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INSIGHT, DISCOVERY, LEARNING, INNOVATION, AND IMPACT

By
Rosalind Franklin
Council of Scientific Research
(RFCSR)

February 25, 2026

Resilience !

FROM CELLS TO CLIMATE

RF0012602

Scientific Research Empowers Social Progress !

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Prof. Eliora Z. Ron

**Emeritus Professor
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from the LETTER EDITOR

Dr. Animesha Rath
The Editor-in-Chief

Dear Readers,

Welcome to the February issue of Science Factors, where we explore a powerful and timely theme: Resilience.

Resilience is more than recovery. It is the capacity of life and the systems we build to adapt, reorganize, and endure. It begins at the microscopic scale, where bacteria evolve under antibiotic pressure and DNA folds in precise patterns that quietly govern gene activity. Even within a single cell, survival depends on structure, interaction, and dynamic balance.

Beyond the cell, resilience becomes systemic. The story of oxygen access during the COVID-19 crisis reminds us that preparedness, supply chains, and infrastructure can determine outcomes as decisively as medicine itself. Changing grasslands and shifting urban bird populations reveal how ecosystems respond sometimes slowly, sometimes irreversibly to human influence, often long before the consequences become visible.

In agriculture and food systems, resilience is rooted in diversity. Indigenous crops like jamun demonstrate how genetic richness strengthens climate adaptability, nutritional security, and rural livelihoods. Microbial innovations offer sustainable solutions to heavy metal contamination, showing how biology itself can restore environmental balance while supporting farmers and safeguarding food safety.

Across our Expert Opinion and Innovation sections, scientists highlight a shared truth: resilience today demands integration. Biology meets artificial intelligence. Ecology meets engineering. Genomics meets physics. Discovery meets translation and deployment. From AI-guided cell therapies to chromatin modeling and bio-based agricultural strategies, resilience is being designed as much as it is discovered.

From molecular architecture to planetary systems, resilience is layered and interconnected. It is fragile, yet persistent. Quiet, yet transformative.

As you turn these pages, we invite you to reflect on resilience not simply as a response to crisis, but as the enduring intelligence of life itself scaling from cells to climate.

Happy reading,

R Animesha

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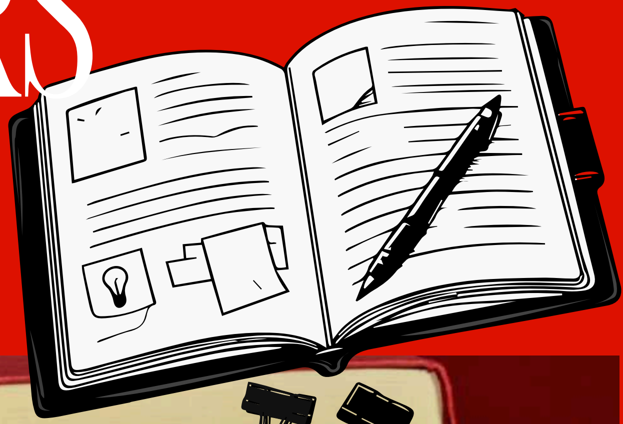
SCIENTIFIC RESEARCH EMPOWERS SOCIAL PROGRESS !

The CONTRIBUTORS



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FEATURED RESEARCH

Behind every discovery lies a story of curiosity, perseverance, and wonder. Science unfolds through relentless research and bold explorations into the unknown. These are the journeys that shape our understanding of the world—and beyond.

| By Dr. Avijit Das

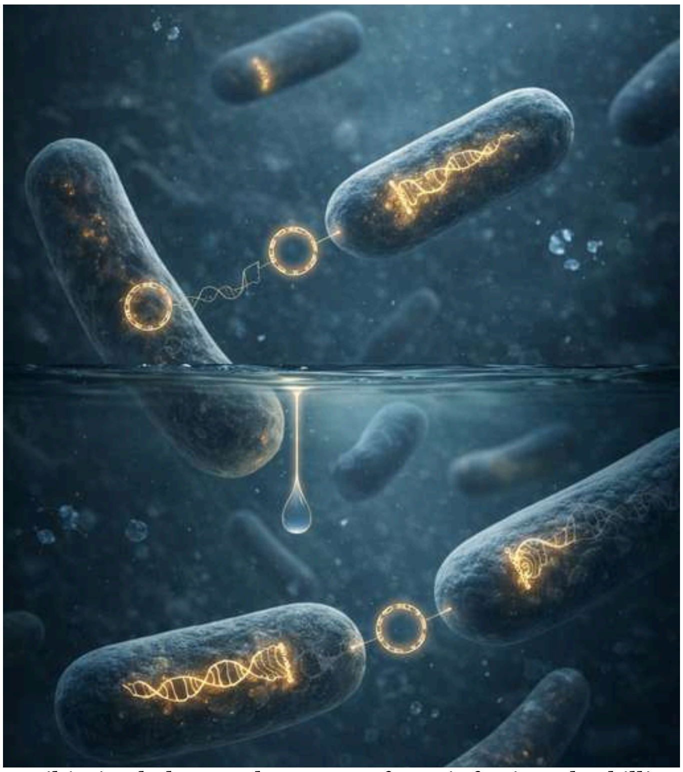
THE SECRET LIFE OF THE CITY'S DRAIN

FEATURED

Every morning, Suresh, a sanitation worker in Faridabad, opened the iron cover of a large city drain. Thick, grey water flowed beneath water from homes, hospitals, clinics, and factories. To most people, it was a waste. To scientists, it was a living record of human health.

One monsoon morning, a group of researchers joined Suresh near the drain. Their leader, Dr. Ananya Iyer, explained why they had come.

"This sewage carries traces of the medicines we use," she said.
"Especially antibiotics."



Antibiotics help people recover from infections by killing bacteria. But when bacteria survive these medicines, they become antibiotic-resistant, and the drugs stop working. This growing problem is called antimicrobial resistance (AMR).

"What happens to antibiotics after they leave our bodies?" Dr. Ananya asked.

"That's what we are trying to understand."

Between June and December 2023, the scientists collected 381 sewage samples from six Indian states. They tested the water and found several commonly used antibiotics amoxicillin, azithromycin, tetracycline, kanamycin, and spectinomycin present again and again.

"These amounts are small," Dr. Ananya said, "but they are constant."

Low, continuous antibiotic levels are dangerous. They don't kill bacteria outright. Instead, they train them to survive. Inside the sewage lived millions of bacteria. Some came from healthy people, others from hospitals. When the scientists studied their DNA, they found thousands of bacterial types, including well-known disease-causing ones like Escherichia coli, Klebsiella, Pseudomonas, Acinetobacter, and Enterococcus.

| By **Dr. Avijit Das**

"These are the same bacteria we see in hospital infections," said another researcher. When the team compared hospital sewage with community sewage, they saw clear differences. Hospital sewage contained more bacteria that were resistant to many drugs. Community sewage had more diversity, but resistance was still common. The bacterial populations also changed with season and location, showing that environment matters.

The most worrying discovery was hidden in the genes. The scientists found over 170 different antibiotic resistance genes (ARGs) in sewage. These genes allow bacteria to block antibiotics, destroy them, or pump them out of their cells.
Even more striking, whenever a certain antibiotic was present in sewage, the scientists often found the matching resistance gene nearby.

"This shows a direct link," Dr. Ananya said.

"Antibiotic pollution is driving resistance."

Bacteria don't keep resistance to themselves. They share it using small DNA carriers called mobile genetic elements, such as plasmids and transposons. These act like USB drives, moving resistance genes from one bacterium to another even between different species. The study showed that many resistance genes in sewage were attached to these mobile elements. This means sewage is not just a storage site. It is a marketplace of genes, where resistance spreads rapidly.

To understand how dangerous this was, the researchers grew live bacteria from sewage in the lab and tested them against antibiotics.

The results were alarming.

More than 90% of the bacteria were resistant to multiple antibiotics. Many belonged to the World Health Organization's critical-priority pathogens, the same ones causing deadly hospital infections.

When the scientists compared the DNA of sewage bacteria with hospital bacteria from India and other countries, they found they were genetically very similar.

"The sewage and the hospital are connected," Dr. Ananya said.

"The drain is a bridge." But there was hope.

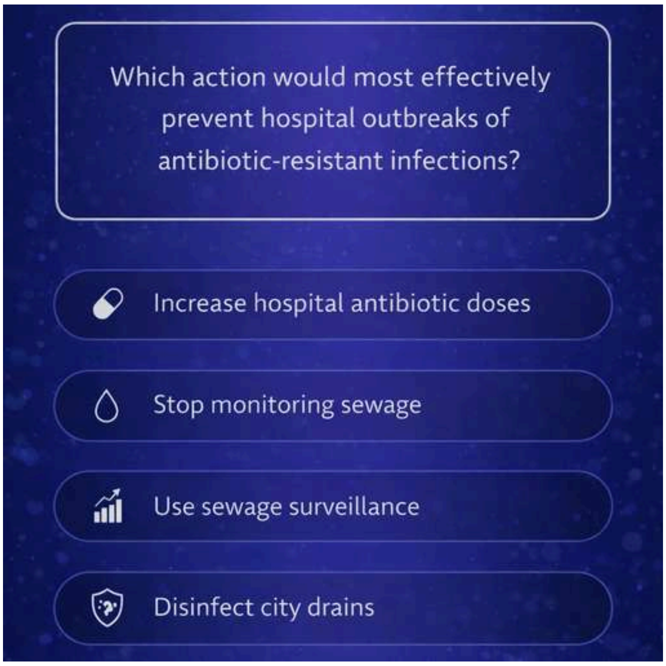
The team developed a simple dipstick test, like a pregnancy test, that can quickly detect resistance genes in sewage. It is cheap, fast, and does not need expensive machines perfect for low-resource settings.

"This can help us detect resistance early," Dr. Ananya explained,

"before it reaches patients."
As Suresh closed the drain cover that evening, he looked at it differently.

That flowing water was no longer just waste.

It was a warning system, recording how antibiotics are used and misused.
The study showed a clear message:
If antibiotics are overused, sewage remembers.
If resistance grows, sewage reveals it.
And by listening to what flows beneath our cities, we may still protect the future of medicine.



REFERENCE:

Paul, D., Talukdar, D., Kapuganti, R.S. et al. Antibiotic contamination and antimicrobial resistance dynamics in the urban sewage microbiome in India. Nat Commun 17, 1274 (2026). https://doi.org/10.1038/s41467-025-68034-3.

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By **Dr. Preeti Sharma**

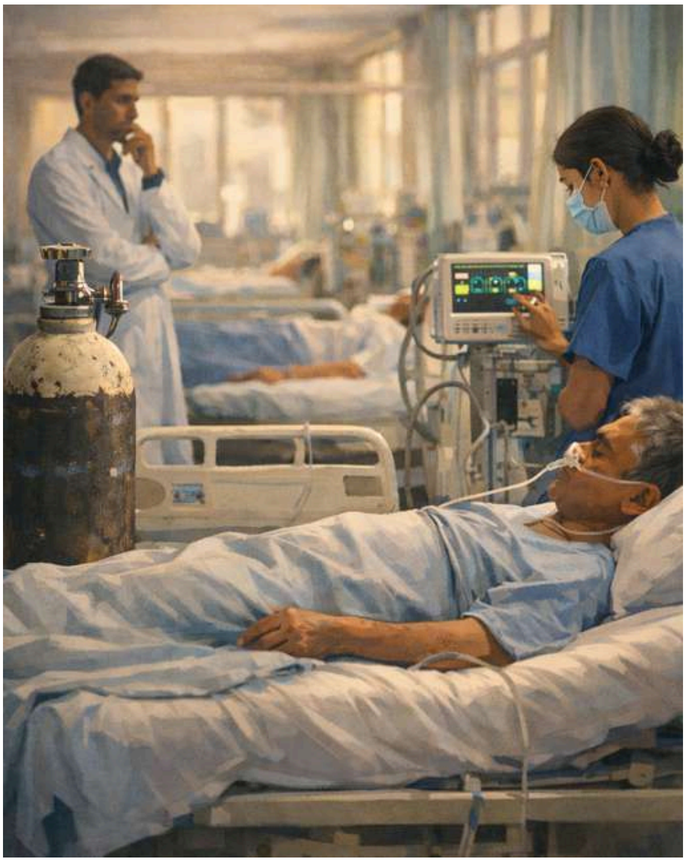
A PANDEMIC MEASURED IN OXYGEN

FEATURED

Dr. Arvind Rao still remembered the sound of oxygen monitors more clearly than any research seminar he had ever attended. In April 2021, as the second wave of COVID-19 swept across India, he was no longer just an infectious disease researcher. He had become a witness to how science, systems, and society collided during a crisis.

Every morning, Dr. Rao walked through the COVID ward of a government hospital in Delhi before heading to his lab. Beds were full. Some patients struggled to breathe, while others waited quietly, their oxygen saturation numbers slowly falling. COVID-19 was not just a viral infection, he knew it was a disease that attacked the lungs' ability to absorb oxygen. Without oxygen, even the strongest medicines could not save a patient.

In the laboratory, Dr. Rao worked with viral genomes. SARS-CoV-2, the virus causing COVID-19, was changing. New variants appeared with small genetic mutations that



made the virus spread faster or evade immunity. But what troubled him more was not the virus alone it was how unevenly patients were surviving.

When Dr. Rao compared patient data from different hospitals, a pattern emerged. Patients with similar disease severity had very different outcomes depending on where they were treated. The difference was not always medicines or doctors. It was oxygen.

COVID-19 patients often develop pneumonia, where air sacs in the lungs fill with fluid and inflammation. Oxygen therapy becomes the most important treatment. Some patients only need low-flow oxygen through nasal tubes. Others require high-flow oxygen, ventilators, or intensive care. But during the surge, oxygen supplies were stretched thin.

Dr. Rao joined a multicentre study tracking COVID-19 patients across low- and middle-income regions. The data showed that most hospitalized patients needed oxygen support at some point. Yet many hospitals lacked enough oxygen cylinders, concentrators, trained staff, or even stable electricity. In some places, oxygen arrived late or not at all.

The consequences were devastating. Patients who did not receive timely oxygen were far more likely to die. Those who required mechanical ventilation had the highest mortality, often because care came too late. COVID-19 was exposing weaknesses that had existed long before the pandemic fragile health systems and unequal access to basic medical resources.

| By **Dr. Preeti Sharma**

In meetings with clinicians, Dr. Rao often heard the same frustration. “We know what to do,” one doctor said. “We just don’t have the tools.” Oxygen, something taken for granted in wealthier hospitals, was missing where it was needed most.

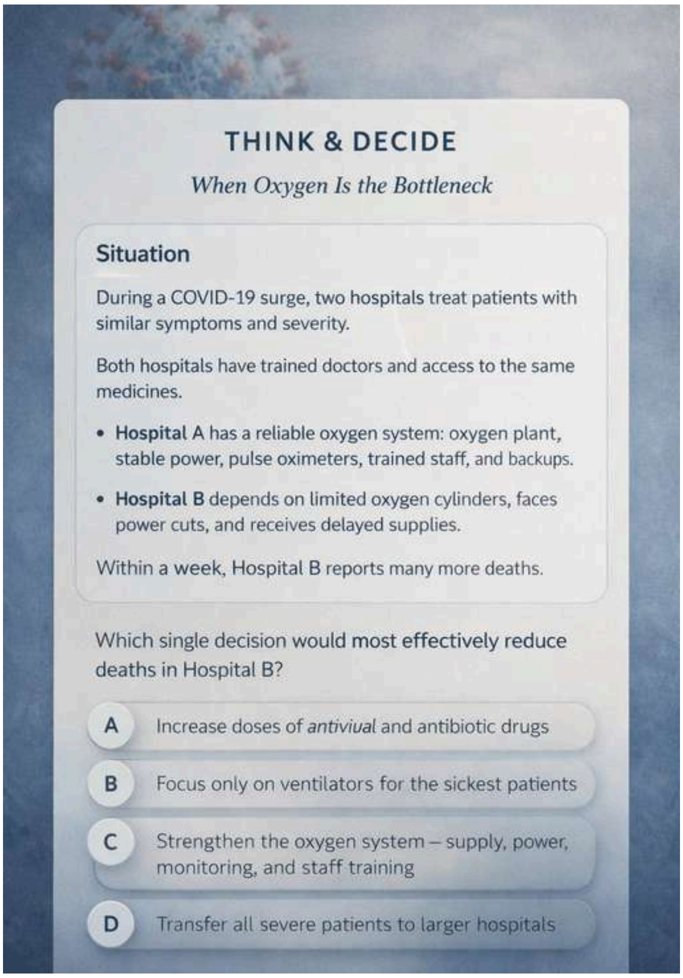
The research also showed something hopeful. Early oxygen therapy saved lives. Simple tools like pulse oximeters small devices that measure blood oxygen helped doctors identify patients who needed support before their condition became critical. Where oxygen systems were reliable, survival improved.

Dr. Rao began to see COVID-19 not only as a viral pandemic but as a systems failure. The virus was the trigger, but the outcome depended on preparedness. Oxygen plants, supply chains, maintenance teams, trained nurses, and electricity mattered as much as vaccines and antivirals.

As vaccines rolled out, hospital admissions slowly declined. The emergency eased, but Dr. Rao worried about forgetting the lessons. COVID-19 would not be the last respiratory pandemic. Pneumonia, tuberculosis, childbirth complications, and surgery all require oxygen. Strengthening oxygen systems would save lives far beyond COVID-19.

One evening, after submitting his final report, Dr. Rao looked again at the ward monitors. Fewer alarms sounded now. He felt relief, but also responsibility. Science had revealed the problem clearly. What mattered next was whether society would act on it.

Resilience, he realized, is not built in moments of panic but in years of preparation. Hospitals that invested in oxygen generation plants, trained biomedical engineers, and reliable backup systems were better equipped to withstand the surge. The lesson was clear: health security depends on strengthening invisible infrastructure before a crisis begins. Oxygen is not a luxury technology; it is a fundamental pillar of care. If nations treat it as essential, future outbreaks may test systems but they will not overwhelm them so devastatingly.



REFERENCE

Relan, P., Albayadi, I.G., et al. Medical oxygen and respiratory support requirements for patients hospitalised with COVID-19 in 23 low-income and middle-income countries: a prospective, observational cohort study. Lancet Glob Health 14, e233–e241 (2026). https://doi.org/10.1016/S2214-109X(25)00482-3

World Health Organization, Geneva, Switzerland.

| By **Dr. Sivan Friedman**

THE GRASSLAND THAT CHANGED SLOWLY

FEATURED

Dr. Mira Rao had been walking the same grassland for twenty years.

When she first arrived as a young ecologist, the land outside the village of Kalyanpur looked like ordinary patches of native grasses, wildflowers blooming in seasons, insects humming quietly. It was not dramatic, but it was alive. Every plant had a place, every season a rhythm.

Then came Silverleaf.

Silverleaf grew fast, stayed green longer, and cattle seemed to like it. Farmers were pleased.

"Look how thick the grass is now," said Ramesh, a local farmer, smiling. "This plant is helping us."

Mira agreed at first. Her early measurements showed more plant biomass, richer soil, and higher nitrogen levels. On paper, the ecosystem looked healthier. If she had stopped there, she might have called Silverleaf a success.

But Mira did not stop.

She kept returning.

After five years, she noticed fewer wildflowers. After ten, fewer grass species. By year fifteen, the diversity that once defined the grassland had thinned. The land was greener but quieter. Uniform.

One afternoon, her student Ayaan asked, "But if the soil is richer and plants are growing more, why is this bad?"

Mira knelt and pulled two plants from the soil Silverleaf and a native grass.

| By **Dr. Sivan Friedman**

"Productivity and diversity are not the same," she said. "Silverleaf feeds the soil, yes. But it also crowds out others. The ecosystem is becoming simpler."

Around the same time, Dr. Luis Fernandez was studying forests half a world away. His invader was not a plant but earthworms species never meant for those soils. At first, nothing seemed wrong. But slowly, the forest floor thinned. Leaf litter disappeared faster than it could form.

"Carbon is leaking out of the system," Luis explained. "The worms are too efficient."

Unlike Mira's grassland, where soil carbon increased, Luis's forest lost it. Different invaders, different effects but both were changing fundamental ecosystem processes.

Meanwhile, in colder northern soils, microbiologist Hana Olsen noticed something else. Introduced microbes were reshaping nitrogen cycles, converting ammonium into nitrate faster than native systems were used to. Plants grew differently. Decomposition shifted. The changes were subtle, but persistent.

Across continents, these scientists began talking.

"What if the key factor isn't the ecosystem," Ayaan suggested during a joint meeting, "but time?"

That question changed everything. When they pooled global data hundreds of studies, thousands of measurements a pattern emerged. Ecosystems often absorbed the shock of invasion at first. Soil nutrients stabilized. Productivity rebounded. Some effects even faded.

But native plant diversity did not recover. The longer an invasive plant stayed, the more native species disappeared. Ten years. Twenty. Fifty. The loss deepened. Time turned mild invasions into permanent transformations.

"What about biodiversity?" Ramesh asked Mira one day. "We always hear that diverse ecosystems are protected." Mira sighed. "They resist invasion better," she said. "But once the invader wins, diversity alone doesn't save them."

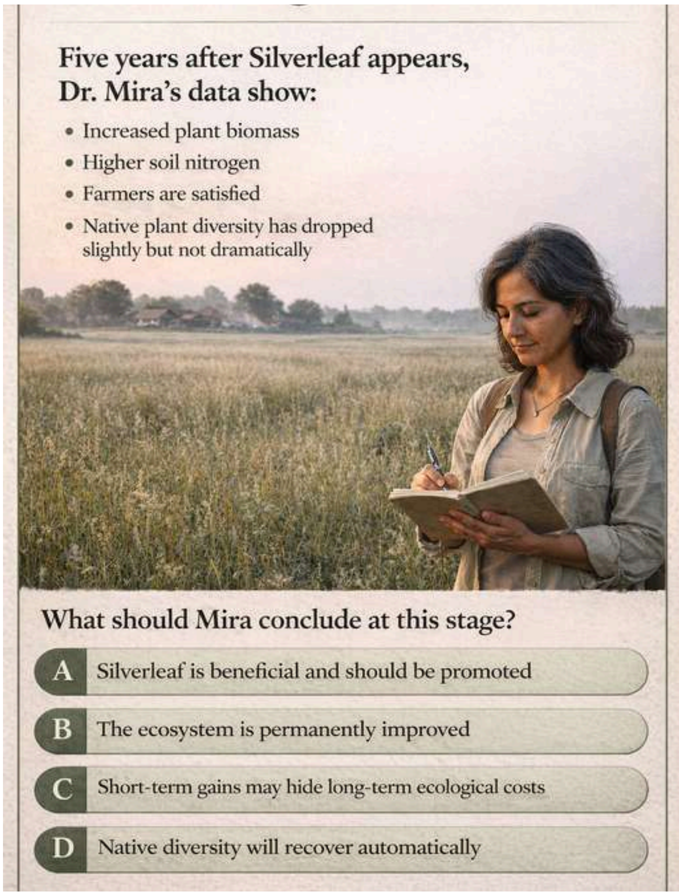
This was one of the hardest truths. Rich ecosystems were not immune. Latitude didn't matter much either tropics, temperate zones, all were vulnerable.

Even traits failed them. Fast growth, big leaves, large bodies these predicted spread, but not damage. The real driver was simpler and more dangerous: how long society waited.

By the end of their collaboration, the scientists agreed on one thing. Invasions are not disasters that explode overnight. They are slow stories, unfolding quietly while people celebrate short-term gains. By the time losses become obvious, they are often irreversible.

Standing once again in her grassland, Mira marked another vanished species in her notebook.

"The tragedy," she thought, "is not that we didn't know invasions were harmful. It's that they didn't look harmful when it still mattered."



REFERENCE

Thakur, M.P., Gu, Z., van Kleunen, M. & Zhou, X. Invasion impacts in terrestrial ecosystems: Global patterns and predictors. Science 390, 381–385 (2025). https://doi.org/10.1126/science.adq3101

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| EXPERT OPINION |

SHAPING INDIA'S FUTURE IN AI-DRIVEN CELL & GENE THERAPY

Dr. Tanveer Ahmad

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| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: CAR-T & CAR-NK cell therapy | AI-guided immunotherapy design | Lentiviral vectors | CRISPR-based therapeutics | Mitochondrial biology

India is at a turning point in the development of cell and gene therapies, especially powerful treatments like CAR-T and CAR-NK cells for cancer and autoimmune diseases. These therapies work by re-engineering a patient's own immune cells to find and destroy diseased cells. The biggest opportunity for India is to skip expensive, slow, trial-and-error approaches used elsewhere and instead build smarter therapies from the start using artificial intelligence (AI). AI can help design better CARs that recognize cancer cells more accurately and stay active for longer, reducing relapse. India has a clear advantage here with its strong IT expertise, growing biotechnology capabilities, and an urgent need to make these life-saving treatments affordable. By combining AI with advanced biology, we can also develop digital cells and human digital twins, which are computer-based models that simulate how cells and therapies behave inside the human body. These digital tools can predict outcomes, test ideas virtually, and help select the best designs before entering the lab or clinic, greatly speeding up development and reducing costs.

To fully unlock this potential, India must focus on a few key investments over the next decade. First, we need integrated research and translation hubs where AI scientists, biologists, engineers, clinicians, and regulatory experts work together under one roof. Today, discoveries often get stuck between the lab and the clinic because these groups operate separately. Second, India must invest in modern biomanufacturing, including scalable viral and non-viral delivery systems, GMP-grade cell processing facilities, and automation. Making therapies affordable depends as much on how we manufacture them as how we design them. Third, we must invest in digital biology platforms, including digital cell modeling and patient-specific digital twins. These technologies can simulate treatment responses, optimize dosing, and identify safety risks early, saving years of development time. Alongside this, strengthening regulatory science and training skilled professionals who understand both biology and data science will be essential. With coordinated efforts from government, academia, startups, hospitals, and industry, India can build a globally competitive ecosystem for advanced therapies.

> *"India has a unique opportunity to build smarter, AI-driven cell therapies from the start making advanced treatments safer, faster, and truly affordable."*

For young scientists entering this field, the most important advice is to think beyond traditional boundaries. The future of cell and gene therapy lies at the intersection of biology, computation, engineering, and medicine. Learning how to work with data, AI tools, and digital models will be just as important as mastering laboratory techniques. At the same time, patience and scientific rigor remain crucial, as biology is complex, and progress takes time. Young

| EXPERT OPINION |

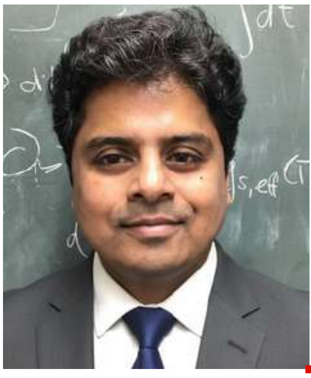
Prof. Ahmad with his lab group members.

researchers should focus on real clinical problems and patient needs, not just fashionable topics. Collaboration, openness, and mentorship will play a key role in success. My own journey from basic cell biology to AI-guided CAR-T design, has shown that meaningful breakthroughs happen when diverse teams work together with a shared goal. The next decade will shape India's position in global biomedical innovation, and young scientists will be central to making advanced therapies safer, faster, and accessible to all.

