society duly and timely apprised of what has been happening behind the walls of a laboratory, organisations like ours have shouldered the responsibility since their inception. Having crossed the thirty-year mark, we've been adding miles after miles to our quota continuously. One such big-ticket offering to society in the days to come is going to be IndiaScience's (India's S&T OTT Channel) 'ENGAGE', which, as the name suggests, is IndiaScience's engagement with school students, where the aim is to propel competitiveness amongst them. Initial responses to this program from various schools have been stupendous.

Well, undeterred by the pandemic, scientists and staff of Vigyan Prasar have continued to work relentlessly in the area of science and technology communication, popularisation, and extension. A number of weekly, fortnightly and monthly reports on India's S&T efforts against COVID-19 continued to reach the masses in time. Similarly, a record number of documentaries produced for IndiaScience were far more than those produced in earlier years. While we write, 'Life in Science with Pallava Bagla', one of the popular serials at IndiaScience, is being shot in the upper reaches of the Himalayas covering the architectural marvel - the Atal Tunnel. Interesting for sure, hope you'll enjoy watching this new year gift from all of us.

Wishing you all once again a very happy new year.

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RECENT DEVELOPMENTS IN SCIENCE AND TECHNOLOGY

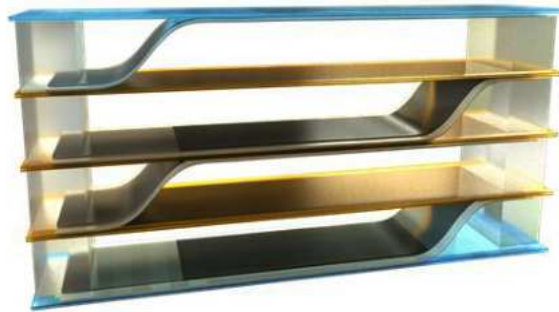
TOWARDS A POCKET-SIZED COOLER

Conventional large-scale cooling devices use vapour compression refrigeration, which are not only bulky but also consume a lot of energy. Cooling devices based on a new kind of materials called caloric materials have emerged as promising candidates to become the next generation of coolers. Several electrocaloric (EC) heat exchangers have been proposed that use different mechanisms and working principles.

The electrocaloric effect is a phenomenon in which a material shows a reversible temperature change under an applied electric field. It is often considered to be the physical inverse of the pyroelectric effect—the ability of certain materials such as gallium nitride to generate a temporary voltage when they are heated or cooled. It is, however, different from the thermoelectric effects (specifically, the Peltier effect), in which a temperature difference occurs when a current is driven through an electric junction with two dissimilar conductors.

In 2006 it was reported that thin films of the material PZT (a compound of lead, titanium, oxygen and zirconium) showed the largest cooling yet reported, with the materials cooling down by as much as 12°C for an electric field change of 480 kV/cm, at an ambient temperature of 220°C. The device structure consisted of a thin film of PZT on top of a much thicker substrate.

Researchers at the University of California, Los Angeles (UCLA), USA, have recently devised a strategy that could enable the fabrication of portable, compact and flexible cooling devices utilising the electrocaloric effect. This strategy, outlined in a paper published in the journal *Nature Energy* (26



The structure of the electrocaloric cooling device created by UCLA researchers. (Credit: Meng et al.)

October 2020 | DOI: 10.1038/s41560-020-00715-3) is based on a four-layer cascade mechanism, putting up to four of the cooling units together in such a way that the cooling temperature span was increased significantly to about 9°C.

The main advantage of the new technology is that EC coolers can be highly efficient, solid-state and compact devices; have few moving parts; and contain no environmentally harmful or combustible refrigerants.

In structure the device resembles a ‘sandwich within a sandwich’. The polymer component is a dual-layer stack of flexible electrocaloric film, separated by carbon nanotubes; voltage is applied (or relaxed) across the layers to change the stack’s temperature.

CREATING DIAMONDS IN MINUTES AT ROOM TEMPERATURE

Diamond is the hardest naturally occurring substance known. Apart from its use in jewellery, diamond finds extensive use in industry. In fact, about 80% of the world’s diamonds are used in industry. Natural diamonds are usually formed over billions of years deep within the Earth’s crust under conditions of intense heat and pressure that cause carbon atoms to crystallise forming diamonds. Natural diamonds are found at a depth of about 150-200 km below the surface of the Earth, where the temperatures average

900 to 1,300°C at a pressure of 45 to 60 kilobars (which is around 50,000 times that of atmospheric pressure at the Earth’s surface).

Apart from natural diamonds, artificial diamonds have been synthesised in laboratories since as far back as 1954. In the lab, they were created by using a process that mimicked the natural conditions within the Earth’s crust; adding metallic catalysts to speed up the growth process. The result was diamonds created under high pressure and high temperature similar to those found in nature, but often smaller and less perfect. These are still manufactured today, mainly for industrial applications.

The other major method of making artificial diamonds is via a chemical-gas process which uses a small diamond

Continued to page 18 →

“Multilateral cooperation is the key to overcoming global challenges such as COVID-19” Dr Harsh Vardhan

“Our premier institution—the Indian Council of Medical Research (ICMR) -is involved in the trial of COVID-19 vaccines’ executions. India is also hosting clinical trials for all the major vaccine contenders. About 30 vaccines are in different stages of development in India. Two of them are in the most advanced stage of development-COVAXIN developed through ICMR-Bharat Biotech collaboration and COVISHIELD from the



Serum Institute of India. The Institute, world’s largest vaccine manufacturer, is conducting trials for the vaccine developed by Oxford University. Both are in Phase-III clinical trial stage. One of our pharma giants, Dr. Reddy’s Laboratories, will distribute the Russian vaccine in India after conducting final-stage human trials and receiving regulatory approval”. Dr. Harsh Vardhan, Minister for Health and Family Welfare, Science & Technology and Earth Sciences said this in his inaugural speech at the First Virtual SCO Young Scientist Conclave, held virtually on 24 November.

He also pointed out, “To give young talent opportunities and leadership in challenging areas of science, India has established five specialised research laboratories. Each laboratory deals with a focussed area of science - artificial intelligence, quantum technologies, cognitive technologies, asymmetric technologies and smart materials”.

Government launches Mission COVID Suraksha to accelerate Indian COVID-19 Vaccine Development

On 29 November 2020 the Government of India announced the third stimulus package of Rs. 900 Crore for the Mission COVID Suraksha-The Indian COVID-19 Vaccine Development Mission. This grant will be provided to the Department of Biotechnology (DBT) for Research & Development of Indian COVID-19 vaccines.

The COVID-19 Vaccine development Mission with end-to-end focus from preclinical development through clinical development and manufacturing and regulatory facilitation for deployment would consolidate all available and funded resources towards an accelerated product development.

Led by Department of Biotechnology and implemented by a dedicated Mission Implementation Unit at Biotechnology Industry Research Assistance Council (BIRAC), the existing activities under National Bio Pharma Mission (NBM) and Ind-CEPI Mission will provide complementary strengths to this Mission.

