

DE NOVO

INSTITUTE OF SCIENCE MAGAZINE 2025

**Can AI Grow a
Better Tomorrow?**



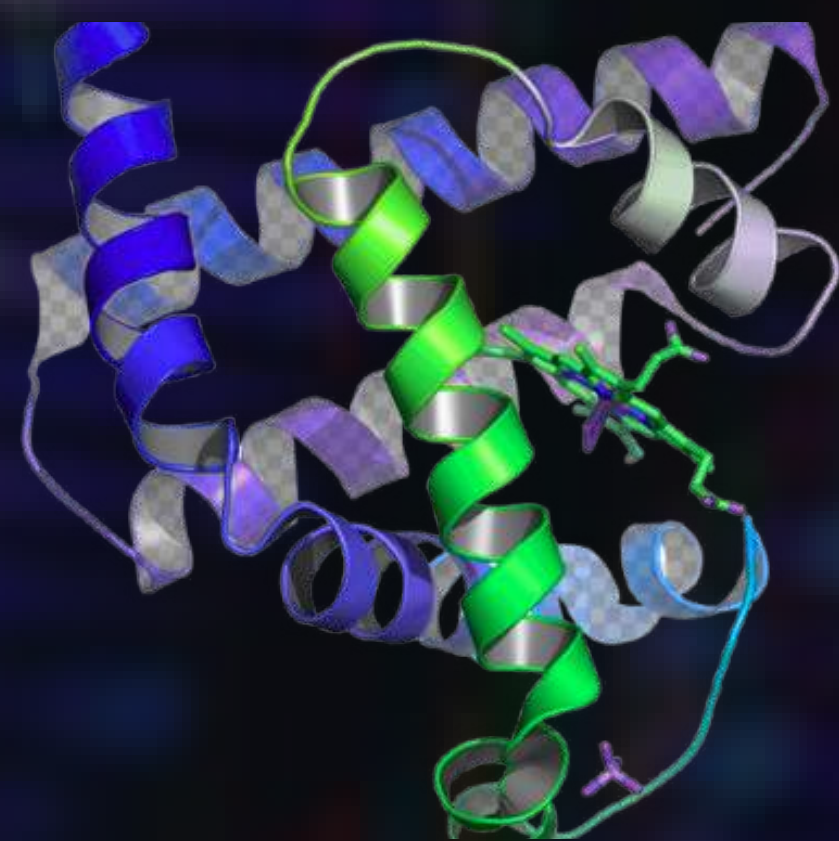
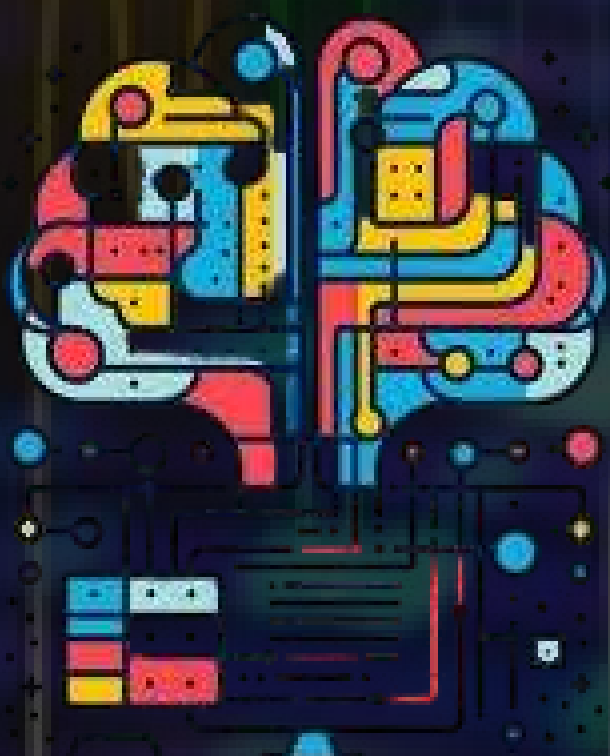
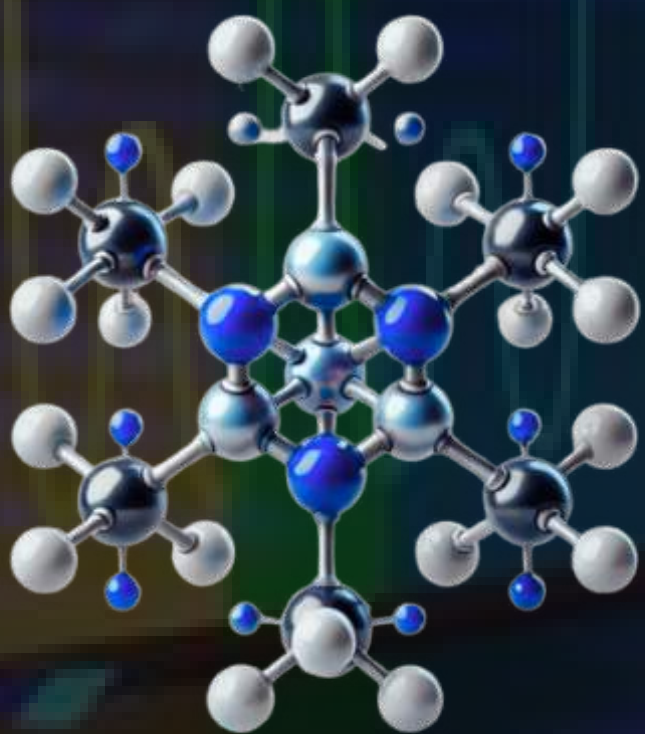
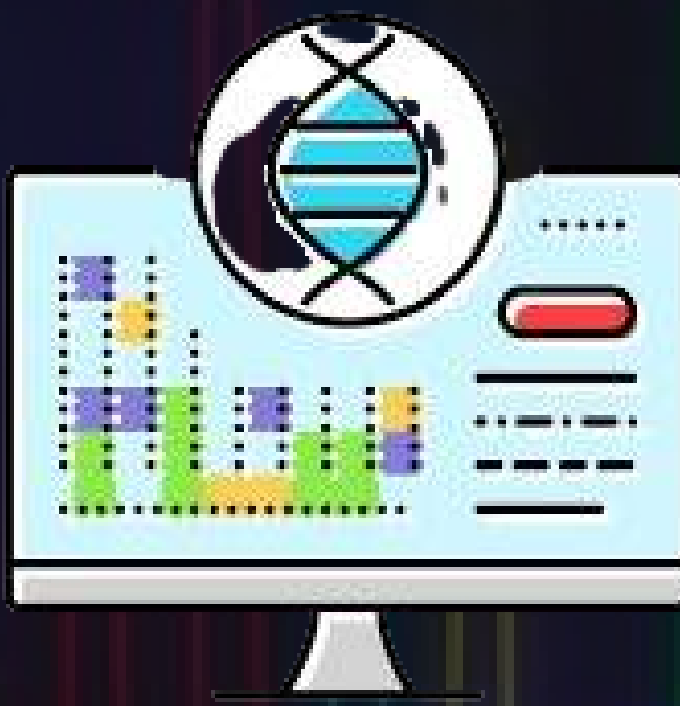
Planting the Future with AI

DE-NOVO

REWIRING LIFE WITH INTELLIGENCE

Institute of Science, Nirma University

2025



CM Message

Current era is of science and technology. The whole world has witnessed the growth of this field by leaps and bounds within last two decades. Youth are the architects of our future, and fostering a culture of science among the young minds of our state is paramount for shaping an innovative tomorrow.



In the age of technology, local innovation holds the key for addressing local challenges. Honourable Prime Minister Shree Narendra Modi always asserts that our youth must be incubated with optimal knowledge and skills, so that they may be able to put in the best result that can match with the requirements for Global market.

I am much pleased to learn that the Institute of Science, Nirma University is celebrating the completion of 21 years of its inception. I hereby extend my best wishes to the Institute of Science of Nirma University for the grand success of the event. I am sure the annual magazine De Novo being published to commemorate the event will be instrumental to bring out new directions for all the faculties, administration staff, students, future aspirants and the Board of Directors of the Institute.

A handwritten signature in red ink, which appears to be 'Bhupendra Patel', written in a fluid, cursive style.

Director's Message

The annual magazine DENOVO provides a platform to express the talents of students, researchers, and faculty at the Institute of Science, Nirma University (ISNU). Over the years, it has become a symbol of creativity, knowledge-sharing, and academic vibrancy within our community. Despite the challenges of recent times, the institute continues to thrive, living up to the expectations of its stakeholders and advancing toward new milestones.



We proudly completed 21 years of our journey in imparting quality education to master's students in Biotechnology, Biochemistry, and Microbiology, while gradually strengthening our presence in cutting-edge research.

Since our inception in 2004 as a teaching institute, we have evolved into one of the most respected research institutes in the western region of India. Our constant commitment to education, training, and innovation has enabled students to flourish and succeed in a competitive global environment. With each passing year, ISNU has moved closer to translational research that addresses societal needs while contributing impactful solutions for the future. The vibrant efforts of our science fraternity have brought recognition not only to the Institute but also to the University at large, contributing significantly to Nirma University's progress and achievements, including NAAC Grade A in 2015 and A+ in 2022.

This year's edition of DENOVO is centred around the timely and thought-provoking theme "AI in Biology." Artificial intelligence is revolutionizing the life sciences, from diagnostics and drug discovery to agriculture and therapeutics. Our students, through their insightful contributions, have explored how AI is reshaping research and expanding possibilities in biology, while also highlighting diverse areas such as heart disease, Agri-tech, biotech startups, and emerging therapies. The inclusion of puzzles, games, and creative elements further adds vibrancy to this edition, making it both informative and engaging.

Director's Message

It is heartening to see our students use DENOVO as a platform to sharpen their scientific writing skills, express their ideas, and contribute to meaningful discussions in the field of life sciences. This magazine is not just a collection of articles but a reflection of the passion, imagination, and intellectual curiosity that our institute nurtures.