Dr. Ahmad's contributions to this field are reflected in his publication in Nature Communications, "AI-guided CAR designs and targeted pathway modulation to enhance multi-antigen CAR T cell durability and overcome antigen escape," https://doi.org/10.1038/s41467-025-68272-5 which explores advanced artificial intelligence driven strategies to improve CAR T cell therapy durability and address antigen escape mechanisms in cancer treatment.

| EXPERT OPINION |

HOW DNA FOLDING CONTROLS OUR GENES



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| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: Computational Biophysicsy | Chromatin Modeling| Statistical Mechanics of Genome Organization

When most of us think of DNA, we imagine a long string of genetic letters A, T, G, and C encoding instructions for life. In reality, DNA inside our cells is not stretched out like a straight thread. Nearly two meters of DNA are tightly packed into a nucleus that is only a few micrometers wide. This raises a question that began to intrigue me deeply: if the DNA sequence is the script of life, what is the stage on which this script is performed? The answer lies not only in the sequence of DNA, but in how it folds. In our recent work (https://doi.org/10.1038/s41467-026-68928-w), my colleagues and I set out to understand this hidden layer of organization. We demonstrate that DNA is not crumpled chaotically, but rather folded with remarkable precision. Increasingly, we are realizing that this folding is not merely a packaging solution it is part of the regulatory logic of the cell itself.

For many years, experimental techniques such as Hi-C and the more refined Micro-C have allowed us to measure which parts of the genome interact with each other inside the nucleus. These powerful methods generate maps of contacts, revealing which genomic regions come into proximity in three-dimensional space. In simple terms, they tell us who "talks" to whom. But they do not directly show us what the actual three-dimensional structure looks like. As a physical chemist working in biology, I felt this was fundamentally a problem of statistical mechanics. DNA is a polymer. Nucleosomes interact. Physical forces govern folding. If we could combine experimental contact maps from Hi-C and Micro-C with physical principles, perhaps we could reconstruct structures consistent with those measurements. There was, however, an important subtlety. Hi-C and Micro-C do not capture a single structure. They measure millions of cells simultaneously, producing contact maps that represent averages over many fluctuating conformations. The data themselves are ensemble-averaged. That realization changed the modeling strategy. Instead of searching for one "correct" structure, we built ensembles collections of many possible conformations that collectively reproduce the experimental contact map. Our models therefore reflect the same statistical nature as the experiments. The genome is not static. It fluctuates. It breathes. It continuously explores different shapes.

> "The genome is not just a sequence of letters it is a dynamic three-dimensional structure, and the way it folds quietly determines which genes come to life."

And from these reconstructions, a striking pattern emerged. DNA in the nucleus is wrapped around proteins called histones, forming bead-like units known as nucleosomes. When we modeled how these nucleosomes organize in three dimensions, we observed that they tend to cluster into compact groups. We call these clusters "nucleosome blobs." To visualize this, imagine a long chain of beads loosely folded in your hand. Some beads gather tightly

EXPERT OPINION

together, forming small clumps, while others remain more extended. These clumps are not permanent they fluctuate yet their statistical presence is robust and reproducible.

What surprised us most was how strongly these blobs correlated with gene activity. Regions that formed tight, stable blobs were often associated with reduced gene expression. In contrast, regions that were more open or fragmented tended to be transcriptionally active. In simple terms, genes do not function only because of what they contain in their sequence. They function depending on the structural neighborhood in which they reside. It is important to note that our modeling does not explicitly simulate every chemical detail such as specific epigenetic marks, protein-binding events, or chromatin-modifying complexes. Yet these effects are not ignored. They are implicitly encoded in the experimental contact maps and nucleosome positioning data that we use as inputs. In other words, the biochemical state of the genome leaves its signature in the interaction patterns we model. Nucleosome positioning, in particular, plays a crucial role. The arrangement of nucleosomes along DNA imposes geometric and entropic constraints. Where nucleosomes are regularly spaced, clustering can emerge more readily; where spacing is irregular the structural landscape changes. Even without modeling each chemical interaction individually, the collective effects of epigenetic regulation are reflected in the physical organization we reconstruct.

This realization shifts our perspective. Gene regulation is not controlled only by biochemical signals or molecular switches. It is also governed by physical organization. When the genome folds, distant elements can become neighbors in three-dimensional space. Regulatory elements can approach or separate from genes. Structural domains can insulate regions or bring them into communication.

> *"The genome is not just a sequence of letters it is a dynamic three-dimensional structure, and the way it folds quietly determines which genes come to life."*

From a physics standpoint, these patterns emerge naturally from interactions between nucleosomes under confinement. What appears biologically complex may, at least in part, be governed by surprisingly simple physical principles. For me, this convergence of physics and biology is one of the most beautiful aspects of this research. The same statistical mechanical ideas that describe polymers and complex systems can illuminate how our genome functions. The architecture of the genome is not merely an academic curiosity. When folding patterns are disrupted, the consequences can be profound. Misregulation of chromatin organization has been implicated in cancer, developmental disorders, and aging. If structural domains break down or reorganize incorrectly, genes may be activated at the wrong time or silenced when they should be active. By reconstructing nucleosome-level folding using experimentally informed modeling, we move toward predictive understanding. We can begin to ask: What structural changes accompany disease states? Which regions are structurally stable, and which are susceptible to reorganization? Can we identify architectural vulnerabilities before pathological changes fully manifest? In the future, such insights may contribute to structural biomarkers or therapeutic strategies targeting chromatin organization itself.

Perhaps the most important conceptual shift from our work is this: the genome is not a static object. It is an ensemble a dynamic landscape of possible configurations shaped by physical constraints. Rather than asking, “What is the structure?”, we should ask, “What is the distribution of structures, and what stabilizes them?” This ensemble perspective allows us to connect molecular interactions at the nucleosome scale with

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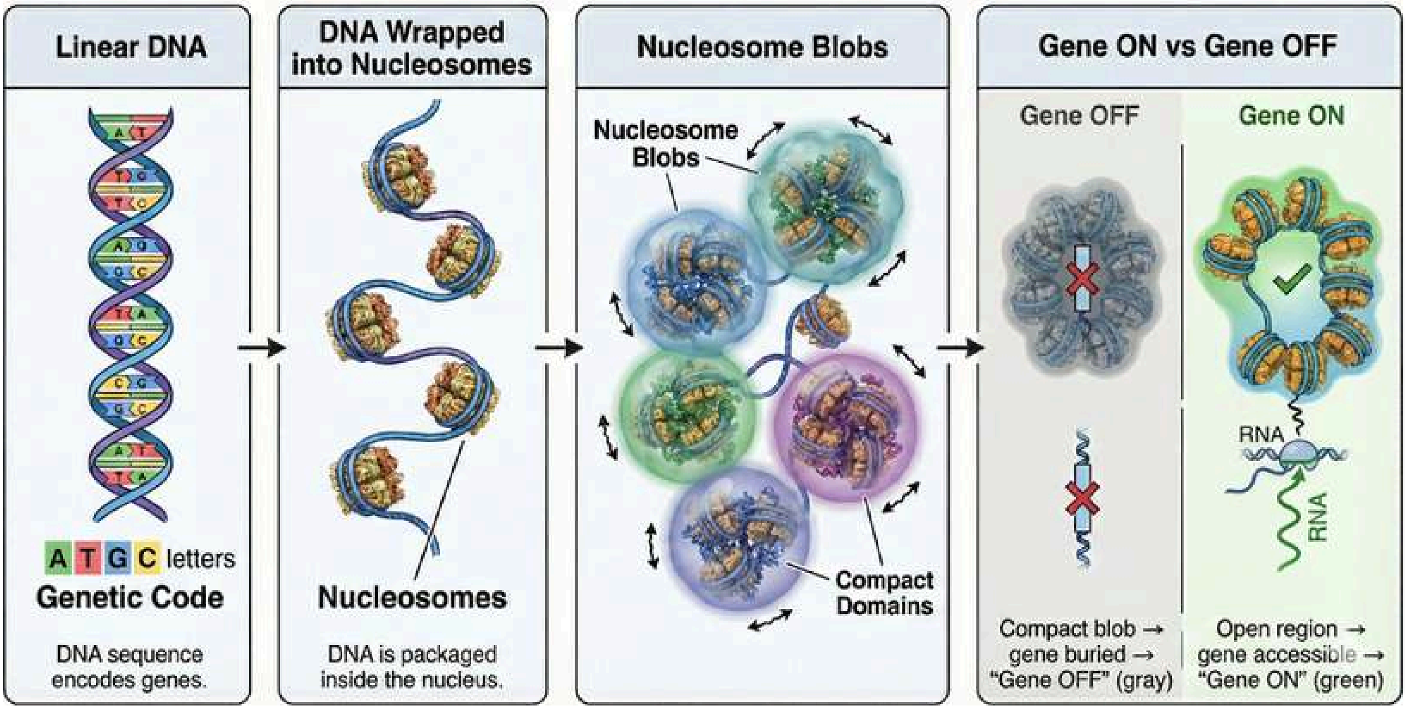
From DNA Sequence to Gene Activity: The Hidden 3D Layer



gene regulation at the cellular scale. It bridges length scales spanning thousands of times in size from nanometers to micrometers within a unified physical framework. We are only beginning to understand this hidden architecture. Future advances may allow us to map nucleosome-level folding across entire genomes, integrate artificial intelligence with physics-based modeling, and build computational "digital twins" of chromatin in health and disease. In my view, the next frontier in genomics lies not only in reading DNA sequences, but in decoding the geometry that organizes them. Because in the end, life is not governed by sequence alone. It is governed by structure, dynamics, and the laws of physics acting quietly inside every cell. And that hidden architecture may hold answers to some of biology's deepest questions.

Prof. Bhattacherjee's contributions to this field are reflected in his publication in Nature Communications, "An Experimentally-Informed Polymer Model Reveals High-Resolution Organization of Genomic Loci," https://doi.org/10.1038/s41467-026-68928-w, which explores how polymer physics–based modeling, guided by experimental data, can uncover the fine-scale three-dimensional organization of genomic regions and provide deeper insights into chromatin architecture and gene regulation.

| EXPERT OPINION |

GENETIC DIVERSITY IN JAMUN: WHY THIS NATIVE FRUIT DESERVES MORE ATTENTION

Dr. Kanupriya Chaturvedi
Principal Scientist, Division of Fruit Crops | ICAR–Indian Institute of Horticultural Research, Bengaluru, India

| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: Agrobiodiversity Conservation | Indigenous Fruit Crops | Nutritional Biochemistry | Molecular Characterization | Climate-Resilient Horticulture

India's landscapes hold extraordinary biological richness. Yet many of our indigenous fruit species remain quietly present rather than consciously valued. As a scientist working at the intersection of agrobiodiversity conservation and farmer livelihoods, my research at ICAR-IIHR has focused on documenting and utilizing the genetic diversity of native fruit crops in ways that strengthen nutritional security while creating sustainable economic opportunities for rural communities.

Jamun (Syzygium cumini Skeels) is one such fruit. For many of us, jamun evokes childhood memories- purple-stained tongue and fingers and its distinctive sweet-astringent taste. But beyond nostalgia lies a scientifically compelling story. Today, global markets celebrate blueberries, cranberries, and exotic imported "superfruits." Yet jamun, growing across India's diverse agro-climatic regions, possesses equally impressive (and sometimes) superior nutritional qualities. Rich in anthocyanins, phenolic compounds, and natural antioxidants, jamun supports metabolic health and combats oxidative stress. Its deep purple colour is not just aesthetic; it signals bioactive compounds with significant health relevance. However, not all jamun fruits are the same. In our recent work (Saini et al., 2026) examining morphological, biochemical, and molecular diversity, we observed remarkable variation among different genotypes. Some types produced larger fruits with higher pulp recovery- traits valuable for processing industries. Others showed significantly higher antioxidant potential. DNA-based analysis confirmed substantial genetic variability within the species. This diversity is not just scientific data. It acts as insurance. It determines how well a crop adapts to climate variability, pest pressures, and changing consumer demands. Jamun is naturally hardy and climate-resilient. With careful selection and scientific validation, it can become an important component of climate-smart horticulture/agroforestry systems.

> *"Jamun shows that India's native fruits hold powerful potential for nutrition, climate resilience, and rural prosperity."*

Jamun's bioactive compounds have drawn attention for their potential anti-diabetic and anti-inflammatory properties. Traditionally valued in indigenous systems of medicine, the fruit and seed extracts are now being examined through modern scientific lenses. For farmers, this scientific attention carries real implications. Jamun trees often grow on marginal lands, in homesteads, or scattered across village landscapes. With improved cultivar identification, vegetative propagation, and value-added processing, jamun cultivation can evolve from seasonal collection to organized horticultural enterprise. Functional beverages, natural food colorants, nutraceutical extracts, fermented products- the possibilities are expanding. Because jamun is perennial and relatively low-input, it fits well within agroforestry and biodiversity restoration systems. When biodiversity is linked to markets and value chains, conservation becomes economically meaningful. Farmers become custodians not just of land, but of genetic wealth.

For young researchers, jamun represents a powerful opportunity. Indigenous fruit crops sit at the intersection of fruit science, molecular biology, food science, computational biology, and rural development. There is scope for genome-level studies, metabolomic profiling, AI-driven compound screening, and climate adaptation research. These are not isolated academic exercises, they are pathways toward building resilient food systems rooted in local biodiversity.

The larger lesson from jamun is simple yet profound. India does not lack biological resources. What we often lack is systematic documentation, scientific validation, and translational pathways. When we apply modern tools to native species, we do not replace tradition, we strengthen it with evidence. Jamun is more than a seasonal fruit. It is a reservoir of nutritional strength, pharmacological promise, genetic resilience, and livelihood potential. In an era shaped by climate uncertainty and lifestyle-related health challenges, such indigenous crops deserve renewed scientific and policy attention. Sometimes innovation does not require discovering something entirely new. Sometimes it requires looking more closely at what has always been growing around us.

> *"Jamun shows that India's native fruits hold powerful potential for nutrition, climate resilience, and rural prosperity."*

From flower to functional fruit: visible expressions of genetic diversity in jamun.

The panel (clockwise from top left) illustrates flowering, fruit development, ripening, and variation in pulp colour and seed characteristics among different types of jamun. This phenotypic diversity mirrors the underlying genetic richness that supports nutritional quality, resilience, and future crop improvement.

Dr. Kanupriya's contributions to this field are reflected in his publication in Scientific Reports, "Morphological, Biochemical, and SSR Molecular Insights of Jamun (Syzygium cumini Skeels)," https://doi.org/10.1038/s41598-026-38816-w, which explores the diversity of jamun through detailed morphological characterization, biochemical profiling, and SSR-based molecular analysis to better understand its genetic variation and potential for crop improvement and conservation.

| EXPERT OPINION |

MICROBIAL SOLUTIONS TO HEAVY METAL CONTAMINATION IN FOOD CROPS

Prof. Ranadhir Chakraborty
Senior Professor, Department of Biotechnology, University of North Bengal, Siliguri, India

| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: Antimicrobial resistance and control | Quorum sensing | Metal resistance and Bioremediation | Microbial genetics | Microbial genomics and Transcriptomics | Gut microbiome of Earthworm and Fish

One of the major factors affecting the safety of food, the environment, and the sustainability of agricultural activities is the issue of heavy metal pollution in agricultural lands. For case in point, the presence of heavy metals such as cadmium, arsenic, lead, and mercury in the agricultural environment is ascribed to industrial waste, wastewater, mining, and excessive fertilizer application. These metals are not degradable, meaning they can accumulate in the tissues of plant crops for human consumption. This, in turn, creates long-term health hazards for human beings. The conventional methods used to decontaminate the agricultural environment are expensive and environmentally disruptive. Therefore, the introduction of microbes to solve the problem of heavy metal pollution is one promising, environmentally friendly alternative to the conventional methods. Microbes have unique mechanisms to survive in metal-polluted agricultural lands; they can biosorb metals, store the absorbed metal inside their cells, degrade the pollutants enzymatically, or reduce the pollutants to less toxic forms. Plant growth-promoting bacteria, such as Pseudomonas, Bacillus, and Enterobacter, can biosorb metal ions in the rhizosphere, thereby reducing the amount of metal absorbed by the plant crops. On the other hand, these bacteria can improve plant growth, stress tolerance, and nutrient uptake. For this reason, the introduction of microbes to the agricultural environment is significant, especially due to the dual benefits it provides. Microbes reduce the toxicity levels of the crops, thereby improving their productivity.

> *"Microbial solutions provide a safe and sustainable way to reduce heavy metal contamination in crops, positioning India to lead globally in bio-based agricultural innovation"*

Capitalizing microbial diversity for local bioinoculants for contaminated farms is the biggest opportunity for India because it has diverse agro-ecological zones that harbor distinct microbial communities that have adapted naturally to environmental stress. These microbes are an untapped opportunity for developing potent microbial solutions for India. These bio-based approaches would be in line with India's commitment to sustainable agriculture, reduction in chemical use, and bioeconomy. Microbial solutions would be easily integrated into existing farming systems with minimum disruption and at low costs. India would be able to solve its problems and become a world leader in microbial solutions for sustainable agriculture.

The priority investments that need to be made in India over the next ten years would be in discovery, translation, and deployment. We need to explore contaminated soils in India using metagenomics and functional microbiology. This is important for discovering metal-resistant and beneficial microbes for plants. By using a combination of genomics, transcriptomics, and metabolomics approaches, we would be able to obtain a better understanding of how

| EXPERT OPINION |

microbes resist metal stress and interact with plants. We need to build infrastructure for translation and deployment for taking discoveries from the lab bench to the field. This would engage producing bioinoculants for pilot-scale production, validation in the field, and regulatory support. We need to devote ourselves to technologies for microbial formulations for longer shelf life and improved performance in the field. We need public-private sector partnerships between academic institutions, agricultural universities, and biotech companies for large-scale production and accessibility of microbial solutions for farmers.

This field provides a lot of opportunities for young scientists to engage in productive research. It combines microbiology, plant science, environmental biotechnology, and the sustainability of agricultural ecosystems. Young scientists should lay a good foundation in microbial physiology and genetics, as well as use modern technologies in the field. It is also important to use the results of the research for the real world by identifying real problems in the field of agriculture. Research done to identify the mechanisms of how microbes reduce metal stress and improve plant health will be important in developing reliable solutions. In addition to the scientific benefits of microbial remediation, this field also carries social responsibility. The challenge of ensuring food safety and sustainability of agricultural ecosystems is one of the major challenges we are facing today. Microbial solutions are safe for the environment, cost-effective, and reliable. India has the opportunity to lead the way in this challenge with its biodiversity, scientific knowledge, and agricultural ecosystems. By investing in microbial research and young scientists, India will be able to create meaningful solutions to this challenge. Microbes, nature's most adaptable chemists, will be an effective and sustainable solution to the problem of heavy metal contamination of food crops.

Prof. Chakraborty's contributions to this field are reflected in his publication in Science of The Total Environment, "Mitigating cadmium-induced stress in Capsicum annuum L. by Pseudomonas aeruginosa strain CD3: Impacts on morpho-physiology, reproductive traits, capsaicin content and soil microbiome," https://doi.org/10.1016/j.scitotenv.2025.181229, which investigates how a beneficial bacterial strain can alleviate cadmium stress in chilli plants, enhancing their growth, reproductive performance, capsaicin content, and positively influencing the soil microbiome, offering promising strategies for sustainable agriculture in heavy metal–contaminated soils.

| EXPERT OPINION |

HOW CITIES ARE CHANGING THE BIRDS AROUND US

Dr. Ashutosh Singh
Scientist, Avian Physiology and Genetics Division Salim Ali Centre for Ornithology and Natural History Coimbatore | Co-ordinator South Asia- Asian Ornithological Alliance | Executive Council Member-Association of Avian Biologist, India
| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: Avian Biology | Molecular Taxonomy | Wildlife Forensics | Bioacoustics

Imagine standing on a bustling street corner in the heart of a city, closing your eyes to absorb the sounds around you. You would hear the low hum of traffic, the distant clattering of construction, and, if you listen closely, the croaking of crows, the flutter of pigeons' wings, and the whistle of black kites. Now, travel just a few miles beyond the city, moving past suburban neighbourhoods and into the areas where urban life transitions to quaint villages and expansive fields. Here, the soundscape transforms completely. The air becomes alive with the clear chirping of sparrows, the chatter of babblers, the sharp calls of lapwings, and the melodious songs of Koel and Robins.

This isn't just a change of scenery; it's a story of survival, with birds adapting in remarkable ways to the world we've built.

We often see cities as places made just for people, but in reality, they are living ecosystems albeit unusual, human-made ones. Every time we cover wild land with roads or swap thatched roofs for glass towers, we're not just shaping our own environment; we're also changing the lives of the birds that have been our neighbours for ages. Around the world, scientists have found that our choices on how we build, plant, and design our cities decide which birds will thrive and which will struggle.

One of the most surprising insights from recent studies isn't about reducing the number of trees or drying up of rivers, but about architecture along rural-urban gradients in India. Researchers have found that the style of human housing significantly influences bird diversity in various locations.

> *"If we design our cities with care, they can echo with wings and birdsong once again."*

The Housing Crisis :For generations, the House Sparrow has been our companion, flourishing in the nooks and crannies of traditional homes. Thatched roofs, eaves with gaps, and older brick structures offered ideal, secure havens for their nests. However, as cities modernize, these "bird-friendly" features are being eradicated. We are replacing the textured, intricate surfaces of the past with the smooth, impenetrable lines of concrete and glass.

This architectural shift has led to a "housing crisis" for cavity-nesting birds. Modern buildings are tightly sealed, leaving sparrows with no place to raise their young, resulting in a sharp decline in their populations in urban areas. Meanwhile, the Rock Pigeon, a descendant of cliff-dwelling species, sees high-rise buildings as ideal. Ledges, air conditioning units, and windowsills mimic their natural habitat, allowing pigeons to thrive where sparrows struggle. The Junk Food Trap: Observing a Black Kite at a garbage dump or a crow grabbing leftover food illustrates the "resource concentration hypothesis." Cities, while calorie-rich due to waste, create uneven food availability. Urban exploiters like House Crows and Black Kites thrive on this abundance, turning our trash into their sustenance. However, for birds that don't eat refuse, cities can become food deserts. Although we enjoy lush parks with ornamental plants, they often lack the native flora that sustains local insect populations. For insectivorous birds like the Indian Robin or Ashy Prinia, these parks become "green deserts," as replacing native vegetation with manicured landscapes diminishes essential insects required for their survival.

The Water Paradox: Water is essential for life, but in urban areas, not all water is equally beneficial. While we may see concrete embankments and reservoirs as refuges, waterbirds perceive them differently. Research shows that natural wetlands vastly outperform man-made alternatives in terms of biodiversity. These vibrant ecosystems, with their floating vegetation and muddy banks, support the specific plants and aquatic life that species like the Black-necked Stork and the Great Egret depend on. By channeling rivers and building concrete tanks, we often destroy this vital habitat. As a result, while some generalist species may survive, specialised waterbirds that make wetlands unique are increasingly confined to smaller areas, making them vulnerable to local extinction.

Invisible Walls: Heat and Haze: The atmosphere of the city has become increasingly hostile. Poor air quality not only harms human lungs but also affects bird habitats. High pollution levels, indicated by the Air Quality Index, have led to fewer sightings of smaller species like the Common Tailorbird, as toxicity creates invisible barriers. Moreover, cities serve as "urban heat islands," absorbing and radiating heat from asphalt and concrete. This rising thermal stress is critical; studies show that as temperatures increase, bird activity declines. Even adaptable species like the House Sparrow must limit their movement during the intense summer heat, retreating to the few remaining cool, shaded spots to survive.

Growing Together: A Path to Coexistence: It's easy to feel like urbanization is an unstoppable juggernaut crushing nature, but that's not the whole story. Cities can support biodiversity; we just have to be smarter and adapt minor changes to bring the birds back. First, it is essential to rethink our approach to "green" spaces. Simply planting a tree is insufficient; we must choose the right species. Native trees, such as the Flame of the Forest (Butea monosperma) and Boswellia serrata, serve more than just an aesthetic purpose; they provide vital food and medicine for birds. We should embrace a bit of wildness allowing patches of scrub and undergrowth to flourish instead of manicuring every inch of land. Second, our architecture can be more thoughtful and compassionate. While we may not return to thatched roofs, we can replicate some of their benefits. Adding nest boxes to modern buildings can create the nesting sites that sparrows and parakeets desperately need. Additionally, preserving old heritage buildings and even structurally intriguing ruins within city limits can offer essential refuge that glass towers simply cannot. Lastly, we need to safeguard the "middle ground." The semi-urban areas at the edges of our cities function as critical buffers and nurseries for biodiversity. Protecting natural wetlands in these zones from development is arguably the most impactful action we can take for waterbird populations.

You don't need to be a city planner to contribute to these efforts. Simple actions like placing a water bowl on your balcony, planting native shrubs in your garden, or engaging in citizen science projects to monitor local bird populations can lead to meaningful change. The silence of the sparrows in our city centres is a warning, but it's not yet a final verdict. By making space for nature in our designs and our daily lives, we can ensure that our cities remain vibrant, euphonious, and full of life not just human, but avian too.

> *"If we design our cities with care, they can echo with wings and birdsong once again."*

Dr. Singh's contributions to this field are reflected in his publication in Scientific Reports, "Avian neighbours: density patterns of synanthropic birds along a rural–urban landscape gradient in Northern India," https://doi.org/10.1038/s41598-026-36510-5, which examines how bird populations respond to changing housing patterns and urbanization across rural–urban gradients, offering important insights into how architectural styles and landscape transitions influence avian diversity and coexistence in rapidly developing regions.

| EXPERT OPINION |

REFLECTIONS ON ADDITIVE MANUFACTURING, COMPOSITE INTELLIGENCE, AND THE EXPANDING HORIZON OF 3D PRINTING

Prof. P. Manoj Kumar
Head - Department of Mechanical Engineering | Deputy Director of Research and Development, Kangeyam Institute of Technology, Tirupur, Tamil Nadu, India | Global Top 2% Scientist.

| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: Polymer Composites| Thermal Energy |Storage Materials| Characterization of Nano-PCM|Solar Thermal Conversion

Additive manufacturing has evolved from a rapid prototyping tool into a transformative engineering philosophy that is redefining how we perceive materials, structures, and performance. What was once considered a convenient fabrication method is now a platform where material science, digital design, and computational intelligence converge. At its essence, 3D printing challenges a long-held engineering belief, that mechanical strength primarily arises from bulk material properties. Instead, it demonstrates that performance can be architected internally, layer by layer, through intelligent structural design.

Our research in polymer–composite additive manufacturing has been guided by a deeper inquiry: can internal geometry be engineered to function as intelligently as the material itself? In fused filament fabrication, infill patterns are not merely internal fillers; they serve as structural skeletons that dictate how loads are transferred, how energy is absorbed, and how failure initiates. When reinforced thermoplastics such as PETG (Polyethylene Terephthalate Glycol)–carbon fiber composites are printed, their mechanical response becomes a combined outcome of composition, interlayer bonding, and architectural topology.

Linear infill structures create continuous stress paths that enhance tensile performance and wear resistance, while three-dimensional lattice configurations enable progressive deformation and superior impact energy absorption. This distinction reveals a powerful shift in design philosophy. In additive manufacturing, geometry becomes a programmable material property. Strength is no longer only a function of stiffness or fiber content; it emerges from the interaction between architecture and material.