Dr Renu Swarup, Secretary, DBT, Ministry of Science & Technology and Chairperson, BIRAC, said, “Mission COVID Suraksha is our targeted effort to enable development of indigenous, affordable and accessible vaccines for our country and will complement the National Mission of Atmanirbhar Bharat”.

ICMR issues advisory on use of Dry Swab RNA Extraction Free RTPCR Method

CSIR-CCMB Hyderabad has developed RNA extraction-free dry swab method for RTPCR-based detection of SARS-CoV-2. The method will save time and reduce cost as compared to standard PCR test using Viral Transport Medium (VTM) and RNA extraction.



This method involves collection of a VTM-less dry oropharyngeal/nasopharyngeal swab from suspect SARS-CoV-2 patients. The swab is then transported to the lab wherein Tris-EDTA - Proteinase K buffer is added, and the sample is incubated for 30 minutes at room temperature. The sample is then subjected to heat inactivation at 98oC for 6 minutes. The extract is then used for RTPCR.

Considering its lesser cost and quick turn-around, the dry swab variant method can be used as a screening tool only in settings where automated RNA extraction is not available.

CSIR-CCMB Successfully tested REME-PHI technology capable of combating the SARS-CoV-2 virus

In the battle against the on-going pandemic, ZECO Aircon Limited (a leading Indian manufacturer of air management systems and the exclusive distributor of RGF in India), in collaboration with RGF Environmental Group, a US-based environmental design and manufacturing company, has successfully tested it’s REME along with PHI technology with CCMB-CSIR laboratory (as per ICMR directives), in a study conducted that revealed the efficiency of REME-HALO with PHI cell on SARS-CoV-2 virus.

This technology was found to be capable of neutralizing active SARS-CoV-2 virus by 97.48% at 15 minutes of activation of REME-PHI Cell on surfaces. REME with PHI is an “active” solution that neutralizes SARS-CoV-2 within the occupied space, eliminating the need for virus particles to travel through the HVAC system air filters or passive UV air purification system.



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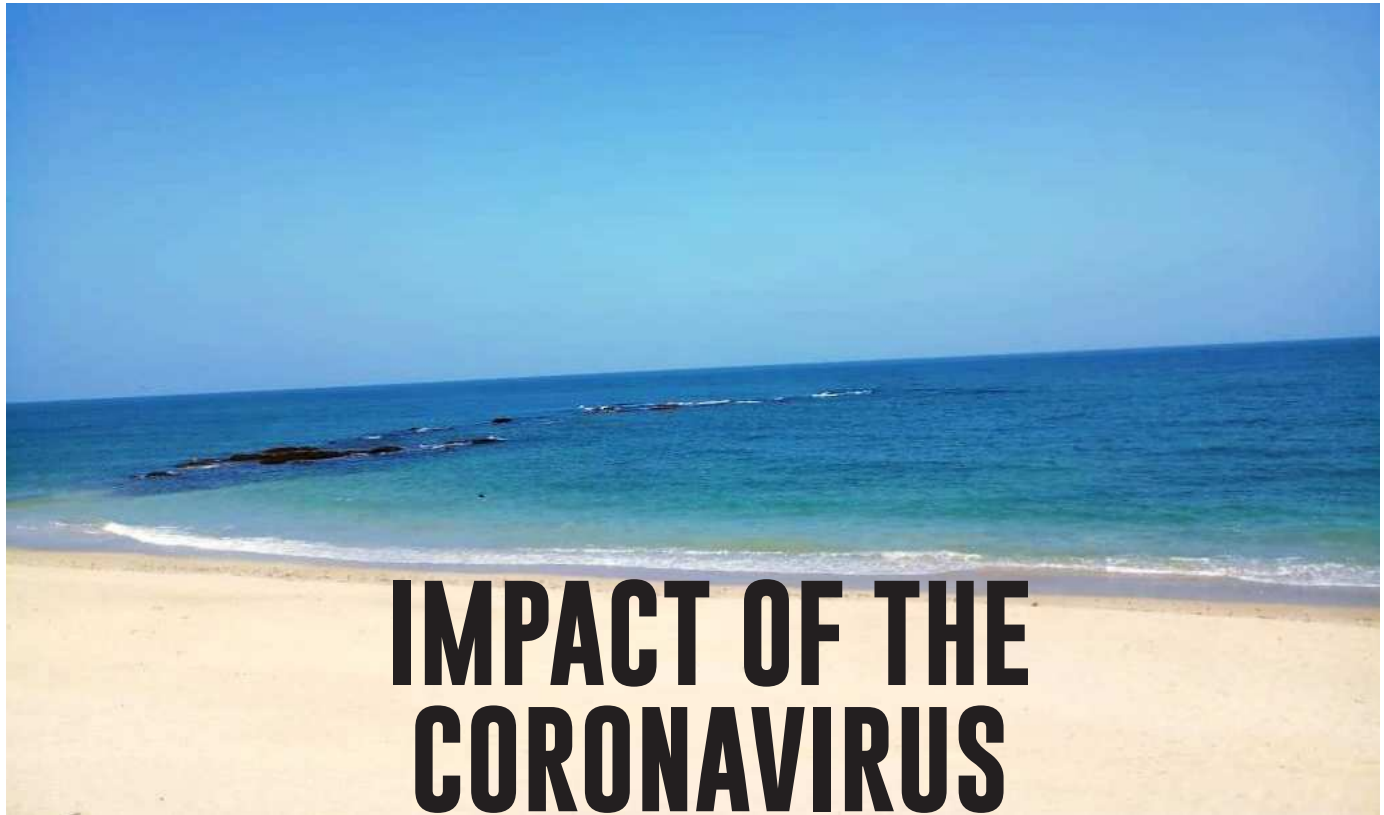
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COVER STORY I

RITESH JOSHI



IMPACT OF THE CORONAVIRUS LOCKDOWN ON NATURE



While the lockdown has been a crisis for humans, it has proved to be an elixir for nature. Magnificent impact of the lockdown on the environment has been visible across the country.

COVID-19,

the disease caused by the novel coronavirus has been identified as a global pandemic. On the one hand, its outbreak has become one of the biggest threats to the life of people and the global economy, on the other hand, it has had quite a few positive impacts on the environment, primarily due to several restrictive measures like complete lockdowns imposed on all kinds of anthropogenic activities, except essential services during the early phase, which has reduced the human footprint considerably. It is also true that the actual measurable quantitative impacts are not very clear as yet. Key environmental indices related to air and water quality and biodiversity, which have been deteriorating during the past several years, have dramatically improved. Though these may have been short-term environmental gains, the period has taught us about the green social behaviour and responsibilities. Stringent eco-friendly efforts are needed to be carried out to maintain the environmental gains of the lockdown. Besides, there is an urgent need to organise mass campaigns on issues relating to environmental awareness to uphold the momentum, which the nature has reset for mankind.

It is now widely acknowledged that the impact of human activities on environment is significant and will have serious consequences for future generations. India is one of the world's 17 'mega-diverse' countries with only 2.4% of the world's land area. But it accounts for about 7-8% of all recorded species, including over 50,000 species of plants and one lakh species of animals. It also has a high level of endemism in species distribution. Of the 35 biodiversity hotspots in the world, India accounts for four.