I extend my sincere appreciation to the editorial team Dr. Darshan Dhakan, Keyur Shah, Dhruvi Patel, Urvi Raval, Vaishnavi Gandhi, Vedanshi Makwana, Meghna Malkan, Aarya Kalhe, Vrushanki Joshi, Maitri Pandya, Mehal Desai, Varia Hitiksha, and Pratham Dasadiya for their dedication and hard work in bringing this year's edition to life. Their contributions, along with the enthusiasm of all our students, have made DENOVO 2025 a remarkable and inspiring effort.

I warmly invite you to read through this edition and experience the curiosity, innovation, and commitment that define the spirit of ISNU. I am confident that you will find it both enriching and enjoyable.

Sarat K. Dalai, Ph.D.
Professor (Biotechnology)
Director, Institute of Science
Dean, Faculty of Science
Nirma University

About DeNoVo

DENOVO Magazine is the annual publication of the Institute of Science, Nirma University, designed as a platform for students to share their knowledge, creativity, and perspectives on the ever-expanding world of life sciences. True to its name “**DENOVO**,” meaning “anew,” the magazine reflects fresh ideas, curiosity, and innovation in every edition.

The 2025 issue carries the theme “**AI in Biology**,” highlighting how artificial intelligence is transforming research, diagnostics, agriculture, and therapeutic strategies. Alongside this focus, the magazine also presents a wide range of articles on heart disease, agri-tech, biotech startups, recent therapies, and other emerging topics. To add balance and engagement, readers will also find puzzles, games, and lighter pieces woven throughout the issue.

At its core, DENOVO aims to nurture scientific writing skills among students while offering readers an accessible glimpse into the latest discoveries, innovations, and achievements in life sciences. More than just a magazine, it is a bridge connecting curiosity with knowledge, and students with the larger scientific community.

We invite you to explore DENOVO 2025, and hope these pages inspire reflection, dialogue, and a renewed passion for science.

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TEACHING PHILOSOPHY

I obtained my Ph.D. in Immunology from JNU, New Delhi in 1998. During 1999–2011 I worked at NIAID (National Institute of Allergy and Infectious Diseases) of NIH, JHUSOM (Johns Hopkins University School of Medicine) and WRAIR (Walter Reed Army Institute of Research) for US Military Malaria Vaccine Development Program in various capacities as a Scientist and Researcher. Since January 2011 I have been teaching Immunology to M.Sc. & Ph.D. students while running my lab as principal investigator at the Institute of Science, Nirma University. After working long years on the bench, I wanted to teach actively by choice, and my decision is largely influenced by my passion to interact with young students and researchers with the intention of helping them learn the complexities of immune system. The period of last 14 years has been a great learning for me **“how to deliver the subject matters to students coming from varied backgrounds, and enable them to think critically and creatively on challenging issues of immunology”**. Here I would like to share my experience.

A teacher has to be an effective communicator. There must be clarity in the thoughts of the teacher so that students get the message. Instead of focusing on lecturing, a teacher has to focus on learning of the subject by students. He/she has to be a facilitator and mentor rather than instructor in the class. Connecting the subject matters to the real-life situations, through various examples, as required in the medical profession as well as in basic/translational research would greatly motivate the students to learn deeper. Trying to impart or disseminate too much information in the classroom without emphasizing on the understanding of the fundamentals makes students bored. Often students try to remember the information for the sake of examination/tests, but they hardly make sense out of it. Engaging students in the discussion of challenging scientific problems and case studies of patients suffering from complex diseases, putting them into the habit of group learning, and inducing the critical thinking help generate new ideas that could be tested in laboratory leading to original research. In last several years during my classroom teaching many innovative ideas have been generated that were tested through M.Sc. dissertation projects, and later were taken up by the Ph.D. students to pursue and refine the same.

TEACHING PHILOSOPHY

For evaluation of learning by the students, I formally or informally follow the higher order thinking prescribed in revised Bloom's Taxonomy. I realized that researchers actively engaged in teaching might have to sacrifice time from their research, but it would be paid off well through generation of innovative ideas making them better thinkers and creative researchers. Thus, I believe that **“Teaching is a Powerful Tool for Research”**. While bringing the research experience to the classroom teaching helps in learning by the students, it also helps the researchers to be harvest the fruit of developing new concepts/ideas through the unbiased thinking of young students.



Prof. (Dr.) Sarat Dalai was conferred upon the prestigious Polyfeenolix- IIS Award for the **“BEST SENIOR IMMUNOLOGY TEACHER AWARD- 2023”** by the Indian Immunology Society for his passionate teaching during IMMUNOCON-2023, New Delhi.



Prof. (Dr.) Sarat Dalai
(Director, ISNU)

“FROM CODE TO CELL”: HOW AI IS DECODING LIFE

AI the buzzword goes along in every nook and corner of IT industry and every other industry on the verge of automation is nothing new now. We have been hearing this word since the beginning of 2020 and this word has tightened its grip ever since. How can we define AI and what is this “BLACK BOX” that we are unaware of? The history of AI goes back to Alan Turing who tried to decipher the most complex machine created by Nazi Germany at the beginning of World War II. This machine called “Enigma” was an encryption machine that was used to send the encoded messages making them difficult to intercept. It was a complex electromechanical machine that used a series of rotors and a plugboard to scramble messages, and it was thought to be unbreakable for a significant period. The Allies, particularly the British at Bletchley Park, in which Alan Turing and his team eventually cracked the Enigma code, which is believed to have significantly shortened the war. This was the first use of computation and Alan Turing in his paper “Computing Machinery and Intelligence” 1950 developed an imitation game, now known as “Turing test” which involves an interrogator trying to distinguish between a human and a machine through text-based conversation.

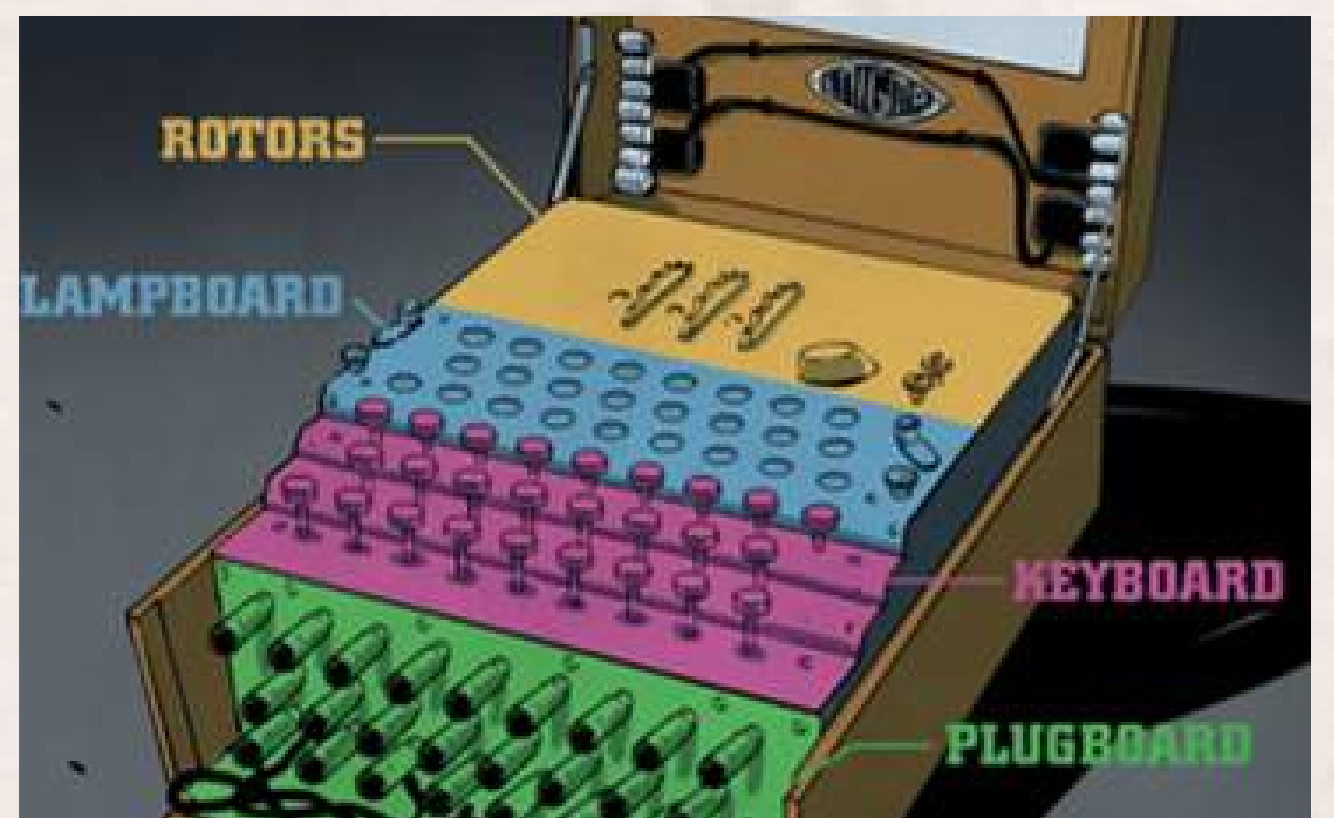
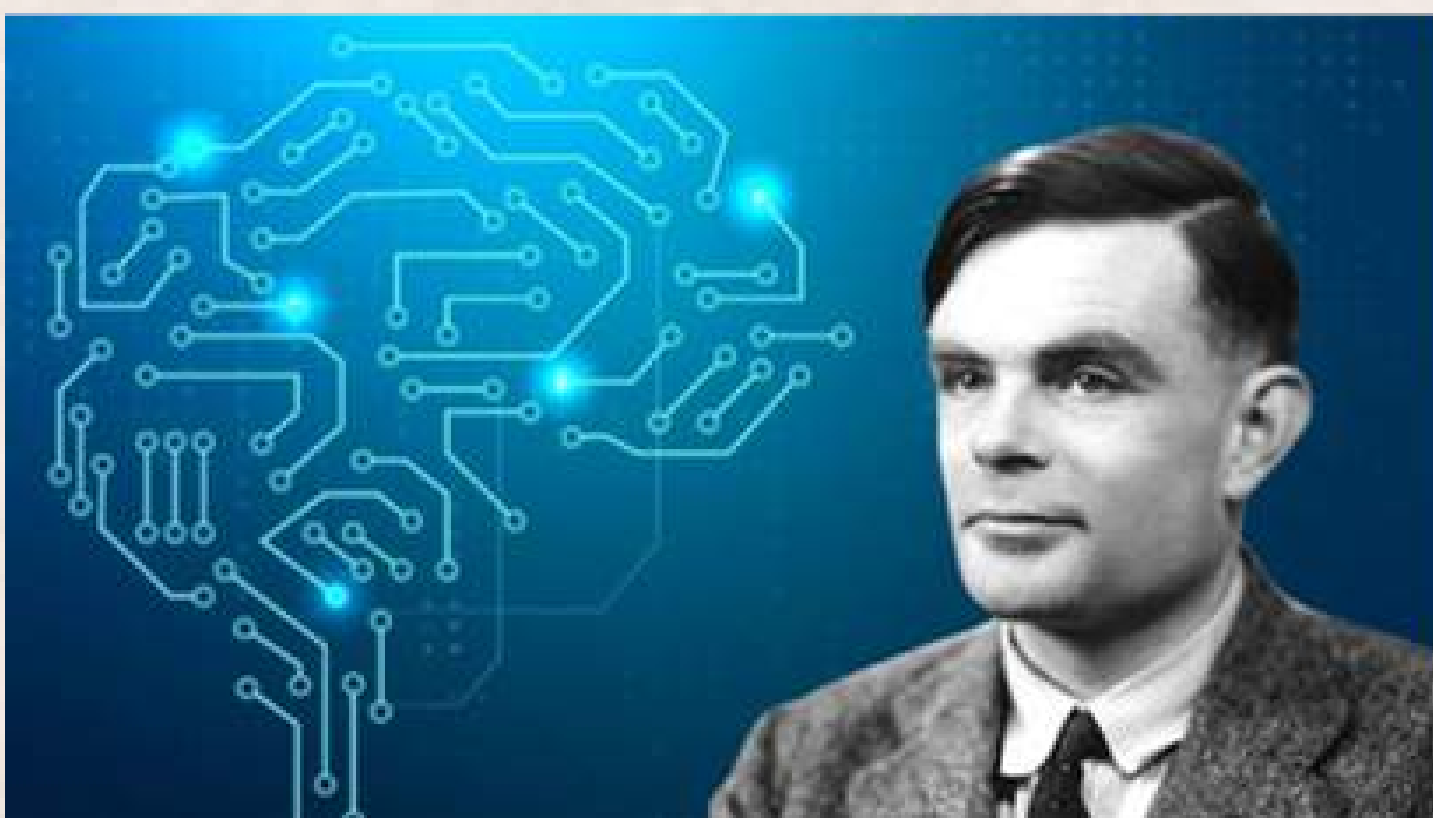