> "In additive manufacturing, strength is no longer poured into a mold; it is intelligently designed, layer by layer, from the inside out."

Such insights are especially significant for lightweight structural systems like unmanned aerial vehicles. Drone frames must achieve stiffness, durability, and crash resistance without compromising weight efficiency. Conventional composite manufacturing often relies on thick laminates and expensive processing techniques to meet these requirements. In contrast, additive manufacturing allows structural intelligence to be embedded within internal lattice frameworks. By optimizing infill architecture and combining it with computationally generated geometries, it becomes possible to achieve performance tuning tailored to specific operational demands.

The integration of generative design and finite element analysis further extends this capability. Instead of manually designing structural forms, engineers can define constraints, preserved regions, and load conditions, allowing algorithms to evolve optimized geometries. This approach redistributes material precisely where it is required, reducing weight while maintaining safety margins. The result is not only material efficiency but also enhanced structural resilience. Stress concentrations are minimized, strain is distributed more uniformly, and displacement remains controlled even under dynamic loading conditions.

Looking forward, the evolution of 3D printing will be driven by deeper integration between materials science and computational intelligence. Machine learning models will predict print outcomes and mechanical performance before fabrication begins. Multi-material printing will enable graded reinforcement distributions within a single component, allowing designers to vary stiffness and energy absorption across different regions. Sustainable composite matrices and recyclable polymers will address environmental concerns without sacrificing mechanical integrity. The embedding of sensors within printed lattice structures may soon enable real-time health monitoring of UAV frames and aerospace components.

For countries like India, additive manufacturing offers a predominantly transformative opportunity. It democratizes high-performance engineering by reducing dependency on costly tooling and centralized production facilities. It encourages localized innovation and supports rapid customization for applications ranging from agriculture and disaster response to logistics and surveillance. Lightweight UAV systems, optimized through digital design and composite synergy, can be produced efficiently while maintaining durability in demanding environments.

Engineering is transitioning from material-centric thinking to architecture-centric intelligence. Mechanical performance can now be digitally sculpted through internal lattices, topology optimization, and composite integration. Additive manufacturing empowers engineers to design from the inside outward, embedding performance directly into geometry rather than relying solely on heavier or more expensive materials.

3D printing is therefore not merely a fabrication technology; it is a redefinition of structural design philosophy. As materials, algorithms, and manufacturing systems continue to converge, we move toward a future where components are not simply built but intelligently engineered at multiple scales. The next decade will likely witness additive manufacturing evolving into a fully integrated digital ecosystem, one where computational design, advanced composites, and sustainable production collectively shape the resilient structures of tomorrow.

> *"In additive manufacturing, strength is no longer poured into a mold; it is intelligently designed, layer by layer, from the inside out."*

Prof. P. Manoj Kumar's contributions to this field are reflected in his publication in Scientific Reports, "Mechanical Characterization of PETG–Carbon Fiber Composite Parts Using 3D Printing for Drone Frame Application," https://doi.org/10.1038/s41598-026-38051-3, which explores how 3D-printed PETG–carbon fiber composites can be structurally optimized to improve strength, wear resistance, and impact performance in lightweight drone frame applications.

| EXPERT OPINION |

BRIDGING THE SURGICAL GAP: THE FRUGAL SIMULATOR REVOLUTIONIZING RURAL TRAINING

Dr. Gnanaraj Jesudian
Member, Board of Directors G4 Alliance Urologist & General Surgeon (CMC Vellore), India | Global Rural Surgery Leader

| Scientific Profile | | Organization Link | | Research Lab Page |

Areas of Expertise: Rural & Remote Surgery | Minimally Invasive Surgical Innovation | Affordable Medical Device Development | Capacity Building for Rural Hospitals

In the world of modern medicine, Minimally Invasive Surgery (MIS) or "keyhole surgery" is the gold standard. It offers patients smaller scars, less pain, and lightning-fast recovery times. But for surgeons in low-resource settings, the path to mastering these skills is blocked by a massive financial wall. High-fidelity simulators can cost upwards of INR 600000, a price tag that keeps life-saving training out of reach for many. Enter the Rural Surgery Innovations (RSI) Simulator: a high-fidelity, full-procedure training platform that costs a fraction of the price and is designed specifically for the realities of rural healthcare.

What happens when you bring together surgeons, artists, and engineers? You get a simulator that doesn't just look like a patient it feels like one. This is because artists, engineers and surgeons worked together to produce this.

The RSI Simulator uses a clever mix of resin, glass fibre, latex, and silicon to replicate the human torso. But the true genius lies in its replaceable organs. Whether it's an appendix, a gallbladder, or an ovary, these components cost only a few rupees each to replace. This allows trainees to perform "full-procedure" resections repeatedly without draining the hospital's budget. Traditional "box trainers" are often too simple they teach you how to move a peg from point A to point B. But real surgery is a team sport. The RSI

> "The RSI Simulator makes modern minimally invasive surgery training affordable and accessible for rural surgeons, ensuring better care for patients everywhere."

Simulator is built to work with frugal technology already used in rural theatres: The Laptop Cystoscope: A plug-and-play imaging device that replaces 12 to 15 lakh laparoscopic towers. Because it must be held by an assistant, it forces the surgeon and the camera-holder to communicate and synchronize a vital skill in a real operating room. The GILLS Device (Gas Insufflation Less Laparoscopic Surgery): Instead of using expensive carbon di oxide gas to inflate the abdomen, this mechanical lift creates the workspace. The simulator's realistic abdominal wall provides the exact resistance a surgeon will feel when using the GILLS device on a living patient.

The impact of this innovation is already being felt across the globe. From workshops in rural India to the Southeast African region (Malawi, Uganda, Kenya), the results are quantifiable. In Malawi, data showed that after training on the RSI model, surgeons performed cystoscopies significantly faster and with fewer mistakes. More importantly, the skills were immediately transferable. Surgeons who trained on the simulator were able to perform minor procedures on real patients under supervision almost immediately afterward.

"The training has successfully transitioned from theory to application, addressing the critical skill gap safely via simulation." Report from Zomba Central Hospital, Malawi

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We believe that the quality of a surgeon's training should not be determined by the size of their hospital's budget. By combining "frugal" materials with "high-fidelity" design, we are democratizing surgical excellence.

The RSI Simulator isn't just a piece of equipment; it's a bridge. It allows rural surgeons to cross the gap from traditional open surgery to modern MIS safely, affordably, and sustainably. This is more than just a training tool it's a crucial step toward ensuring that every patient, regardless of where they live, has access to the best surgical care possible.

Location	Participants	Key Outcome
Lilongwe	22 Surgeons	96% of post-training procedures were faster and
Blantyre	11 Surgeons	Successful adoption of Laptop Cystoscopy in
Zomba	11 Surgeons	Safe transition from simulation to real-world

Malawi surgeons practising with the Simulator

Zomba surgeons performing on real patients

Full procedural Urology and Laparoscopy Simulator

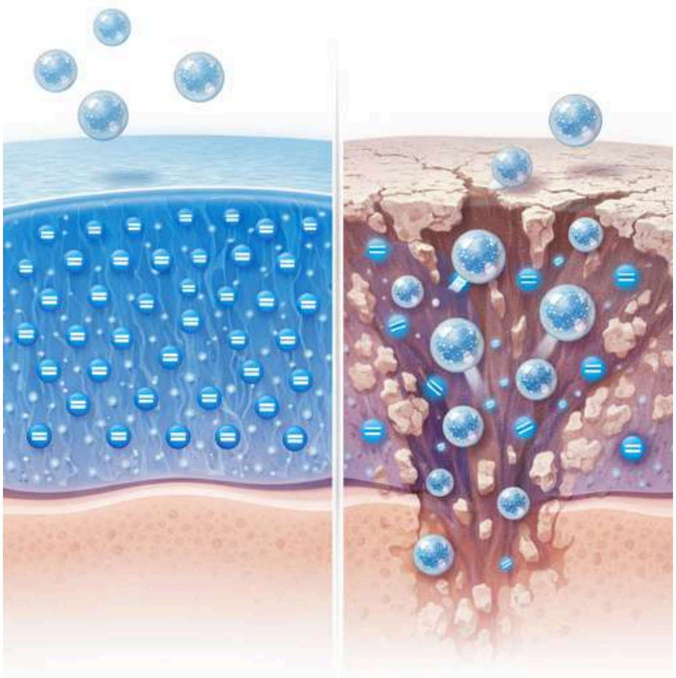
SCIENCE STORIES RESEARCH & EXPLORATIONS

Behind every discovery lies a story of curiosity, perseverance, and wonder. Science unfolds through relentless research and bold explorations into the unknown. These are the journeys that shape our understanding of the world—and beyond.

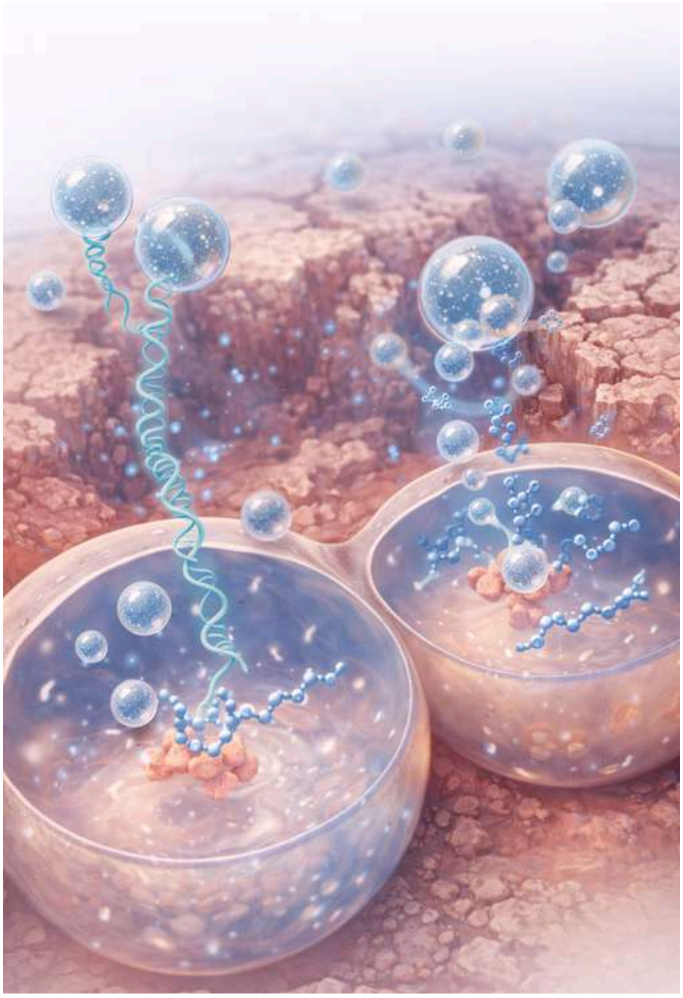
By **Dr. Preeti Sharma**

THE WHISPERING MESSENGER IN THE KNEE

In a small town lived an old carpenter named Ramu, who loved walking every morning to watch the sunrise. Over the years, his knees began to hurt. Walking became slow, painful, and stiff. The doctor told him he had osteoarthritis a condition where the soft cushion inside the joints, called cartilage, slowly wears away. Ramu was told the usual advice: painkillers, rest, maybe surgery later. But deep inside his knee, something more interesting was happening, something that a group of curious scientists wanted to understand and fix. Inside Ramu's knee lived tiny workers called cartilage cells.



When the knee was young and healthy, these workers lived in a thick, sponge-like cushion filled with special molecules that held water and kept the joint smooth. These molecules also carried negative electrical charges, like tiny magnets pushing away similar charges. As years passed and osteoarthritis grew worse, the cushion thinned, many of these charged molecules were lost, and the knee became rough, dry, and damaged. The workers were tired and confused, and they could no longer repair the damage properly. One day, a team of scientists imagined a helper character named Nano, a microscopic delivery vehicle far smaller than a grain of dust. Nano was designed to carry a very special message not a medicine itself, but instructions.



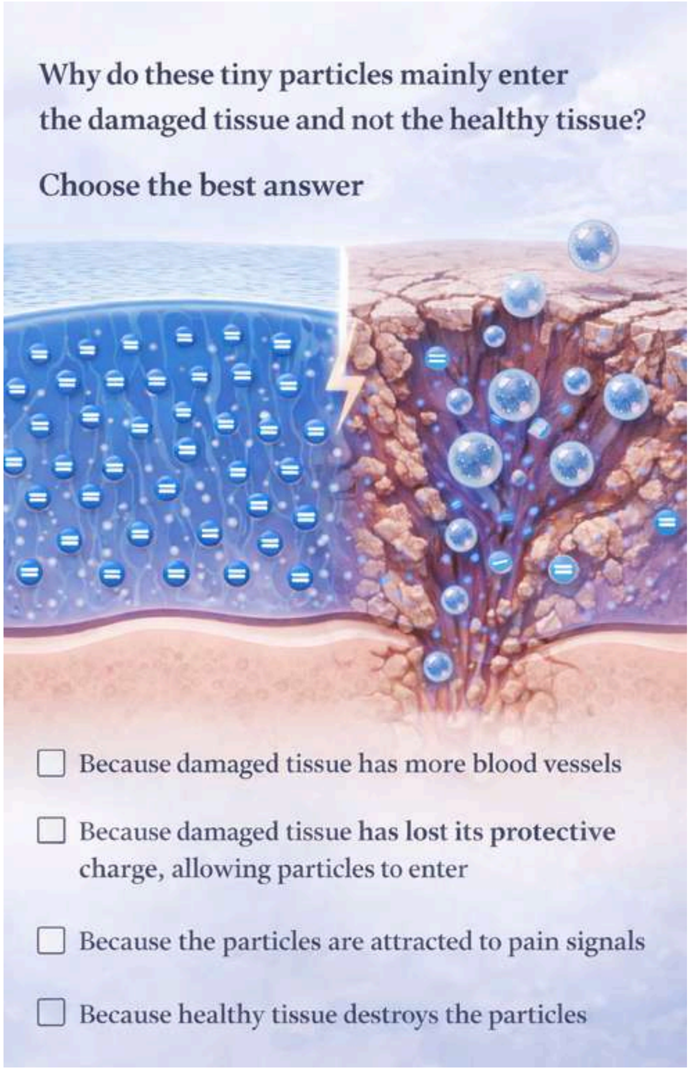
These instructions were written in a language called messenger RNA, or mRNA, which tells cells how to make helpful proteins. Instead of delivering a finished product that might break quickly, Nano would deliver a recipe so the cells could cook the medicine themselves. But Nano had a problem. Healthy cartilage is full of negative charges that would push Nano away, just like two magnets with the same side facing each other. So the scientists gave Nano a clever design: it was also negatively charged.

This meant Nano would be pushed away from healthy cartilage but would feel welcome in damaged cartilage, where those negative charges had been lost. In other words, the worse the damage, the easier it was for Nano to enter. This was a big idea the disease itself guided the treatment to the right place. To test this, the scientists first gave Nano a harmless glowing message, so they could see where it went. When Nano entered mildly damaged joints, the glow was weak. But in badly damaged joints, the glow was strong and bright. This showed that Nano could sense how severe the disease was and respond accordingly. The

| By **Dr. Preeti Sharma**

worse the osteoarthritis, the more Nano delivered its message. The knee itself decided where the treatment should go. Next, the scientists gave Nano a more important message. This time, Nano carried instructions to make ghrelin, a natural hormone. Ghrelin is often called the "hunger hormone," but it also has another side it can protect cells, reduce inflammation, and help tissues survive stress. The idea was simple: if cartilage cells could make ghrelin right inside the joint, they might protect themselves and slow the damage. Nano traveled into the damaged knee, found the tired cartilage workers, and quietly delivered the ghrelin message. The workers read the instructions and started producing ghrelin on their own. Slowly, changes began to happen. The cartilage broke down more slowly. The bone beneath it stayed healthier. The joint became calmer and less inflamed. Even the pain signals sent to the brain were reduced. In animal studies, knees treated with Nano carrying ghrelin instructions stayed stronger and healthier than untreated knees. The animals moved more easily and showed fewer signs of pain. Importantly, Nano itself did not harm the joint or the body. It simply delivered its message and disappeared, like a good messenger who knows when to leave. This story shows a new way of thinking about treatment. Instead of forcing medicine everywhere, the scientists let the disease guide the therapy. Instead of repeatedly injecting fragile drugs, they taught cells how to heal themselves. For people like Ramu, this research brings hope a future where painful joints are not just numbed, but protected and repaired from within. In the end, Nano was not a hero with strength, but with intelligence listening to the damaged knee, delivering help only where it was needed most, and whispering the right message at the right time.

Researchers now believe this strategy could open doors beyond osteoarthritis. By designing smart nanoparticles that respond to the chemical environment of diseased tissues, treatments may become more precise and longer lasting. One day, patients like Ramu may walk at sunrise again, not with pain, but with quiet confidence in science working within them.



REFERENCE

Dewani, M., Mamidwar, A.R., Rawal, M. et al. A disease-severity-responsive nanoparticle enables potent ghrelin messenger RNA therapy in osteoarthritis. Nat. Nanotechnol. (2026). https://doi.org/10.1038/s41565-025-02101-0

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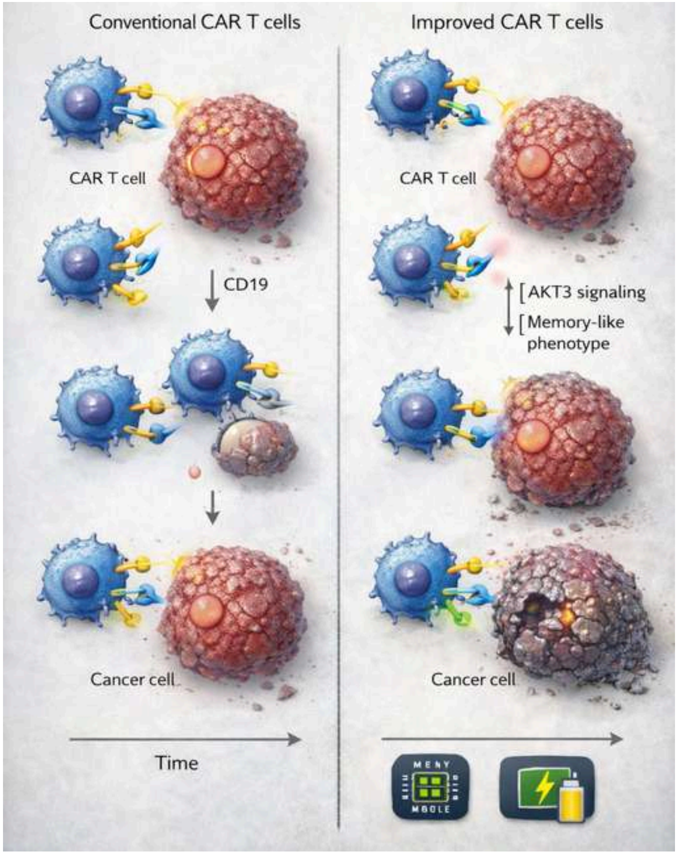
| By **Dr. Ipsita Mohanty**

TEACHING THE BODY TO FIGHT SMARTER WITH CAR T CELL THERAPY

In the Indian town of Nandipur, there was a well-known cancer hospital where people from nearby villages came with hope and fear mixed together. At this hospital worked Dr. Kavita Sharma, a cancer specialist who believed strongly in a treatment called CAR T cell therapy. She explained it simply to patients: “We take your own immune soldiers, train them in the lab, and send them back to fight cancer.”



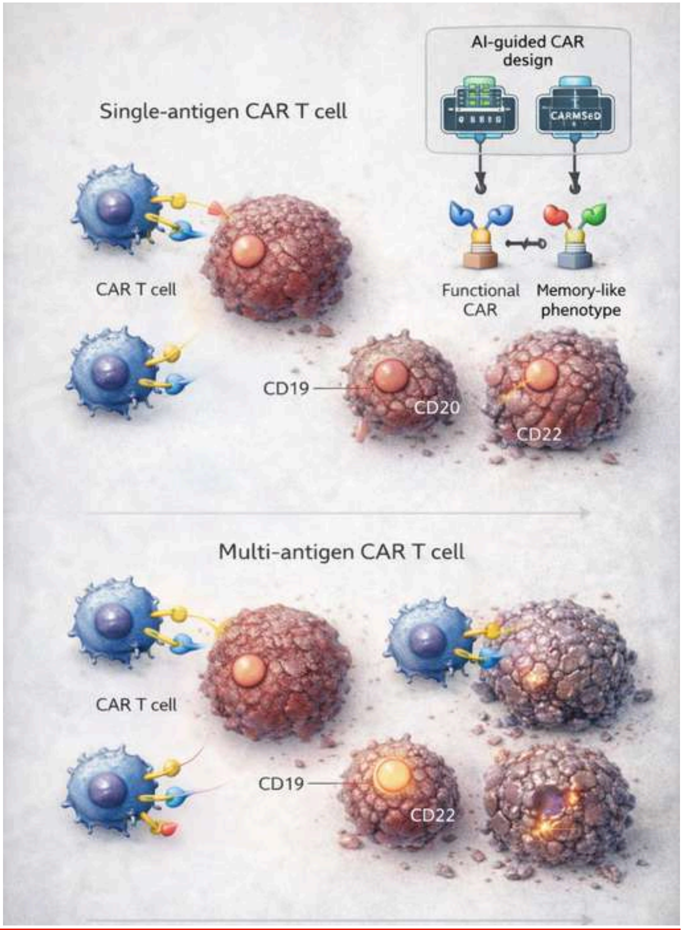
For some patients with blood cancers like leukemia, this therapy worked like a miracle. People who had almost lost hope began to recover. But Dr. Kavita also saw the painful side. Many patients improved at first, only to return months later when the cancer came back. One evening, she said to her colleague Dr. Arjun Mehta, “The soldiers we send are brave, but they don’t last long. And the enemy is learning how to hide.”

Dr. Arjun explained the two biggest problems. First, the trained immune cells often became tired and weak too soon after entering the body. They fought hard at the beginning but slowly lost energy and stopped working. Second, cancer cells were clever. They sometimes removed the surface signal that the immune cells were trained to recognize. When that signal disappeared, the immune cells could no longer see the cancer, allowing it to slip past.

The doctors wanted to change this. They wanted immune cells that could stay strong for a long time and could recognize cancer even if it tried to hide.

To do this, Dr. Arjun worked with Rohit, a young scientist who used computers to solve medical problems. Instead of testing hundreds of immune cell designs blindly, Rohit used artificial intelligence. His computer model studied many past designs and learned which ones worked well and which ones failed. It could even predict if a design would over-activate the immune cell and exhaust it. With this help, the team chose better designs from the start, saving time and effort.

But design was only part of the solution. Earlier treatments trained immune cells to recognize only one signal on cancer cells. If that signal disappeared, the treatment



| By **Dr. Ipsita Mohanty**

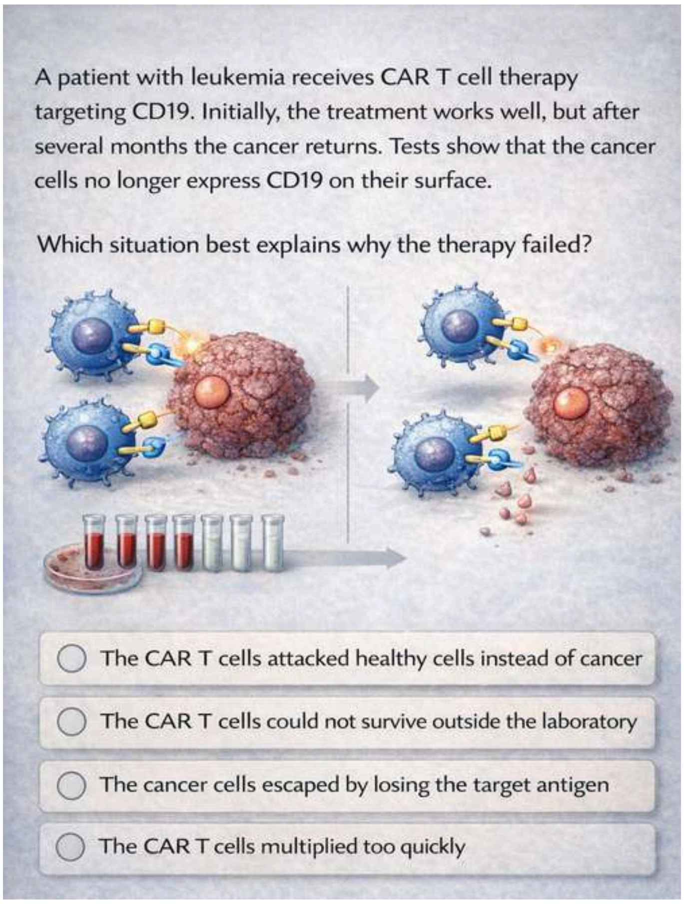
failed. This time, the doctors trained immune cells to recognize two or even three signals at once. Dr. Kavita explained it to patients using a simple example: “Earlier, our guards recognized the thief only by his shirt. Now they recognize his face, voice, and walk.” Even if cancer cells lost one signal, the immune cells could still find them.

There was still another issue: energy. Some immune cells rushed into battle too aggressively and burned out. The research team discovered that a protein inside the cells, called AKT3, was pushing them to fight nonstop. They used a clever tool to gently remove this protein inside the immune cells. Without AKT3 pushing them too hard, the cells became calmer, smarter, and longer-living, behaving more like experienced guards who knew how to conserve strength.

When these improved immune cells were tested in the lab and in mice with leukemia, the results were encouraging. Cells that recognized two cancer signals survived longer and killed cancer more effectively. With internal energy control added, the cells stayed active even longer. The most advanced version, which recognized three signals, could destroy cancer cells even when the cancer tried to hide by removing common markers, making relapse much harder.
One patient, Mr. Raghav, listened carefully as Dr. Kavita explained the new approach. “So my own cells will fight smarter, not just harder?” he asked. She smiled and said, “Exactly.”

The doctors reminded everyone that this work was still in the research stage and not yet a routine treatment. But it showed a powerful idea: by combining AI-based design, multi-target recognition, and better internal energy control, cancer-fighting cells could become stronger, longer-lasting, and harder to fool. In Nandipur hospital, hope came not from shortcuts, but from understanding the problem deeply and fixing it step by step.

Dr. Kavita often told her students that the future of medicine would belong to therapies that learn and adapt just as diseases do. CAR T cells were no longer just engineered weapons; they were becoming intelligent systems shaped by biology and data together. If research continued to move carefully from laboratory to clinic, treatments might one day be tailored precisely to each patient’s cancer. For families waiting in hospital corridors, that possibility alone was a reason to keep believing.