India is known for a wide range of ecosystems and their myriad biodiversity due to its varied bio-physical environments. Besides, the country is endowed with a diverse range of biological resources due to the presence of different bio-geographic regions. On the one hand, the Indian Himalayan region is spread over 5 lakh km² and on the other, the vast coastline stretches over 7,517 km. However, fragmentation of habitats, unsustainable land-use practices and habitat loss, climate change and rise in the level of pollution are some major threats, negatively influencing India's rich biodiversity.

Spread of the coronavirus pandemic has created an emergency situation all across the country and compelled the Government to impose a long lockdown to restrict its rapid spread at community level. Industries, companies, schools and colleges-everything was shut down for about two months. It stopped all modes of transportation. All these actions caused

a huge economic loss across the world. Unfortunately, some people lost their lives, some lost jobs and some struggled for earning their daily meals during the period. While the lockdown has been a crisis for humans, it has proved to be an elixir for nature. Magnificent impact of the lockdown on the environment has been visible across the country.

Improvements in the air quality

There has been another aspect of the coronavirus pandemic that made the whole human race realise that they are not the only driving force on earth. The lockdown has restored nature in a way we have never seen before during the last several decades. Due to stringent travel restrictions, shutting down of the industries and halting of all kinds of commercial and construction activities, the impact of air quality improvements has been clearly visible. Carbon emissions sharply fell during the lockdown and the levels of harmful pollutants like suspended particulate matter PM₁₀ and PM_{2.5}, NO₂ and SO₂ in the air also dropped sharply.

Satellite data has also authenticated the fact that there was a substantial decrease in the level of suspended particulate matter after the lockdown over most of the parts of the country. The Centre for Atmospheric & Oceanic Sciences, Indian Institute of Science, Bengaluru has also pointed out that multi-spectral measurements of aerosol absorption indicated that the drastic decrease in pollution levels was mainly due to a reduction in fossil fuel burning emissions. A study titled 'Effect of lockdown amid COVID-19 pandemic on air quality of the megacity Delhi', published in the journal *Science of the Total Environment*, has revealed that PM₁₀ and PM_{2.5} concentrations and NO₂ and CO levels in the air of NCT of Delhi have considerably fallen as compared to pre-lockdown period and the air quality has improved considerably. The satellite data of the European Space Agency also revealed similar data, which indicated that there has been a significant reduction in NO₂ levels during the lockdown period.

Improvements in the water bodies

There has also been considerable improvement in the water quality of our rivers and oceans after the lockdown, especially in terms of dissolved oxygen, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) as compared to the pre-lockdown period. During the lockdown, the release of the industrial wastes into the oceans and rivers was stopped, which brought a significant change in the water quality. Even the water of River Ganges in Rishikesh and Haridwar was found suitable for drinking after chlorination, for the first time in decades. Our aquatic life was suffering from the negative consequences





of solid waste and plastic pollution, and interestingly, during the lockdown, the pollution level in most of the water bodies came down because of restricted tourist activities.

Similar reports have also been received from Delhi. The analysis of the water quality of River Yamuna across the Delhi stretch, done by the Delhi Pollution Control Committee and Delhi Jal Board, has indicated an improvement in water quality, which was mainly due to reduction of industrial pollutants. It would not be an exaggeration to say that now our rivers are once again rejuvenated and can sustain the threatened aquatic life.

Critically endangered river Dolphins were spotted back in River Ganges after 30 years in the State of West Bengal. Tens of thousands of migratory birds gathered in our sea coasts. Overall, the sudden changes in the environment and the subsequent changes in ecosystems marked a dramatic shift for whole world.

Impact on protected areas and wildlife

The lockdown has certainly influenced our protected areas and wildlife. In normal times, most of India's National Parks and Wildlife Sanctuaries remain open for tourists from November to June and lakhs of tourists visit them during this period. But this year, no human activities happened in these protected areas, which allowed the wild animals to move freely within their home-range. Quite a few reports of wild animals straying and strolling in public places have also been received during the lockdown.

The lesser whistling duck, which was uncommon in the city of Guwahati in Assam was seen during the period. This duck has been spotted from the Dighalipukhuri Lake in the centre of the city, which is a rare occurrence. Similarly, the hooded pitta, which is rare summer migratory bird in the north-western

Shivalik landscape, was sighted in forests near Haridwar city. News of frequent sightings of the cheer pheasant, which is threatened in its geographic range, were also received from different parts of Garhwal Himalaya. The unusual nesting of Olive Ridley Turtles in daylight was reported from Rushikulya rookery and Gahirmatha coasts in Odisha. This has happened after a long time, probably because no human activities were happening along the beaches.

Some of the future strategies to sustain the gains of lockdown would involve participatory planning and governance in the field of pollution abatement, water management, waste management, coastal resilience, climate mitigation and adaptation, and forest and wildlife management. Moreover, environmental awareness has to be kept as a thrust area to sensitise the people, especially students who can bring a qualitative change in environmental health through adopting eco-friendly green habits, lifestyle management and contributing for a clean and green environment.

The lockdown has benefitted nature in a way we never saw in the living history. Besides, it has also taken us back to world of realisation, which we have left behind centuries ago. The period has taught us about appreciating nature, engaging ourselves, taking ownerships and responsibilities, making us self-dependent, and in redefining our goals and ambitions. The pandemic and lockdown have provided us with a future blueprint for the kind of green responsive behaviour, which is a basis of life. Now it is up to us whether we want to walk with nature even after lockdown is lifted or on the same old obscure path.

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COVER STORY II

SHAILZA MISHRA AND DHRUTI ACHARYA

SOCIAL DISTANCING: LESSONS FROM NATURE TO ANCIENT RITUALS AND THEIR CURRENT IMPACT ON OUR SOCIAL STRUCTURE



In many societies, some social distancing practices were representative of class or status of the person in society. However, this practice is not restricted to humans and numerous examples are found in the animal and plant world.

IN 1956, Issac Asimov, a biochemist and science fiction writer of *The Naked Sun* described the life on planet Solaria, wherein inhabitants follow extreme form of social distancing and communicate through holographic projections. We never thought that we will have to live through Issac Asimov's fiction and as a society would have to give up fundamental human gestures like touch, hug or cuddle, and that social distancing or self-isolation will become part of our lives.

The practice of social distancing existed in human civilisations, ancient rituals and its rules are even followed by nature. In fact, social distancing norms were followed long before any recorded pandemic. For instance, the Newar civilisation in Nepal practised an ancient ritual of self-isolation for 2-weeks at Yita Chapa—community hall in Kathmandu—after travel through Himalayas. Similarly, 'sutak' and 'patak' were practised in India for quarantine after birth and death, respectively in society. The cultural etiquettes like "bowing" (followed in Japan) or "namaste" (followed in India) is still used as a gesture of greeting to minimise physical contact between people.