Figure: Showing Alan Turing (left) and the enigma machine model (right).

Source: (<https://hackaday.com/2017/08/22/the-enigma-enigma-how-the-enigma-machine-worked>)

However, with the advent of new computational technologies and increased computing power there has been a shift in the ability of computers to analyze data and develop complex models of the real world.

THE HARDWARE

Hardware



The first step that led to emergence of AI is through the evolution of data storage devices. The increased storage of data has made a pivotal shift in the ability of computers to retrieve the huge amount of data for developing complex models of the real world. Hard Disks are not sufficient to store the amount of data generated every day and so now Cloud storage is used to store the huge amounts of data. The second step that has led to evolution of AI is through the increased computing power using transistors and Very Large-Scale Integration of these transistors into chips. This has led to generation of CPUs (Central Processing Units) which are the brain of the computer.

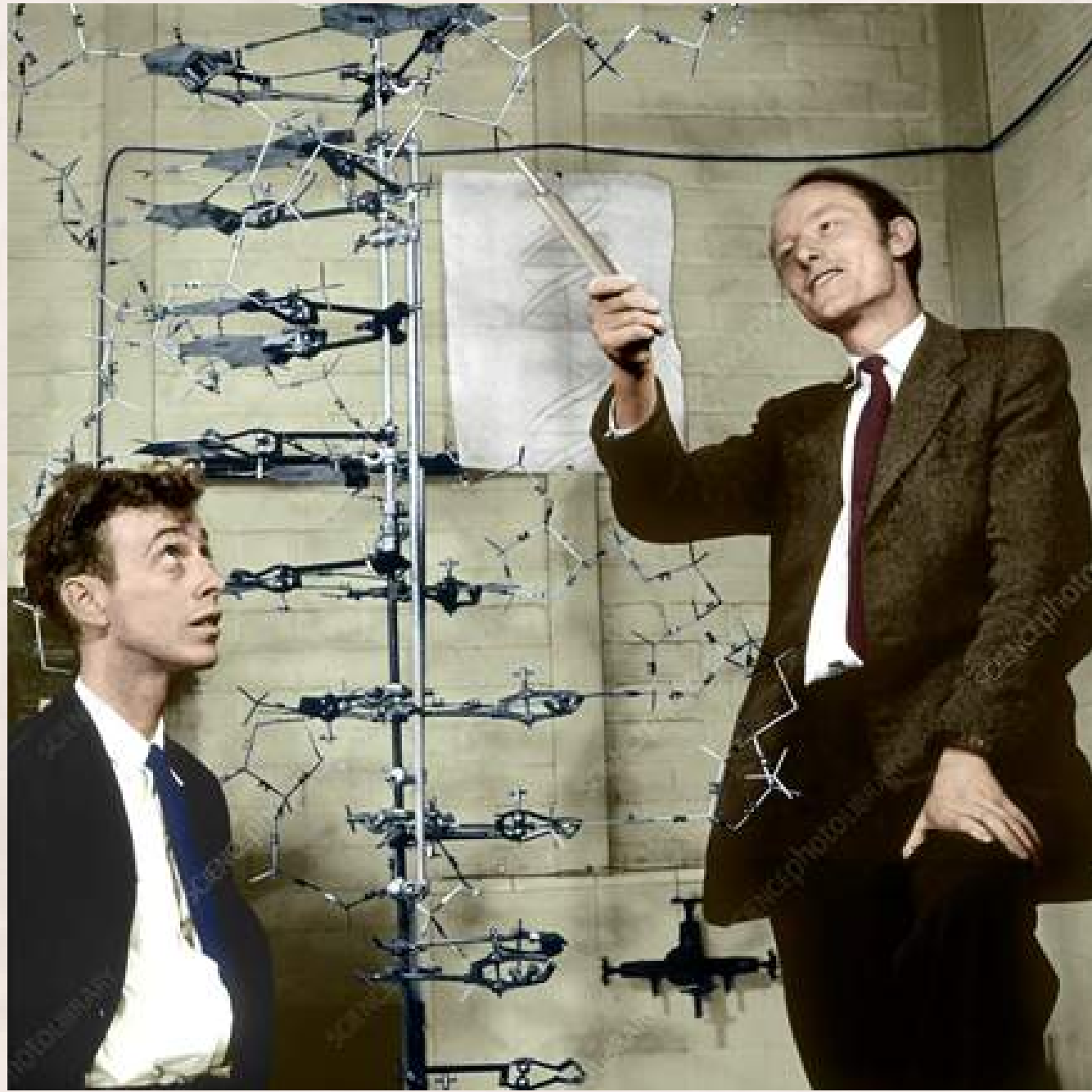
With newer generations of these CPUs and a better design GPUs (Graphical Processing Units) were born. These GPUs have many smaller specialized cores which provide massive performance. The hardware required for storage, retrieval and processing of the data has been pivotal in the development of AI technologies.

Software



The next important area that has led to emergence of the AI is the development of tools, algorithms and softwares that have enabled an efficient data analysis. The development of algorithms to make quick search through large databases has improved our ability to retrieve the correct information quickly. The statistical algorithms to process different types of datasets and generate inferences has again led to application of machine learning to variety of fields. The advent of Natural language processing algorithms has further led to development of ChatGPT and other such generative AI models.

BIOLOGY AND AI



Biological science has also undergone rapid shifts since the finding of genes or “factors” as Mendel called them to define the patterns of inheritance to finding the structure of the genetic material by Watson and Crick (Figure on right: Source: A. BARRINGTON BROWN, © GONVILLE & CAIUS College / coloured by Science Photo Library). Upon finding that there are 4 nucleotides that write the entire code of life, a whole new area of investigation began called “**Genomics**”. The study of Genomics was to understand the code of life and how it changes across individuals, generations and in certain disease conditions. With the advent of

genomics, scientists across the world began to decode the life through the “Human Genome Project” in 2003. With the development of sequencing technologies, most importantly next generation sequencers, more and more projects were being launched to understand the variations of this code across different individuals and in certain disease conditions.

The large-scale sequencing projects such as “1000 Genomes”, “UK BioBank” and “HapMap Project” further led to increase in the amount of data. The amount of data generated increased exponentially but the ability to understand these large-scale datasets was a huge challenge. Hence came the field of “Bioinformatics” which deals with handling, analysing and making inference from large sizes of data from human datasets. Databases such as NCBI, Ensemble and DDBJ were developed to store all of these datasets and tools such as BLAST (Basic Local Alignment Search Tool), HMM (Hidden Markov Models), de Bruijn Graph theory for assembly and Prodigal for gene prediction were developed. Each of these developments required the knowledge of computer science and information technology in order to solve the challenges with genome datasets.

PROTEIN FOLDING PROBLEM

The current landscape of artificial intelligence has changed biological science to a larger extent where more data intensive technologies are being used to solve for different problems.