REFERENCE

Ansari, M.S., Chauhan, V., Singh, A. et al. AI-guided CAR designs and targeted pathway modulation to enhance multi-antigen CAR T cell durability and overcome antigen escape. Nat Commun (2026). https://doi.org/10.1038/s41467-025-68272-5

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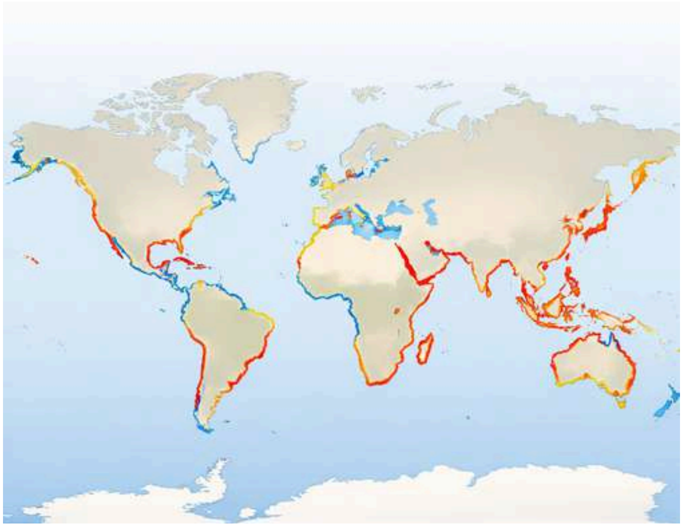
| By **Dr. Priyangana Deb**

A STORY OF A CHANGING COAST

On a warm morning by the sea, a young researcher named Mira stood on a quiet beach, watching waves roll in and slide back into the ocean. She had grown up here, in a small coastal town where fishing boats lined the shore and children played near the water. But over the years, Mira noticed something unsettling: the sea was slowly creeping closer to the houses, storms were stronger, and parts of the beach were disappearing. Mira wasn't alone in seeing this change. Around the world, millions of people living near coasts were facing similar problems. This concern led Mira and her colleagues Leo, a data scientist, Asha, a climate expert, and Noah, a geographer to work on a big question: Which coastlines of the world are most vulnerable, and why?

To answer this, the team imagined the world's coastlines as a long ribbon wrapping around the planet. They divided this ribbon into thousands of small pieces, each about one kilometer long, and carefully studied the natural features of each piece. Leo explained that not all coastlines behave the same way. Some are rocky and steep, like cliffs that stand strong against waves. Others are flat, sandy, or muddy, like river deltas and lagoons, which are much easier for water to flood or wash away. To compare all these coastlines fairly, the team used a tool called the Coastal Vulnerability Index, which works like a report card for the coast.



Asha described the ingredients of this "report card." They looked at how steep or flat the land is, because flat land floods more easily. They studied the shape of the coast whether it was rocky, sandy, or formed by river sediments. They examined waves and tides, since strong waves and large tides can wear down the shore faster. They also considered how sea level is changing and whether the shoreline is already eroding or building up. Each factor was scored from low to high risk, and then combined to show how vulnerable each stretch of coast is.

As the team assembled the global map, surprising patterns emerged. Noah noticed that many tropical and subtropical countries especially in parts of Africa, South America, and South Asia showed very high vulnerability. Places like low-lying river deltas and sandy shores were especially at risk. These areas are home to many people, but the land there is soft and flat, making it easy for floods and erosion to cause damage. In contrast, countries with steep, rocky coastlines such as parts of northern Europe often showed lower vulnerability, even though they still experience storms.

Mira focused on the human side of the story. She explained that this vulnerability is not just about nature; it affects real lives. Coastal regions support fishing, farming, ports, tourism, and unique ecosystems like mangroves and wetlands. When coastlines erode or flood, homes can be lost, drinking water can become salty, and livelihoods can disappear. The team found that in many highly vulnerable countries, natural features like coastal slope, landform type, and tidal range play the biggest role in increasing risk.

As their work came together, the researchers realized something important. This global map was not meant to scare people it was meant to guide action. By knowing which regions are most vulnerable and what causes that vulnerability, governments and communities can make smarter decisions. They can protect natural barriers like mangroves, plan safer locations for cities, and prepare for rising seas instead of reacting after disasters happen.

On the final day of the project, Mira returned to her hometown beach. She looked at the waves again, but this time with a deeper understanding. The coast was not just a line on a map it was a living, changing system shaped by land, water, and climate. Their global study showed that while some shores are naturally strong, others need urgent care. The story of the world's coastlines, Mira realized, is really a story about people learning how to live wisely at the edge between land and sea.

Yet Mira also understood that vulnerability is not destiny. Coasts have always changed, but human choices can either increase risk or build resilience. Restoring coral reefs and mangrove forests can soften wave energy. Thoughtful urban planning can prevent construction in the most fragile zones. Early warning systems and community education can reduce harm when storms arrive. Science, she believed, must travel beyond journals and into policy rooms, classrooms, and fishing docks. The map her team created was not an end point; it was a starting guide. With knowledge, cooperation, and care, communities can adapt and ensure that future generations still find life, work, and wonder along the sea's shifting edge.

REFERENCE

Basnayake, V., Duong, T.M., Ranasinghe, R. et al. A global assessment of coastal vulnerability and dominant contributors. Nat Commun 17, 578 (2026). https://doi.org/10.1038/s41467-025-67275-6.

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| By **Dr. Jnana Ranjan Prusty**

THE SMOKE BEHIND CLOSED DOORS

Every morning in Korail, one of the largest informal settlements on the edge of Dhaka, Bangladesh, Ayesha Begum wakes before dawn. Her home is a single-room structure made of tin sheets and bamboo, tightly packed among thousands of others. There is no gas connection inside her house, and electricity is unreliable. When she prepares breakfast for her family, Ayesha lights a small clay stove using scraps of wood and paper. Often, these are not enough. Just outside her door lies a mound of waste plastic bags, food wrappers, sachets, broken containers collected by the wind and daily life. She tears a plastic wrapper and feeds it into the fire. The flame flares up instantly, but thick black smoke fills the room. Her eyes sting, her chest tightens, and her young son Rahim begins to cough. Ayesha knows the smoke is harmful, but without affordable fuel, she does what many around her do she burns plastic to survive.

Across the narrow lanes of Korail, this practice is common and quietly accepted. Karim, a rickshaw puller, burns plastic at night to boil water during winter. Salma, a garment worker, mixes plastic with charcoal to cook quickly before leaving for her shift. Everyone understands that the smoke smells toxic, yet few talk about it openly. For years, this practice remained largely invisible to authorities and researchers. This silence is exactly what a recent study published in Nature Communications set out to break.

The researchers wanted to know whether household plastic burning was a rare behavior or a widespread reality across low-income communities in the Global South. Instead of focusing on a single country, they conducted a large international survey, gathering information from over 1,000 key informants across 26 countries, including Bangladesh, Nigeria, Kenya, Indonesia, Brazil, and other nations where energy poverty and plastic waste are major challenges. These informants—community workers, NGO staff, researchers, and local experts were asked simple but powerful questions: Do people burn plastic in their homes? How common is it? Why does it happen?

The answers revealed a clear and troubling pattern. Burning plastic in households is not an isolated habit. It is reported across cities and settlements in South Asia, sub-

| By **Dr. Jnana Ranjan Prusty**

Saharan Africa, and Latin America. In many places, plastic is burned alongside wood, charcoal, or agricultural waste for cooking, heating, and sometimes simply to get rid of accumulating garbage. The practice is widespread precisely because the conditions that cause it are widespread.

In Korail, garbage collection is irregular. Plastic waste piles up in open drains and empty corners. At the same time, clean fuels such as LPG or electricity are expensive and often unavailable to the poorest households. The study shows that this combination of failed waste systems and unaffordable energy pushes people toward plastic burning. Plastic is free, easy to ignite, and always nearby. For families struggling to cook a meal or stay warm, it becomes a last-resort fuel.

But the smoke comes with severe consequences. When plastic burns, it releases toxic chemicals and fine particles that penetrate deep into the lungs and bloodstream. The study highlights how this smoke increases the risk of breathing problems, heart disease, and long-term illnesses, including cancer. Because cooking usually happens indoors, women and children are the most exposed. In Ayesha's home, Rahim's persistent cough and Salma's constant headaches are not unusual; they reflect a hidden health crisis unfolding behind closed doors.

One of the most important messages of the paper is that this is not a personal failure. Ayesha does not burn plastic because she is unaware of the risks. She does it because the systems meant to protect her clean energy supply, waste management, and affordable services do not reach her community. The researchers stress that blaming households misses the real problem. Plastic burning is a symptom of deeper inequalities and infrastructure gaps.

The study calls for solutions that address the root causes: affordable access to clean cooking fuels, reliable waste collection, and policies that recognize household plastic burning as a serious health and energy issue. When these systems improve, communities like Korail will not need warnings or enforcement to stop burning plastic; the practice will disappear naturally.

Until then, the smoke continues to rise each morning, not because people choose it, but because they have been left with no safer alternative.

Quiz

In a city survey, plastic burning is rarely reported in official energy statistics, even though it is observed locally.

Why might this practice remain largely invisible in data and policy discussions?

- [ ] It happens only in rural areas
- [ ] It is considered a formal energy source
- [ ] It is informal, episodic, and not systematically measured
- [ ] It t produces no measurable pollution

REFERENCE

Bharadwaj, B., Gates, T., Rose, S. et al. Prevalence of plastic waste as a household fuel in low-income communities of the Global South. Nat Commun 17, 50 (2026). https://doi.org/10.1038/s41467-025-67512-y

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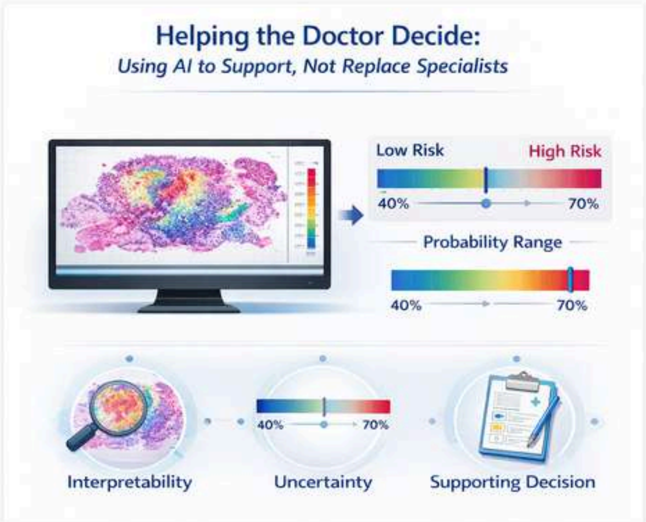
| By **Dr. Priyanka**

WHEN THE SLIDE FOUND ITS VOICE

Dr. Sharmila Iyer had spent most of her life looking through a microscope. Every morning, she opened wooden boxes filled with glass slides thin slices of tumor tissue stained in shades of pink and purple. To others they looked like abstract art, but to her they were clues about a patient's future. Still, something bothered her. "These slides tell me how the tumor looks," she often said to her junior doctor Rohan, "but not always how it will behave." That missing piece usually came from gene tests, which showed which genes inside the tumor were active or silent. But gene tests were costly, slow, and rarely done in government hospitals. One day, Rohan asked a simple question. "Madam... what if the slide itself could tell us about the genes?" Dr. Sharmila smiled politely. "That would be wonderful, Rohan. But slides don't talk."



Across the hospital campus, in a small computer lab, Neelam Verma was struggling with a different frustration. She was an AI researcher working on cancer prediction models and knew AI performed best when microscope images were combined with gene data. But in real hospitals, gene data was usually missing. "So our best models stay stuck in research papers," she sighed. Then an idea slowly formed. "What if AI could learn the link between tissue patterns and gene activity," she thought, "and then guess the genes when they are missing?"

Neelam and her team built an AI system they called PathGen. They trained it using thousands of cancer cases where both pathology images and real gene data were available. Over time, the AI learned deep connections between how cancer tissue looks and how genes behave. Some genes push cancer to grow fast. Some try to stop it. Some control how cells mature. PathGen learned these patterns step by step. Instead of directly predicting genes, PathGen started with random noise and slowly refined it until a meaningful synthetic gene profile appeared. "It's like sculpting," Neelam explained. "You remove the unnecessary parts until the shape becomes clear."

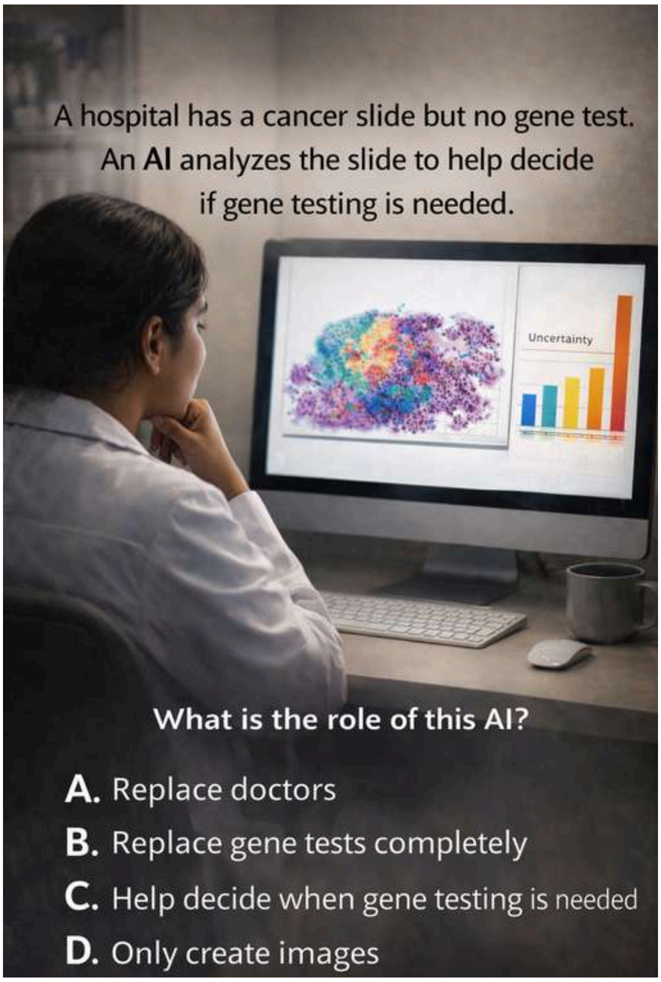
| By **Dr. Priyanka**

When Dr. Sharmila agreed to test PathGen, she remained cautious. The system was asked to predict how aggressive the cancer is and how risky the patient's survival may be. The results surprised everyone. When predictions used only the slide, they were good. When predictions used slides plus PathGen's synthetic gene data, they became much better. Even more surprising, results using synthetic gene data were very close to those using real gene tests. "So the AI is not guessing blindly," Rohan said softly. "It's learning real biology."

What impressed Dr. Sharmila most was transparency. PathGen didn't just give numbers. It showed colored maps on the slide, highlighting dangerous regions of the tumor and calmer ones. It revealed that tumors were not uniform. "This matches what we see in practice," she said. PathGen also shared something doctors value deeply: uncertainty. Instead of saying "this is the answer," it said, "this is the likely range." "In medicine," Dr. Sharmila said, "certainty without honesty is dangerous."

The team also checked fairness across age, gender, and hospitals. The answer was reassuring. PathGen behaved consistently across groups. Slowly, the real value became clear. PathGen was not replacing gene tests; it was helping doctors decide who truly needs them. One afternoon, Dr. Sharmila reviewed a new patient's slide. Instead of ordering expensive tests immediately, she used PathGen first. "This patient shows high risk," she said. "Here, gene testing will really help." For another patient, she decided the opposite. That was the breakthrough. PathGen gave a voice to silent slides, helping doctors listen before spending precious resources. As Neelam shut down her computer that evening, she felt proud not because the AI was powerful, but because it was useful. "We didn't teach a machine to replace doctors," she said. "We taught it to help slides tell their hidden story." And at last, the slide learned how to speak.

In time, Dr. Sharmila began to imagine a future where every district hospital could access such support, even without advanced genomic labs. If tools like PathGen became widely available, they could narrow the gap between urban research centers and resource-limited clinics. Patients would not wait months for answers, and treatment decisions could begin sooner. For Neelam and her team, that was the true success turning artificial intelligence into practical compassion, one slide at a time.



REFERENCE

Dey, S., Banerji, C.R.S., Basuchowdhuri, P. et al. Generating crossmodal gene expression from cancer histopathology improves multimodal AI predictions. Nat Commun 17, 259 (2026). https://doi.org/10.1038/s41467-025-66961-9

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| By **Dr. Dhanashree Mundhe**

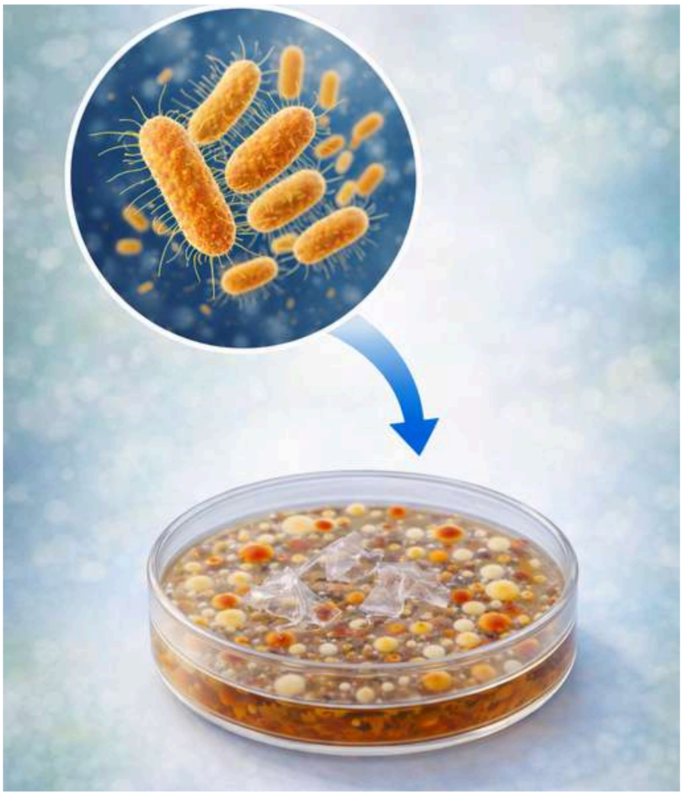
THE PLASTIC PUZZLE: HOPE IN A TINY ENZYME

Ananya Sharma was a curious science student growing up in Bhubaneswar, a city shaped by rivers, busy markets, and crowded streets. Every morning on her way to college, she noticed the same troubling sight plastic bags tangled in drains, food containers floating near water edges, and piles of waste that looked unchanged week after week. Leaves and paper slowly disappeared, but plastic stayed exactly the same. One day, she asked her teacher why plastic did not break down like natural materials. Her teacher explained that some plastics, especially polypropylene, are designed to be strong and long-lasting. This durability makes them useful but also makes them extremely difficult for nature to destroy. That answer stayed with Ananya and quietly shaped her curiosity.

Several hundred kilometers away in Delhi, Dr. Ramesh Iyer was working as a microbiologist, spending long hours studying bacteria—organisms so small that most people rarely notice them. Ramesh believed that nature often hides powerful solutions in the smallest forms. While examining bacteria collected from soil near a waste site, his team noticed something unusual. One bacterium, called Micrococcus, behaved differently near plastic surfaces. It did not consume the plastic, but it appeared unusually active around it. Curious about this behavior, Ramesh decided to investigate further.

The researchers discovered that this bacterium produced a special protein called an enzyme. Enzymes act like tools in living systems, helping chemical reactions happen faster. This enzyme belonged to a group known as multi-copper oxidases, which are known to add oxygen to tough natural materials such as plant fibers. Ramesh wondered whether the same process could work on plastic. If the enzyme could weaken strong natural materials, perhaps it could also begin to weaken polypropylene, one of the most common plastics used in packaging.

To test this idea, the scientists produced the enzyme in the laboratory and applied it to small strips of polypropylene plastic, similar to those used in food containers. They avoided heating the plastic or treating it with harsh chemicals, wanting to see what the enzyme could do on its own. After one day, the results surprised them. The plastic strips became slightly lighter, and under a microscope their smooth surfaces appeared rough and cracked. Chemical tests showed that oxygen-containing groups had formed on the plastic surface. The enzyme had not destroyed the plastic, but it had clearly weakened it. This change was small, but it was important.



| By **Dr. Dhanashree Mundhe**

Around the same time, Ananya began an internship at a research institute and read about this study. She was excited to learn that plastic could be broken down, at least partially, by natural enzymes. Her mentor explained that while the enzyme did not finish the job, it made the plastic easier for other natural processes to continue breaking down. Ananya realized that big problems do not always need dramatic solutions. Sometimes, meaningful progress begins with small, careful steps.

The scientists were careful not to exaggerate their findings. The enzyme did not magically remove plastic waste from the environment, and the experiments were conducted under controlled laboratory conditions. Applying such solutions to real-world waste management would take time and further research.

Today, Ananya dreams of working in environmental biotechnology, imagining future waste treatment systems where enzymes help recycle plastics gently, without burning or toxic chemicals. Ramesh continues his research, knowing that this enzyme is only one piece of a much larger puzzle. Their story reminds us that plastic pollution did not appear overnight and will not disappear overnight either.

Yet the discovery changed how both of them looked at the problem. Instead of seeing plastic as an unmovable enemy, they began to see it as a material that might slowly yield under the right biological pressure. Researchers started asking deeper questions. Could the enzyme be improved through protein engineering? Could multiple enzymes work together, each attacking a different chemical bond? Could waste treatment plants one day include biological reactors where microbes gently pre-treat plastic before recycling?

Ananya learned that science rarely moves in leaps; it advances through refinement. Even a slight surface crack on plastic can make it more vulnerable to sunlight, heat, and other microbes. Each small weakness becomes an opening. Around the world, similar teams are exploring enzymes, microbial communities, and green chemistry approaches to reduce dependence on incineration and landfills. The road ahead is long, but it is no longer invisible. With patience, collaboration, and evidence-based innovation, solutions once hidden in soil may help reshape how society manages its most persistent waste.

REFERENCE

Kulshrestha, P., Katiyar, R., Zargar, A.N. et al. Multi copper oxidase from Micrococcus sp. IITD107, a promising candidate for polypropylene biodegradation. npj Mater Degrad 10, 8 (2026). https://doi.org/10.1038/s41529-025-00720-5.

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By **Dr. Poulami Chakraborty**

THE FOG THAT WOULD NOT SETTLE

Every winter, Dr. Laxmi Verma arrived at her laboratory before the sun rose. From the terrace of the atmospheric science building in Delhi, she could barely see the road below. The city was wrapped in thick fog, the kind that silences traffic

and turns streetlights into glowing halos. Flights were delayed, trains crawled, and people blamed the cold. But Dr. Laxmi knew the fog was telling a deeper story.

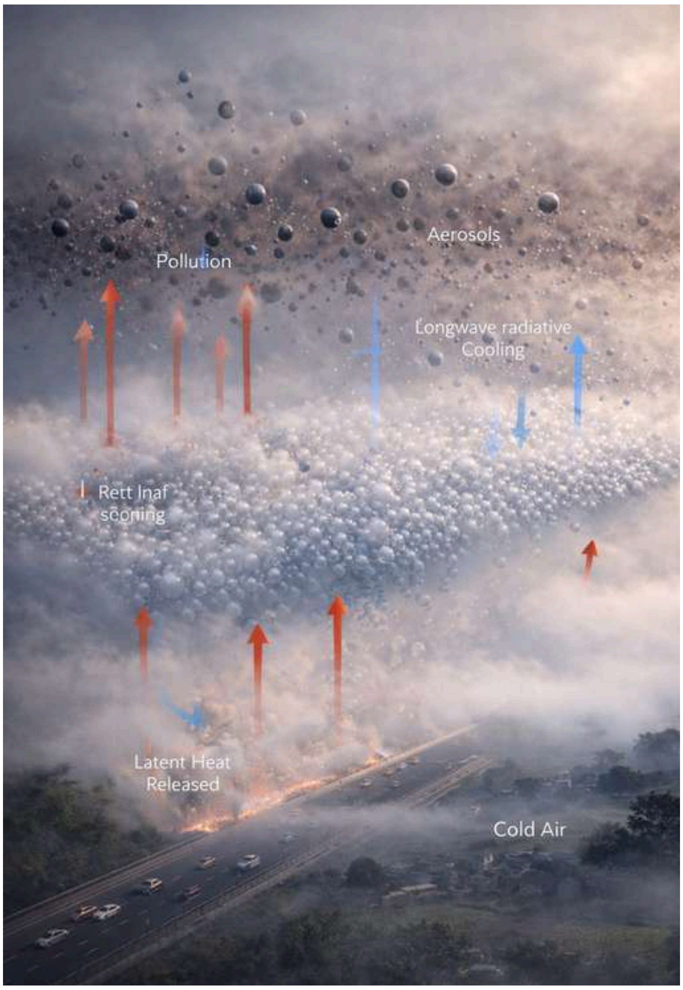
For years, she had studied winter fog over the Indo-Gangetic Plain. Traditional explanations pointed to low temperatures and high humidity. Yet the fog was changing. It was becoming thicker, rising higher, and lasting longer than before. Weather conditions alone could not explain this shift.

One morning, her student Arjun pulled up satellite images from the last fifteen winters. “Look at this,” he said. The fog layer was no longer thin and close to the ground. On many days, it reached almost half a kilometer high. More importantly, the base of the fog stayed near the surface, while the top kept rising.

Dr. Laxmi zoomed in on the layers above the fog. There it was a dense blanket of aerosols. Tiny particles released from vehicles, industries, crop residue burning, and household fires remained trapped in the atmosphere overnight. They didn’t vanish with the sunset. They waited.

“These particles are sitting above the fog,” she said quietly. “And they are changing it.”

Using fifteen years of satellite data, Dr. Laxmi examined fog thickness, droplet size, and liquid water content. The results were surprising. On polluted nights, fog droplets near the top of the fog layer were larger, and the fog contained more liquid water. This was unexpected because pollution is often associated with smaller droplets.



| By **Dr. Poulami Chakraborty**

To understand the physics behind this, Dr. Laxmi turned to advanced computer simulations. She used a high-resolution weather and chemistry model capable of simulating fog, aerosols, radiation, and heat exchange at the same time. She ran two scenarios: one with low aerosol pollution and one with high pollution.

The polluted case revealed the hidden mechanism.

Aerosols acted as cloud condensation nuclei, allowing more water vapor to condense into droplets. This condensation released latent heat, gently warming the air inside the fog. Warmer air rises, and this created subtle upward motion within the fog layer.

At the same time, the fog top cooled rapidly. The dense droplets released heat into space through longwave radiation, cooling the upper fog layer more strongly than the lower part. This created a temperature contrast warmer below, cooler above.

The fog began to mix internally.

“This vertical mixing is the key,” Dr. Laxmi explained to Arjun. “It pulls moist air upward, thickening the fog from the top.”

The more pollution there was, the stronger this effect became. Aerosols were not just passive particles; they were actively invigorating the fog. The fog grew deeper, denser, and more persistent.

