

# Transcript

Of our research,  
people, and culture



# Taking a Granular Approach: Could a Rice Protein Drive Climate-Resilient Agriculture?



Dr. P. V. Shivaprasad  
Associate Professor

In a groundbreaking exploration of plant epigenetics, Dr. Vivek Gandhivel and Dr. Shivaprasad at NCBS are redefining how we understand plant adaptation to environmental stress. At the heart of their work lies a rice-specific variant of a 'histone' protein that was previously hypothesized but never characterized in plants, until now.

Histones, often described as 'beads on a string', are protein complexes around which DNA winds, forming a complex called chromatin. Small chemical modifications on histones or DNA can regulate gene expression, thereby turning genes on or off. Dr. Shivaprasad's team has identified a unique variant of the H4 histone in rice plants—one of the five main histones in a eukaryotic cell—that profoundly alters chromatin structure and function.

This variant functions like a molecular gatekeeper: it silences a large set of genes under normal conditions, but during salt stress—the condition in which the plant is forced to take in saline water from the soil—it flips the metaphorical switch, allowing stress-response genes to activate, and granting the plant the superpower of salt-tolerance. This switch controls the expression of thousands of genes in rice, making it a powerful regulatory tool in the plant's response to high salinity.

*"A naturally salt-tolerant variant of Indian rice is grown in the saline backwaters of Kerala, which also exhibits unique chromatin patterns involving the same H4 histone variant,"* says Dr. Shivaprasad. His team's findings have far-reaching implications and shed light on possible new avenues for climate-resilient crop engineering. In contrast to traditional breeding methods that target one or a few genes, harnessing such histone variants could offer a much broader approach to stress tolerance and climate resilience.

*"We've essentially found a master switch for salt tolerance,"* Dr. Vivek Gandhivel adds. *"Salinity is a big problem, even in the hinterlands. This is a good starting point to develop salt tolerant plants."*

Interestingly, the H4 histone variant regulates genes differently at specific stages of development in the rice plant. Beyond regulating a stress response at the seedling stage, this H4 variant appears to play a pivotal role in rice reproductive tissue development.

Dr. Shivaprasad's lab probes this aspect of the H4 histone variant and other histone variants as well, such as the H2A.X, and chromatin remodelers that impact hundreds of genes at once. The team is also investigating peptide signalling, regulation of embryo and endosperm, genomic imprinting, and the epigenetics of RNA-directed DNA methylation.

Dr. Shivaprasad highlights the importance of curiosity-driven work that is grounded in rigorous science. Citing the example of how cut grass grows back so fast, he mentions how curiosity led him and his co-worker Dr. Harshith to investigate a rapid wound response that is lacking in dicot leaves. They identified short-chain growth-promoting peptide hormones that are triggered within just eight minutes of injury—offering staggering potential for agricultural applications far beyond rice.

While India has expertise in breeding and field-level agronomy, and a few institutions even look at climate-resilience in crops, there are very few labs with the tools to engineer difficult native crops. Dr. Shivaprasad's lab at NCBS is one of the labs that can take on this task—and as the challenges of climate change intensify, Dr. Shivaprasad advocates for stronger investment in molecular plant biology for future resilience.

Read the full paper here:

<https://www.nature.com/articles/s41477-025-01974-2#article-info>



# Next Generation Genomics Facility: Powering Discovery



Genome sequencing is transforming how we understand life, enabling breakthroughs in medicine, agriculture, conservation, and fundamental biology, and the Next Generation Genomics Facility (NGGF) makes that happen, every day.

The NGGF is at the heart of cutting-edge genomics research at NCBS, delivering state-of-the-art sequencing services for a wide range of biological questions. Slightly different from other labs that pursue specific research questions, the facility also supports both international and national genome sequencing projects, develops cost-effective methods/protocols/ reagents, and trains researchers in genomics.