In many societies, some social distancing practices were representative of class or status of person in society. For example, the Victorian-era "crinoline" was a large, voluminous skirt used to create a barrier between the genders in social settings. Women also used large hats and face masks/veils to keep pesky strangers away. The volume of skirt or the size of their hat represented their respective social status.

By mid 1300s, state-organised responses to control surging communicable diseases were initiated. Society was vigilant to observe that those who tended patients carrying infections also eventually fell sick with same infections. So, city health officials used to put measures in place to limit person-to-person contact. Port-cities turned away ships carrying cargo and passengers that were arriving from any infected area. During middle ages, control of the outbreak of Black Death (bubonic plague) in Europe and Asia was one early evidence-based quarantine (derived from the Italian term *quaranta giorni*, which means 40 days). Sailors and their cargo were under quarantine for 40 days as a precautionary measure to minimise spread of infections in port-cities. Strict isolation and community ostracisation for indefinite period was followed for leprosy patients. Till recent times, diseases like tuberculosis and HIV were associated with stigma, social

isolation and discrimination. Unfortunately, some of these social-distancing practices have deepened inequalities in our societies and ostracisation of infected people.

The practice of social distancing is not restricted to humans and numerous examples are also found in the animal world. Despite how unnatural social distancing may feel, it is very much a part of natural world, practised by fishes, mammals, insects and birds. How do these animals prevent diseases? They simply do it by distancing themselves or by expelling the diseased one from the community. The World Wildlife Fund (WWF) has compiled a list of animal species that include marine turtles, blue whales, snow leopards, polar bears, jaguars and platypus, which primarily prefer self-isolation and semi-solitary lives except during mating season. Whereas some animals choose social distancing strategies that vary from shunning a sick animal to maintaining interactions with only the closest relatives. In the animal world, monkeys, fishes, insects, birds, and lobsters detect and distance themselves from sick members of the community, and this action is termed as "behavioural immunity" by ecologists.

In social insects which live in colonies like ants, honeybees and termites, the infected ones purposefully leave the colony or induce self-destruction. For instance, ants engage into destructive disinfection by using antimicrobial secretions like formic acid. A typical ant colony comprises of one or more fertile females (queen), sterile females (workers) and fertile males (drones). The worker ants comprise of foragers (search



for food for colony) and nurses (take care of the brood). Worker ants are attracted towards infected pupa and kill pupa and the ant-infecting fungus, *Metarhizium brunneum*. This fungus spreads when its spores are passed from ant to ant through physical contact; it takes one to two days for the spores to penetrate the ant's body and cause sickness

that is often fatal. Researchers mimicked the natural way for introducing infections and applied fungal spores directly to a subset of 11 ant colonies. At the onset of disease, the healthy ants in fungus-exposed colonies started rapid and strategic social distancing. It is interesting how ants have evolved this social behavior of destruction-linked defense to protect their colonies. The killed pupa serves as a protein reservoir for the colony.

Similar social distancing norms are followed by lobsters. Due to their commercial value, a lot of research has been done on different lobster species. It is found that juvenile lobsters are prone to infection by *Panulirus argus* virus. As observed in field and laboratory sniff-test experiment, the healthy lobsters distance themselves from diseased members by differences in urine smell. They even abandon their safe-abode upon arrival of a sick lobster in their den.

Like ants and lobsters, honeybees and tadpoles also rely on chemical signals to identify the sick member. Guppies or rainbow fishes also follow strict scrutiny process, wherein they distance themselves from other tank/aquarium members which have clamped fins, paleness, bad odour and diseased pheromones. In animal world, ruthless enforcement of social distancing is observed in chimpanzees, as they attack visibly sick fellow chimps.

The flipside of social distancing is that it has associated trade-off which limits the benefit of social activities like capturing prey, staying warm and avoiding predators. Not all animals exhibit social distancing behaviour; for instance, "a wolf pack" symbolises a highly ordered social structure comprising of adult male and female wolves, offspring, siblings and relatives. Wolves take care for each other and also nurture their sick and injured members. When their pack-mate dies, they mourn the loss. They also exhibit emotional bonds with members of other packs. Similarly, elephants show empathy to their herd members and support the sick member with food and water. These social species stay-together even during threats of infection and just change their grooming interactions to prevent the risk of spread of infection.

Besides animal kingdom, plants also practise social distancing and it is evident through the phenomenon of "crown shyness" - the tendency of some tall trees to form beautiful crown-like canopy structures that help in avoiding direct contact with surrounding trees. This phenomenon is documented in the mangrove (*Avicennia germinans*), lodgepole pine (*Pinus contorta*), Japanese larch (*Larix*



kaempferi), and several other species. This allows sunlight to reach forest floors, and gaps in the treetops prevent the spread of leaf-munching bollworms and parasitic vines. Growing evidences suggest that plants can sense physical and chemical signals from neighbouring plants and halt its canopy growth to avoid tussling at treetops. The idea of social distancing by trees is now being adapted as green dividers to demarcate physical distances in workplaces, restaurants, etc.

It is undeniable that the current pandemic has brought our lives to a standstill and in absence of an efficacious vaccine or drug for SARS-CoV-2, social distancing is an important and effective preventive measure to reduce the transmission of the virus. Although socially distancing ourselves from individuals with contagious infections is an instinctive behaviour, social network is a fundamental psychological and physiological need of every individual. The prolonged social distancing during this pandemic has reshaped our society into individualism, social rejection, stigma and loss of community feeling. Long-term isolation will impact the mental and emotional health of all age-groups and add further to stress and chaos associated with the pandemic.

People who have undergone quarantine or hospitalisation have shown varying degrees of abnormal psychosocial behaviour. Even healthcare workers who are tirelessly working for COVID-19 management have to follow strict quarantine protocols which is further adding to their work-associated distress. Although it is important to maintain physical distance, we need to be socially, emotionally connected with our family, friends, neighbours and peers, so that we can support the most vulnerable among us.

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UNSDG Goal 1: No Poverty

Can science and technology help achieve it?

United Nations Sustainable Development Goals (UNSDGs), 17 in number, have been set aside to address important yet burning issues the world face today. In our last issue, we detailed these goals and targets associated with them. Starting with this issue of Dream 2047, we bring to you a series of articles that would cover the role of science and technology with respect to each of these goals. In this inaugural article, we bring to you the role of science and technology in combatting the issue of poverty, which is the first goal in the list of UNSDGs.

COVID-19 struck the world in 2019. Its effect was felt during the whole of 2020, and no one knows how long it would continue in 2021. The economy took a big hit. So did all the efforts around the world to eradicate poverty, which in turn is the UN Sustainable Goal #1: No Poverty.