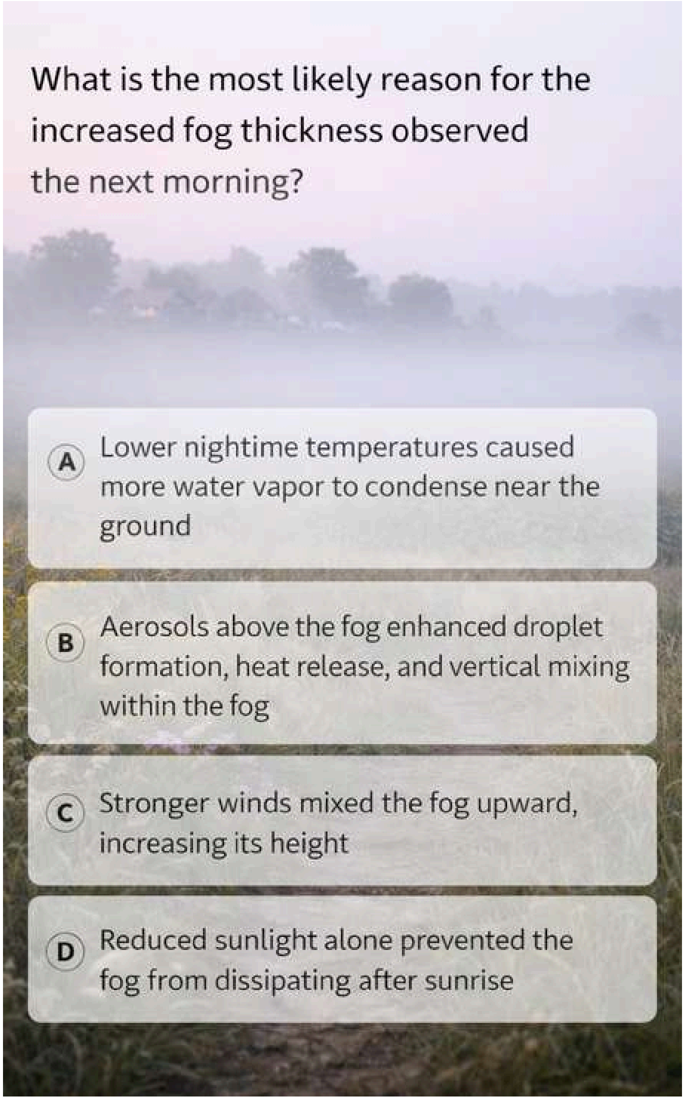
The effect was strongest at night. Without sunlight to warm the surface and break the fog apart, the pollution-driven mixing dominated. During the day, aerosols could reduce sunlight and sometimes suppress fog growth. But by nightfall, the fog returned stronger.

Dr. Laxmi realized the broader meaning of her findings. Thicker fog meant poor visibility, transport disruptions, accidents, and economic loss across northern India. This was no longer just a forecasting problem it was a public health and pollution issue.

At a meeting with policymakers, she summarized it simply:
“When we increase air pollution, we are feeding the fog. Clean air doesn’t just help lungs it helps the sky clear too.”

As Dr. Laxmi walked home one evening, the fog closed around her again. But now she understood it completely. The fog was no longer just cold air and water vapor. It was a system shaped by human activity.

The fog was not settling anymore.
It was growing.



REFERENCE

Arun, N., Sarangi, C., Kanawade, V.P., Singh, M.K. & Gautam, R. Widespread fog invigoration due to aerosols over Northern India. Sci Adv 12, eadx166 (2026). https://doi.org/10.1126/sciadv.adx166.

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| SCIENCE DESK |

CAN EVERYDAY PLASTICS AFFECT WOMEN'S HORMONES?

Dr. Rushikesh Joshi
University School of Sciences, Gujarat University, Ahmedabad, Gujarat, India
| Scientific Profile |
| Organization Link |
Areas of Expertise: Reproductive Endocrinology & PCOS | Environmental Toxicology

Your recent work focuses on how everyday chemicals like plasticizers might affect women's hormone health. Can you tell us what you are currently investigating in your day-to-day research and why these matters?

Hormones in the female body act as vital messengers that regulate menstrual cycles, ovulation, metabolism, and fertility. In women with Polycystic Ovary Syndrome (PCOS), this hormonal balance is already sensitive and often disrupted. Our research focuses on how everyday chemicals known as endocrine-disrupting chemicals (EDCs) particularly phthalates and bisphenol A (BPA), commonly found in plastics, food packaging, and cosmetics may further interfere with this delicate hormonal system. We study how exposure to these chemicals correlates with hormonal changes, reproductive health issues, and metabolic disturbances in women with PCOS. By comparing women with PCOS to healthy controls, as well as urban and rural populations, we have observed consistently higher levels of BPA and certain phthalates in women with PCOS. These levels significantly correlate with key reproductive hormones such as luteinizing hormone and estrogen, suggesting that EDC exposure may intensify hormonal imbalance. Although EDCs may not directly cause PCOS, our findings indicate that they can add stress to an already impaired endocrine system, potentially worsening symptoms. This highlights the importance of greater awareness, safer consumer choices, and preventive strategies to better manage PCOS and improve long-term women's health outcomes.

What is PCOS, and why is it an important health issue for women?

Polycystic Ovary Syndrome (PCOS) is a common hormonal disorder affecting women during their reproductive years. It is often marked by irregular periods, ovulation difficulties, elevated male hormone levels, acne, weight gain, and challenges with conception. However, PCOS extends beyond these visible symptoms. It is closely linked to metabolic disturbances, particularly insulin resistance, which increases the risk of diabetes, obesity, and cardiovascular disease over time. The condition varies widely among individuals; some experience menstrual irregularities, while others struggle more with fertility, weight, or metabolic health. Beyond physical symptoms, PCOS can also impact mental well-being, contributing to stress, anxiety, and reduced quality of life. Given its early onset and long-term consequences, PCOS should be viewed not merely as a reproductive disorder but as a multifaceted condition involving hormonal, metabolic, and lifestyle factors. Effective management requires a comprehensive approach that combines medical care, lifestyle changes, and attention to environmental influences on hormonal health.

What are phthalates, and where do people usually encounter them?

Phthalates are synthetic chemicals used to make plastics soft, flexible, and durable, which is why they are widely present in everyday products. They are commonly found in food packaging, plastic containers, bottled water, cosmetics, personal care items, vinyl flooring, toys, household dust, and even certain medical devices. Because many phthalate derivatives break down slowly, they persist in the environment, leading to continuous human exposure. Unlike some chemicals that remain tightly bound within materials, phthalates can gradually leach into food, water, air, and dust. People are exposed through ingestion, inhalation, and skin contact, often repeatedly over long periods. As endocrine-disrupting chemicals (EDCs), phthalates can interfere with the body's hormonal system. Long-term exposure has been associated with disruptions in reproductive hormones, metabolic imbalance, and conditions such as PCOS, raising significant concerns for women's health.

Why did you decide to study phthalates in women with PCOS?

PCOS is a condition in which the hormonal system is already sensitive and imbalanced, leading to irregular periods, elevated male hormones, insulin resistance, and ovulation difficulties. Since phthalates are endocrine-disrupting chemicals, we aimed to investigate whether regular exposure to these everyday chemicals could further disturb hormone balance in women with PCOS.

| SCIENCE DESK |

CAN EVERYDAY PLASTICS AFFECT WOMEN'S HORMONES?

Given their widespread presence in plastics, food packaging, cosmetics, and household products, long-term exposure to phthalates is nearly unavoidable. While earlier studies linked phthalates to reproductive hormone changes, many relied on urine samples that reflect only short-term exposure. To better understand their biological impact, we examined phthalate levels in blood (serum), which may more accurately reflect active exposure. Our goal was to determine whether environmental chemicals act as additional stressors on the already vulnerable hormonal system in PCOS, helping improve awareness, prevention, and overall management strategies.

What did your study find when you compared women with PCOS and healthy women?

PCOS is a condition marked by chronic endocrine and metabolic imbalance, making affected women particularly sensitive to environmental factors. Phthalates such as DEHP and its metabolite MEHP are endocrine-disrupting chemicals that interfere with hormone synthesis and signaling. We investigated whether these chemicals further influence the already disrupted hormonal system in women with PCOS.

Our serum-based analysis revealed significantly higher levels of DEHP and MEHP in women with PCOS compared to healthy controls. Notably, DEHP levels showed positive associations with luteinizing hormone, LH/FSH ratio, and estradiol only in the PCOS group, suggesting a disease-specific interaction. By measuring serum levels, we captured the biologically active fraction of phthalates. These findings suggest that phthalates act as environmental modifiers that may worsen hormonal imbalance in PCOS, underscoring the need to consider environmental exposure in its pathophysiology and management.

Did these chemicals affect hormones in women with PCOS?

Phthalates such as DEHP and its active metabolite MEHP disrupt endocrine function through molecular pathways highly relevant to PCOS. These chemicals can interfere with the hypothalamic–pituitary–ovarian (HPO) axis by altering gonadotropin regulation and estrogen feedback mechanisms, leading to changes in luteinizing hormone (LH) secretion.

In our study, serum DEHP levels were positively associated with LH, LH/FSH ratio, and estradiol in women with PCOS, but not in healthy controls, suggesting a disease-specific effect. Phthalates may also worsen hyperandrogenism by influencing steroidogenic enzymes in the ovary. Additionally, activation of nuclear receptors such as PPARs links phthalate exposure to insulin resistance and metabolic dysfunction. Together, these findings indicate that phthalates act as environmental modifiers that amplify hormonal imbalance in PCOS rather than directly causing it.

Does this mean that phthalates cause PCOS?

No, our study does not prove that phthalates cause PCOS. PCOS being a complex condition has many contributing factors, including genetics, metabolism, and lifestyle. Our findings suggest that phthalates may contribute as one of those factors in worsening hormonal imbalance or increasing the severity of symptoms in women who already have PCOS. More long-term studies and further research are needed to understand cause-and-effect relationships.

What is the main message of your study for the general public?

Phthalates are common chemicals found in many plastic products, and in women with PCOS they can disturb hormone balance as observed in our study. Women with PCOS have already imbalanced hormones and hence imbalanced periods and ovulation. Phthalates that enter the body through food, plastics, or cosmetics, further interfere with these hormones, particularly those involved in egg release and menstrual regulation. Our findings suggest that phthalates may not directly cause PCOS, but they can worsen hormonal problems in women who already have this condition. This highlights the importance of reducing unnecessary plastic exposure as part of protecting women's hormonal and reproductive health.

| SCIENCE DESK |

CAN EVERYDAY PLASTICS AFFECT WOMEN'S HORMONES?

What future research is needed in this area?

Future research should focus on identifying the molecular pathways through which phthalates influence PCOS, including their effects on hormone signaling, ovarian function, insulin regulation, and gene expression related to steroid production and metabolism. This deeper understanding could support the development of more targeted treatment strategies. Urban–rural and region-specific studies are also important, as environmental exposure varies with lifestyle and industrialization. Comparing different populations may help explain variations in hormonal responses and guide location-specific prevention efforts. Finally, large-scale, long-term studies are needed to validate current findings, identify vulnerable groups, and clarify how environmental exposure interacts with genetics and lifestyle. Such evidence will be essential for shaping public health policies and improving PCOS management

Dr. Joshi's contributions to this field are reflected in his publication in BMC Endocrine Disorders, "Investigating the impact of phthalate exposure on endocrine function in women with polycystic ovary syndrome, DOI: 10.1186/s12902-026-02166-5, which examines how exposure to endocrine-disrupting chemicals such as phthalates may influence hormonal balance in women with PCOS, highlighting potential environmental contributions to reproductive and metabolic dysregulation.

| SCIENCE DESK |

CAN ARTIFICIAL INTELLIGENCE SAVE OUR CROPS? LESSONS FROM SMART PEST DETECTION

Dr. Betty Martin
SAP, SASTRA Deemed University,
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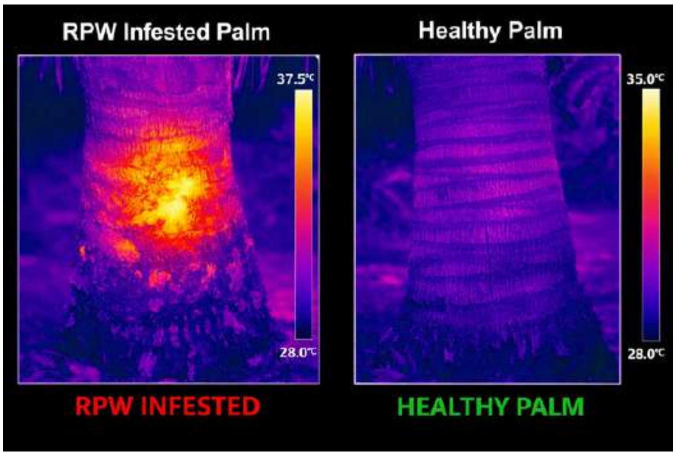
| Scientific Profile |
| Organization Link |
Areas of Expertise: AI & Spectral Analysis | Intelligent Sensor Systems | Embedded & Microprocessor-Based Technologies | Biomedical Signal Processing

How can AI and thermal cameras help farmers detect hidden pest infestations before serious crop damage occurs?

AI and thermal cameras can help farmers detect hidden pest infestations by identifying subtle heat changes in plants before visible damage appears. In the case of Red Palm Weevil (RPW), the larvae feed inside palm trunks, making early infestation difficult to detect through visual inspection. However, their internal activity generates abnormal heat patterns on the trunk surface. In this system, a low-cost setup using a Raspberry Pi and a long-wave infrared (LWIR) thermal camera captures thermal images of palm trees under real field conditions. These images are preprocessed to reduce the effects of sunlight and wind, ensuring accurate temperature normalization. A deep learning Convolutional Neural Network (CNN), trained on 6,000 labeled thermal images (healthy and infested), learns to recognize specific heat signatures and texture patterns associated with infestation. The trained model runs directly on the Raspberry Pi, enabling real-time, on-site detection without the need for complex infrastructure. Through an IoT-enabled web interface, farmers and agricultural officers can access results easily and make timely decisions. By combining thermal imaging, AI-based classification, and IoT deployment, this approach provides a low-cost, non-invasive, and scalable solution for early pest detection, reducing crop loss, minimizing pesticide overuse, and supporting sustainable agriculture.

How does your AI-based thermal imaging system work?

Our AI-based thermal imaging system detects early Red Palm Weevil (RPW) infestations by identifying subtle



temperature changes on palm tree trunks. Since the larvae feed inside the trunk, visible symptoms appear only at advanced stages. However, their metabolic activity produces slight heat variations that can be captured using a long-wave infrared (LWIR) thermal camera under real field conditions.

The captured thermal images are first preprocessed through resizing, enhancement, and ambient temperature normalization to reduce the effects of sunlight and wind. The system then extracts important thermal texture patterns and hotspot features associated with internal infestation. A Convolutional Neural Network (CNN) is trained on a large dataset of healthy and infested palm images, enabling it to accurately distinguish between normal and abnormal heat signatures.

The trained AI model runs directly on a Raspberry Pi, allowing real-time, on-device classification with minimal delay. Through IoT integration, the results can be accessed via a web-based interface, enabling farmers and agricultural officers to monitor plantations continuously and make timely management decisions.

Why is early pest detection crucial for farmers and food security?

Early pest detection is essential because it allows farmers to act before infestations cause irreversible crop damage and major economic losses. Many pests, such as the Red Palm Weevil, remain hidden during the early stages of infestation, silently reducing plant health and productivity. Detecting them early helps protect crop yield and prevents severe production losses. Timely identification also reduces farmers' financial burden by preventing large-scale crop failure and minimizing income loss. When infestations are

CAN ARTIFICIAL INTELLIGENCE SAVE OUR CROPS? LESSONS FROM SMART PEST DETECTION

detected at an early stage, targeted treatment can be applied, which helps prevent pests from spreading across large agricultural areas. Moreover, early detection reduces the overuse of pesticides by enabling precise and localized intervention rather than blanket chemical spraying. This supports sustainable agricultural practices, protects environmental health, and ensures safer food production. In essence, early pest detection safeguards crops, stabilizes farmer livelihoods, controls pest outbreaks efficiently, reduces chemical dependence, and strengthens long-term food security for communities

How can this technology be applied in real-world farming conditions?

This AI-based thermal imaging system can function as a smart early warning tool in real farming environments, enabling the detection of hidden pest infestations such as Red Palm Weevil (RPW) before visible damage occurs. Using portable thermal cameras, farmers or field officers can capture on-site images of tree trunks under natural conditions. The embedded CNN model then performs real-time classification, distinguishing between healthy and infested trees within seconds.

Through IoT integration, the system allows continuous farm surveillance and remote monitoring via a user-friendly interface. This enables timely decision-making and targeted pest control, reducing unnecessary pesticide application and preventing large-scale spread. The technology can be scaled across various plantation systems, including coconut, oil palm, sago palm, and date palm farms, as well as large agricultural estates.

In the future, integration with drone-based thermal imaging could further enhance large-area monitoring and precision agriculture practices. Overall, this technology provides a non-invasive, rapid, cost-effective, and scalable solution that supports early pest detection, minimizes crop loss, and strengthens farm management under real-world conditions

How can similar approaches be extended to other crops and pests?

AI-based thermal imaging can be extended to other crops because pest and disease attacks often cause hidden physiological stress that leads to measurable temperature changes before visible symptoms appear. These stress signals show up as thermal hotspots, enabling early detection. The same AI pipeline can be adapted by training crop-specific models using new thermal datasets. This approach can be applied to crops such as rice, wheat, tomato, banana, sugarcane, and grapes, as different pests create distinct thermal patterns.

By building crop-specific and potentially multi-modal AI systems, this technology can support early detection, reduce crop loss, and promote sustainable agriculture across diverse farming systems.

Dr. Martin’s contributions to this field are reflected in his publication in Scientific Reports titled “Smart IoT Thermal Imaging Approach for Early Identification of Red Palm Weevil (RPW) Infestation on Palms,” DOI: 10.1038/s41598-025-32783-4, which presents an AI-enabled thermal imaging and IoT-based system for the early detection of hidden Red Palm Weevil infestations, offering a scalable, non-invasive solution to improve plantation monitoring and protect crop yield.

| SCIENCE DESK |

AI-DRIVEN SMART FORMING: TRANSFORMING THE FUTURE OF LIGHTWEIGHT MANUFACTURING

Dr. Rohit A. Magdum
Assistant Professor, Mechanical Engineering, Rajarambapu Institute of Technology (RIT), Maharashtra, India
| Scientific Profile |
| Organization Link |
Areas of Expertise: Intelligent Manufacturing Systems | AI-Driven Process Optimization | Lightweight Metal Forming

How is modern manufacturing evolving from force-driven systems to intelligent systems?

When we think about manufacturing, we often imagine massive machines, powerful presses, and the sheer force required to shape metal. For decades, industrial progress was defined by brute strength. Advancement in metal forming was measured by the tonnage of a hydraulic press, the heat of a furnace, or how efficiently a worker could repeat a manual task. The factory floor was dominated by mechanical repetition, precision driven by force rather than intelligence. Today, however, a profound shift is unfolding. We are moving away from the "Age of Force" into what may rightly be called the "Age of Intelligence." Manufacturing systems are no longer just executing instructions; they are beginning to observe, learn, and adapt. As we stand at the threshold of the next industrial transformation, one truth becomes increasingly evident: "The future of metal forming lies not in increasing force, but in increasing intelligence."

Why is magnesium, particularly AZ31 alloy, important for lightweight engineering, and what challenges limit its widespread adoption?

Magnesium, especially the AZ31 alloy, is highly attractive for lightweight engineering because it is the lightest structural metal available and offers an excellent strength-to-weight ratio. In industries such as automotive and aerospace, reducing weight is critical. For electric vehicles, lighter structures improve battery efficiency and driving range, while in aerospace, weight reduction directly lowers fuel consumption and emissions. However, magnesium is considered a difficult material to process. Its hexagonal close-packed crystal structure limits its ability to deform at room temperature, leading to poor ductility and a higher risk of cracking during forming. To improve formability, magnesium often requires warm forming conditions. This introduces additional complexity, as parameters such as temperature, strain rate, tool path, and step depth must be carefully controlled. Even small deviations can cause tearing, excessive thinning, or surface defects. These processing challenges have slowed its widespread adoption in large-scale manufacturing despite its significant lightweight advantages.

Why is traditional trial-and-error optimization inadequate for modern metal forming processes?

For much of the past century, metal forming optimization relied on empirical experimentation. Engineers used One-Variable-at-a-Time approaches, adjusting temperature or feed rate individually and observing the results. While this method provided incremental insight, it was inefficient and often failed to capture the complex interactions between multiple process variables. Real manufacturing systems are inherently nonlinear. A slight increase in temperature may improve ductility but reduce surface quality. A change in tool step size might enhance dimensional accuracy while increasing thinning. Achieving multiple objectives simultaneously becomes a challenging balancing act. The cost of such experimentation material waste, energy consumption, and machine downtime is significant.

How does artificial intelligence transform process optimization in modern manufacturing?

By employing machine learning algorithms, we can analyse patterns hidden within experimental data. A limited set of structured experiments can train predictive models capable of estimating outcomes across thousands of parameter combinations. Instead of blindly searching for optimal conditions, engineers gain a comprehensive map of the process landscape. This approach does not replace engineering judgment; it enhances it. AI offers clarity in complexity. It allows engineers to make informed decisions with confidence, dramatically reducing development cycles and improving resource efficiency. In this new paradigm, intelligence becomes the driving force behind precision manufacturing.

How do smart production systems with AI and real-time adaptation transform metal forming and create opportunities for sustainable manufacturing ?

AI-driven forming shifts manufacturing from reactive inspection to predictive control. Traditionally, defects such

AI-DRIVEN SMART FORMING: TRANSFORMING THE FUTURE OF LIGHTWEIGHT MANUFACTURING

as tearing or springback were identified only after the part was produced. Corrections were made retrospectively, often resulting in rework or scrap.

In smart production systems, sensors embedded within the forming setup continuously monitor temperature, force, and deformation behavior. These data streams provide real-time insight into the health of the process. When integrated with AI models, machines can dynamically adjust operating parameters to maintain optimal conditions. For magnesium alloys, this capability is transformative. Real-time adaptation expands the practical forming window, making advanced lightweight materials more reliable and industry-friendly. Such systems not only improve quality but also reduce waste and energy consumption critical factors in sustainable manufacturing.

For emerging economies like India, this represents a strategic opportunity. As electric mobility expands and advanced manufacturing gains prominence, intelligent forming systems can position domestic industries at the forefront of high-value production.

How does AI-driven predictive control improve metal forming processes and support sustainable manufacturing?

Technological advancement alone is insufficient. The real transformation must occur in education. The profile of the mechanical engineer is evolving. Tomorrow's engineer must understand not only material behavior and process mechanics but also data analytics and algorithmic modeling. Bridging the gap between the physical and digital domains is essential. Students must become comfortable navigating both laboratory experimentation and computational prediction. By integrating artificial intelligence with core manufacturing principles, institutions can prepare engineers capable of leading the next industrial revolution.

This interdisciplinary mindset will determine how effectively nations adopt intelligent production systems.

How do AI-driven optimization and digital twin technology contribute to sustainable and intelligent manufacturing?

As we look toward the future, sustainability must guide every innovation. Lightweight components reduce operational energy consumption, but manufacturing itself must also become greener. AI-driven optimization minimizes material waste by reducing defective parts. Intelligent tool path design lowers energy consumption. Predictive models decrease unnecessary experimentation. These benefits collectively reduce the environmental footprint of production.

The concept of the digital twin further amplifies this potential. A digital twin is a virtual replica of a physical forming process, capable of simulating various scenarios before actual production begins. By integrating simulation with machine learning, engineers can optimize a process entirely in the digital domain before manufacturing the first physical component.

Imagine forming a complex aerospace structure hundreds of times virtually, perfecting every parameter, and then producing it physically with high confidence in success. This integration of simulation, data, and adaptive control represents the future of intelligent manufacturing.

How does intelligent manufacturing empower engineers and redefine the future of sustainable engineering?

Intelligent forming is not about replacing engineers with algorithms. It is about empowerment. Artificial intelligence serves as a collaborative partner, enhancing human creativity and insight. The engineer remains at the center defining objectives, interpreting results, and ensuring responsible implementation.The transformation is already underway. Machines are learning, data is flowing, and materials are becoming lighter and stronger. The question before us is not whether manufacturing will become intelligent, it is how thoughtfully we harness this intelligence to build a smarter, more sustainable world. Lightweight manufacturing is no longer just about reducing mass. It is about elevating intelligence. And in that evolution lies the future of engineering excellence.

Dr. Magdum's contributions to this field are reflected in his publication in Scientific Reports titled "Multi-response optimization and machine learning-based prediction of straight-groove warm incremental sheet forming of AZ31 magnesium alloy," https://doi.org/10.1038/s41598-026-37761-y, which uses machine learning to optimize warm forming of AZ31 magnesium alloy for improved lightweight manufacturing.

| SCIENCE DESK |

MICROPLASTICS IN OUR WETLANDS: A GROWING ENVIRONMENTAL CONCERN

Dr. Sumi Handique
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| Scientific Profile | | Organization Link |

Areas of Expertise: Microplastics Research | Freshwater Pollution | Environmental Monitoring Soil & Agricultural Impact Assessment | Heavy Metals | Climate-Driven Ecosystem Changes

Wetlands are regarded as the most valuable ecosystems providing several important ecosystem services including creating a natural habitat for diverse species of plants and animals, recharging groundwater aquifers, preventing floods by acting as a natural sponge absorbing excess rainfall, regulating the climate. However, with increasing urbanization, urban wetlands have become major sinks for pollutants from various anthropogenic sources. Among these pollutants, the presence of microplastics (MPs) has become a pressing concern because of the ecotoxicological risks they pose and also because they act as vectors, adsorbing hazardous chemicals like heavy metals, polyaromatic hydrocarbons (PAHs) and biological pathogens. The combination of microplastics and these co-contaminants often produces a synergistic effect increasing their health risks in humans and other organisms.

Plastics form the basic structural element of all types of products for human use, but due to the mismanaged handling of these plastic wastes they have become a burden on the environment. Environmental degradation processes such as ultraviolet radiation, mechanical abrasion, wind and water induce the fragmentation of larger plastic debris into microplastics (MPs), defined as solid polymer particles ≤5 mm in size. The term "microplastics" refers to plastic particles measuring 5 mm or less in size. Microplastics can be classified as primary, which are intentionally manufactured at microscopic sizes for specific applications, and secondary, which are formed through the breakdown of larger plastic debris such as bottles, tires, or textiles. Microplastics are generally divided into four shape profiles, fibres, fragments, films and sphere. MPs can also be classified by the type of polymer, with some of the most common plastics produced globally being polypropylene, polyethylene, polyvinyl chloride, polystyrene, polyethylene terephthalate and polyurethane etc. Modern lifestyles are full of single-use plastic items such as straws and cups. It's thought that we use plastic cutlery once for an average of three minutes, but it remains in the environment for hundreds of years. Single-use plastic, including food packaging, is also one of the biggest contributors to plastic pollution. Other major sources commonly identified include tire wear particles, synthetic textile fibers, plastic packaging fragments, agricultural plastics, and treated wastewater effluent. Scientists suspect microplastics are also blown through the atmosphere by wind and settle once it snowed or rained. Different factors affect the behavior, fate, and toxicity of microplastics including their degree of degradation, association with microorganisms, and the number and concentrations of pollutants adsorbed onto the surface of the microplastic.

Wetlands are especially vulnerable to microplastic pollution because they act as natural sponges absorbing excess storm water runoff. Rivers, stormwater runoff, and drainage systems carry plastics from urban and agricultural areas into wetlands where dense vegetation physically traps floating debris and fine plastic particles. High organic matter in the wetland sediments binds and retain microplastics in the wetlands. Understanding MPs input in wetlands is crucial to link their pollution level with land use, industrial activity, urbanization, and hydrological dynamics . Seasonal factors such as rainfall, flooding, and water level fluctuations further influence the transport, redistribution, and concentration of microplastics, while human activities including road traffic, wastewater discharge, agricultural plastic use, and recreational littering intensify inputs.

| SCIENCE DESK |

Dr. Sumi with her lab group members.