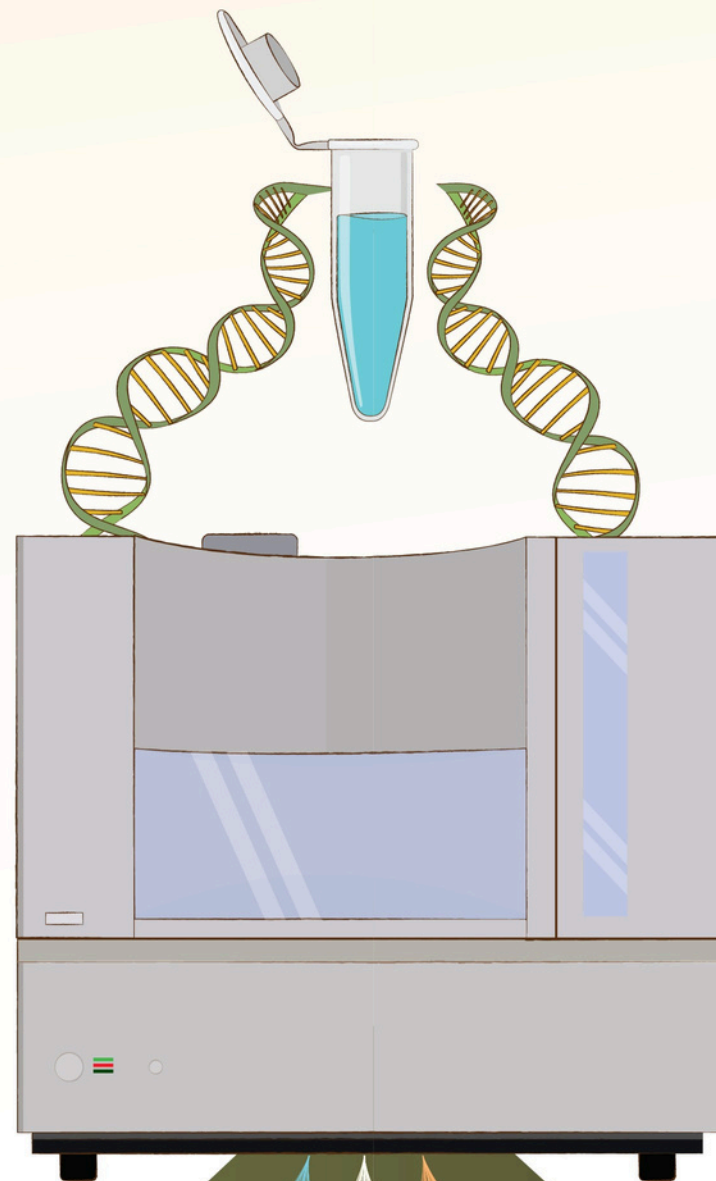
Dr. Awadhesh Pandit, Facility in-Charge, says, *“Our mission is to provide high-throughput sequencing services and make genomics infrastructure accessible to all researchers—both in terms of quality and affordability.”*

The NGGF operates across four main service verticals. The first is Sanger sequencing, where they offer PCR product sequencing, plasmid sequencing, and human cell line authentication, having processed nearly 2,00,000 samples over the past decade for more than 100 labs. Next-generation sequencing (NGS) is the second, covering applications from RNA-sequencing, ChIP sequencing, and metagenomics to whole-genome sequencing. To date, the facility has handled over 1,00,000 NGS samples for more than 80 research laboratories.

For the third vertical, single-cell genomics, the team uses the 10x Genomics platform for projects such as single-cell RNA sequencing and ATAC sequencing, already having delivered more than 60 projects. Finally, for the fourth vertical, the NGGF team conducts NGS training for internal and external users, and hosts integrated omics workshops once or twice a year. They recently wrapped up their 8<sup>th</sup> Hands on Workshop on “Integrated OMICS” in July, and have trained over 500 researchers to date.

## From COVID-19 Genomic Surveillance...

During the COVID-19 pandemic, the NGGF played a pivotal role in India’s genomic surveillance efforts. As part of the Indian SARS-CoV-2 Genomics Consortium (INSACOG) initiative and the Rockefeller Foundation Genomic Surveillance Project, the team sequenced more than 40,000 SARS-CoV-2 samples from both clinical and wastewater sources, providing crucial data for tracking variants and informing public health decisions. The wastewater sample sequencing done in collaboration with the Tata Institute of Genetics and Society (TIGS) enabled the rapid detection of emerging variants across Karnataka, supporting timely public health decisions.



## ...To Affordable In-House Genomics Innovations

Innovation is one of the pillars at the NGGF. Dr. Pandit’s team has had some recent breakthroughs in establishing genomics protocols. The team has developed a high-quality single amplicon sequencing method for the Illumina MiSeq platform, reducing sequencing costs by up to 40% (*read the paper*; QR code below). They have also optimized an ATAC-sequencing protocol using *Drosophila* brain in tissue to enhance chromatin accessibility profiling in neurobiology (*view publication*; QR code below).

Their most recent protocol, developed in collaboration with Dr. Baskar, IIT Mandi, involves custom DNA probes that successfully deplete nearly 97% of ribosomal RNA in *Drosophila melanogaster* (*view article*; QR code below).

Furthermore, the NGGF has developed in-house magnetic beads for Sanger cleanup that are 100 times cheaper than commercial alternatives. The team has also devised a 10 times cheaper option for PCR products and NGS library purification which is just as efficient as the market alternative.

*“These innovations not only reduce project costs, but also make high-quality genomics accessible to a larger community of researchers”,* says Dr. Pandit.

## Looking Ahead: Bigger Data, Broader Access

The facility is currently focussed on doubling their single-cell sequencing capacity from 10,000 to 20,000 cells per sample, and introducing spatial transcriptomics services that will be central to some of the work done at NCBS. High-throughput long-read sequencing technology is also on the horizon, promising deeper genomic insights.