Proposed and put forth in 2015 along with other goals, eradicating poverty has been on top priority with the UN and its agencies the world over. Figures speak about the huge magnitude of poverty. More than one billion children live in poverty. A number of ideas, steps, plans, and projects have been mooted from time to time to eradicate poverty. Amongst these, the identification of macro and micro issues is a leading one. This is where a number of researchers feel that local aid is the major and a macro issue. However, others feel that combined endeavour of local, state, and national governments would be more effective in lowering the levels of poverty. Whether it is local aid distribution or efforts being made at the national level, a conduit for all of them to reach the beneficiary would ultimately be science and technology. This is something that everyone agrees to as well. In order to move ahead of the identification of these issues, it's of paramount importance that agencies involved in poverty eradication allocate proper time and resources. Besides the COVID-19 pandemic, we all know that there are a number of preventable

available big data is duly analysed and patterns to map the beneficiaries with the local aid are executed effectively. Thanks to artificial intelligence, inferences are drawn from exercises related to these analyses, thus assisting in an effective policy formulation. While policy ensures a framework and a path for a formulated approach to



diseases like pneumonia that impact the lives of more than two million children annually. Science and Technology has provided the required ammo to combat this major issue. However, despite the available medicines and vaccines, proper planning, and sufficient money, poverty still exists. This is where S&T is required to execute a well-planned systematic and scientific planning to aid allocation of proper time and resources.

Resources should reach all affected in time and thus requires a well-thought out and practically realisable policy that reaches the needy. This is possible when

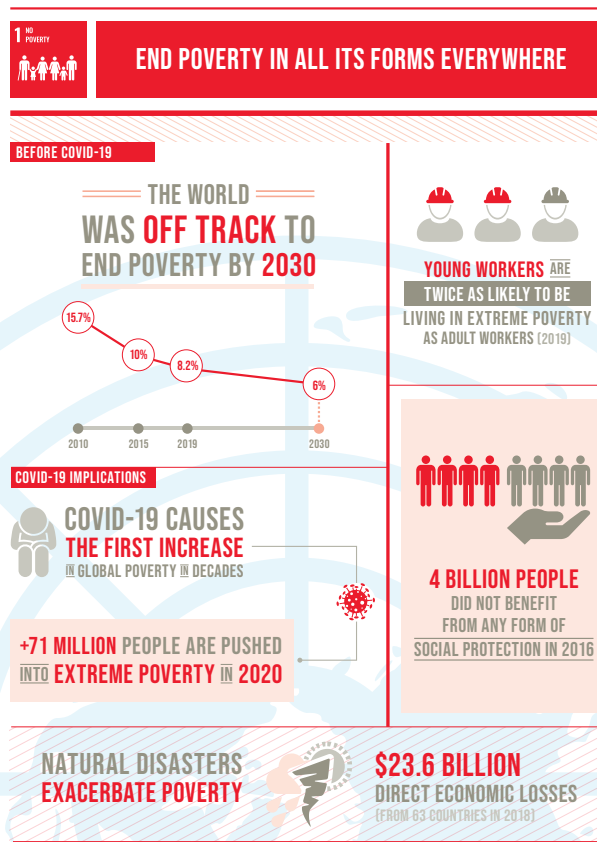
combat poverty, the improving global economy is prime and important. For this, creating more and more new job opportunities is thus the obvious next step. S&T plays an important role in this direction. With upcoming newer technologies, newer growth possibilities promise new job opportunities and sustainable wages for all.

For people to be made ready to work, providing education to one and all is a very important point. There are a number of regions in developing countries, where physical access to the elementary education system is difficult.

Thus, with new technologies getting into place, education can be made accessible to poor people in far-flung areas through mobile education, something we all noticed during the current pandemic when students and teachers coped with the new normal through the Internet.

For people to work and earn their wages, it is important that they remain safe and healthy. This means that providing access to healthcare to one and all is very important. For this to be realised, local, state, and national governments with the help of healthcare organisations-hospitals, research institutions, insurance agencies, and NGOs-would be required to work in complete harmony, as well-oiled machinery. Any flaw or discontinuity in it would result in a global pandemic, and what we have witnessed in 2020 is the most recent and live example of it. COVID-19 retarded all the efforts that were initiated by the UNSDG since its start in 2015. From S&T standpoint, to make healthcare easily accessible to one and all, mobile healthcare through mobile phones can provide medical information for people in geographically inaccessible areas and are impoverished.

Continuing with the advantages of mobility in lessening poverty, mobile banking has been reported as one of the major S&T-linked contributors. In countries where poverty looms large, the poor can invest timely and without any middlemen irrespective of any geographical hindrance.



SUSTAINABLE DEVELOPMENT GOALS

ACCESS MORE DATA AND INFORMATION ON THE INDICATORS AT [HTTPS://UNSTATS.UN.ORG/SDGS/REPORT/2020/](https://unstats.un.org/sdgs/report/2020/)

Among the long list of factors associated with poverty is access to clean water. Reports indicate that more than 748 million people around the world, because of poverty and lack of sanitation, do not have access to clean water. This results in poor health, which in turn is a big factor related to poverty. Improved techniques and innovative methods to assist agencies in order to provide required access to clean water are high on the list of associated domains of science and technology. Relevant researches and high-level scientific deliberations continue to remain on top of every discussion and policy formulation related to clean drinking water access being made available to one and all.

Along with water, food and shelter are two other issues closely associated with poverty. For food to be produced in ample quantity to feed the poor, it is essential and necessary that farming methods improve in a continual manner. Improve, apply, and stabilise-that is

how innovative techniques related to agricultural practices have contributed significantly in eradicating poverty. It is equally important to ensure that new techniques, for example, sowing practices for growing rice in saltier water are adopted. This can certainly reduce the hunger of poor millions around the globe.

Encouraging more and more women to come forward and be part of this initiative is very critical. For this, creating scientific awareness amongst the masses, especially women, is very important. In developing nations, making women scientifically aware is important because of her role in family and society is highly important. Empowering women with scientific temper would contribute in building strong foundations of the economy. Equal opportunities being provided to women, especially in the S&T sector, would bring in more job opportunities.

Waste management has emerged as a major factor due to ever-increasing migration towards the cities. The solution to waste management is again driven by science and technology. Access to information through mobile telephony is yet another factor that has emerged as a major factor that distinguishes the haves from the have nots. Major reference works indicate that the digital divide has surfaced as a major issue that can be resolved with every individual getting access to information through mobile devices. Improving the mode of transportation is yet another area where S&T intervention can bring in the required relief.

The list of issues related to poverty is a long one, and those associated who can help eradicate it are duly dependent on the application of science and technology. Hence, proven!

Image Courtesy: UN SDG

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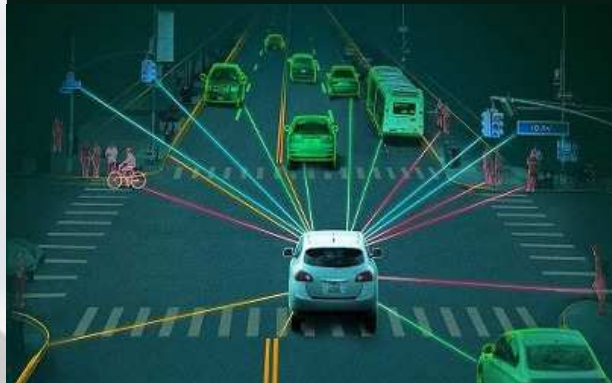
Automobiles were first developed in the year 1879 by Karl Benz. It was one of the biggest breakthroughs of the time as it made travel faster and easier. Since then we have experimented with them and have seen many developments. Continuous research is being done to introduce latest technology in automobiles. These days we see vehicles connected to smartphones and the Internet. Cordless calling is making them more productive; GPS systems are helping to avoid congestions and many more developments are improving our driving experience.