Deepor Beel Wetland, located in the Brahmaputra floodplain, is home to a variety of birds, including migratory species. It is demarcated as a bird sanctuary and is an ecologically significant Ramsar site. Deepor Beel supports an impressive count of fish species diversity comprising 55 species, 21 families, and 9 orders. The wetland serves as a critical, high-density breeding and staging ground for over 70 migratory species and 200 total bird species. It provides vital food resources, particularly during winter, for threatened species like the Lesser and Greater Adjutant Stork, Spot-billed Pelican, and Baer's Pochard. The wetland provides critical food resources and livelihood to local fishermen and provides ecosystem services to nearby communities. However, Deepor Beel, faces severe anthropogenic pressures, including rapid urbanization and an adjacent dumping site, increasing its vulnerability to MPs contamination. These MPs pose great ecotoxicological risks to fish and birds that feed on these fish species. Ingestion of these MPs may cause reduced physical blockages, blocked digestive systems, reduced feeding and growth rates, inflammation, false satiation, and reduced fecundity affecting the fish population. Living organisms also get tangled in microplastics. A study revealed that omnivorous fish ingest more microplastics than carnivorous and herbivorous fishes explaining that omnivorous organisms ingest a wide range of food, which exposes more microplastics to the fishes. Throughout the trophic level, the microplastics can get ingested by smaller organisms and can be transferred from the prey to predators, thus increasing environmental toxicity levels. The microplastics resemblance to plankton and grains make them easy targets for fishes ingestion. The seasonal sampling, most importantly pre-monsoon and post-monsoon sampling of microplastics is necessary as the temperature, intense solar radiations, strong winds and seasonal water fluctuations significantly influence the fate transport. Microplastic pollution in freshwater wetlands is not a single-dimensional problem, but a complex issue involving their accumulation in water and sediments, uptake by organisms, associated ecological risks, and transfer across trophic levels. By combining field observations, biological analyses, source apportionment, and ecological modelling, researchers can provide a comprehensive picture of how microplastics enter wetland systems, persist over time, and influence ecosystem functioning.

Deepor Beel wetland, a Ramsar Site in Assam, India

Dr. Handique's contributions to this field are reflected in his publication in Environmental Pollution, "Assessing spatial and seasonal dynamics and source apportionment of microplastics in Deeporbeel wetland in Assam-India using the PCA-APCS-MLR receptor model," https://doi.org/10.1016/j.envpol.2025.127474, which investigates the distribution patterns of microplastics across different seasons and identifies their potential sources using advanced receptor modeling approaches, offering important insights into pollution dynamics and environmental management of wetland ecosystems.

| SCIENCE DESK |

THE SCIENCE OF MINDFULNESS AND STRESS RELIEF

Anisha Rajan
Psychologist & Certified Mindfulness Practitioner Research Scholar | Amity Institute of Behavioural and Allied Sciences, Noida, Uttar Pradesh, India

| Scientific Profile | | Organization Link |

Areas of Expertise: Mindfulness-Based Interventions | Stress Appraisal & Regulation | Preventive Mental Health

Stress has become so common that it is rarely questioned. Students call it academic pressure. Professionals call it workload. Families call it responsibility. It is normalised even expected. But prolonged stress is not neutral. Chronic activation of stress responses disrupts sleep, weakens immune functioning, strains cardiovascular regulation, and impairs emotional control. Over time, it reshapes how individuals interpret and respond to everyday challenges. Stress stops being a reaction. It becomes a lens. Modern stress is shaped not only by external demands, but by how those demands are interpreted. Perceived stress reflects the extent to which life circumstances are appraised as overwhelming or beyond one's coping capacity. This appraisal process plays a central role in long-term psychological and physiological outcomes.

Stress is triggered by events, but it is intensified by the way those events are interpreted. Mindfulness alters this interpretive process. Because mindfulness sounds simple paying attention, observing the breath, staying present it is often dismissed as a superficial wellness practice. In scientific terms, however, mindfulness is structured attentional training. It involves observing thoughts, emotions, and bodily sensations without immediately identifying with them or reacting automatically. Stress intensifies when cognitive appraisal and physiological arousal reinforce one another. A stressor may trigger a thought, which activates autonomic arousal, further heightening the perceived threat. Without awareness, this cycle becomes habitual and self-reinforcing.

Mindfulness introduces a pause appraisal shifts. Rumination diminishes. Reactivity softens, which infers that the pause changes how we evaluate, dwell on thoughts, and respond. The stressor may remain unchanged but the escalation process is interrupted. Evidence supports this mechanism. Across randomised controlled trials synthesised in recent evidence evaluating structured mindfulness-based interventions among non-clinical adults, the studies consistently report reductions in perceived stress compared with control conditions. Effect sizes in preventive mental health research are typically modest. Yet consistency across trials suggests that attentional training can meaningfully influence stress appraisal under controlled conditions. Perceived stress is not benign. Elevated levels predict increased vulnerability to anxiety, depressive symptoms, sleep disturbance, immune dysregulation, and cardiovascular strain. Even modest reductions, when implemented at scale, may carry meaningful public health implications. We should not wait for stress to become a disorder before deciding it deserves attention, because waiting for stress to crystallise into disorder is costly.

Mental health systems often step in only after symptoms reach a diagnostic level. A preventive approach, however, focuses earlier when stress patterns are still flexible, and change is more possible. When implemented with care and consistency, mindfulness-based interventions can play an important role here. They are adaptable across settings and can be integrated into universities, workplaces, and community environments not as therapy, but as a foundational skill that strengthens regulation before stress escalates. At the same time, mindfulness is not simply an app reminder or a social media trend. It is most effective when practiced as a structured, disciplined process. Programs such as Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT) involve guided practice over several weeks. Their outcomes depend on engagement, regular practice, and thoughtful

implementation.

On an individual level, practice often begins in simple moments: noticing the breath before reacting during conflict, pausing before replying to a difficult message, recognising the thought "I cannot handle this" as a mental event rather than an unquestioned fact. Consider a student facing examination pressure. The thought arises: I am going to fail. The body tightens. Anxiety increases. Without awareness, the mind spirals. With training, the student notices the thought, observes the physical reaction, and gently redirects attention to the task. The exam itself has not changed. What changes is the internal escalation. Mindfulness does not remove stressors. It changes the way we relate to them. Its mechanism is specific: it strengthens attention and emotional regulation, making appraisal more balanced. It does not replace structural causes of stress, such as economic pressures or institutional demands. Instead, it addresses how stress is processed internally. Importantly, mindfulness draws on capacities we already possess attention and self-regulation. When nurtured deliberately, these capacities can become protective resources rather than dormant abilities. Research suggests that structured mindfulness-based programs can reduce perceived stress under controlled conditions. Bringing those findings into everyday settings requires careful implementation and realistic expectations.

Preventive mental health does not grow through trends. It grows through steady, evidence-informed practice that reduces avoidable suffering.

What is triggered automatically can be regulated intentionally.

Ms. Anisha Rajan's contributions to this field are reflected in his publication in npj Mental Health Research, "Effects of mindfulness-based interventions on perceived stress among non-clinical adults: a systematic review and meta-analysis," https://doi.org/10.1038/s44184-026-00188-4, which systematically evaluates existing evidence to assess how mindfulness-based interventions reduce perceived stress in non-clinical adult populations, providing consolidated scientific insight into their effectiveness for mental well-being.

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"*Crack the Science Code – Science is Fun*" makes learning science exciting through exploration and playful discovery.

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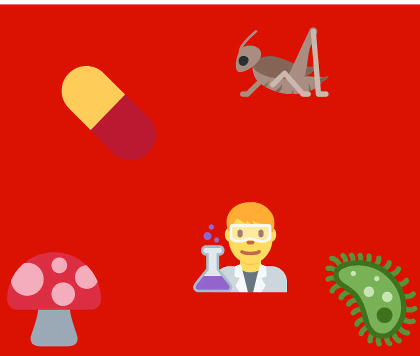
Answers here – don't peek!



Q1

What is a key advantage of delivering mRNA instead of a finished drug?

A. It works instantly
B. Cells produce the therapeutic protein themselves
C. It never degrades
D. It replaces surgery

Q2

One major challenge in modern cancer immunotherapy is:

A. Overproduction of oxygen
B. Immune cells becoming exhausted
C. Too much sunlight exposure
D. Excess bone growth

Q3

AI systems in hospitals are mainly used to:

A. Replace medical staff
B. Predict and support clinical decisions
C. Eliminate laboratory tests
D. Reduce patient numbers

Q4

Which factor most increases a coastline's risk of flooding?

A. High cliffs
B. Flat, low-lying land
C. Cold temperatures
D. Deep ocean trenches

Q5

Why is plastic sometimes burned in low-income communities?

A. It is environmentally friendly
B. It produces clean air
C. Cleaner fuels are unaffordable or unavailable
D. It is required by law

Q6

Why are enzymes being studied for plastic waste?

A. They can heat plastic
B. They may help break down tough materials naturally
C. They increase plastic strength
D. They change plastic color

Q7

Air pollution can affect fog by:

A. Reducing humidity completely
B. Preventing cloud formation
C. Changing droplet formation and thickness
D. Stopping temperature change

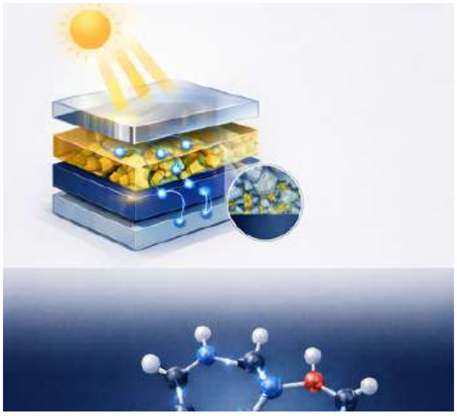
Q8

Many recent scientific advances combine biology with:

A. Traditional farming
B. Artificial intelligence and data science
C. Manual calculations only
D. Newspaper reporting

DISCOVERY HIGHLIGHTS

PHYSICAL SCIENCE AND ENERGY



A SIMPLER PATH TO MORE EFFICIENT SOLAR CELLS

Perovskite solar cells are among the most promising next-generation energy technologies. They are lightweight, low-cost, and highly efficient but they often suffer from instability and energy losses inside the material. A new study introduces a clever solution: improving the solar cell without using a traditional hole transport layer. Researchers incorporated a nanocomposite made of nickel oxide (NiO) and graphitic carbon nitride (g-C_3N_4) directly into methylammonium lead iodide (MAPI), a common perovskite material. This modification helped form larger, higher-quality crystal grains with fewer defects reducing energy loss caused by charge recombination. The improved design enhanced light absorption, boosted charge transfer, and significantly increased performance. The power conversion efficiency rose from 8% to nearly 15%, while stability improved for over 600 hours under ambient conditions. This work moves perovskite technology one step closer to stable, affordable, and highly efficient solar energy solutions.

Arjun V. et al., Dalton Transactions, 2026.

SAFER YET POWERFUL: A NEW GENERATION OF ENERGETIC MATERIALS

Explosives and propellants are essential for defense, aerospace, and space exploration but making them both powerful and safe has long been a scientific challenge. Most high-energy materials deliver strong performance, yet remain dangerously sensitive to heat, friction, or impact.

A new study introduces a smarter design strategy to solve this problem. Researchers used innovative bridging and self-assembly techniques to create a series of high-nitrogen energetic materials that combine strength with stability. These newly synthesized compounds demonstrate high density, excellent thermal resistance, and strong detonation performance while remaining remarkably insensitive to shock and friction. One standout compound showed performance comparable to well-known materials like HMX, but with improved safety characteristics.

The research highlights how molecular design using controlled chemical bridging and self-organization can produce next-generation energetic materials that are both powerful and more stable. This breakthrough opens new possibilities for safer explosives in aerospace and defense applications.

Banik S. et al., ACS Applied Materials & Interfaces, 2026.

CHEMICAL SCIENCE & ADVANCED MATERIALS

A SMARTER WAY TO BUILD LIFE-SAVING MOLECULES

Quinolines are powerful chemical compounds found in many medicines, including antimalarial and anticancer drugs. However, synthesizing these complex molecules often requires multiple steps, time, and resources. A new study presents a faster and more efficient solution. Researchers developed a one-pot, three-component reaction that brings together simple starting materials 2-aminobenzonitriles, aldehydes, and active methylene compounds to directly produce highly functionalized 4-aminoquinoline derivatives. Using a tin-based catalyst ($SnCl_4$), the reaction unfolds through a sequence of carefully controlled steps condensation, cyclization, and aromatization all within a single reaction vessel. The method delivers excellent yields (up to 88%) in just 12–14 hours and works with a wide range of chemical building blocks. Beyond simple quinolines, the strategy can also construct complex fused molecular frameworks, expanding its synthetic power. This streamlined approach offers a greener, more efficient pathway for producing valuable pharmaceutical compounds.

Pradhan A. et al., Journal of Organic Chemistry, 2026.

A SIMPLER PATH TO MORE EFFICIENT SOLAR CELLS

Radioactive iodine released from nuclear waste poses serious

DISCOVERY HIGHLIGHTS

environmental and health risks. Removing it quickly and efficiently especially from wastewater remains a major scientific challenge. A new study introduces an advanced nanoporous polymer network designed specifically for ultrafast iodine capture. Researchers engineered the material by chemically linking nanoparticles together in water using a sustainable crosslinking strategy. This process created a highly porous structure with a large surface area and abundant amine functional groups ideal for trapping iodine molecules. The result is remarkable: the material absorbs iodine extremely rapidly, reaching equilibrium in about one minute in water. It also performs efficiently in vapor, aqueous, and organic environments and remains effective even in wastewater containing high concentrations of competing ions. Importantly, the material can be reused multiple times in continuous-flow systems. This innovation offers a scalable and practical solution for nuclear waste remediation, bringing us closer to safer and cleaner industrial waste management.

Anand A. et al., Materials Horizons, 2026.

INFECTIOUS DISEASES & PATHOGEN BIOLOGY

BACTERIA FROM THOUSANDS OF KILOMETERS AWAY ARE FALLING ON THE HIMALAYAS

Potato is one of the world's most important food crops, valued for its nutrition, affordability, and productivity. However, fungal diseases continue to threaten postharvest storage and market quality. Researchers have now reported the first confirmed case of rubbery rot disease in potatoes in India, detected in markets in Haryana. The disease was traced to Geotrichum candidum, a fungal pathogen identified through detailed morphological study and multi-locus genetic analysis. Laboratory tests showed that infected tubers developed a whitish fungal growth, a foul odor, and a characteristic rubbery texture over time. The team confirmed the pathogen's identity using DNA sequencing and fulfilled Koch's postulates to establish causation. This discovery is significant for Indian agriculture, as early detection and accurate identification are essential for managing postharvest losses and protecting food security. The findings lay the groundwork for future disease control strategies.

Padiyal A. et al., Microbial Pathogenesis, 2026.

A RARE VIRAL RECOMBINATION DISCOVERED IN INDIA

Viruses constantly evolve but sometimes they do something unexpected. Scientists in India have now reported the first detection of a rare recombinant Enterovirus G (EV-G) strain carrying a gene borrowed from an entirely different virus family. The newly identified strain was found in diarrheic piglets and contains a torovirus papain-like cysteine protease (PLCP) gene inserted into its genome. Such cross-family recombination events are uncommon and can influence viral fitness, adaptability, or virulence. Genetic analysis revealed that the Indian strain is closely related to East Asian variants and likely emerged through recombination events dating back several decades. Molecular clock estimates suggest evolutionary links to strains circulating in Japan, China, and South Korea.

This discovery deepens our understanding of viral evolution and genetic exchange across virus families. Monitoring such recombinant strains is critical for animal health, livestock biosecurity, and the early detection of potential zoonotic threats.

Sawant P.M. et al., Virus Genes, 2026.

WILDLIFE & BIODIVERSITY

DISCOVERY HIGHLIGHTS

AI FOR WILDLIFE: A NEW DATASET TO PROTECT THE HOUBARA BUSTARD

The Houbara bustard is a vulnerable bird species of ecological and cultural importance. Protecting its nests from predators and human intruders is critical but monitoring vast desert landscapes is a difficult and time-consuming task. A new study introduces HBID24K, a large-scale wildlife monitoring dataset designed to support artificial intelligence based conservation. The dataset contains over 24,000 camera-trap images, including thousands of annotated images of Houbara bustards and potential intruders. Collected over more than a decade using multiple camera models and varying conditions, the dataset captures real-world diversity and complexity. Researchers tested 10 advanced object-detection models and found that YOLOv10 delivered the strongest performance in identifying birds and threats. By combining ecology with deep learning, this work provides a powerful tool for automated wildlife protection and offers a foundation for broader conservation efforts worldwide.

Ali S.S. et al., Scientific Data, 2026.

A NEW FISH SPECIES DISCOVERED IN NORTHEAST INDIA

Rivers of Northeast India continue to reveal hidden biodiversity. Scientists have now identified and described a new freshwater fish species, Tariqilabeo kaladanensis, from the Kaladan River basin in Mizoram. The newly discovered species belongs to the labeonin group of carps and stands out due to several distinctive physical features, including unique scale patterns, specific gill raker counts, and the absence of a mid-lateral stripe along its body. These subtle but consistent differences separate it clearly from closely related species. To confirm the discovery, researchers also analyzed mitochondrial DNA. The genetic data showed significant divergence from other known species in the same genus, providing strong molecular evidence that this is indeed a new species.

This finding highlights the rich and still-unexplored freshwater biodiversity of the region and underscores the importance of continued ecological research and conservation efforts in India’s river systems.

Zirkunga M. et al., Journal of Fish Biology, 2026.

ATMOSPHERE & CLIMATE

SMART BIOCHAR BOOSTS RICE GROWTH AND SOIL HEALTH

Healthy soil is the foundation of sustainable farming, yet many rice-growing regions struggle with declining fertility and poor nutrient use especially in acidic soils. A new study explores an innovative solution using nanotechnology derived from agricultural waste. Researchers developed an iron-functionalized magnetic nanocarbon material from rice husk biochar. When applied to soil, this nanoscale biochar significantly improved rice growth. Plants showed longer roots, taller shoots, and nearly 50% higher biomass compared to untreated soil.

Beyond plant growth, the material enhanced soil chemistry by increasing pH, organic carbon, and essential nutrients such as nitrogen, phosphorus, and potassium. Advanced sequencing revealed that it also reshaped the rhizosphere microbiome, enriching beneficial microbial groups that support nutrient cycling and plant health. By combining waste recycling, nanotechnology, and microbiome engineering, this research offers a promising strategy for restoring soil fertility and improving crop productivity in a sustainable way.

Shyam S. et al., Journal of Environmental Management, 2026.

CLIMATE AND URBANIZATION MAY EXPAND RIVER POLLUTION HOTSPOTS

Rivers are lifelines for millions but growing urbanization and climate change are reshaping their chemistry in subtle and concerning ways. A new study investigates how dissolved organic carbon (DOC) interacts with toxic metals in the Upper Meghna River system, revealing emerging environmental risks. Using advanced spatial analytics and interpretable machine learning, researchers identified key thresholds: when DOC levels rise above about 6 mg/L and built-up land exceeds 25%, the risk of harmful metal mobility—particularly lead, chromium, and nickel increases

DISCOVERY HIGHLIGHTS

significantly. These high-risk zones cluster around industrial and densely populated areas. Future projections based on CMIP6 climate scenarios suggest that pollution hotspots could expand by 10–15% by 2050 due to continued urban growth and intensified monsoon patterns. The findings highlight the need for targeted river management strategies, including riparian buffers and cross-border cooperation between India and Bangladesh to address transboundary pollution challenges.

Sultana F. et al., Science of the Total Environment, 2026.

ENGINEERING & TECHNOLOGY

A SMART INTERFACE BOOSTS NEXT-GENERATION SOLAR CELLS

Perovskite solar cells are leading candidates for high-efficiency tandem photovoltaics, but wide-bandgap designs often suffer from surface defects and energy losses at material interfaces. These tiny imperfections reduce voltage, efficiency, and long-term stability. Researchers have now developed a controlled templated growth strategy to solve this problem. By forming a thin, quasi-2D perovskite layer on top of a 3D wide-bandgap perovskite absorber, they created a highly ordered interface that improves electronic coupling and reduces defects. The 2D layer passivates surface vacancies and suppresses nonradiative recombination, leading to a 100 mV increase in open-circuit voltage and a significant boost in efficiency. The optimized devices achieved a champion power conversion efficiency of over 21%, while retaining more than 80% performance after 4000 hours of storage. This interface engineering approach strengthens both efficiency and durability, bringing tandem perovskite solar cells closer to commercial reality.

Gupta D. et al., ACS Applied Materials & Interfaces, 2026.

A SMART COATING TO STOP BATTERY DENDRITES

Lithium metal batteries promise higher energy density than today's lithium-ion batteries, making them attractive for electric vehicles and next-generation energy storage. However, their biggest challenge is dendrite formation needle-like lithium structures that grow during charging, causing short circuits and safety risks. Researchers have now developed a hybrid inorganic–organic bilayer coating that stabilizes lithium metal anodes and controls how lithium deposits during cycling. This protective artificial solid electrolyte layer guides uniform lithium nucleation, preventing uneven growth and dangerous dendrites. The coated lithium anodes demonstrated stable cycling for over 1000 hours with low overpotential, and maintained more than 80% capacity retention after extended high-rate cycling in lithium–NMC cells. Advanced simulations revealed that the bilayer promotes smoother lithium ion distribution and lateral growth, leading to safer and more uniform deposition.

This work highlights the power of interface engineering in overcoming one of the most critical barriers to high-energy lithium metal batteries.

Ashwin P.V. et al., ACS Applied Materials & Interfaces, 2026.

HEALTH & MEDICINE

WHEN TUBERCULOSIS SPREADS SILENTLY

Tuberculosis is often associated with chronic cough and lung infection. But in some cases, the disease spreads silently throughout the body in a severe form known as miliary tuberculosis—a life-threatening

DISCOVERY HIGHLIGHTS

condition that can be difficult to diagnose. A recent case report describes a 42-year-old man who arrived at the hospital in an altered mental state and later suffered cardiac arrest despite intensive treatment. Only after autopsy did doctors discover widespread granulomas across multiple organs. Specialized staining confirmed disseminated tuberculosis, and septicaemia was identified as the cause of death. Miliary TB can present with vague symptoms, making early detection extremely challenging. In some instances, diagnosis occurs only postmortem. This case underscores the urgent need for heightened clinical suspicion, especially in high-risk populations, and emphasizes the importance of early, comprehensive screening to prevent fatal outcomes.

Ahsan E. et al., Medicine, Science and the Law, 2026.

HOW TISSUE STIFFNESS MAY DRIVE ORAL CANCER RISK

Oral Submucous Fibrosis (OSF) is a chronic scarring disease of the mouth, commonly linked to areca nut chewing. Over time, the tissue becomes stiff and rigid and in some cases, progresses to oral cancer. But how does this transformation happen at the molecular level? A new study highlights the role of TRPV4, a calcium-permeable ion channel that acts as a cellular "mechanosensor." Researchers examined tissue samples across different stages of OSF and oral squamous cell carcinoma. They found that TRPV4 expression increased significantly as the disease advanced, especially in later stages and in cancerous tissues. The findings suggest that as the oral tissue becomes stiffer, TRPV4 activity rises, potentially triggering pathways that promote fibrosis and malignant transformation. This research sheds light on how mechanical stress within tissues may contribute to cancer development and identifies TRPV4 as a potential biomarker or even a future therapeutic target in oral precancerous conditions.

Raha S. et al., Gene, 2026.

PLANETARY & SPACE SCIENCE

CAN GREEN SPACES CLEAN URBAN AIR?

Bengaluru was once known as India's "Garden City." Today, rapid urban expansion has transformed much of it into dense concrete landscapes, bringing rising air pollution levels. A new study explores whether restoring green and blue spaces can help reverse this trend. Using satellite data from 2001 to 2024, researchers analyzed aerosol levels, particulate matter, and black carbon concentrations across the city. Advanced statistical models revealed a clear pattern: large tree-covered areas significantly improved nearby air quality, especially when canopy cover exceeded 2 square kilometers. Dense and healthy vegetation within urban neighborhoods reduced particulate matter levels, even in highly built-up zones. Surprisingly, water bodies often considered beneficial for urban cooling did not show the same pollution-reducing effect and in some cases were associated with poorer air quality. The benefits of greenery were also uneven, favoring affluent wards more than informal settlements. The findings highlight that thoughtfully planned urban forests not just scattered parks can be a powerful tool to combat pollution in rapidly growing cities.

Jaison M. et al., Environmental Monitoring and Assessment, 2026.

LIGHT-SPEED LINKS BETWEEN SATELLITES

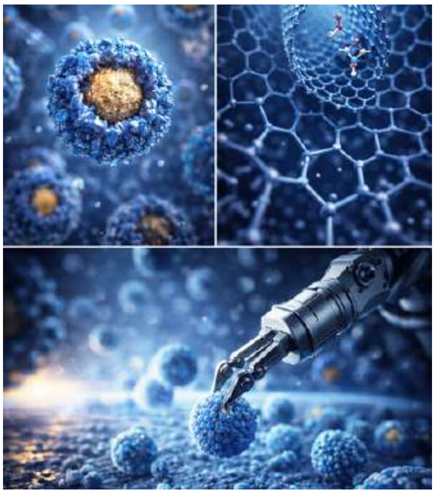
As satellite networks expand to support global internet, Earth observation, and deep-space missions, fast and secure communication between satellites has become essential. Traditional radio-frequency systems are reaching their limits. Optical wireless communication using laser beams instead of radio waves offers a powerful alternative. A new study proposes an advanced inter-satellite optical communication system using two-dimensional diagonal permutation shift optical code division multiple access (2D DPS-OCDMA). This technique allows multiple signals to share the same optical channel while maintaining high data security. The system was tested under realistic space conditions, accounting for pointing errors, receiver size, and transmission losses. The results are impressive: reliable communication over distances up to 16,000 kilometers, data rates reaching 120 Gbps, and error rates well below

DISCOVERY HIGHLIGHTS

correction thresholds. Because decoding requires a specific optical code sequence, the design also enhances security against interception. This breakthrough strengthens the foundation for next-generation satellite constellations and secure space-based communication networks.

Armghan A. et al., Scientific Reports, 2026.

NANOTECHNOLOGY



SMART NANOFIBERS FOR FASTER AND SAFER WOUND HEALING

Healing a wound is more than just closing a cut it requires controlling infection, reducing inflammation, and supporting tissue regeneration. Scientists are now turning to nanotechnology to design smarter wound dressings that actively support this process. A new study presents electrospun nanofibers made from polycaprolactone (PCL), reinforced with gelatin and infused with thyme essential oil. The resulting hybrid material mimics the structure of the body's extracellular matrix, improving moisture balance and supporting cell growth. The optimized formulation showed remarkable biological performance. It completely eliminated harmful bacteria such as MRSA and E. coli within 12–24 hours and inhibited more than 95% of biofilm formation. The material also demonstrated strong antioxidant activity, helping reduce oxidative stress during healing. By combining structural support, antimicrobial protection, and controlled release of natural compounds, this multifunctional nanofiber dressing represents a promising next-generation solution for advanced wound care.

Verma P. et al., International Journal of Biological Macromolecules, 2026.