Dr. Pandit confirms that the facility will also continue training researchers, and working towards in-house, cost-effective options for reagents, solutions, and protocols to democratize genomics and research. He adds, *“The goal is always to make genomics affordable, using in-house but effective alternatives, so more scientists can explore bold research questions.”*

From real-time pandemic tracking to next-generation cost-cutting innovations, the NGGF is ensuring that world-class genomics is not just for a select few, but for the entire scientific community.

### Papers mentioned in the article

1. High-quality single amplicon sequencing method for illumina MiSeq platform using pool of ‘N’ (0-10) spacer-linked target specific primers without PhiX spike-in



2. Optimized protocol for assay for transposase-accessible chromatin by sequencing (ATAC-seq) from *Drosophila melanogaster* brain tissue



3. Efficient ribosomal RNA depletion from *Drosophila* total RNA for next-generation sequencing applications



## Publication Highlights

### Bacteria Regulate DNA Replication Speed Based on Nutrient Availability

Dr Anjana Badrinarayanan's group observed the DNA replication machinery in live bacteria to discover that nutrient and deoxyribonucleoside triphosphate (dNTP) availability alters how fast DNA is replicated. This sheds light on how bacteria adapt replication in response to varying conditions within the cell.

The complete study is available here:  
<https://www.sciencedirect.com/science/article/abs/pii/S0960982225002945>



### Circadian Rhythms Determine When Cells Divide, and Their Fate

Dr. Shaon Chakrabarty and group studied how circadian rhythms subtly influence cell cycles, especially cell division. The study found that cell divisions occur at certain circadian phases, and altering the circadian clock does not affect the sequence of cell divisions as much as it influences the results of this growth. This offers the opportunity to time therapies for when the cells are most vulnerable, especially in cancer.

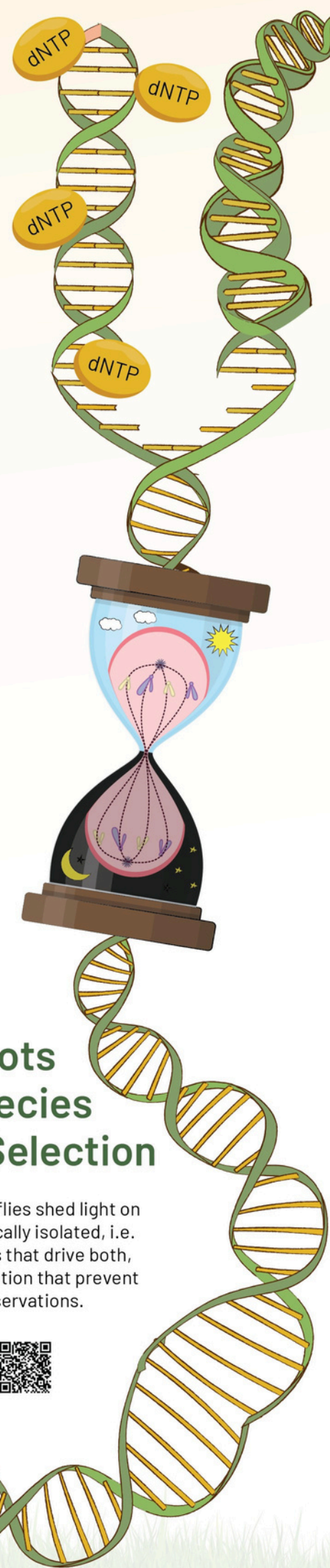
Read more about the study here:  
<https://news.ncbs.res.in/research-explained/hacking-time-improving-cancer-therapies>



### Butterfly Genomic Hotspots Reveal the Secrets of Species Divergence and Natural Selection

Dr. Krushnamegh Kunte and his group's study on butterflies shed light on how new species form when populations are geographically isolated, i.e. allopatric divergence. They identified genomic hotspots that drive both, adaptation to local environments and reproductive isolation that prevent interbreeding, further supplemented by behavioural observations.

The complete study is available here:  
<https://onlinelibrary.wiley.com/doi/10.1111/mec.17703>



### Rare Histone Protein Variant Found in Rice Plants Imparts Salt Resilience

Dr. P.V. Shivaprasad's group discovered a rice-specific variant of histone H4 (H4.V) that enhances the plant's tolerance to salt stress. In wild-type plants, H4.V switches on only when needed, acting as a toggle switch between stress response and growth stages, offering a possible genetic switch to engineer salt-resilient rice crops.