One of the biggest achievements in this field was the development of “AlphaFold” which solved the 100-year problem of near perfect protein fold prediction which most of us did not expect to happen in our lifetimes. AlphaFold is the most ground breaking application of AI in biological science. AlphaFold combines numerous deep learning innovations to leverage the combined knowledge from 50 years of experimental science, stored in sequence and structure databases. It relies heavily on multi-sequence analysis using information on conserved peptide structures, but also on evolutionarily coupled residues.

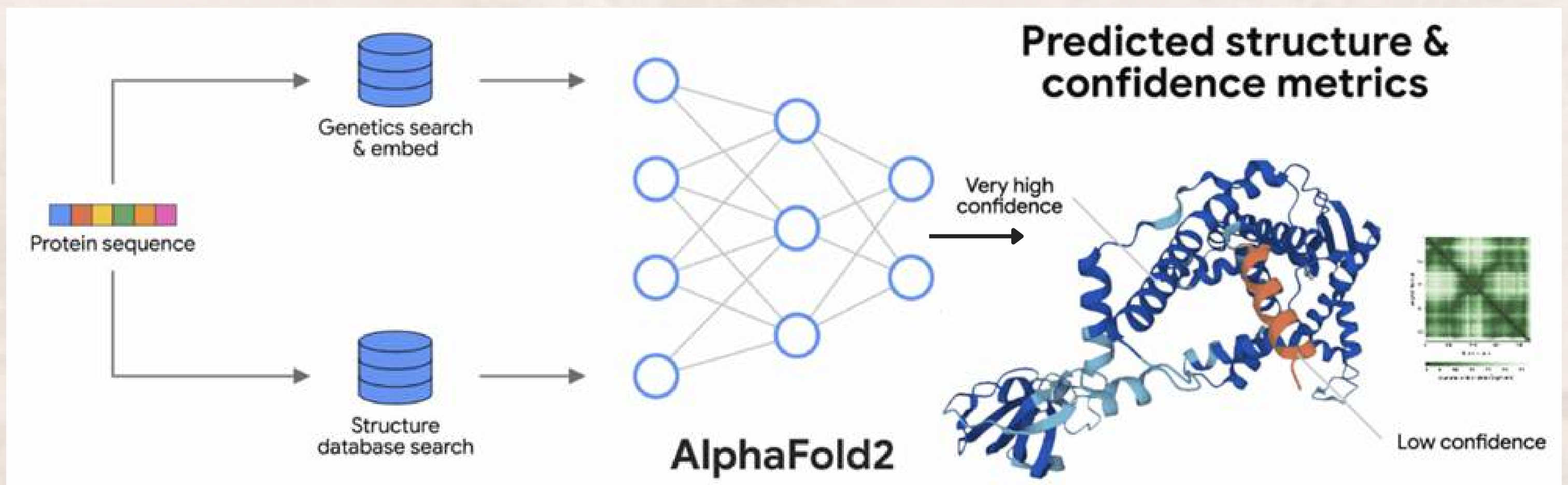


Figure: The Figure shows the data used by AlphaFold2 to model protein structure prediction from protein sequences (Source: <https://www.ebi.ac.uk/>)

MICROSCOPY AND IMAGE ANALYSIS

AI is also transforming image processing and microscopy. With advanced algorithms such as “Neural networks” which are trained on specific annotated training images, the algorithm can detect minute features which can go undetected and can provide finer details of the cell. The reconstruction of high-resolution images from microscopy is another important advancement that AI has achieved which can improve the images and make analysis much more efficient.

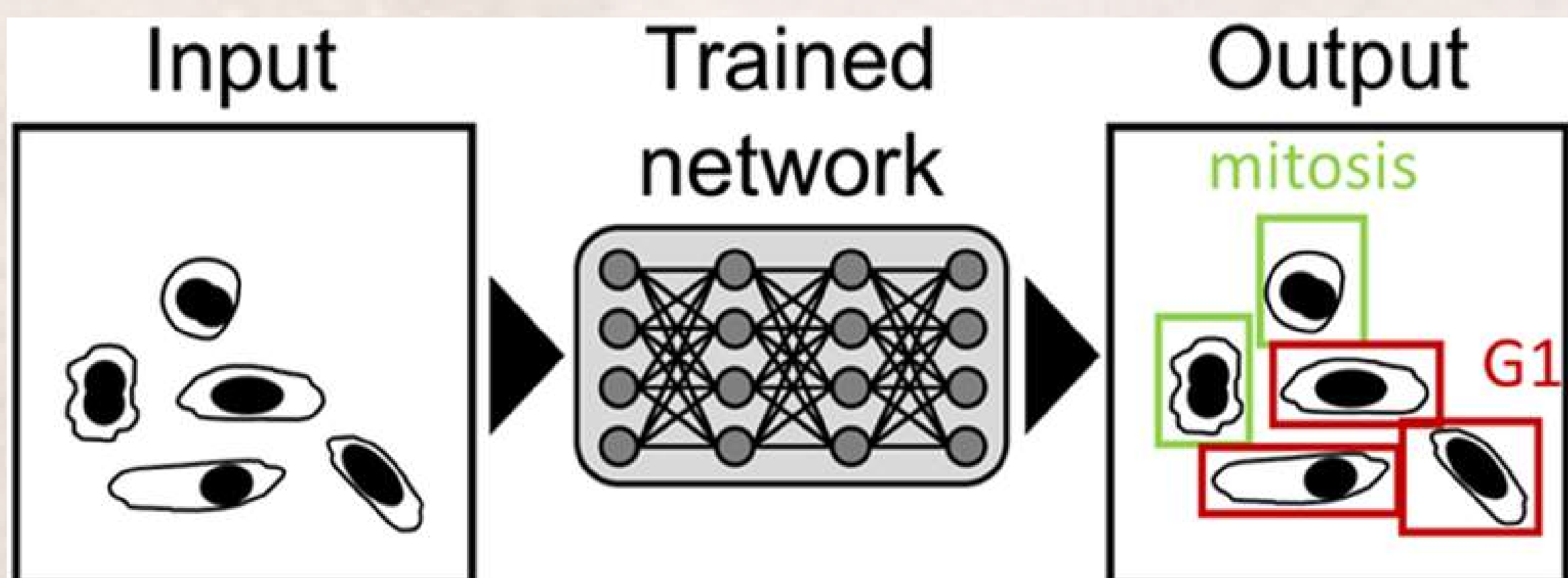


Figure: Showing the working of Neural Networks for the identification of cells under different stages of mitosis.

Deep learning algorithms such as enforcement learning and Neural networks have further improved image processing and its analysis distinguishing the most important features across noise. [Andre Esteva](#) and his colleagues developed a CNN (Convolutud Neural Networks) model that could diagnose and differentiate skin cancer from other standard skin lesions with accuracy comparable to dermatologists by analysing dermoscopic images.

EARLY CANCER DETECTION

Diagnostic labs across the world have now started using sequencing technologies as a method to diagnose and treat cancers at a very early stage. The tests such as “Galleri” are now being developed which can detect the cancer using a biopsy and identify the type  cell free DNA through liquid of cancer at stage 0. These diagnostic tests use Next Generation sequencing data as a method to evaluate the cancer when none of the imaging technologies can detect. Such early cancer detection tests also rely on the available datasets and the AI algorithms to provide confidence in the cancer detection and hence can be used for general screening for cancer.

CELL CULTRE AND AUTOMATION

Cell culture is one of the notoriously high maintenance jobs and required daily media change for example in culturing the iPSCs. However, newer technologies such as “[CellXpress.ai](#)” have now developed workflows and technologies that optimized critical elements such as media change and passaging and hence automates the process. This further can lead to efficient trials of drugs on cell cultures and hence save a lot of time for scientists.

BIOLOGY INSPIRED AI MODELS

Our immune system only allows lymphocytes, that recognize certain antigens, to be cloned and proliferated with such identical antigenic receptors. This phenomenon known as clonal selection presents itself as a learning problem driven by context (antigen) and an appropriate response. This led to the invention of the Artificial Immune System, a class of computationally intelligent, rule-based machine learning systems, inspired by the intricacies of the immune system of vertebrates. Akin to their living counterparts these models excel in recognizing something presented to it as an “antigen” and take the most appropriate response making them ideal for applications such as antiviruses and anti-spams.

PROMISING FUTURE

The future holds immense potential for transformation of biological sciences and healthcare using Artificial Intelligence. Artificial Intelligence is emerging as a transformative force in biological science and healthcare, bridging the gap between complex biological data and actionable insights. However caution is warranted as the performance of these models will depend on the training datasets and how generalisation has been incorporated into each machine learning model at the time of training. The underfitting of the data and at the same time overfitting of the data both can cause the models to be biased and less accurate. However, the pace at which new datasets are generated and the rate at which improvements are made will definitely play a pivotal role in this quest. Whether it's predicting disease, designing drugs, or deciphering the mysteries of life at the molecular level, AI is now an indispensable tool in every biologist's toolkit. So, if you're curious, now's the time to dive into this captivating intersection of science and technology—where the future of biology is being driven by AI.

EXPLORING THE IMPACT OF ARTIFICIAL INTELLIGENCE ON BIOLOGICAL SCIENCES

Artificial Intelligence (AI) is emerging as a transformative force in biological sciences, with applications spanning genomics, proteomics, drug discovery, and biomedical imaging. This study aimed to assess awareness, experience, and perceptions of AI among individuals in life sciences.