TURNING NITRATE POLLUTION INTO USEFUL AMMONIA

Nitrate contamination in water is a growing environmental problem, often linked to agricultural runoff and industrial waste. Converting this pollutant into useful chemicals like ammonia offers a sustainable solution but doing so efficiently remains a challenge. Researchers have now designed an advanced electrocatalyst built around a tiny iron oxyhydroxide nanocore anchored with cobalt–molybdenum (CoMox) clusters. These clusters work together with the iron core through cooperative redox reactions, allowing electrons to flow efficiently during the electrochemical process.

When an electric potential is applied, the material converts nitrate into ammonia with high efficiency, while also producing hydrogen. Isotope-labeling experiments confirmed that the nitrogen in ammonia originates directly from nitrate. The improved performance arises from the synergy between the metal-oxide core and the attached molecular clusters, which create more active reaction sites. This study opens new possibilities for designing next-generation catalysts that transform environmental pollutants into valuable chemicals through clean electrochemical processes.

Samanta K. et al., Inorganic Chemistry, 2026.

OCEAN & MARINE SCIENCE

A NUTRIENT-RICH AQUATIC PLANT WITH FUNCTIONAL FOOD POTENTIAL

As the demand for sustainable and nutrient-dense foods grows, researchers are turning to aquatic crops for innovative solutions. A new study highlights Water Mimosa (Neptunia oleracea) var. CAU-Ekaithabi as a promising functional food with exceptional agronomic and nutritional value. This aquatic legume demonstrated strong growth performance, producing high stem yields and vigorous branching. Nutritional analysis revealed impressive levels of protein, fiber, and essential minerals particularly potassium, iron, calcium, and magnesium along with a favorable

DISCOVERY HIGHLIGHTS

potassium-to-sodium ratio. Phytochemical profiling showed high antioxidant activity and abundant bioactive compounds, including phenolics, flavonoids, vitamin C, and several rare molecules associated with neuroprotective potential. Advanced GC-MS and LC-MS analyses confirmed the presence of compounds with possible applications in nutraceutical and therapeutic formulations. These findings position water mimosa as a sustainable aquatic vegetable with significant potential for health-focused diets, functional foods, and future bioactive product development.

Haldhar S.M. et al., Food Chemistry, 2026.

NEW HYBRID PLASTICS FOUND IN COASTAL ECOSYSTEMS

Plastic pollution in the ocean is no longer limited to bottles and bags. Over time, plastic waste interacts with sand, metal, concrete, and marine organisms creating entirely new hybrid materials.

In the first binational study of its kind, researchers examined beaches in India and Thailand to map the distribution and characteristics of three emerging plastic forms: plasticoncrete, plastimetal, and plastisessiles.

Plasticoncrete consists of plastic fibers and fragments embedded in hardened concrete. Plastimetal forms when plastics bind to rusted metal surfaces. Plastisessiles are plastics attached to marine organisms such as oysters and mussels. Across both countries, 29 distinct forms were identified, with polyethylene (PE) and polypropylene (PP) fibers dominating the samples.

Most of these materials were dense enough to sink, suggesting they form locally and accumulate on the seabed rather than remaining suspended in water.

This research highlights a new dimension of marine plastic pollution one that reshapes coastal ecosystems and demands closer monitoring of how plastics transform in the natural environment.

Gunasekaran K. et al., Environmental Research, 2026.

NON-DESTRUCTIVE PRECISION AGRICULTURE

A FASTER, NON-DESTRUCTIVE WAY TO MEASURE ROSEMARY'S VALUABLE COMPOUNDS

Rosemary is prized for powerful natural compounds like carnosic acid (CA) and rosmarinic acid (RA), known for their antioxidant and antimicrobial properties. However, measuring these compounds usually requires destructive, time-consuming laboratory tests. A new study introduces a faster and non-destructive solution using spectral analysis. Researchers collected spectral data from rosemary plants in the field, as well as from dried leaves and powdered samples. They also used UAV-based hyperspectral imaging to capture canopy-level information. By applying advanced data processing techniques and partial least squares regression (PLSR), the team developed robust models to estimate CA and RA both before and after harvest. To simulate real-world conditions, they used a "leave-one-day-out" testing strategy, strengthening the model's practical reliability. The method showed strong accuracy for carnosic acid estimation across canopy, dry leaves, and powder samples. While rosmarinic acid estimation was more challenging at the canopy level, accuracy improved significantly in post-harvest samples. This approach offers a rapid, reliable alternative to traditional chemical testing, with promising applications in precision agriculture and post-harvest quality control.

Mishra A. et al., Computers and Electronics in Agriculture, 2026.

A RAPID, NON-DESTRUCTIVE WAY TO ESTIMATE SOIL NITROGEN

Soil nitrogen is one of the most important indicators of soil fertility and crop productivity. However, traditional laboratory methods for measuring available nitrogen are time-consuming, labor-intensive, and costly—limiting their use in routine soil monitoring. A new study explores a faster alternative using visible–near infrared (Vis–NIR) and mid-infrared (MIR) spectroscopy to predict available nitrogen in soils from the Indo-Gangetic Plains of India. Researchers combined spectral data with chemometric and machine learning techniques to develop reliable prediction models. After testing multiple preprocessing methods and regression algorithms including Partial Least Squares Regression (PLSR), Random Forest, Support Vector Regression, and MARS the strongest performance came from MIR spectroscopy paired with PLSR. This combination achieved high prediction accuracy (R^2 = 0.84), outperforming Vis–NIR models and other machine learning approaches. The findings suggest that MIR spectroscopy with PLSR offers a rapid, cost-effective, and environmentally friendly method for soil nitrogen estimation.

Seema et al., Soil Advances, 2026.

| SCIENCE IN FOCUS |

SCIENCE IN FOCUS

DRDO Advances India's Human Spaceflight Dream with Critical Parachute Test

India took an important step forward in its journey toward human spaceflight with a successful parachute qualification test conducted under the Gaganyaan programme. The drogue parachute system, developed and tested by the Defence Research and Development Organisation (DRDO) in coordination with Indian Space Research Organisation (ISRO), is a vital safety component of the mission.

To understand why this test matters, it helps to know what happens when astronauts return to Earth. After orbiting the planet, the crew module re-enters the atmosphere at extremely high speeds. During this phase, it experiences intense heat and strong aerodynamic forces. Once it slows down to a safe level, a carefully designed parachute system is deployed in stages to bring the module safely into the sea.

The drogue parachute is one of the first parachutes to open during descent. Its main job is not to fully stop the capsule but to stabilize it and reduce its speed further. Think of it as a braking and balancing system. Without proper stabilization, the crew module could tumble or descend at an unsafe angle, increasing risk during landing.

In the recent qualification test, engineers evaluated whether the drogue parachute could deploy correctly under simulated real-flight conditions. This includes checking its timing, structural strength, aerodynamic performance, and reliability under stress. The test ensures that the parachute can withstand the extreme forces experienced during atmospheric re-entry.

A "qualification-level" test means the system is being validated for actual mission use, not just experimental evaluation. It confirms that the design meets strict safety and performance standards required for carrying human astronauts.

This achievement is significant because human spaceflight demands much higher safety margins compared to satellite launches. Every system from heat shields to parachutes must function perfectly. The drogue parachute test strengthens confidence that India's crew module recovery system is progressing toward readiness.

The Gaganyaan mission aims to send Indian astronauts into low Earth orbit aboard an Indian rocket and safely return them to Earth. With each successful test like this, India moves closer to joining the small group of nations capable of independent human spaceflight.

This milestone reflects India's growing technological capability, indigenous engineering strength, and commitment to space exploration.

| SCIENCE IN FOCUS |

SCIENCE IN FOCUS

AI & Climate Science Integration: A New Era for Weather and Disaster Prediction in India

India is increasingly combining artificial intelligence (AI) with climate science to improve weather prediction, disaster preparedness, and public safety. This integration represents a major shift in how climate information is analyzed and delivered to citizens, farmers, and emergency responders.

Traditionally, weather forecasting relies on complex physical models that simulate atmospheric conditions using large volumes of data from satellites, weather stations, radars, and ocean buoys. While these models are powerful, they require significant computing time and sometimes struggle with highly localized events like sudden lightning strikes or flash floods.

AI changes this landscape. Machine learning systems can analyze massive historical datasets to detect patterns that humans or traditional models may miss. For example, AI can help predict extreme rainfall, forest fires, heatwaves, and lightning activity with improved speed and resolution. These tools learn from past climate behavior and continuously improve as more data becomes available.

In India, the India Meteorological Department (IMD) has begun integrating AI-based systems into its forecasting processes. AI models are being used to enhance short-term rainfall predictions, cyclone tracking, and early-warning systems for lightning, a major cause of weather-related deaths in the country.

One of the innovative ideas emerging from this integration is the development of a conversational climate advisory system often informally referred to as “MausamGPT.” The concept is to create a chat-based platform that allows citizens to ask simple questions like:“Will it rain in my district tomorrow?” “Is there a heatwave warning this week?” “Should farmers irrigate crops today?”

Instead of reading complex meteorological bulletins, users could receive personalized, easy-to-understand responses in regional languages. This makes climate information more accessible, especially in rural areas.

AI tools are also being explored for wildfire detection through satellite imagery analysis and for improving flood forecasting by analyzing river basin data in real time. These systems help authorities issue earlier warnings and plan evacuation or relief measures more effectively.

The integration of AI and climate science represents an important interdisciplinary research direction. It combines meteorology, data science, remote sensing, and public communication. By leveraging AI, India is not only improving forecasting accuracy but also transforming how climate information reaches society.

As climate change increases the frequency of extreme weather events, AI-supported forecasting systems could play a crucial role in protecting lives, agriculture, and infrastructure.

Beyond forecasting, this shift also opens new opportunities for climate resilience planning. AI systems can assist policymakers in identifying long-term climate trends, assessing infrastructure risks, and designing adaptive strategies for vulnerable regions. For farmers, smarter advisories could optimize sowing dates, irrigation schedules, and crop selection based on hyper-local weather insights. Urban planners may use AI-driven climate models to improve drainage systems, manage heat islands, and strengthen disaster response networks. As computing power grows and data becomes richer, AI-enabled climate platforms could evolve into integrated decision-support systems, bridging science and society in ways that are faster, clearer, and more inclusive than ever before.

REFERENCE

Press Information Bureau (Government of India). Releases on AI applications in climate and disaster management (January–February 2026).

| SCIENCE IN FOCUS |

SCIENCE IN FOCUS

India's first dedicated solar observatory mission, Aditya-L1, reached an important scientific milestone in early 2026 by releasing its second cycle of observational data for researchers worldwide. This step strengthens India's role in global space science and solar research.

Aditya-L1 was launched by the Indian Space Research Organisation (ISRO) to study the Sun from a special location in space called the Lagrange Point 1 (L1). This point lies about 1.5 million kilometers from Earth in the direction of the Sun. From this stable position, the spacecraft can continuously observe the Sun without interruptions caused by Earth's shadow.

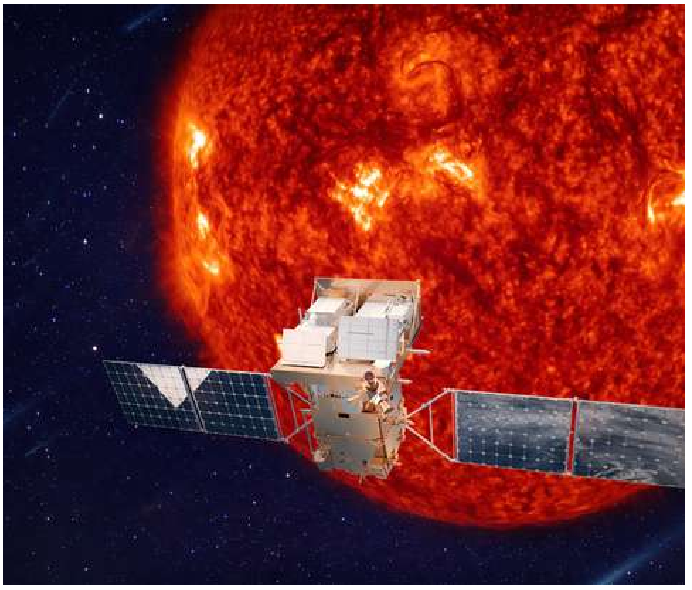
The mission carries several scientific instruments designed to study different layers of the Sun from its visible surface (photosphere) to its outer atmosphere (corona). These instruments measure solar radiation, magnetic fields, solar winds, and energetic particles emitted by the Sun. Understanding these processes is important because solar activity directly affects Earth's space environment.

Solar flares and coronal mass ejections (CMEs) are powerful bursts of energy from the Sun. When directed toward Earth, they can disturb satellites, GPS systems, communication networks, and even power grids. By analyzing Aditya-L1 data, scientists can better understand how these solar storms form and evolve.

The "second data cycle" means that the spacecraft has completed another round of systematic observations and calibrated measurements. After careful processing and validation, ISRO released the datasets to the international scientific community. Researchers from universities and space agencies around the world can now download and analyze this data to study solar physics in greater detail.

This open-data approach is important. Science progresses faster when researchers collaborate and compare findings. By making Aditya-L1 data publicly available, India contributes to global efforts to improve space weather forecasting and deepen our understanding of the Sun's behavior.

The release of these datasets also signals that the spacecraft's instruments are functioning well and



Space & Astrophysics Data: Aditya-L1 Shares New Solar Observations with the World

delivering reliable measurements. For India, this is a major achievement moving from launching satellites to conducting high-precision astrophysics research that supports the global scientific community.

Aditya-L1 is not only a technological success but also a symbol of India's growing presence in deep space science. With each new data release, scientists come closer to solving long-standing questions about solar heating, magnetic activity, and space weather dynamics.

As solar activity continues to rise toward the peak of its 11-year cycle, Aditya-L1's observations become even more valuable. Continuous monitoring from L1 allows scientists to track subtle changes in solar winds and magnetic structures before they impact Earth. Over time, these datasets will help refine space weather prediction models and strengthen early-warning systems for satellites and power networks. Beyond practical applications, the mission also inspires young researchers, signaling that India is ready to contribute meaningfully to the next era of global space exploration.

REFERENCE

Indian Space Research Organisation – Official Aditya-L1 mission updates and data releases (2026).

INNOVATIONS & PATENTS

Every great invention begins with a bold idea—and a patent to protect it. Innovations drive progress, and patents turn breakthroughs into lasting impact. From lab benches to the marketplace, this is where creativity meets protection.

| By **Dr. Sourav Kumar**

A BIODEGRADABLE IMPEDIMETRIC PAPER-BASED SENSOR FOR RAPID UREA DETECTION IN MILK

In a small town near Bhilai, a college student named Riya loved drinking milk every morning. One day her little brother Aman asked, "Didi, how do we know if milk is pure?" Riya remembered hearing that some sellers add urea to milk to make it look thicker and last longer. "Too much urea can harm our body," she told Aman. "But testing milk in a lab is expensive."

At her institute, Riya met Dr. Arun, a friendly scientist who said, "We are making a simple test that anyone can use at home." He showed her a tiny strip that looked like paper. "This is our paper sensor," he smiled.

Dr. Arun explained its three parts like a sandwich. First was the bond paper base. On top of it, they pasted two thin copper-foil strips like small tracks. Finally, they coated the working area with a special layer made from wax mixed with an enzyme called urease.

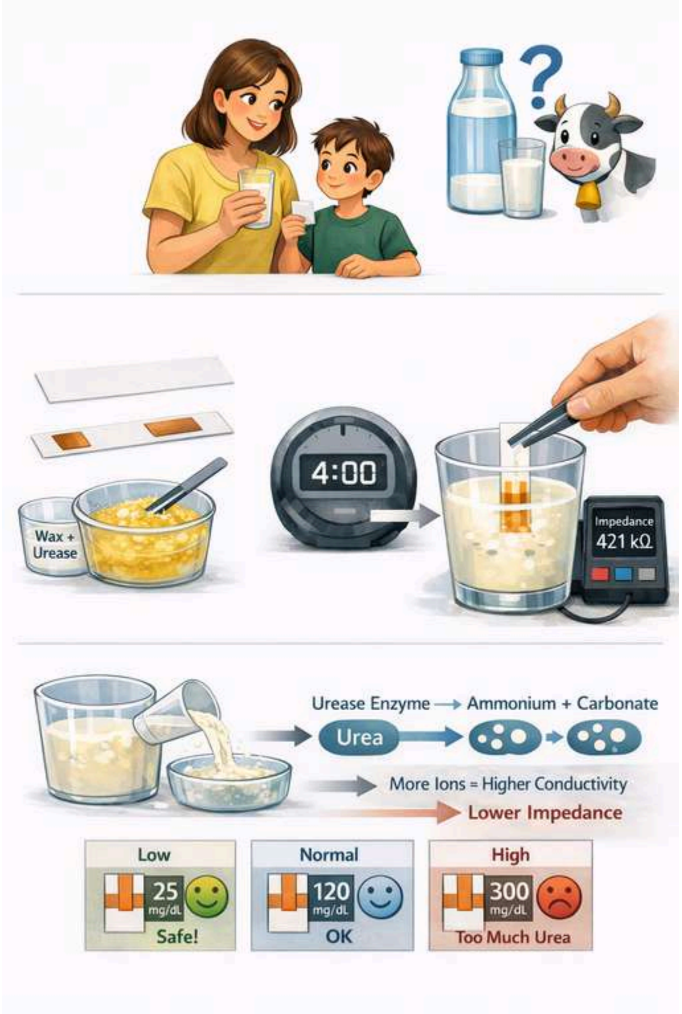
"Why urease?" Aman asked. Dr. Arun said, "Urease breaks urea into ammonium and carbonate ions. If more urea is present, more ions are made. That makes the milk conduct electricity better, and the impedance goes down." He added, "We measure that change using an impedimetric method, and from the reading we can estimate the urea level."

Riya was surprised: "Will it work for different milk?" Dr. Arun nodded. "Yes, it works even when milk fat changes, from about 0.2% to 4.5%, and it can detect urea roughly from 20 to 350 mg/dL. It can even notice very low levels, around 5–20 mg/dL."

Then he showed how they make it: cut paper to size, paste the two copper strips, prepare warm wax–urease mixture, and dip the electrode area for 2–3 seconds. "To test," he said, "dip the sensor into milk and measure impedance often at 1 MHz. In about 4 minutes, you get a stable result."

Riya smiled. "So a simple paper strip can protect families."

Dr. Arun nodded. "That's the goal safe, low-cost milk testing at home."



INNOVATION

Reference:

Adhikary, A.; Bose, A.; Tapadar, A.(2006) "A Paper-Based Sensor for Urea Detection in Milk and a Method of Fabrication Thereof."

📄 ***Patent Number***: 578141

🏫***Developed by***: Indian Institute of Technology Bhilai, India.

| By **Dr. Sudha Shankar**

From Sugarcane Waste to Clean Water

In a small village near a sugar factory, there lived a young environmental engineer named Kavita. Every day she noticed two big problems. The factory produced huge piles of sugarcane bagasse, and the nearby river was becoming polluted with heavy metals from small industries.

One evening, Kavita spoke to her grandfather, who had worked in farming all his life.
"Dada, we have so much agricultural waste, and our water is getting dirty. There must be a way to solve both problems together."

Kavita started studying sugarcane bagasse carefully. She learned that it is rich in cellulose and hemicellulose, natural plant materials that can hold chemicals. "What if we turn this waste into something useful?" she wondered.

She collected fresh bagasse from the sugar mill. First, she cleaned it and dried it for about a day. Then she ground it into fine powder. After that, she treated the powder with a chemical called sodium periodate at a warm temperature. This process changed the plant fibers and created special reactive groups that could catch metal ions.

When the reaction was complete, Kavita filtered the mixture and collected the liquid supernatant. This liquid became her biocoagulant.

She added the liquid to polluted water that contained lead, cadmium, and cobalt. Slowly, the heavy metals attached to the modified plant molecules and formed tiny particles. These particles settled down and could be removed easily. In the right conditions of pH and dosage, the method removed more than 80–99% of heavy metals.

The villagers were amazed. What was once waste from sugarcane had become a powerful tool to clean polluted water.

Kavita smiled and said,
"Nature already gives us answers. We just have to learn how to use them wisely."

Soon, Kavita began working with the village council to build a small treatment unit near the river. Farmers helped collect bagasse regularly from the sugar mill, turning waste into a steady resource. Local students visited the site to learn how simple science could protect their environment. Kavita also tested whether the used metal-rich residue could be safely stabilized and disposed of without harming the soil. As the river water slowly grew clearer, the community realized that sustainable solutions do not always require expensive technology sometimes they begin with local materials, careful research, and the courage to think differently.

INNOVATION

Reference:

Deka, B. J.; Timashetti, P. M.; Jilagam, N. K. (2026)"An Agro Based Coagulant from Sugarcane Bagasse for Heavy Metal Sequestration from Water and Wastewater."

📄 ***Patent Number***: 578006

🏢 ***Developed by***: Indian Institute of Technology Roorkee, India.

| By **Dr. Priyanka**

VEHICLE-TO-VEHICLE (V2V) CHARGING

Mohan and Mahesh planned an overnight road trip to a hill station for a picnic. Both were driving electric cars. Late at night, while driving through a quiet highway stretch, Mahesh noticed his battery had dropped to 25%. The net charging station was far away.

Luckily, their cars had a new feature vehicle-to-vehicle (V2V) charging.

Mahesh's car (the receptor vehicle) automatically detected that its battery level was below the safe limit of 30%. It sent a secure digital request to nearby vehicles. Mohan's car (the donor vehicle), which still had 75% battery, received the message.

Before charging began, the cars established a secure encrypted connection using wireless communication (like Wi-Fi Direct or 5G-V2X). They exchanged real-time information on battery levels, speed, distance, and alignment. Mohan's car confirmed it could share power safely since its battery would stay above 40%.

Once approved, Mohan's car activated its wireless power transmitter, creating an oscillating magnetic field using resonant inductive coupling. Mahesh's car had a wireless receiver coil that captured this magnetic energy and converted it into electricity to charge the battery.

Since both cars were moving, sensors like LiDAR, radar, GPS, and speed sensors constantly monitored distance and alignment. A frequency tuning module automatically adjusted the charging frequency (between 20–100 kHz) to maintain efficient power transfer even during small speed changes.

An intelligent AI control system analyzed real-time data battery SoC, temperature, motion, and environmental conditions. It predicted energy demand, reduced power loss, corrected misalignment, and ensured stable charging. The battery management system monitored temperature and voltage, ready to stop charging if anything became unsafe.

On their dashboard screens (HMI), both friends could see live updates, charging rate, alignment status, and battery percentage.

By morning, Mahesh's battery reached 90%, and charging stopped automatically.

Their picnic began with a smile powered not by a station, but by smart, cooperative technology on the highway.

INNOVATION

Reference:

Jose, K. J., & Gupta, M. K. (2026) A Wireless Vehicle-to-Vehicle (V2V) Charging System and a Method Thereof

Patent Number: 578006

| By **Dr. Avijit Das**

SMART IDEAS IN REAL TIME

In a manufacturing plant, a young technician named Akash worked on the assembly line every day. One afternoon, he noticed that a machine was stopping frequently because of a small alignment issue. “If we adjust the guide plate slightly, we can reduce downtime,” he thought.

Earlier, Akash would have written this idea on paper and placed it in a suggestion box, hoping someone would read it. But now the factory had a new system a real-time, AI-powered improvement platform.

Akash opened the mobile app and entered his idea. He described the problem, suggested the solution, and even uploaded a photo of the machine. Within seconds, the system confirmed that his idea had been received.

Behind the scenes, the system used artificial intelligence to analyze Akash’s suggestion. It compared it with past factory data and predicted the possible benefits. The evaluation showed that the change could reduce downtime by 8% and save significant production hours.

Next, the system ranked Akash’s idea along with others based on impact, feasibility, cost, and available resources. Because it had strong potential and required minimal effort, it was placed high on the priority list.

Managers received notifications to review it. The idea moved from “New” to “Approved” and then to “Implementation.” Everyone could track its progress in real time. Automated reminders ensured that no one forgot their tasks.

After implementation, the dashboard updated automatically. It showed improved productivity and reduced downtime. Akash could see the measurable impact of his idea. His name appeared on the improvement leaderboard, motivating him and others.

Akash realized that this system did more than collect ideas it turned employee suggestions into real, measurable improvements quickly and transparently.

INNOVATION

Reference:

Gautam, A., & Ittamalla, R. (2025). A real-time, AI-driven system for capturing, evaluating, and implementing manufacturing process improvement

Patent Number: 578039

Developed by: Indian Institute of Technology Hyderabad

By **Dr. Preeti Sharma**

FROM LAKE WEED TO LIVING SOIL

In a small farming village, there was a large lake covered with thick green plants called water hyacinth. The plant spread quickly and blocked sunlight from reaching the water. Fish began to die, and the lake started to smell. The villagers were worried.

A young agricultural scientist named Ravi saw this as both a problem and an opportunity. “What if we turn this harmful plant into something useful?” he asked.

Ravi collected the water hyacinth from the lake. First, he washed it carefully to remove mud and dirt. Then he dried it and cut it into small pieces. To make it safe, he boiled the pieces for a few minutes. This helped kill harmful germs and soften the plant fibers.

Next, Ravi treated the plant material with humic acid and biochar. This step helped remove heavy metals like lead and cadmium. Tests showed that most harmful metals were reduced by more than 80%. The plant was now safer to use.

Then came the special step. Ravi added helpful microbes like Lactic Acid Bacteria, Mycorrhizae, and Trichoderma. He mixed the treated plant with natural ingredients such as cow dung, neem cake, Gaukripa Amrit, banana peel extract, coconut water, and biochar. These ingredients made the mixture rich in nutrients.

He placed the mixture in a closed space where the temperature rose to about 55–60°C. The microbes became active and quickly broke down the plant material. In just 48 hours, the mixture turned into dark, odor-free, nutrient-rich compost.

Farmers used this compost in their fields. Crops grew faster, roots became stronger, and yields increased. The soil became healthier and richer in microbes.

The villagers smiled. The plant that once damaged their lake now helped grow their food.

Ravi said, “Nature gives us problems, but it also gives us solutions.”

INNOVATION

Reference:

Pathak, A. (2025). A Bio-Enhanced Organic Composting Process Using Water Hyacinth. Indian Patent Application No. 202521051170

Patent Number: 577846

Developed by: Envique Private Limited, Nagpur, India

Dr. Aditi Jain, Ph.D.
SCIENTIFIC PARTNERSHIPS MANAGER, INDIA
AMERICAN SOCIETY FOR MICROBIOLOGY, UNITED STATES OF AMERICA

A conversation with Dr. Aditi Jain

When you began your PhD, did you imagine a career beyond the lab, or did this path unfold gradually?

- I began my PhD journey with an open mind, which in hindsight feels quite bold given the societal pressures to have it all figured out. The motivation was always to learn, upskill, and put that knowledge to good use. Around the third year, I started thinking more intentionally about career options post-PhD, paying attention to opportunities and learning from conversations with professors and visitors coming to the Indian Institute of Science (IISc), and those I met at scientific events. One-on-one meetings with my advisor were invaluable in helping me understand what roles would feel like a natural fit for me. I've always believed career choices can evolve, and if something genuinely excites you even if it's unconventional, it's worth taking a leap of faith.

Many researchers feel that stepping away from the bench means stepping away from science. Did you ever feel that tension, and how do you see it now?