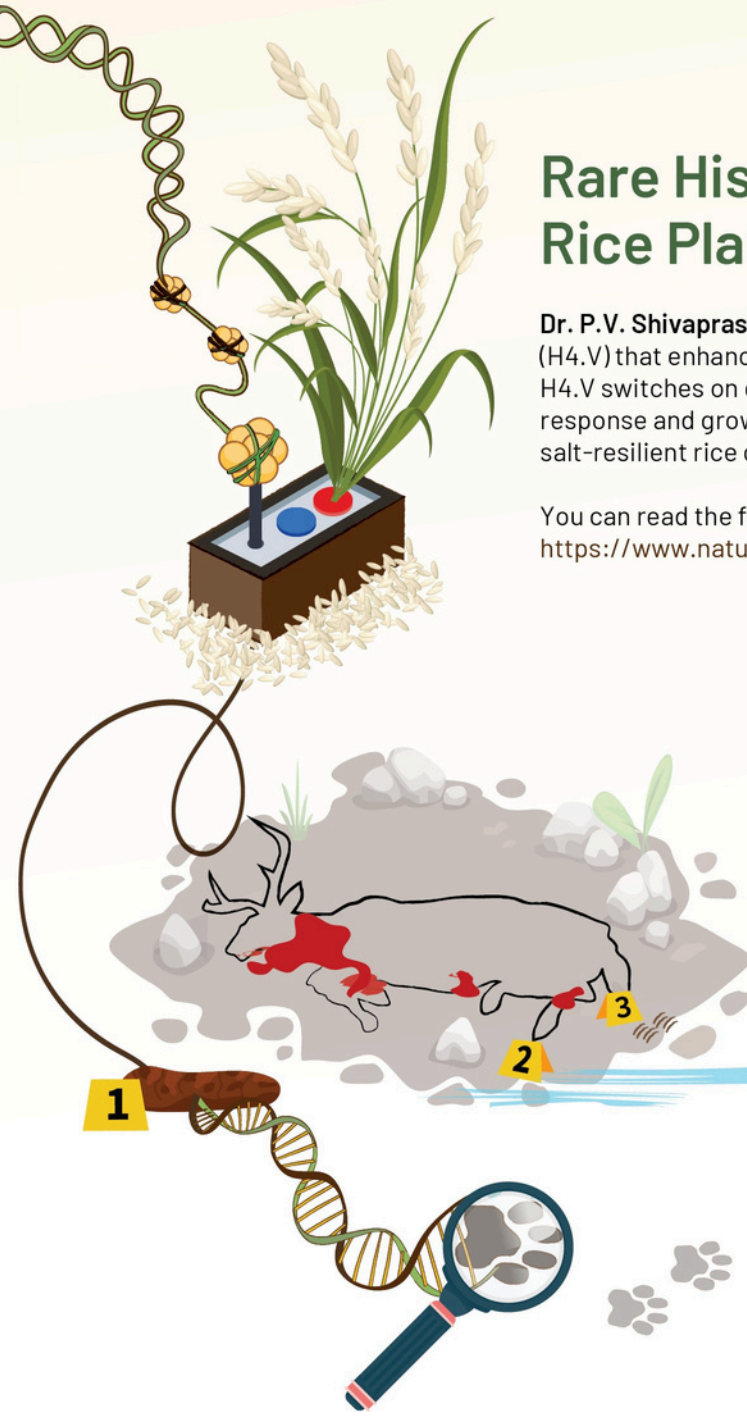
You can read the full article here:  
<https://www.nature.com/articles/s41477-025-01974-2#article-info>



### DNA From Prey Kill Sites Identifies Specific Predators

Prof. Uma Ramakrishnan's lab established that it is possible to accurately identify specific predators using DNA from scat, saliva, and hair samples collected from and near prey kill sites. This non-invasive monitoring of predator-prey interactions has significant implications for evidence-based tiger-livestock conflict management.

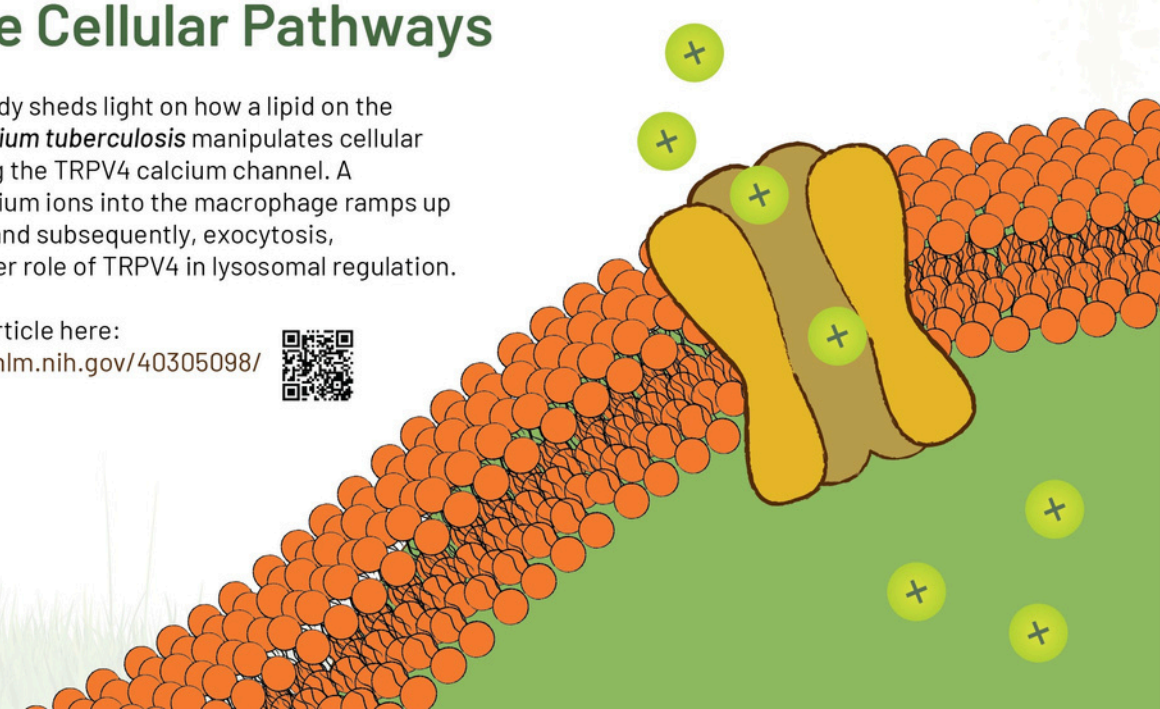
You can read the full article here:  
<https://www.sciencedirect.com/science/article/abs/pii/S0006320725001545?dgcid=author>