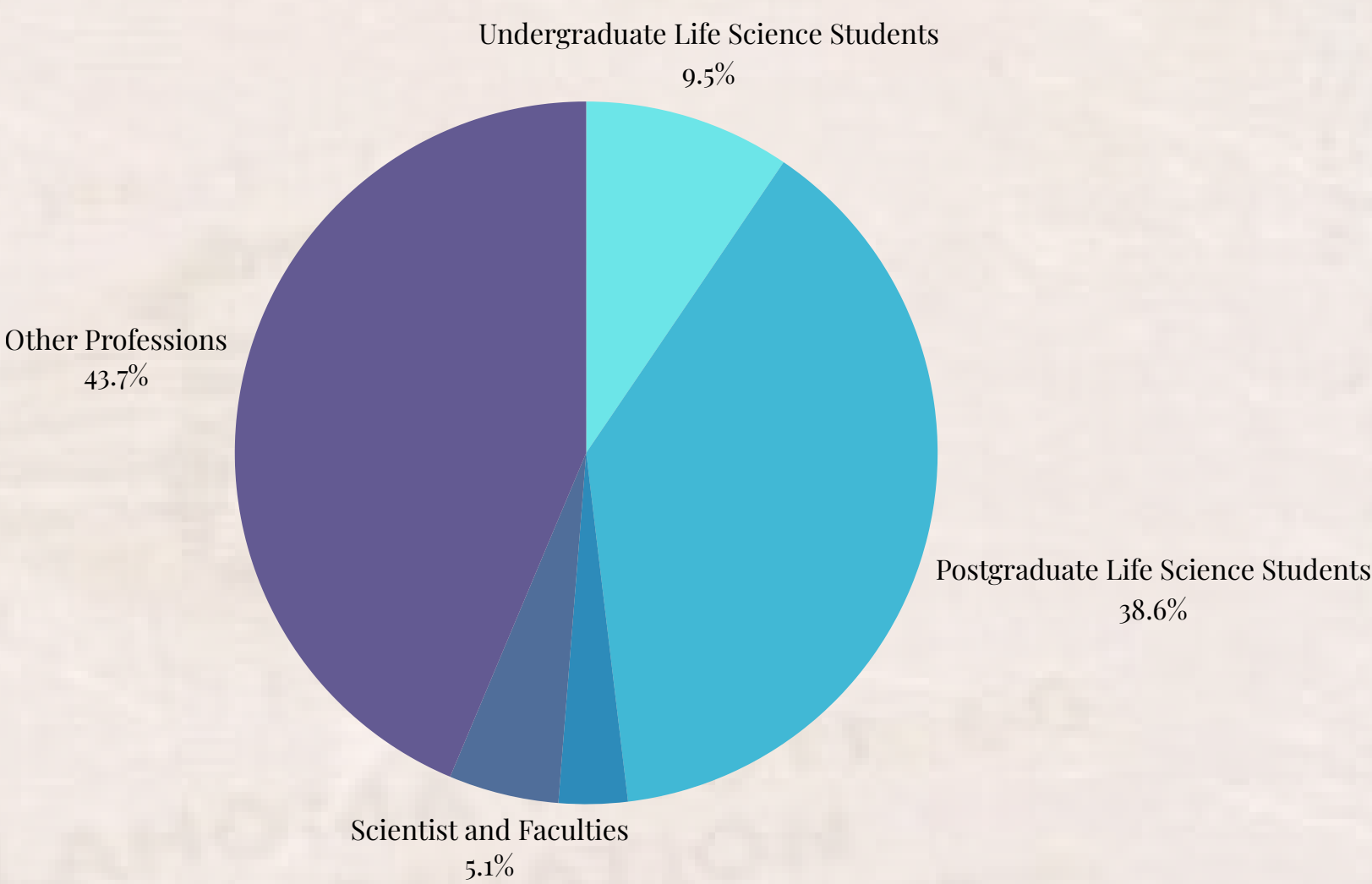
A Google Form-based survey was distributed to undergraduate students, postgraduate scholars, and research professionals from biology-related backgrounds. It gathered data on participants' familiarity with AI, exposure to computer science or coding, prior use of AI tools (excluding ChatGPT), and their views on AI's future role in biology.

The findings reveal a high level of awareness of AI's growing importance but varied degrees of practical experience. Many respondents were optimistic about AI's potential to enhance research efficiency and create new opportunities, while some expressed concerns about its influence on the role of human researchers.

The results highlight the importance of structured training programs and interdisciplinary collaboration to ensure effective integration of AI in biological research workflows. This foundational insight can guide future initiatives aimed at preparing the life science community for AI-driven advancements.

ANALYSIS

Respondent Professions Distributions (N=158)



The largest respondent group falls under other than Master of Science professions (43.7%), followed by Postgraduate Life Science Students (38.6%). Undergraduates, Research Scholars, and Scientists/Faculty collectively make up less than 25% of the sample, indicating heavy skew toward non-grouped professions and postgraduates.

• Perceived Opportunities from AI in Biological Sciences

Postgraduate Life Science Students overwhelmingly believe AI will provide more opportunities (48 Yes vs. 11 Maybe, 1 No). The "Other" profession group shows substantial optimism as well, but with a notable "Maybe" segment (23 Maybe vs. 40 Yes). Scientists/Faculty respondents are least convinced, with equal Yes and Maybe counts (4 Yes, 2 Maybe) and a small No segment.

	Yes	No	Maybe
Undergrad Life Science	6	6	3
Postgrad Life Science	36	8	17
Scientist or Faculty	2	1	2
Research Scholars	4	2	2
Other Professions	36	13	20

• AI Awareness and Coding Experience by Profession

Across all groups, AI awareness (total 121) far exceeds coding experience (total 52), indicating a broader conceptual familiarity over practical skill. "Other" professions lead in both AI awareness (52) and coding experience (32), highlighting this group's stronger technical engagement. Undergraduate and Scientist/Faculty groups show the largest awareness-to-experience gaps, suggesting potential training targets.

	AI awareness'	Coadding Knowledge
Undergrad Life Science	13	2
Postgrad Life Science	48	14
Scientist or Faculty	2	2
Research Scholars	6	2
Other Professions	52	32

• Perception of AI's Impact on Human Researchers

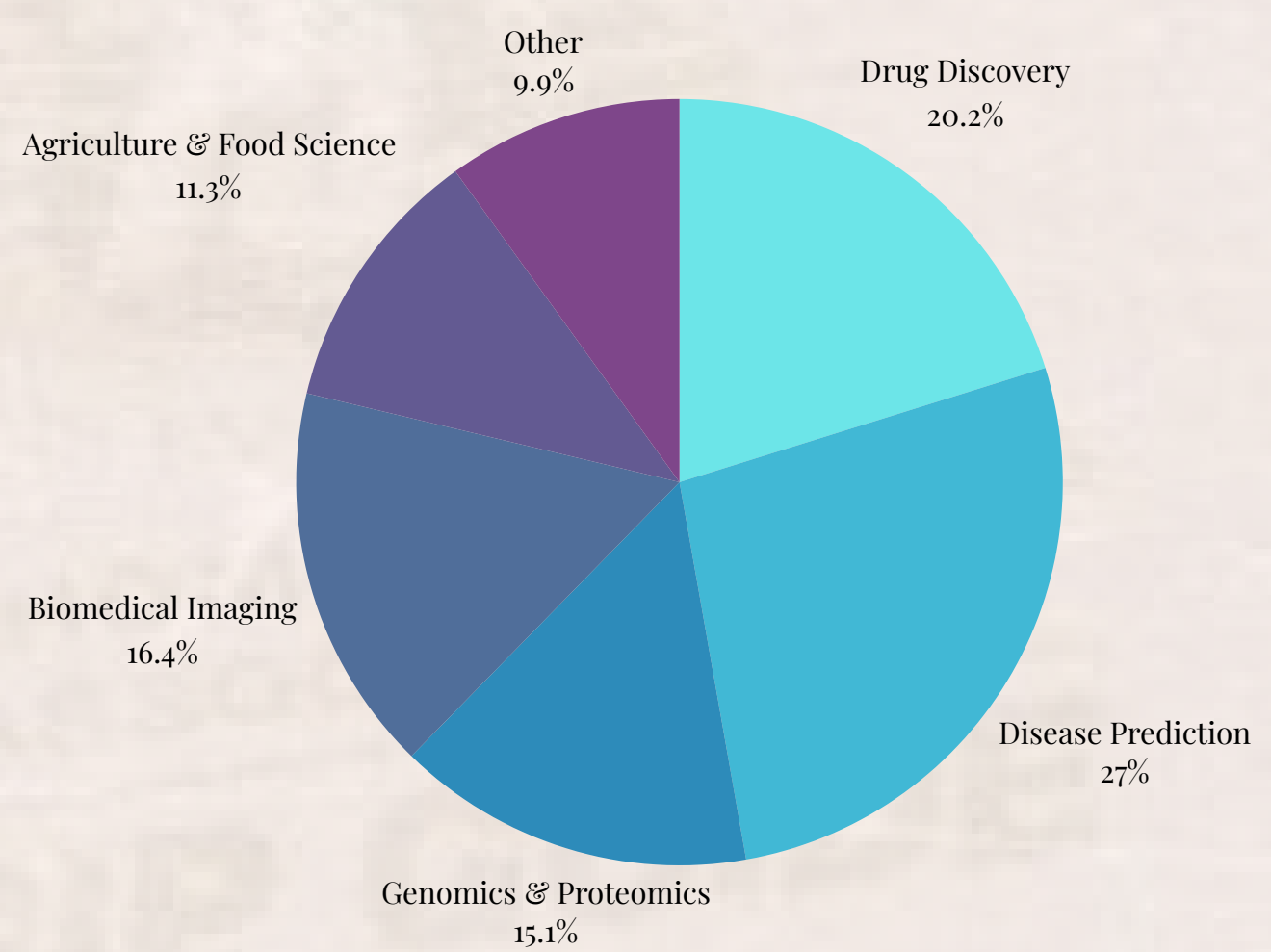
The chart illustrates the variation in perception among respondents from different academic and professional backgrounds. A significantly higher proportion of participants from postgraduate life sciences and other professional sectors responded affirmatively, indicating strong optimism regarding AI's impact. These trends suggest that perception of AI’s transformative potential may be influenced by academic exposure and interdisciplinary engagement.