- I think context is important here and it really depends on the path you choose. For me, stepping away from the bench didn't feel like leaving science. The best part of roles in the publishing sector is that it's just another way of staying connected to scientific discovery. I do miss the thrill of wet lab experiments, but I take equal pride in contributing to publishing programs and bringing them to India in ways that advocate for regional priorities and needs. It's really about impact, whether that's generating knowledge at the bench or enabling research to reach the world.

Which aspects of your scientific training have been most valuable in your current role outside active research?

- I firmly believe that, apart from technical expertise, people skills can greatly influence both one's workplace experience and career trajectory. I'm grateful to my lab seniors and colleagues who set a strong example of empathetic leadership, mentorship, and excellence in work which is something I continue to draw inspiration from.

You now work closely with global scientific communities. How would you describe the role that scientific societies play in shaping research culture today?

- Scientific societies play an indispensable role in shaping research direction, culture and priorities. They carry a legacy of advancing science to improve our lives through trusted literature and knowledge dissemination. Beyond publishing, societies advocate for issues of global importance, provide evidence-backed feedback to decision makers, and champion ethical standards. They create platforms for networking, mentorship, and career development, with the aim of ensuring that scientists at all stages have access to resources and opportunities.

In your work at the American Society for Microbiology, what have you learned about why partnerships and networks are becoming so critical in modern science?

- I agree that building partnerships and nurturing networks have become critical to modern science because the complexity of today's challenges whether antimicrobial resistance, climate change, or emerging pathogens cannot be solved in isolation. Through my work at an international scientific society like ASM, I've witnessed that collaborations can open doors to diverse expertise, resources, and perspectives that accelerate discovery and innovation, and set

- new standards of scientific excellence. International networks amplify impact by creating platforms for knowledge exchange, enabling scientists to break silos to resolve global issues with collective knowledge.

What opportunities for students and early-career researchers do global societies like ASM offer that are often overlooked, especially in India?

- Global societies like ASM offer a wealth of opportunities for students and early-career researchers, especially in India. Through free ASM membership under the Global Outreach category for anyone affiliated with eligible countries (India is currently on the list), members gain access to career resources, fellowship and travel grant applications, and networking platforms. Programs like the ASM Future Leaders Mentorship Fellowship provide structured guidance to emerging scientists, while initiatives such as the ASM Career Development Grant for Postdoctoral Women offer up to $2,000 for skill-building through courses, lab visits, or conferences. Students can also start ASM Student Chapters at their universities, hosting events like career panels, industry visits, and science fair judging to foster leadership and community engagement. Beyond this, ASM's YouTube channel hosts videos on cutting-edge microbiology and professional development insights. ASM's Science Communication Toolkit is also another valuable resource for researchers to learn how to share their work effectively. The ASM meetings such as the ASM Global Research Symposium series are great platforms to showcase one's research work and receive valuable feedback from global experts.

What misconceptions do scientists commonly have about careers beyond academia, particularly roles that sit at the science–policy–community interface?

- One of the common misconceptions I continue to address whenever I'm asked about a career in publishing sector, is that people think such roles are mainly about science communication, and manuscript editing. While communication is an essential component, these roles are far more multidimensional. For instance, in scientific publishing, the job is not just to edit papers; it involves data analysis, peer review management, ethical oversight, community engagement, and creative ways to disseminate published research. Similarly, roles in science policy would require understanding regulatory frameworks, stakeholder negotiation, and translating evidence into actionable guidelines, not only summarizing research. Community-focused positions require program development, advocacy, public speaking and capacity-building, which demand leadership and networking skills beyond technical expertise.

What kinds of experiences during a PhD can genuinely help someone transition into partnership-, outreach-, or policy-focused roles?

- PhD scholars can sometimes become very focused on their own world - their thesis, their best poster award, their imaging slot, and their struggles. The ability to think beyond oneself and navigating working relationships within the lab teaches so much about building partnerships. There's no magic bullet for easing the transition to broader roles. It improves over time from learning to work with different personalities and varied working styles. I truly believe, it starts with these basic, and perhaps overlooked experiences.

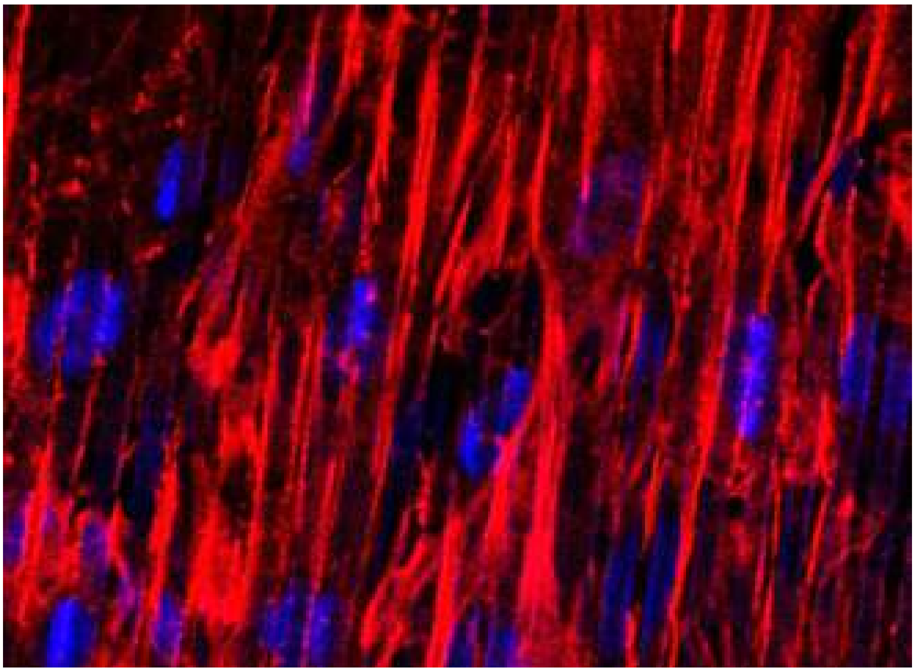
Has working beyond the bench changed how you define success or purpose as a scientist?

- Once, over a lunch discussion with colleagues, someone asked, 'What success means to you?'. I was pleasantly surprised by the different answers, which made me reflect on how everyone finds their own motivation to work harder. I wouldn't say working beyond the bench has changed how I define success, but a series of experiences, personal and professional, certainly have.

- As a PhD student, there's always an underlying pressure to finish the degree, and the uncertainty about the future feels much higher. In contrast, as a working professional, while the challenges are different, there's more emotional clarity and maturity, which allows you to think beyond tangible goals. For me, real success is when people can trust you easily and that trust is what makes everything else possible.

Do you think scientists are adequately trained to think about impact beyond publications? What needs to change?

- I see that times have changed. Earlier, scientists were trained to focus on publications because they're a measurable outcome and that's fine unless it becomes an obsession leading to ethical misconduct. But now, they are investing in science communication, entrepreneurship, and even incorporating policy perspectives into finding solutions, embedding these into training programs. AI, international forums, and global collaborations have drastically expanded scientists' exposure to more impactful ways and reasons for conducting research.



What is one habit or mindset shift that helped you navigate your transition most effectively?

- One habit I cannot advocate enough is nurturing a social circle. Speaking with friends, family, and mentors not only provides support but also helps stay focused on what one can control and not stress over what we cannot.

If a PhD student reading this is uncertain about their future in academia, what is the most important advice you would offer?

- Over a lifetime, career decisions aren't set in stone. One can change paths even after years in a role. No path comes with zero uncertainty and being okay with the unknowns helps alleviate the stress of seeking stability. It's tempting to collect advice from many people, but that often leads to more confusion. It's extremely important to filter out what truly works for you, considering one's own strengths and family commitments.

| OBITUARY |

Madhav Gadgil

India lost one of its most respected environmental scientists on 7 January 2026, when Madhav Gadgil passed away in Pune at the age of 83. For more than five decades, he worked to understand India's forests, wildlife, and people and to protect them for future generations.

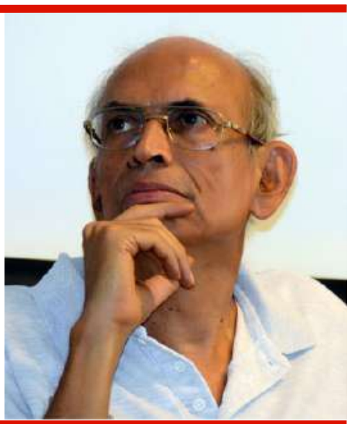
Born on 24 May 1942 in Pune, Gadgil grew up in a family that valued learning. He studied biology at Fergusson College in Pune, completed his master's degree in zoology from the University of Mumbai, and later went to Harvard University, where he earned his PhD in 1969. At Harvard, he was influenced by leading ecologists and developed a strong interest in mathematical ecology and animal behavior. After a short teaching period in the United States, Gadgil returned to India in 1971. He joined the Indian Institute of Science (IISc), Bengaluru, where he would spend more than thirty years building modern ecological research in the country. He founded the Centre for Ecological Sciences at IISc a pioneering institution that trained generations of Indian ecologists. He also helped establish the Centre for Theoretical Studies.

Gadgil believed that ecology was not just about forests and animals. It was also about people. He introduced scientific, quantitative methods to study ecosystems in India and emphasized that humans are an important part of nature, not separate from it. His work connected science with real-life issues such as forest management, biodiversity conservation, and sustainable development.

One of his most important achievements was helping India establish its first biosphere reserve the Nilgiri Biosphere Reserve in 1986. His research in the 1980s played a major role in identifying the ecological importance of the Nilgiri region. This was a turning point in India's conservation history. In 2010, the Government of India appointed him chairman of the Western Ghats Ecology Expert Panel (WGEEP), widely known as the Gadgil Commission. The panel studied the fragile Western Ghats mountain range and recommended that large parts of it be declared ecologically sensitive. His 2011 report sparked national debate. Environmentalists supported his strong conservation measures, while some state governments and groups opposed them. Even though not all recommendations were accepted, the report changed the way India discussed environmental protection.

THE SCIENTIST WHO GAVE NATURE A VOICE

(1942–2026)



Gadgil also played an important role in shaping the Biological Diversity Act of 2002 and promoted the idea of People's Biodiversity Registers, encouraging local communities to document and protect their natural resources. He believed that conservation should involve villagers, farmers, and indigenous communities.

Throughout his career, Gadgil published over 250 scientific papers and several influential books. His book This Fissured Land (co-authored with Ramachandra Guha) explored India's ecological history. He wrote in both English and Marathi, making science accessible to ordinary people. He also wrote columns for newspapers like The Hindu and Sakal, sharing stories about nature with the wider public.

His contributions were recognized globally. He received the Padma Shri in 1981 and the Padma Bhushan in 2006 from the Government of India. Internationally, he was honored with the Volvo Environment Prize, the Tyler Prize for Environmental Achievement, and in 2024, the prestigious Champions of the Earth Award from the United Nations.

Beyond science, Gadgil was known for his simplicity and integrity. As a young man, he was also an athlete, holding high jump records during his college days. He was married to noted meteorologist Sulochana Gadgil, who passed away in 2025. He is survived by his children.

Madhav Gadgil's legacy lives on in India's forests, in its environmental laws, and in the many students he mentored. He showed that science can guide society toward wiser decisions. More than a researcher, he was a bridge between knowledge and action a scientist who gave nature a strong and thoughtful voice.

India remembers him not only as an ecologist, but as a guardian of its natural heritage.

By
Rosalind Franklin
Council of Scientific Research
(**RFCSR**)

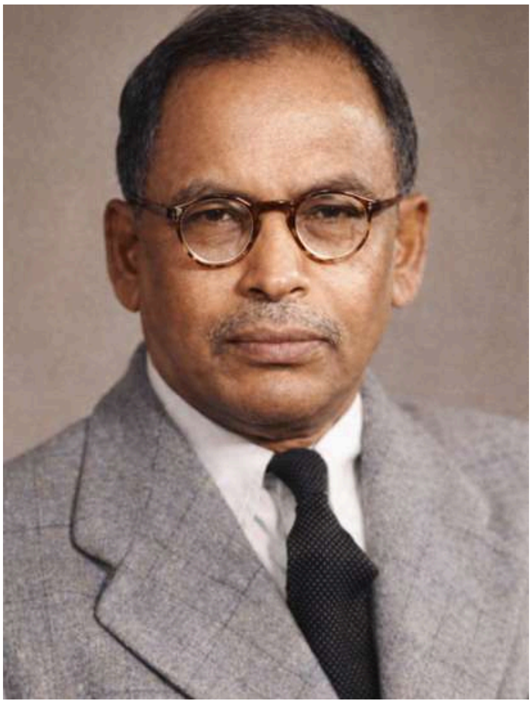
SCIENCE NEWS & OPPORTUNITIES

"Science News & Opportunities" keeps you updated with the latest scientific breakthroughs and opens doors to exciting careers, scholarships, and research programs.

Meghnad Saha: The Visionary Who Decoded the Stars

01

February 16 marks the death anniversary of Meghnad Saha, one of India's most distinguished astrophysicists. He passed away on 16 February 1956, leaving behind a powerful scientific legacy that continues to influence modern astronomy.



Saha is best known for the Saha Ionization Equation, developed in the 1920s. This equation explained how the temperature of stars affects the ionization of elements in their atmospheres. In simple terms, it helped scientists understand why stars show different spectral lines and how their temperatures can be measured. His work laid the foundation for modern stellar astrophysics and helped astronomers classify stars more accurately.

Beyond research, Saha was deeply committed to nation-building. He played a key role in establishing scientific institutions in India and promoting scientific education. He also served as a Member of Parliament, advocating for scientific planning and development.
His contributions remain a cornerstone of astrophysics and Indian science.

National Science Day and the Legacy of C. V. Raman

02

February 28 is celebrated every year in India as National Science Day to honor the discovery of the Raman Effect by C. V. Raman in 1928. On this day, Raman announced that when light passes through a transparent material, a small fraction of it changes its wavelength. This change occurs because light interacts with the molecules of the substance.

This discovery was groundbreaking because it provided a new way to study the molecular structure of materials. Today, this principle is used in Raman spectroscopy, an important tool in chemistry, physics, medicine, and even space research. Scientists use it to identify unknown substances, detect diseases, and analyze materials at the molecular level.

For this remarkable contribution, C. V. Raman became the first Indian scientist to receive the Nobel Prize in Physics in 1930. National Science Day celebrates his achievement and promotes scientific thinking and innovation across India.

Things YET TO BE DISCOVERED

From the dark depths of our oceans to the farthest reaches of the cosmos, countless mysteries remain unsolved. Science continues to push the boundaries of the known, revealing just how much is still left to uncover. What lies beyond our current understanding may reshape the future of humanity.

| SCIENCE YET TO BE DISCOVERED |

PADMA SHRI 2026: INDIA'S SCIENCE & ENGINEERING LEADERS

Dr. A. E. Muthunayagam is a distinguished space scientist and one of the pioneers of India's cryogenic rocket engine development. He played a key role in strengthening India's liquid propulsion systems at the Indian Space Research Organisation (ISRO). His contributions helped advance India's launch vehicle technology, making the country more self-reliant in space missions. He received the Padma Shri for his lifelong dedication to space engineering and national technological development.

Dr. Ashok Kumar Singh is an agricultural scientist and plant breeder associated with the Indian Council of Agricultural Research (ICAR). He has worked extensively on improving crop varieties to increase yield and climate resilience. His research has supported farmers by promoting better seed technologies and sustainable agricultural practices. He received the Padma Shri for strengthening India's agricultural research and food security efforts.

Dr. Chandramouli Gaddamanugu is a technology entrepreneur and innovator known for contributions in engineering solutions and industrial automation. His work has focused on advancing indigenous technology and promoting innovation-driven development. Through his leadership in technical enterprises, he has supported India's growing engineering ecosystem. He received the Padma Shri for his impact on applied science and industrial technology development.

Dr. Gopal Ji Trivedi is a science educator and researcher who has contributed to promoting scientific awareness and grassroots innovation. He has worked to popularize science among students and rural communities, encouraging practical scientific learning. His efforts have helped bridge the gap between laboratory research and public understanding. He was honored with the Padma Shri for advancing science education and outreach.

| SCIENCE YET TO BE DISCOVERED |

PADMA SHRI 2026: INDIA'S SCIENCE & ENGINEERING LEADERS

Prof. Juzer Vasi is an electrical engineer and academic associated with the Indian Institute of Technology Bombay. He has made significant contributions in power engineering and electrical systems research. His work has influenced energy systems, renewable integration, and engineering education in India. He received the Padma Shri for excellence in engineering research and mentoring future technologists.

Dr. K. Ramasamy is a scientist known for contributions in applied engineering research and technical development. His work has supported innovation in manufacturing and industrial processes. Through research and leadership roles, he has helped strengthen India's engineering capabilities. He received the Padma Shri for advancing applied scientific research and promoting technological self-reliance.

Dr. Krishnamurty Balasubramanian is a scientist recognized for contributions to chemical and material sciences. His research has helped improve understanding of molecular systems and advanced materials. Through academic and research leadership, he has strengthened India's scientific infrastructure. He received the Padma Shri for his impact on scientific research and innovation.

Dr. Kumarasamy Thangaraj is a renowned geneticist associated with the Centre for Cellular and Molecular Biology. He is known for groundbreaking research in human genetics, population studies, and rare diseases. His work has helped understand India's genetic diversity and medical conditions. He received the Padma Shri for his outstanding contributions to genetic research and biomedical science.

| SCIENCE YET TO BE DISCOVERED |

PADMA SHRI 2026: INDIA'S SCIENCE & ENGINEERING LEADERS

Dr. Prem Lal Gautam is an agricultural scientist who has worked on crop improvement and sustainable farming systems. His research has supported farmers in hill regions by developing improved cultivation practices. He has contributed to strengthening agricultural resilience in challenging environments. He received the Padma Shri for his service to agricultural science and rural development.

Dr. Shubha Venkatesha Iyengar is an aerospace scientist associated with India's space research ecosystem. She has contributed to satellite systems and mission engineering, supporting India's expanding space missions. Her work has strengthened technical capabilities in spacecraft development. She received the Padma Shri for her contributions to aerospace science and engineering.

Dr. Veezhinathan Kamakoti is a computer scientist and academic leader associated with the Indian Institute of Technology Madras. He has contributed to indigenous processor development and cybersecurity research, including India's "SHAKTI" microprocessor initiative. His work promotes technological self-reliance in computing systems. He received the Padma Shri for his contributions to computer engineering and digital innovation.

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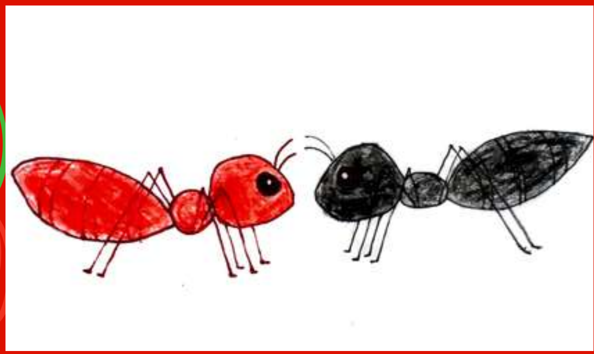
RESEARCHERS LIFELINE RESEARCH HEALTH

back to school

CURIOUS KID'S



NAME: **Shivanya Das**

Age: **4 Years**

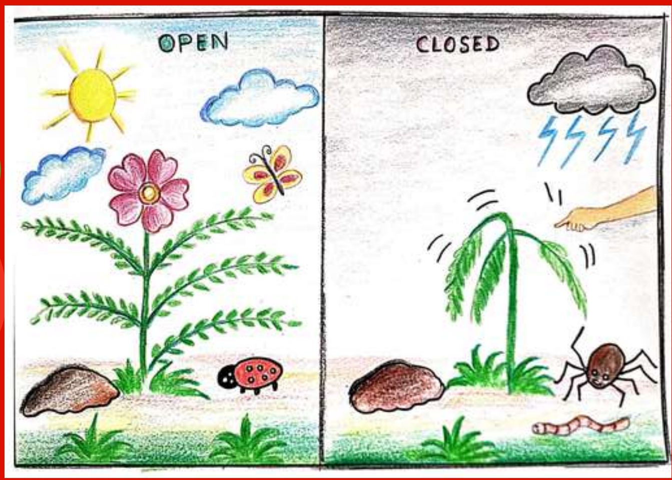
SCHOOL: **LKG-D DAV Public School, Chandrasekharpur, Bhubaneswar, Odisha, India**

FOCUS:

Why Did One Ant Bite Burn Like Fire?

One day, I was playing in my school garden when an ant bit me. It started burning like fire! After a while, another ant bit me, but this time it didn't hurt much. I felt confused and asked my teacher why. She told me that some red ants don't just bite, they also sting. They put a tiny drop of venom into the skin. This venom has a chemical called formic acid that wakes up special pain nerves in our body. These nerves quickly send a "danger!" message to the brain, which is why it burns and hurts. Many black ants don't deliver a painful bite and lack a stinger, so they can't inject strong venom. That's why one bite feels fiery, and the other feels small and mild.

back to school



NAME: **Tanisha Tejashree Sahoo**

Age: **9 Years**

SCHOOL: **Loyola School , Bhubaneswar, Odisha, India**

FOCUS:

The Secret Life of a Shy Plant?

This picture shows a special plant that can open and close its leaves. On the right side, the leaves are closed because something touched it, like a hand or even thunder vibrations. On the left, the leaves are open in sunlight and calm weather. This plant is called Mimosa pudica, also known as the "touch-me-not" plant. When something touches it, tiny signals travel inside the plant like messages. These signals make water move out of special cells at the base of the leaves. When the cells lose water, they shrink, and the leaves fold. After some time, water moves back in, and the leaves open again. It's the plant's way of protecting itself!

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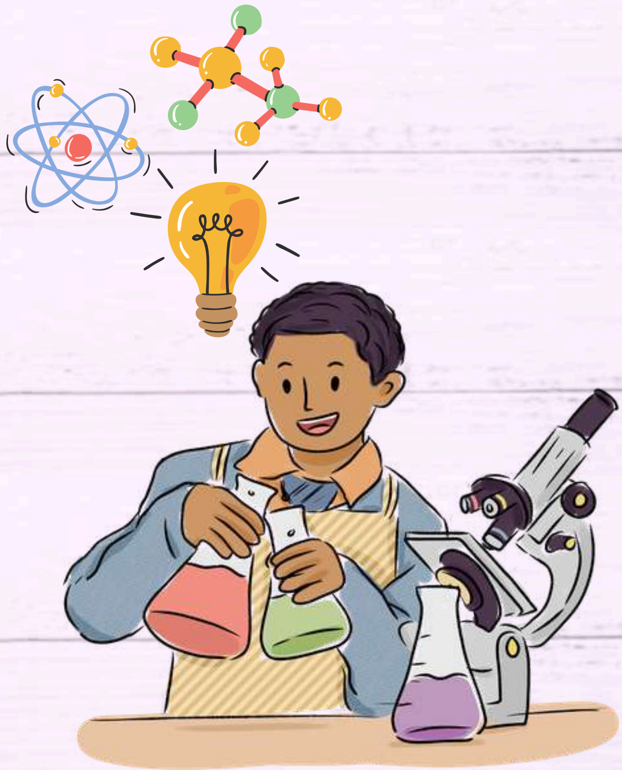

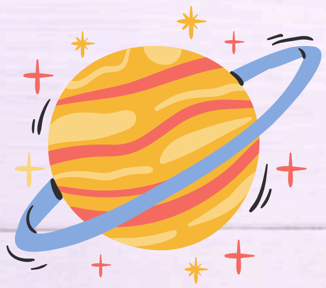

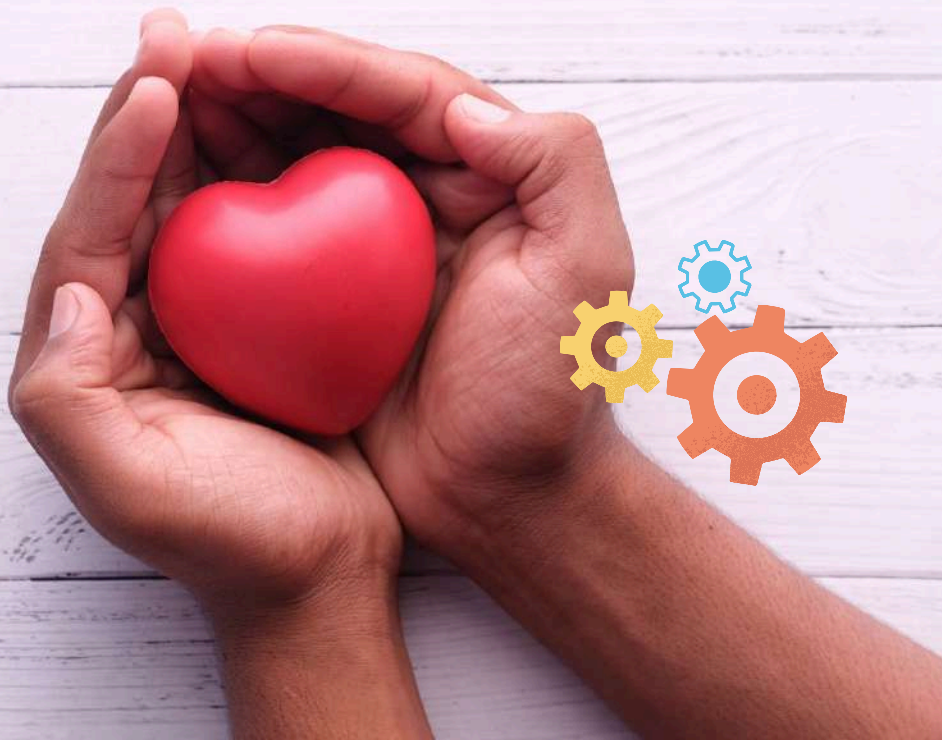


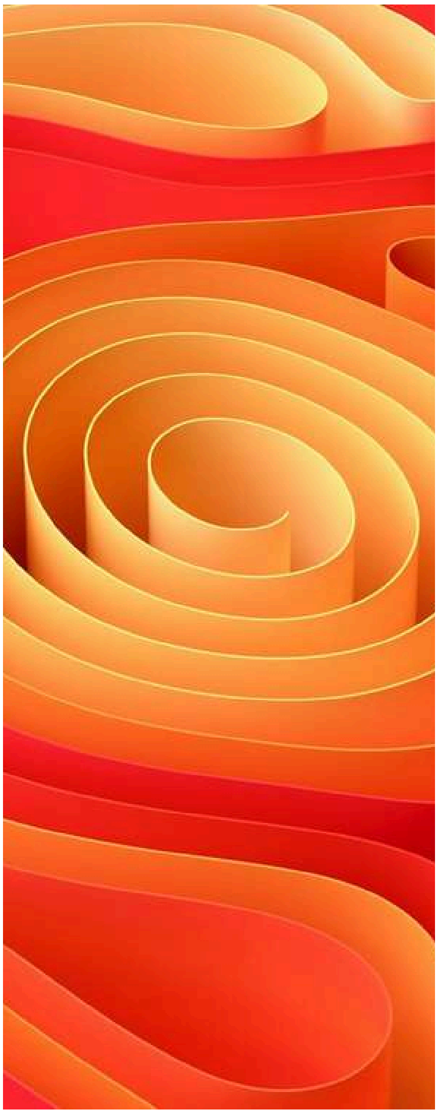



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