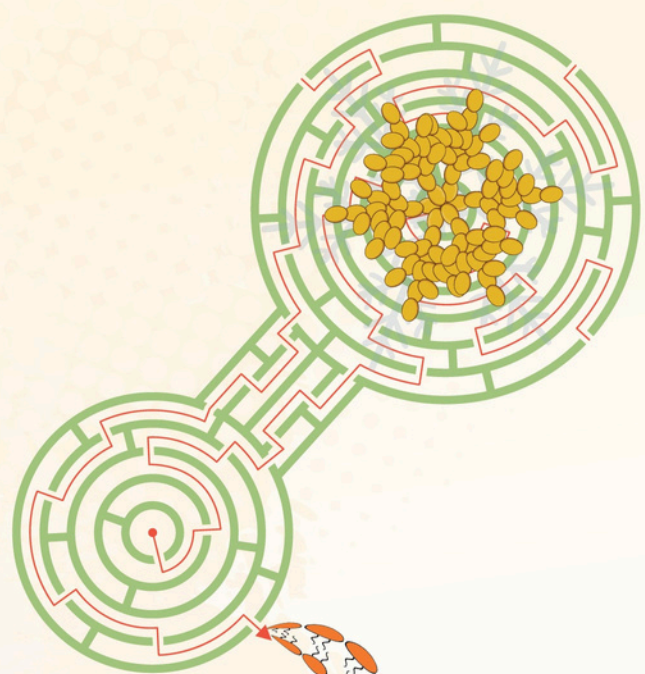


### Surface Lipids on TB Bacterium Manipulate Cellular Pathways

Dr. Varadharajan's study sheds light on how a lipid on the surface of *Mycobacterium tuberculosis* manipulates cellular pathways by activating the TRPV4 calcium channel. A resultant influx of calcium ions into the macrophage ramps up lysosome production and subsequently, exocytosis, highlighting the broader role of TRPV4 in lysosomal regulation.

You can read the full article here:  
<https://pubmed.ncbi.nlm.nih.gov/40305098/>





## Density-Driven Fluid Flows Drive Yeast Colony Growth

A recent study from **Dr. Shashi Thutupalli's** lab shows that clusters of snowflake yeast generate their own nutrient-transporting fluid flows using metabolic byproducts. These density-driven flows act as "biophysical scaffolds" to overcome limitations of diffusion, enabling exponential growth in large multicellular clusters without any special adaptations.

The complete study is available here:  
<https://www.science.org/doi/10.1126/sciadv.adr6399>



## Cell Membranes are Dynamic and Asymmetric

**Prof. Madan Rao** and his group recently published a study on how cells maintain uneven lipid distributions across their two membrane leaflets using energy-driven processes. Actomyosin contractile forces and active lipid flipping drive segregation of liquid-ordered and disordered domains, showing that cell membranes are living, dynamic layers.

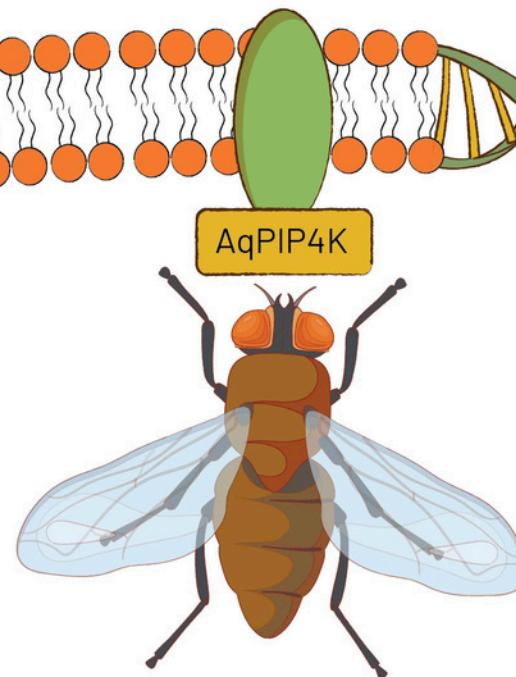
The complete study is available here:  
<https://pubs.rsc.org/en/content/articlelanding/2025/fd/d4fd00207e/unauth>