Several tech giants are bringing in vehicles which can drive themselves with little or no human assistance. These vehicles are referred as semi-autonomous vehicles. They can steer, accelerate, decelerate, stop and change lane without human intervention. These developments have led a way to fully autonomous vehicles which can turn out to be really helpful.

Companies such as GM, Tesla, Mercedes, BMW, Nissan etc. are investing both time and money in these projects to make driving totally free of human interaction. Though the developments started early, companies have not yet been able to completely deploy autonomous vehicles on road. Many projects are under different phases of

Pendulum test for sensors in driverless car

This article presents a brief introduction to autonomous vehicles and discusses a new approach to solve the problem of sensor failures in them.



(Photo Source: Artificial Intelligence and Internet of Things for Autonomous Vehicles)

testing where engineers are continuously working to overcome challenges. The day is not far away when these vehicles will be taking us places all by themselves!

Artificial Intelligence and Internet of Things or IoT have entered the world of automation in a big way. IoT is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers and has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Basically, IoT interconnects

various devices to make them more efficient. It interconnects a group of sensors, software, network connectivity, and necessary electronics to collect and transfer data connecting objects of daily use to the internet which further helps in real-time data monitoring. This function is the very basic requirement for developing autonomous cars.

Sensors which are connected to various vehicles keep on transferring the collected data to the Cloud which further processes it to generate algorithms to avoid traffic, obstacles, pot-holes and many more factors. Nowadays, autonomous vehicles are using V2X protocol which connects the vehicle to anything that has an impact on it. This kind of communication helps various vehicles, infrastructures, networks, and pedestrians to

connect with the self-driving car. This protocol is beneficial because it helps in improving road-safety, efficiency, mobility, sustainability, and driver convenience.

AI and IoT both have historical moorings. In 1500s, Leonardo da Vinci sketched the first automobile, which had the capability to move without the force provided by a push or pull. This automobile had a spring attached to it and always moved on a predefined path (often referred to as the “First Robot”). Soon after, in 1868, Robert Whitehead developed “Torpedo” which could propel itself underwater. This invention proved as a game changer for the naval fleets. As technologies advanced, in 1945, an engineer, Ralph Teetor, developed the first cruise control to smooth out car rides. Stanford cart, a major advancement, was developed in 1961, which was the first truly autonomous vehicle. The key reason to develop this cart was to avoid the 2.5-second delay between

LEVELS OF DRIVING AUTOMATION

0	1	2	3	4	5
NO AUTOMATION	DRIVER ASSISTANCE	PARTIAL AUTOMATION	CONDITIONAL AUTOMATION	HIGH AUTOMATION	FULL AUTOMATION
Manual control. The human performs all driving tasks (steering, acceleration, braking, etc).	The vehicle features a single automated system (e.g. it monitors speed through cruise control).	ADAS. The vehicle can perform steering and acceleration. The human still monitors all tasks and take control at any time.	Environmental detection capabilities. The vehicle can perform most driving tasks, but human override is still required.	The vehicle performs all driving tasks under specific circumstances. Geofencing is required. Human override is still an option.	The vehicle performs all driving tasks, under all conditions. Zero human attention or interaction is required.
THE HUMAN MONITORS THE DRIVING ENVIRONMENT			THE AUTOMATED SYSTEM MONITORS THE DRIVING ENVIRONMENT		

the sending and receiving of commands by the moon rover. Currently, the most advance stage of autonomous vehicles (Deliverable on road) has been achieved by Tesla Autopilot in 2015. This enabled hands-free control for highway and freeway driving.

There are six levels of autonomy. Each of these has a specified definition of autonomy attained by the automobile. Currently we are at the third level of autonomy as the vehicles are capable of self-driving with little intervention. Several companies, such as Google, Tesla, Nissan and many more are working with full efforts to soon launch fully autonomous vehicles in the market which would have attained level four, or above, in autonomy.

Sensors and Pendulum test

Autonomous vehicles offer several advantages to both the manufacturer and the consumer. But, we should be aware of the problems that they may have which should be solved in order to avoid serious accidents.

One such problem is 'Sensor Failures'. Sensors are the components which are solely responsible for the detection of objects in the external environment of the vehicle. These sensors provide the input which needs to be processed for autonomous vehicles to take further decisions. There is a probability that these sensors may fail during the run. However, a simple pendulum test can tell whether the sensors are working correctly and are in sync with each other in an autonomous car. Glitch-free communication between sensors is crucial to run the driverless cars which are making a debut as new mode of transport around the world.

The driverless or the self-driven vehicles rely on IoT platform in which sensors are the 'things' that "talk" to

each other and share input information. For controls to work correctly, it is important that the inputs collected by sensors are correct. But, if one or more sensors have failed, the inputs will be wrong and a diagnostic run using a pendulum is required. For this, an oscillating pendulum is placed in the path of the car. Three sensors, namely Camera, Radar, and Lidar are put to test.

If the sensory information provided by the camera identifies the object as a sphere, then it would give a 'true', else false. If the sensory information provided by the Radar identifies the predefined velocity of the pendulum (\pm error) then it would indicate 'true', else false. If the sensory information provided by the Lidar identifies the predefined radius of the bob (within \pm error), it would give 'true', else false.

If the all three conditions return the value 'true', then all the sensors are working fine. If any of the values turns out to be false, then the sensor with false value is not working fine. In that case, a warning can be activated and either the car will move off the road or will prompt the driver to take over.

Sensors are eyes and ears of an autonomous car. A periodic check-up of the health of the sensors is required for the vehicle to navigate and run on busy roads without any accident. Sensors fail mainly because of two factors: faulty hardware or weather conditions such as sun glare, fog, rain, and snow.

Autonomous vehicles are equipped to analyse the external environment with a variety of interactive sensors which include Radar, Lidar, Sonar, GPS, Odometer and many more. These sensors interpret sensory information to identify navigation paths, avoid obstacles, steer through lanes, read signs and much more. These self-governing vehicles analyse the external situation

PROS & CONS OF AUTONOMOUS VEHICLE

Pros:

- Autonomous vehicles can prove to be of great use once we master the design. They can reduce number of accidents taking out the 'human error' component, as the whole system is controlled by complex algorithms which accurately determine the correct stopping distance from one vehicle to another.
- They can reduce traffic congestion. As the autonomous cars are connected to each other by the V2V protocol, it helps the vehicles in "platooning" as they brake or accelerate simultaneously. This increases the lane capacity and reduces the congestion significantly. Autonomous cars can pre-detect traffic congestions using GPS and change its route instantly. It can also detect any constructions and detours. It reacts to the system accordingly.
- An autonomous car drives itself, communicates with various structures and vehicles, drops you at your destination, locates a vacant spot, parks itself and therefore reduces parking hassles.
- It saves time as the passenger/driver has spare time to do their work without worrying about road safety.
- It provides wider access of transportation to children, senior citizens and disabled who would be able to travel without any assistance.