	Yes	No	Maybe
Undergrad Life Science	6	6	3
Postgrad Life Science	36	8	17
Scientist or Faculty	2	1	2
Research Scholars	4	2	2
Other Professions	36	13	20

Expert Article

- Key Areas for AI Contribution in Biology

Disease prediction is viewed as the top area for AI impact, accounting for over a quarter (27.22%) of responses. Drug discovery (20.25%) and Biomedical Imaging (16.46%) are the next most cited areas, together representing over one-third of interest. Agriculture & Food Science is the least selected key area among the listed options at 11.39%



- AI Tool Adaptation Journey

The progressive reduction in the number of potential AI tool users based on key barriers. Starting from a total of 158 respondents, 37 were not following recent AI developments, 78 lacked coding experience, and 114 had no prior exposure to AI tools in biological research. These sequential filters culminated in a significant drop in the final pool of respondents actively engaged with AI tools, highlighting critical gaps in awareness, technical skills, and practical experience.

SUMMARY

Profession	Responses (N= 158)	Follow latest development of AI	Not Follow latest development of AI	Percentage	Feels like AI alter the role human research	Yes	No	Maybe
Undergrad Life Science	15	13	4	8,667%	2,667%	3	6	6
Postgrad Life Science	61	48	16	7,869%	2,623	17	8	36
Scientist and Faculty	5	2	1	40	20	2	1	2
Research Scholars	8	6	4	7,500	5,000	2	2	4
Other Professions	69	52	19	7,536	2,754	20	13	36

CHI-SQUARE ANALYSIS

The Chi-square test used to examine whether differences in AI awareness, coding experience, and perceptions of AI’s opportunities were meaningfully related to participants’ academic or professional backgrounds. The survey data consisted of categorical variables such as profession type, educational level, and response options (“Yes,” “No,” “Maybe”) which makes parametric tests unsuitable. The Chi-square method is ideal in this context because it allows for testing the independence of such categorical variables without assuming a normal distribution. By applying this method, it becomes possible to identify whether the variations observed between groups reflect actual associations rather than random variation, thereby supporting more reliable interpretations of the survey findings.

To evaluate the association between participants' professional backgrounds and their perceptions and experiences related to Artificial Intelligence (AI), a series of Chi-square tests were conducted. These statistical tests help determine whether observed differences in responses across categories (e.g., professions) are statistically significant or due to random variation.

Test	Chi-Square	P Value	Degree of Freedom
Professions vs Impact on Human Research	647,680,006	59,398,212	8
Professions vs Prior AI Tool Use	220,031,322	69,897,193	4
Professions vs Following AI developments	480,102,443	30,832,954	4
Professions vs Belief in AI changing Research	2,458,121,615	182,986	8
Professions vs Key contribution area	3,023,709,019	6,610,196	20

• Profession vs. Belief that AI will change Biological Research

This test yielded a Chi-square value of 24.58 with 8 degrees of freedom (df) and a p-value of 0.0018, which is highly significant ($p < 0.01$). This result indicates a strong association between the respondents’ profession and their belief that AI will significantly impact biological research. In simpler terms, people's professional backgrounds influence how strongly they believe AI will transform the field. For instance, students, researchers, and professionals may have varying levels of exposure or expectations based on their experience, which is reflected in this significant difference.

CONCLUSION

Survey results show disease prediction as the top anticipated AI application (27%), followed by drug discovery and biomedical imaging, which together make up over one-third of responses. Agriculture and food science ranks lowest (~11%).

Respondents are primarily from “Other” professions (43.7%) and postgraduate life science students (38.6%), with undergraduates, research scholars, and scientists/faculty forming less than a quarter of the sample. Postgraduates are the most optimistic, with 48 positive responses and only one negative, while scientists/faculty show the most balanced mix of positive and uncertain views.

Although 121 (77%) respondents report AI awareness, only 52 have coding experience. “Other” professions lead in both areas, while undergraduates and scientists/faculty show the largest skill gaps, highlighting them as priority targets for training.

These insights reveal high optimism but uneven readiness, emphasizing the need for targeted skill-development programs to support AI integration in life science research.



Dr. Darshan Dhakan &
Keyur Shah

PUZZLE

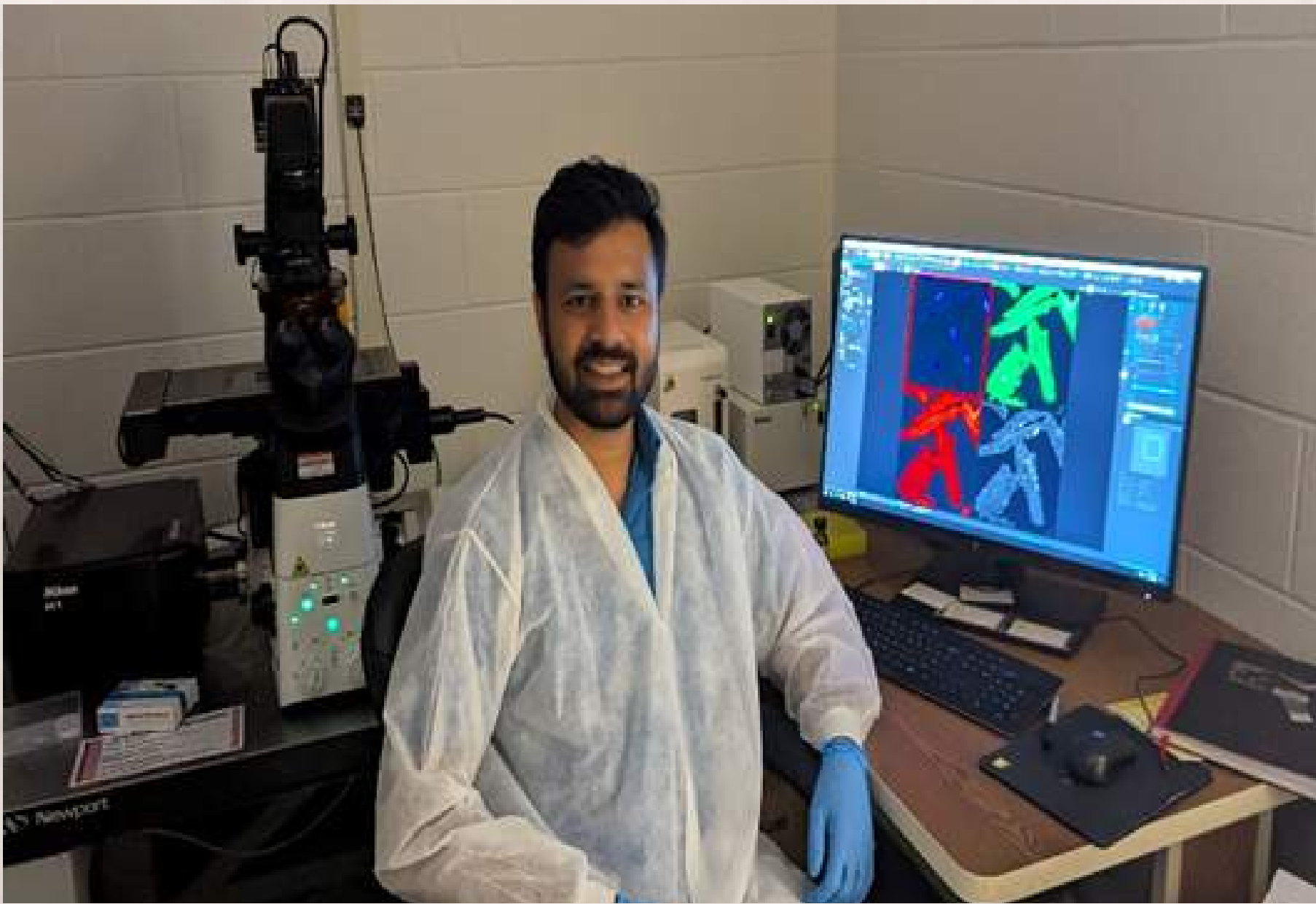
ANOKHI ANTAKSHARI

Example:

1. Tool used for editing genes precisely? CRISPER
2. What is the machine learning method used in predicting gene-disease links? Regression
3. Which sequencing technology allows rapid genome analysis? NGS

1. What is the process of programmed cell death called? _____
2. What is the name of the WHO's mRNA vaccine tech transfer hub country? _____
3. What is the process of predicting gene locations in genomes? _____
4. Term for AI models that simulate brain activity? _____
5. The lipid-based system used to deliver mRNA vaccines? _____
6. What is the method of separating DNA fragments by size? _____
7. Name of monoclonal antibodies used to treat COVID-19? _____
8. Nobel Prize 2022 for click chemistry was shared with Carolyn...? _____
9. Which cytokine is key in antiviral defense and produced by infected cells? _____
10. AI tool used for understanding human language in biomedical texts? _____

BK_{Ca} CHANNEL: TINY GATEKEEPERS WITH BIG IMPACTS ON HEART HEALTH AND CELLULAR COMMUNICATION



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THE Fundamental Unit of Life, a lesson introduced in high school, first taught us about the concepts of diffusion and osmosis. During my undergraduate studies, these ideas were expanded with greater detail, including distinctions between active and passive transport. Later, the discovery of key molecular players such as ion channels and transporters brought even more depth.

My current research, which began during my Ph.D. and continues in my postdoctoral work, centers on active transport mechanisms mediated by ion channels, particularly in the context of cardiovascular physiology and pathology. As someone working at the intersection of ion channel biology and heart health, I have long been fascinated by how small molecular entities can exert profound physiological effects. One such tiny player is BK_{Ca} channel, a large conductance calcium-activated voltage-regulated potassium channel, known to have the largest potassium conductance across human physiology.