## Lipid Kinase from Sponge Regulates Growth in *Drosophila*

**Prof. Raghu Padinjat's** study reveals that a lipid kinase, AqPIP4K, derived from a sponge, has been conserved through evolution to resemble human PIP4K biochemically. AqPIP4K was also able to regulate growth in *Drosophila* mutants through the insulin receptor's activity.

You can read the full article here:  
<https://journals.biologists.com/jcs/article-abstract/doi/10.1242/jcs.263881/368299/Conserved-biochemical-activity-and-function-of?redirectedFrom=fulltext>



## GenDiS3: A Global Database of Protein Structural Domain Superfamilies

**Prof. R Sowdhamini's** team, using advanced bioinformatic tools, has updated the GenDiS (Genomic Distribution of structural Superfamilies) database for better detection and validation of hits, and accurate domain identification of protein sequences. GenDiS3 offers a view of the common different structural protein domains across all known sequences. This open-access resource helps identify evolutionary patterns and structural biases in proteins.

The complete study is available here:  
<https://academic.oup.com/database/article/doi/10.1093/database/baaf035/8127847?login=true>

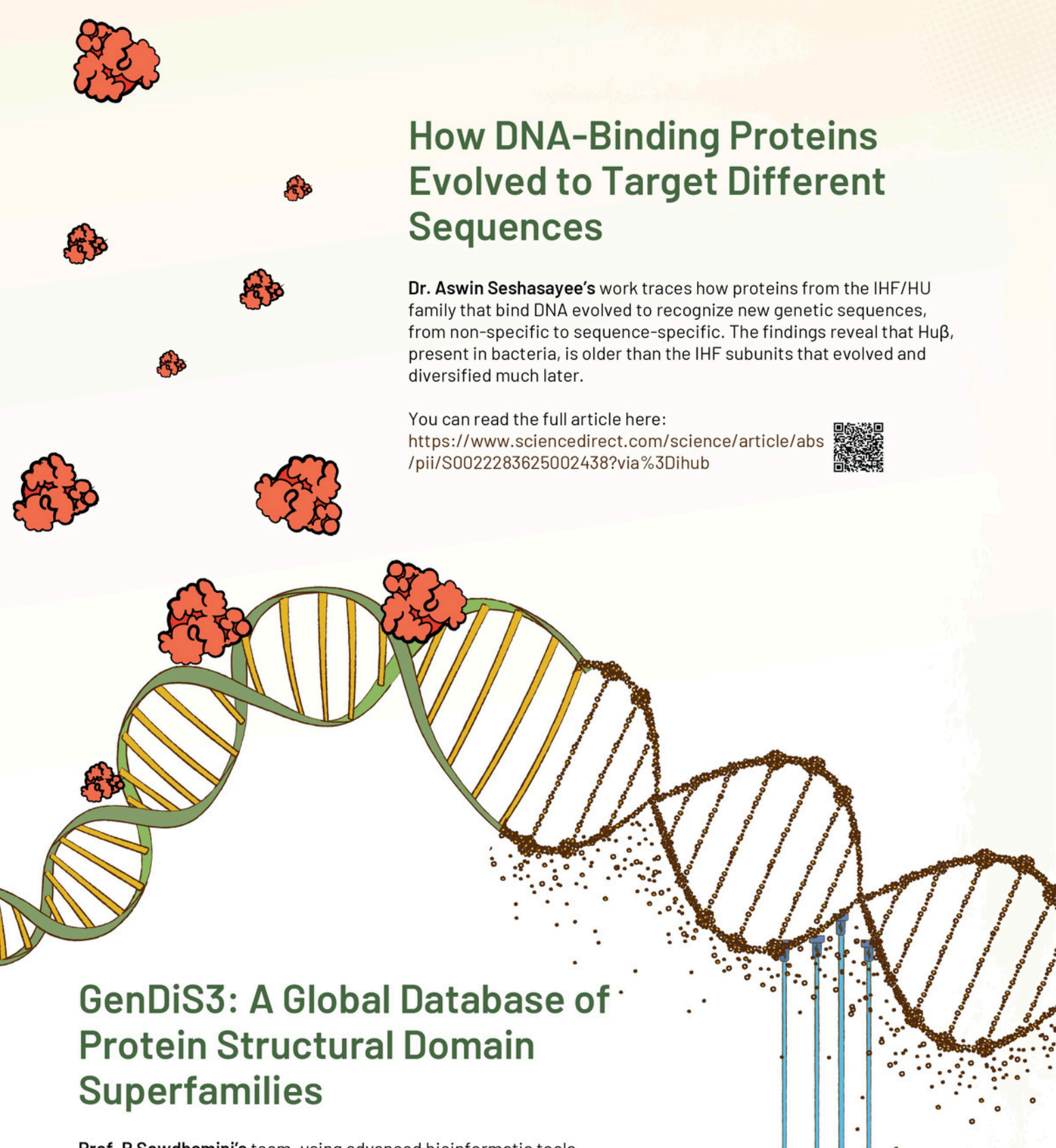
Explore the database here: <https://caps.ncbs.res.in/gendis3/>