Cons

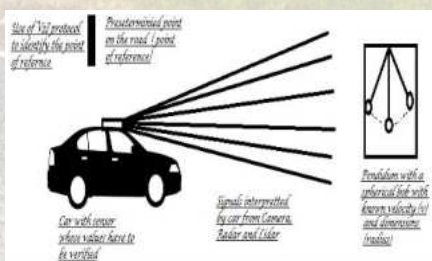
- Autonomous vehicles are costly, as they have high-end sensors and technology to function. One needs to pay extra for software, vehicle parts and sensors.
- Unexpected errors in programming may happen.
- Autonomous vehicles are continuously monitoring user data and hackers may break in to steal this data.
- Autonomous vehicles reduce job opportunities.
- Sensors may not perform as expected in certain weather conditions or technical reasons, leading to incorrect data collection, failures, even accidents.

in a number of ways, finally selecting the one which is most optimal.

These vehicles also collect data from various other sources such as infrastructures, other vehicles, pedestrians, and networks to gain as much information as they can to function properly.

This Pendulum Test Method of solving the problem of sensor failures by verification can be easily implemented with very minimalistic resources and technologies. As this method provides regular checks to the sensors, accidents from sensor failures can be avoided.

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Value addition through dehydration of flowers and foliage

By learning the technology to dehydrate flowers and foliage housewives, unemployed youth, school dropouts, amateurs, and enthusiasts can earn their livelihood.

Flowers have long been admired by humans to beautify their environment. These are also object of ritual, religion, romance, medicine, and a source of food. Floriculture has become a lucrative business in many parts of the world including India. Garden lovers and amateurs grow flowers around their homes and dedicate entire part of their living space to flower gardens. Fresh flowers, though quite attractive, are very expensive and short-lived. Moreover, they are available only during a particular season. Sometimes, farmers cannot get the price of the produce due to glut in the market; therefore, flower dehydration and value addition is one of the best alternatives under such circumstances. Flowers can be dried with high precision so that they look like natural fresh flowers and can be preserved for a longer period of time.

Dehydrated flower and foliage products are long lasting and retain their aesthetic value irrespective of the season. The shelf life of dehydrated flowers and foliage may be reasonably long if protected from moisture and dust. Dried flowers and plant parts

have been exported for the last four decades and today these are in very high demand and add an enriched value to the flourishing industry. India is one of the leading countries and export more than 60% dry flower products; and major export destinations of Indian floriculture products are Europe, USA and Asian countries

Different types of colourful flowers and foliage are grown in rural and hilly areas in different seasons but most are wasted under natural process; therefore, to conserve these beautiful vegetations for longer time, dehydration technique seems to be very useful. Dehydration of flowers and foliage by various methods can be used for making decorative floral crafts items like greeting cards, floral segments, wall hangings, calendars, etc., for various purposes. Extensive plant parts like stems, roots, shoots, buds, inflorescences, fruits, fruiting shoots, cones, seeds, foliage, bracts, thorns, barks, lichens, fleshy fungi, mosses, etc., can be preserved by drying them. There are many flowers like anemone, zinnia, allium, carnation, stock, freesia, narcissus, chrysanthemum, pansy,

daffodils, marigold, rose, lilies, etc., and foliage like ferns, aspidistra, eucalyptus, ivy, laurel, magnolia, etc., respond well to different types of drying techniques.

The demand for dry flowers, dry foliage, attractive plant parts, dried floral arrangements and floral crafts is increasing day by day. There is a large potential to develop the dry flower industry in every country to provide employment to housewives, school dropouts, and rural women. This concept of using dried plant material, which is known for their long-term beauty and elegance, has given hobbyists and entrepreneurs a new, exciting and profitable ornamental business. In other countries, the dried flowers industry is quickly developing and gathering demands among clients who prefer the natural looks in their surroundings like homes office, etc. Dried flowers also offer a value-added opportunity for producers who supply raw materials to wholesalers, retail florists and craft retailers.

For obtaining good quality dried flowers and foliage, there are different techniques of drying:

1. Air drying: This method of drying is very common where the plant material is tied with rubber bands and attached to rope or wire in hanging position in a well-ventilated dark area. Flowers may also be dried by spreading over some absorbing material such as blotting paper or newspaper and kept in dark or in the sun for quick drying. Slightly immature stage of good flowers should be selected for air drying.

2. Press drying: In this method, the flowers and foliage are placed between the folds of blotting papers and newspaper sheets. For quick drying these can also be kept in oven at an appropriate temperature. Floral crafts items like greeting cards, floral designs, etc., are made by this method as by doing so, flowers and foliage becomes flat and these creations may be framed also. There are different types of plant materials which are used in press drying at different temperatures and time period as shown below:

Plant material	Temperature (in oven)	Time
Pansy	35-39°C	48 hours
Leaves of silver oak, thuja, adiantum, nephrolepis and flowers of hibiscus, haematoxylon, calliandra, marigold and <i>Cassia biflora</i>	35-39°C	48 hours
<i>Euphorbia leucocephala</i> , <i>Galphimia nitida</i> , <i>Lantana camara</i> , <i>Lantana depressa</i> and <i>Lantana montevidensis</i>	40-44°C	24 hours
Flowers of <i>Ixora</i> sp. and <i>Mussaenda</i> sp.	45-49°C	24 hours

3. Embedded drying: Embedded drying is one of the most important methods of drying flowers as the flowers retain good shape and colour. Different desiccants like sand, borax, silica gel, saw dust, perlite and their combinations are used for embedding material and it varies for cultivars. Silica gel is considered ideal for delicate flowers like roses, dahlia, carnations, etc. Deep containers for embedding and drying also plays important role in maintaining shape and form of different plant materials. Embedding of rose buds in silica gel is considered to be the best, as it retains its

colour and shape. Sometimes fine sand is also used which seems to be the best because it is easy to handle, heavy and does not react with water vapour.

4. Oven drying: In this method, plant materials are kept at controlled temperatures for a specified time period with the objective of retaining original colour, shape, texture, etc. Microwave oven is considered to be the best for drying in which flowers and foliage are kept in the embedding material in nonmetallic container or glassware.

5. Glycerine drying: This method is mostly used for preserving leaves. Different concentrations of glycerine and water and different methods are used for drying foliage. Immersing the thick foliage (Silver oak, Rubber plant, Cordyline, etc.) in glycerine solution in a concentration of 1:2 or 1:3 results in preservation in 7-10 days, while thin textured leaves (Boston fern, Asparagus, etc.) are dried by uptake method in 4-6 days. Once the colour of leaves turns darker, it indicates that foliage is glycerine dried and can be stored after wiping with wet tissue and subsequent drying in air. Traces of antibiotics are also necessary in glycerine to prevent microbial growth.