In biological systems, the BK_{Ca} channel encoding gene *Kcnma1* is highly conserved from *Drosophila* to *Homo sapiens*. The channel's ubiquitous expression across both excitable and non-excitable cells places it at the center of various physiological functions, including the regulation of gene expression, autonomic control of urinary and erectile function, modulation of vascular tone, neuronal signaling, cardiac rhythm, and aging. In recent years, mutations in the *Kcnma1* gene have been linked to several human channelopathies, positioning BK_{Ca} channels as promising targets for therapeutic intervention.

In adult cardiomyocytes, the BK_{Ca} channel localizes exclusively to the inner mitochondrial membrane due to a unique c-terminal splice variation in the Kcnma1 gene called BK_{DEC}. Activation of BK_{DEC} has been recognized in mediating cardioprotection against ischemia-reperfusion injury. While working with neonatal cardiomyocytes, we were surprised to find mitochondrial as well as plasma membrane localization of BK_{Ca} channel in neonatal cardiomyocytes. This preliminary result sparked our curiosity in deciphering the role of BK_{Ca} in neonatal cardiomyocytes in comparison to the well-established role of BK_{Ca} channels in adult cardiomyocytes. In our study, we found the molecular switch lies in the increase of the C-terminus DEC splice variant with developing hearts. This study enhanced our understanding of how the BK_{Ca} channel in the plasma membrane facilitates potassium fluxes in neonatal cardiomyocytes, which are essential for development. At the same time, in the later part of the development, the energy demand of the heart muscle increases, which brings the focus to mitochondria. The presence of BK_{Ca} channels in mitochondria in adult cardiomyocytes is essential for mitochondrial structure and function. At the functional level, we discovered that the opening of BK_{Ca} channels at the organ or cellular level causes apoptosis and increases myocardial infarction in neonates. The contrasting outcome of BK_{Ca} channels in neonates, as opposed to adults, was attributed to the plasma membrane localization and opening of BK_{Ca} channels. For the first time, our study highlighted the importance of the BK_{Ca} channel into account before selecting the appropriate pharmacological therapies in the pediatric population.

In my second work, we started exploring the role of ion channels in the tiniest of organelles called extracellular vesicles (EVs). These nanometer-sized, lipid bilayer-enclosed vesicles (40–1000 nm) are secreted by most cell types and are known to contain a wide array of biomolecules, including proteins, mRNA, microRNA, and lipids. In recent years, EVs have gained traction as diagnostic and therapeutic tools in the treatment of cardiovascular disease, cancer, and neurological disorders.

EVs originate within the intracellular environment, where potassium concentration is ~140 mM, and are released into the extracellular space, where potassium is ~4 mM. Given this huge ionic gradient, we hypothesized that EVs must harbor functional potassium ion channels to counter the osmotic stress and maintain structural integrity during biogenesis and secretion. This hypothesis circled back to the BK_{Ca} channel, due to its biophysical nature, which is a large-conductance potassium channel. Therefore, we started characterizing the presence of BK_{Ca} channels in EV membrane. As an electrophysiologist, the biggest challenge was to record functional BK_{Ca} channel activity in intact exosomes due to its tiny nature traditional patch clamp system could not have been incorporated. Hence, we introduced a novel electrophysiological method called ‘near field electrophysiology’ in collaboration with the Mechanical and Aerospace Engineering Department at OSU. In near-field electrophysiology, highly sensitive potassium actuators were able to record the potassium currents in the intact EVs, which were sensitive to iberiotoxin, a specific blocker for BK_{Ca} channels.

The molecular identity of BK_{Ca} channel in EVs was established for the first time. Furthermore, our results indicated that the presence of BK_{Ca} channel is vital for surviving in the osmotic potassium handling observed during the biogenesis of EVs. Moreover, the presence of BK_{Ca} channel showed selectivity in packaging the contents within the EVs, where several cardioprotective miRNAs were present in EVs isolated. Lastly, the cardioprotective-rich miRNA in EVs containing BK_{Ca} channels were able to mediate cardioprotection from in vitro oxidative stress and in vivo from cardiac ischemia-reperfusion injury.

Our study, for the first time, recorded the presence of functional channels in EVs, which are crucial for maintaining their structural integrity and survival in differential potassium ionic gradients.

As we push toward more targeted therapies, whether using EVs for drug delivery or tailoring interventions for pediatric cardiac care, understanding when and where to modulate BK_{Ca} channels could be the key. These tiny molecular gatekeepers are teaching us, yet again, that in biology, size never limits significance.

Lastly, my two cents to the budding scientists: “You are the spark in the dark, the question in the silence, the curiosity that refuses to rest”. Science is not just a discipline; it’s a journey of wonder, resilience, and discovery. Every great breakthrough began with a fundamental question, someone who dared to ask why, who looked at the unknown and said, “let’s find out”. The journey might not be easy, linear, or predictable, but it will always be meaningful, transformative, and worth every step. So, keep observing, keep questioning and keep believing.



Dr. Sridhar Sanghvi
(Alumni, ISNU, 2012-14)

Quantcure

Bridging the Drug Gap with AI for Every Disorder



Our Mission: One Drug for Every Disorder. This ambitious vision drives Quantcure, a pioneering deeptech startup, in its quest to revolutionize drug discovery. The urgent need for this mission is starkly evident in the pharmaceutical landscape: while over 22,962 distinct disorders have been identified, a mere 4,700+ approved drugs exist to treat them. This leaves a vast majority of human ailments without a dedicated therapeutic solution.

This critical shortage is most pronounced in orphan diseases rare conditions affecting small patient populations. Despite significant advances in biomedical research, these diseases often remain underserved because traditional drug discovery is notoriously slow, costly, and inefficient. Conventional methods typically span 10-15 years and incur over \$2.5 billion in costs for a single drug, with a staggering 90% failure rate in clinical trials. This makes investment in treatments for rare conditions economically unattractive for most companies.

However, AI-assisted drug discovery offers a transformative solution. By leveraging machine learning, predictive modeling, and MLOps automation, AI pipelines can slash costs by 40-60% and significantly reduce discovery timelines. Quantcure is at the forefront of this revolution, committed to bridging the gap between cutting-edge deep technology and pharmaceutical sciences to deliver quicker, better, and safer drugs to market.

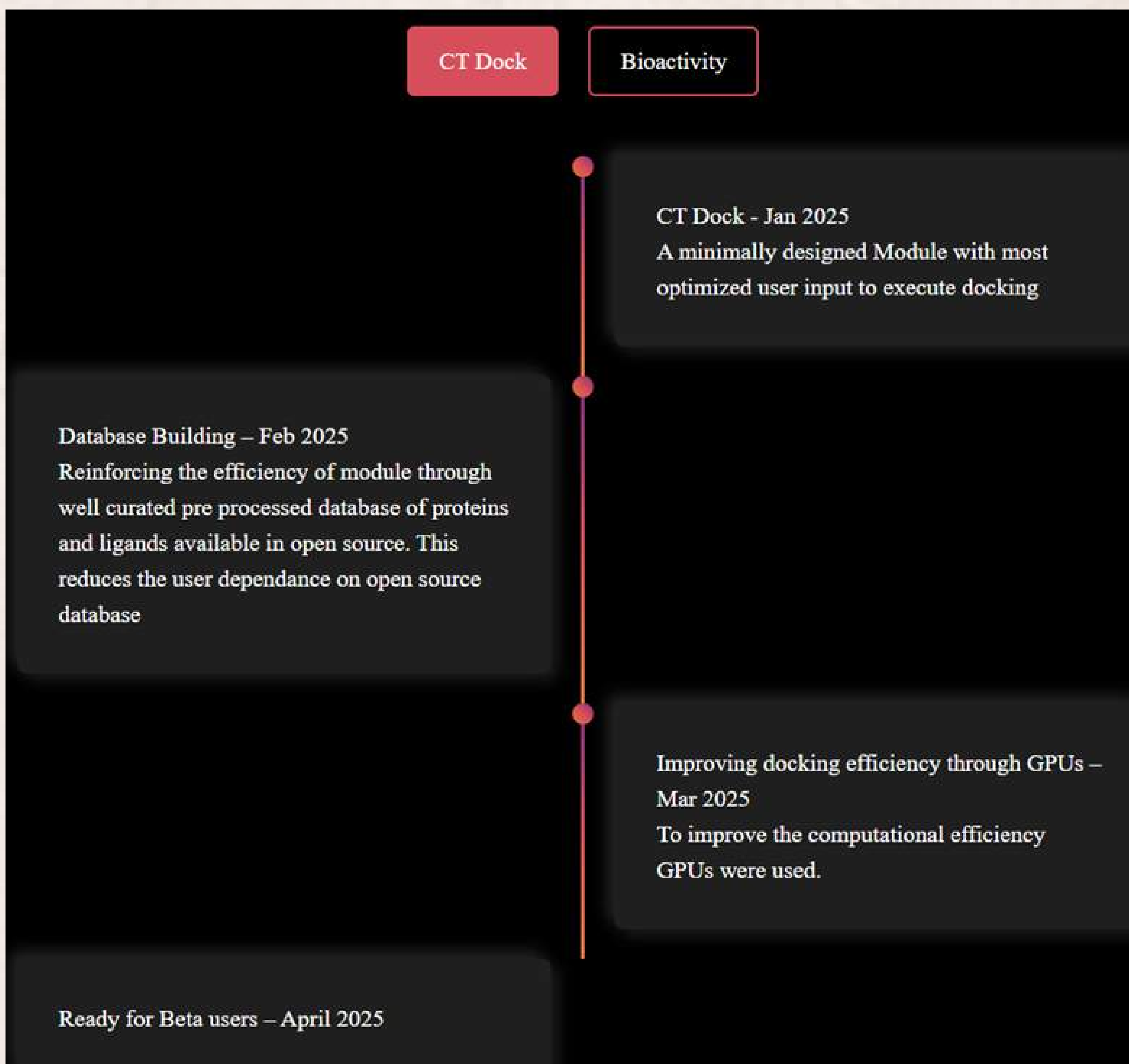
Democratizing Drug Discovery with an Intuitive AI Platform

Quantcure's innovative solution empowers even non-coders to develop highly accurate machine learning models. Users can simply input their validated biological and chemical datasets (or utilize Quantcure's curated datasets), and the intuitive platform handles the complex processes of model training, optimization, and deployment. This unprecedented automation dramatically accelerates crucial steps such as target identification, lead optimization, and predictive toxicology.