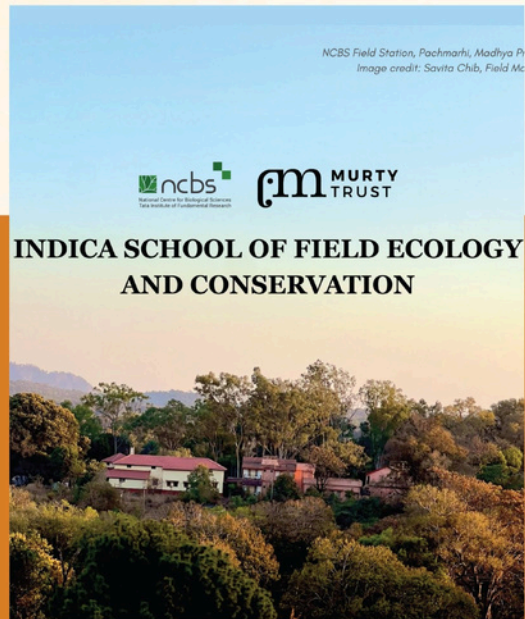
## How DNA-Binding Proteins Evolved to Target Different Sequences

**Dr. Aswin Seshasayee's** work traces how proteins from the IHF/HU family that bind DNA evolved to recognize new genetic sequences, from non-specific to sequence-specific. The findings reveal that Hu $\beta$ , present in bacteria, is older than the IHF subunits that evolved and diversified much later.

You can read the full article here:  
<https://www.sciencedirect.com/science/article/abs/pii/S0022283625002438?via%3Dihub>



# Event Highlights



## Indica School of Field Ecology and Conservation: An MoU with Murty Trust

NCBS has launched the Indica School of Field Ecology and Conservation, supported by a grant from the Murty Trust. The school will offer field-based training in ecological methods, ethics, and biodiversity regulations for PhD students, early-career researchers, and practitioners. Founded in 2017, the Murty Trust supports India's progress through philanthropic investments in science, culture, nature, and social impact.

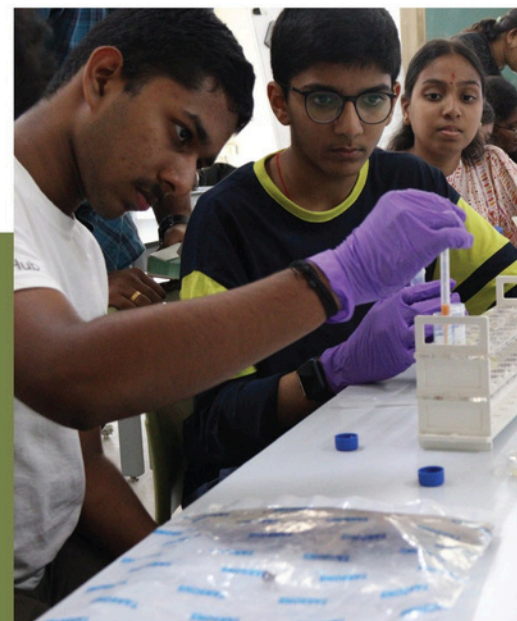


## India's First Vascular Biology Symposium at NCBS

The Vascular Biology Symposium at NCBS brought together vascular biologists from across India for two days of talks, discussions, and posters. Co-organised by Dr. Soumyashree Das (NCBS) and Dr. Rudra Nayan Das (Shiv Nadar Institution of Eminence), the event featured sessions on vascular cell identity, metabolism, homeostasis, inflammation, and niche biology, and concluded with a panel on "Bridging the Gap from Bench to Bedside". Supported by the Anusandhan National Research Foundation (ANRF), this is the first national platform dedicated to vascular biology.

## NCBS Summer Camp 2025

The 2025 edition of the NCBS Summer Camp hosted enthusiastic undergraduate students for three days of immersive science. With hands-on experiments, lab visits, and mentorship from researchers, the camp introduced young minds to the process of scientific inquiry and life at a research institute.