6. Freeze drying: Freeze drying of ornamental plants like *Aspidistra* spp., *Fatsia japonica*, *Mahonia* spp., *Magnolia* spp. and Eucalyptus, is an effective method of flower preservation which relies on the principle of sublimation. Hence, colour and even fragrance are retained. In this method flowers are placed in a refrigerated chamber below the freezing point and vacuum is created, which causes the moisture to sublimate. Several varieties of different flowers can be successfully dried using this method, retaining their naturalistic appearance.

Once the flowers and foliage are dehydrated these can be turned into many exquisite value-added dried flower products like:

a) Dry flower arrangement: Dry flowers may be arranged in bouquets or wall displays after fastening them to decorative bands. Pressed leaves and flowers may be laminated (which extends the life of the product) and arranged in an album, e.g., *Helichrysum*, *Delphinium*, *Helipterum*, *Amaranthus*, *Nigella*, *Carathmus*, *Gypsophilla* and rose, etc.

b) Bouquets: A flower bouquet is a collection of flowers in a creative arrangement. Bouquets are arranged in vases, urns using floral bricks. The style of flower arrangement can be either traditional or modern.

c) Potpourri: Potpourri is a mixture of dried, naturally fragrant plant parts, used to provide a natural scent. It is usually placed in a decorative wooden, glass or plastic bowl, or tied in small bags made from fabric.



d) Floral jewellery: The dried flowers can be electroplated with gold and platinum to make exquisite jewellery. Orchid flowers are widely used in Thailand, Singapore and Malaysia to make electroplated jewellery.

e) Press dried flower products: It includes a wide variety of products suitable for different purposes like wall hangings, greeting cards, collages, book marks, paper weights, value-added paper bags, diaries, file covers, etc.

For upcoming entrepreneurs, value addition through dehydration has a great potential to develop new markets, as there are many opportunities of diversification of products. Moreover, there is a need to create awareness among people and to impart skill for this technology, so that housewives, unemployed youth, school dropouts, amateurs, and enthusiasts can utilise this technology to earn their livelihood.

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National Science Film Awards 2020

The tenth edition of the National Science Film Festival of India (NSFFI) was celebrated online during 24-27 November, 2020. The festival was earlier scheduled to take place during 18-22 March, 2020 in Agartala, Tripura. The event had to be postponed due to the unfolding pandemic situation. It was jointly organized by Vigyan Prasar and the Tripura State Council of Science and Technology, Govt. of Tripura.

The festival had entries (Films) invited under four major categories, with two of them being introduced the first time this year. The four categories were Interface-Films funded by government and non-government institutions/organizations; Fusion- Films category for independent film makers; Out of the Box-Films by media institutions/film schools/universities/college students; and Rainbow- Films category exclusively for films made by school students. This year, 372 entries were received in different languages. Among them, 115 shortlisted films selected by the ten-member jury were screened during the festival. These include films in Hindi, English, Urdu, Malayalam, Kashmiri, Bengali, Marathi, Punjabi, and Tamil languages.

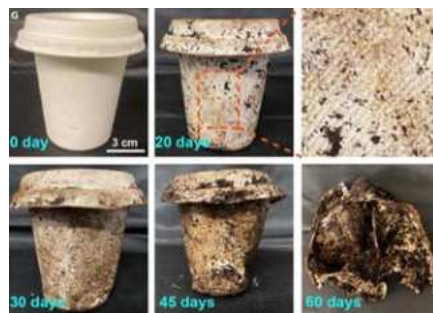


"This year we have introduced two new categories of awards one is 'Poonam Chaurasia Memorial Award' in the memory of Poonam, an extremely talented young cameraperson who left for heavenly abode quite untimely. The award is meant to encourage young female science film makers. The second one is 'Destination Award' given to one of the best films from the region where the National Science Film Festival is organized", said Nimish Kapoor, the convenor, National Science Film Festival of India, Vigyan Prasar. The chairman of the jury and eminent filmmaker Girish Kasaravalli announced the title of the award winning films.

The festival also offers a platform to let science and film enthusiasts freely interact with film-makers, scientists and experts. It is also an opportunity for aspiring science filmmakers to learn the crafts and tricks of the trade, through master classes, workshops and panel discussions. Aside from recognizing and rewarding science films and filmmakers, the festival is intended at creating a better public understanding of the universe; encourage citizen science and public participation; and promote appreciation of science films

today, substantial quantities of plastic waste keep piling up and polluting our environment. Among the most common thrown-away plastic items are disposable tableware—mostly cups and plates used in restaurants, parties and large gatherings.

Hongli Zhu and colleagues at Northeastern University in Boston, USA, have come out with a viable alternative to address this problem. They have designed a set of "green" tableware made from sugarcane and bamboo waste that does not sacrifice on convenience or functionality and could serve as a potential alternative to plastic cups and other disposable plastic tableware. This non-toxic, eco-friendly material takes only 60 days to break down in normal temperature and is clean enough for use as food containers, as reported in the journal *Matter* on 12 November 2020 (DOI: 10.1016/j.matt.2020.10.004).

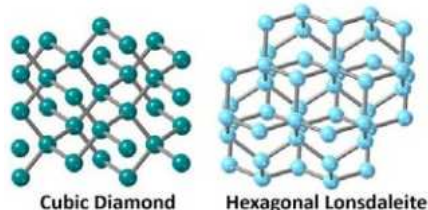


This image shows the decomposition of the biodegradable tableware over 60 days. (Credit: Liu et al.)

Zhu's team at Northeastern University decided to start with sugarcane bagasse—the pulp by-product of sugarcane extraction. However, sugarcane fibre is short and so, from a mechanical point of view, waste from sugarcane is not so strong. The researchers, therefore, made a hybrid, mixing the shorter fibres with long bamboo fibre in order to enhance the mechanical strength.

The researchers added alkyl ketene dimer (AKD), a widely used eco-friendly chemical in the food industry, to increase oil and water resistance of the moulded tableware, ensuring the sturdiness of the product when wet.

← Continued from page 3



The crystal structures of cubic diamond and hexagonal Lonsdaleite have atoms arranged differently.

as a "seed" to grow larger diamonds. Temperatures of about 800°C are required. While the process is quite slow, these diamonds can be grown large and relatively defect-free.

Now, an international team of researchers led by the Australian National University (ANU) and RMIT University in Melbourne, Australia has developed a process to make diamonds in just a matter of minutes—and that too at room temperature. The two types included one similar to those typically worn in jewellery, and another type called Lonsdaleite, which is found naturally at the site of meteorite impacts and is harder than most diamonds. The

research was published in the journal *Small* on 4 November 2020 (DOI: 10.1002/smll.202004695).

In a normal diamond, atoms are arranged in a cubic crystalline structure, but it is also possible to arrange these carbon atoms in a hexagonal crystal structure. This different form of diamond is called Lonsdaleite, named after British crystallographer and Fellow of the Royal Society, Kathleen Lonsdale, who studied the structure of carbon using X-rays. National Science Film Awards 2020

TOWARDS BIODEGRADABLE TABLEWARE

Disposable plastics have become an ever-growing threat to our environment and the reason is their non-biodegradable nature. Discarded plastics take decades to decompose in nature. Although a large portion of disposable plastic is recycled

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