## PRISM Fellowship 2025: An NCBS-Project EduAccess collaboration

The PRISM (Promoting Research and Inclusion in STEM) Fellowship 2025, a 2-month programme which supports students from marginalised communities pursuing their Master's in life sciences in India, welcomed its first cohort in May-June 2025. The fellowship provides mentorship, community support, and guidance. A collaboration between Project EduAccess and academic mentors at NCBS, the program aims to make research careers more inclusive and accessible for those facing social, geographic, or economic constraints.





## NCBS Hosted Nobel Laureate Sir Paul Nurse

NCBS had the honour of hosting Nobel Laureate in Physiology or Medicine (2001) Sir Paul Nurse, who delivered an engaging talk on cell cycle regulation and shared insights from his ongoing research. In a candid discussion with researchers, he spoke about scientific freedom, interdisciplinary thinking, and curiosity-driven research, encouraging young scientists to stay curious, explore widely, and lead with kindness.

## archives open day school edition

17th April 2025  
Archives at NCBS  
Bengaluru



### Art Workshop

by Srivatsa K R  
10 AM to 12 PM  
For Children between 7 to 10 years

### Open Day for Schools

Visit the Archives!  
2 PM to 3.30 PM  
For school students 12 years and above

### Origami Workshop

by Kinjal Shah  
10 AM to 12 PM  
For Children between 11 to 14 years

### History of Science Quiz

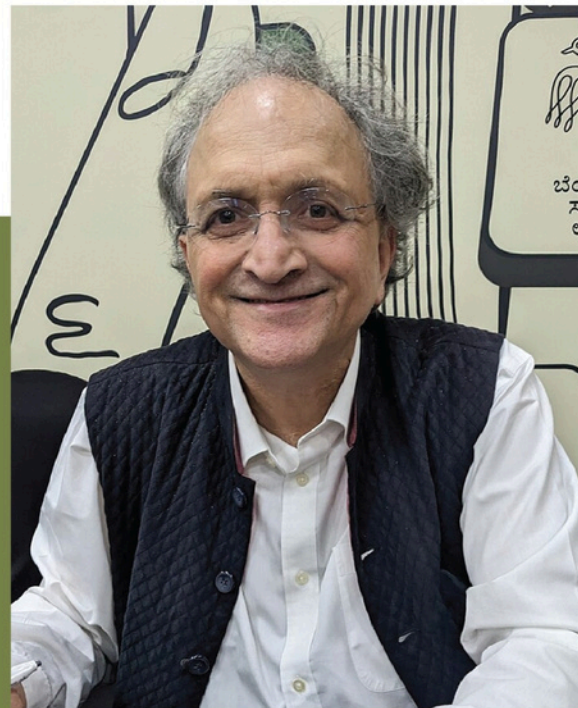
by Berty Ashley  
4 PM  
Open to students between 15 to 18 years

## NCBS Archives Open Day (School Edition)

The NCBS Archives hosted a special Open Day for school students, featuring an engaging mix of activities including an art workshop, archives tour, and a quiz on the history of science. The event offered students a creative and interactive introduction to science, natural history, field-based sketching, and archival research.

## Dr. Ramchandra Guha's Public Lecture

Noted historian Dr. Ramachandra Guha delivered a public talk at NCBS on "The Three Waves of Environmentalism". He touched upon rural resistance, state-led exploitation, mass movements like Chipko, and today's urban, climate-focused activism. He highlighted India's environmental model which is more rooted in justice and livelihoods than wilderness conservation like the Western model, and stressed on the need to balance global climate goals with local sustainability and livelihoods. He also signed copies of his book *Speaking with Nature: The Origins of Indian Environmentalism*.



## 12<sup>th</sup> Undergraduate Lecture Series: The Language of Life

The 12<sup>th</sup> edition of the Undergraduate Lecture Series, led by PhD students and postdocs from NCBS and inSTEM, invited undergraduate students to explore biological communication across scales, from molecules to ecosystems. This year's theme was "The Language of Life." Now in its 12<sup>th</sup> summer, the series seeks to foster analytical thinking, build concepts, and encourage an understanding of experimental approaches among undergraduate students with an interest in biology.

# Accolades and Recognition



**Prof. Uma Ramakrishnan**

Professor and Dean of Faculty

## Associate Member, European Molecular Biology Organization (EMBO)

*"What an honour to be elected an Associate member of EMBO! This is a sign that the barriers between molecular biology and ecology are dissolving. As always, I am grateful to my lab colleagues, mentors, collaborators, NCBS, and all those who fund our research. I'm excited to share our discoveries with colleagues from across the world, and hope this opportunity will build bridges in an otherwise fragmented world."*

## Academic Fellow, International Union of Physiological Sciences

The IUPS Academy of Physiology recognizes distinguished physiologists for their contributions to the field and promotes global engagement in physiology research, education, and outreach. The Academy also supports mentoring and visibility for emerging scientists.

Dr. Vatsala Thirumalai was elected to be an Academic Fellow 2025 for her outstanding contributions to physiological sciences.



**Prof. Vatsala Thirumalai**

Professor and Dean of Research

## For more updates on the latest happenings at NCBS,

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