By democratizing access to cutting-edge AI, Quantcure enables researchers and organizations of all sizes to:

- Rapidly identify promising drug candidates.
- Simulate complex molecular interactions.
- Predict efficacy and potential side effects with unparalleled precision.

This user-friendly approach dramatically compresses discovery timelines and reduces R&D expenditures. By allowing those without deep computational expertise to develop sophisticated ML models, Quantcure is not just improving drug discovery; they're making it accessible, faster, and more successful.



Quantcure's AI-Powered Approach to Urgent Needs

Quantcure's platform directly tackles inefficiencies by leveraging deep learning across key stages:

- **Accelerated Target Identification:** AI algorithms swiftly analyze vast biological data (genomics, proteomics, disease pathways) to pinpoint drug targets, significantly reducing initial discovery time for rare diseases.
- **Enhanced Compound Screening & Optimization:** Generative AI designs novel drug candidates with optimized properties. Virtual screening of millions of compounds can be performed rapidly, predicting efficacy and side effects before costly lab work. This ensures more potent compounds with fewer side effects for specialized orphan drug development.

- **Improved Predictive Modeling:** AI simulates drug interactions within the human body, providing critical insights into pharmacokinetics and pharmacodynamics. This predictive power anticipates drug behavior, reducing risks and improving success rates in later stages.

Features in Pipeline: Deeper Molecular Understanding

Quantcure is continuously evolving its platform, with features in the pipeline designed to push the boundaries of molecular interaction understanding:

- **Revisiting Drug-Compound Interactions:** Future enhancements will delve deeper into compound-protein interaction profiles, aiming to explain these complex relationships in novel ways.
- **Universal Framework for New Targets:** Quantcure is constructing a new, universally accurate framework to facilitate the discovery of drugs for novel targets, integrating multiple biological pathways and fundamental bio-knowledge to expand therapeutic possibilities.

Addressing the Orphan Disease Opportunity

While widespread implementation of these technologies remains limited, and few platforms fully integrate them into a seamless, scalable workflow, Quantcure is filling this gap, providing an intelligent, end-to-end solution to streamline and de-risk therapeutics development for orphan diseases. Their focus on orphan diseases ensures that their technology addresses critical unmet medical needs, unlocking a high-value market while bringing life-changing treatments to patients who have been historically overlooked.

With global orphan drug sales expected to exceed \$250 billion by 2027, supported by regulatory incentives, market exclusivity, and faster approval pathways, this segment offers a compelling commercial opportunity for forward-thinking drug development organizations like Quantcure.

Quantcure operates with core values of patient centricity, integrity, and innovation. By embracing AI and making its power accessible, Quantcure is fundamentally reshaping the healthcare landscape, paving the way for a future where effective, safer treatments reach patients, especially those with historically overlooked rare diseases faster than ever before.



Dhruvi Patel
(24-MBT-029)

TECHNOLOGIES IN LIFE SCIENCE

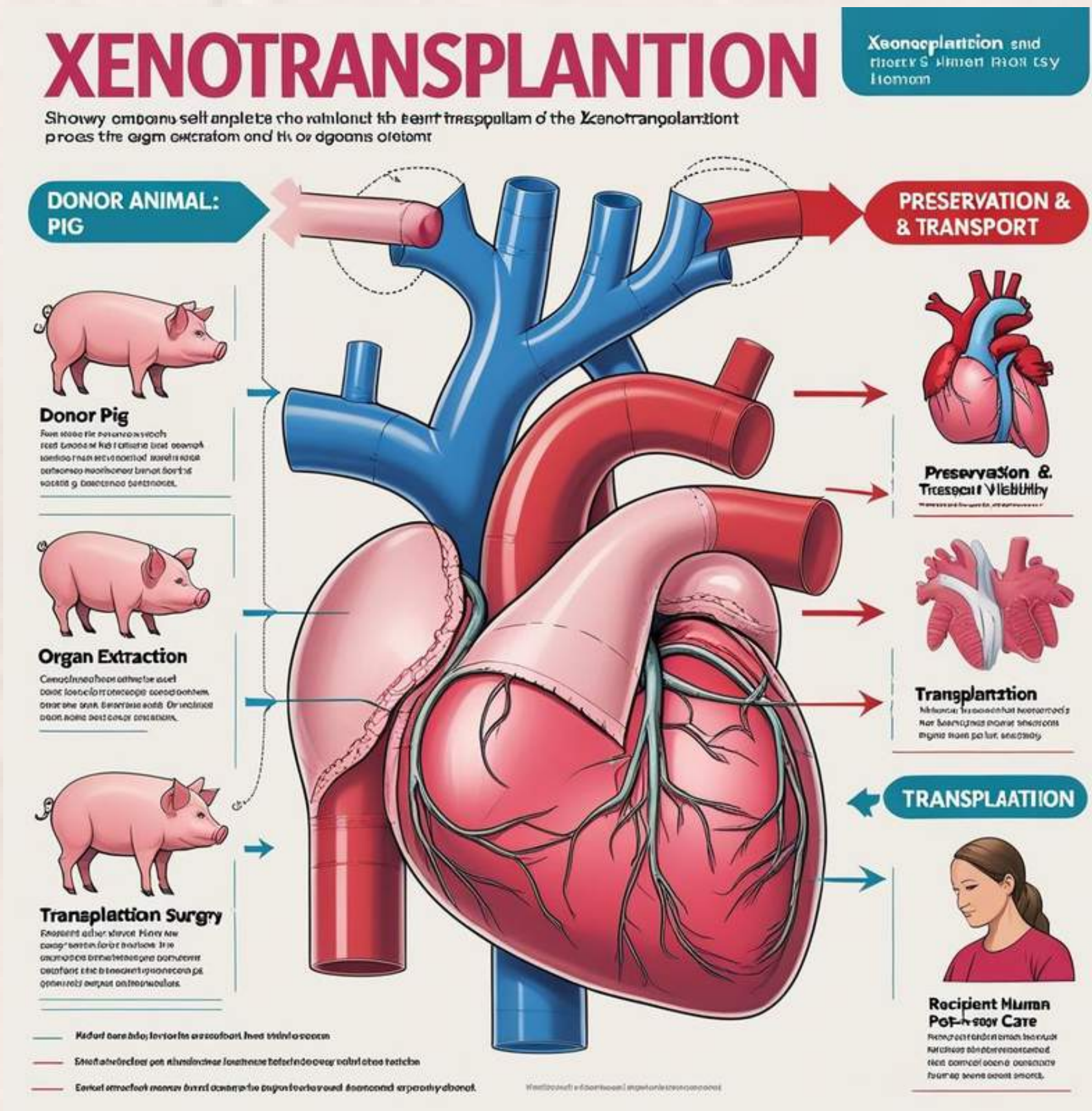
The rapidly evolving world of technology is transforming the way we understand and explore life sciences. With innovative methods, research is becoming faster, more precise, and more impactful making both science and daily life easier. From breakthroughs that redefine medical possibilities to tools that decode life at the tiniest levels, these technologies play a vital role in shaping our future.

In this section, you will find articles on:

- **Xenotransplantation**
- **Tough-cell Adhesive- A Sticky Revolution in Medicine**
- **DNA Nano-switch capillaries**
- **One cell at a time – The revolution in RNA sequencing**

XENOTRANSPLANTATION

"Piggy Banks of Hope: The Future of Organ Transplants Lies in Xenotransplantation"



Imagine a world where no one dies waiting for an organ transplant. Sounds like science fiction? With advances in xenotransplantation, this could soon become science fact.

The Organ Shortage Crisis

The demand for organ transplant in the US is outpacing the supply, with

over 100,000 people on the waiting list and only 46,000 procedures performed in 2023. Kidney disease affects over 14% of US adults, with 800,000 living with kidney failure and 25,000 kidney transplants performed annually.

The Pig Solution

Pigs have become promising candidates for organ donation to humans. Their organs are similar in size and function to human organs, and pigs reproduce quickly, offering a potentially unlimited supply. However, the leap from pig to human isn't as simple as a surgical transplant, it involves complex genetic engineering and careful immune matching. Xenotransplantation is used as one of the techniques to achieve our goal.

What is Xenotransplantation?

Xenotransplantation is defined as the grafting of cells (xenogeneic cells), tissues, or entire organs from a non-human animal into a human recipient. In practice, research has focused primarily on pig-to-human xenografts because the porcine organs like kidney are comparable in size and basic functions to human organs.

PERVs: The Hidden Threat

One of the major hurdles in xenotransplantation has been the presence of PERVs—Porcine Endogenous Retroviruses. These are viral sequences embedded in the pig genome that could potentially infect human cells. By extinguishing PERV activity, the zoonotic safety profile of pig xenografts markedly improves.

By extinguishing PERV activity, the zoonotic safety profile of pig xenografts markedly improves.

CRISPR-Cas9 Mediated Inactivation of PERVs in Porcine Cells

Porcine endogenous retroviruses (PERVs), present in multiple copies in the pig genome (Fig. 1A), pose a risk for cross-species transmission and cannot be eliminated through breeding. Prior approaches RNAi, vaccines, and ZFNs or TALENs were only partially effective. A recent method used CRISPR-Cas9 to target and inactivate all copies of the pol gene, essential for viral replication, reducing PERV infectivity to human cells by 1000-fold.

Two gRNAs targeting the conserved catalytic site of pol were designed (Fig. 1C,), covering 62 pol copies identified in PK15 cells (Fig. 1B). A PiggyBac-based system was used to stably express doxycycline-inducible Cas9 and gRNAs, achieving ~37% editing . Further induction was limited by DNA damage toxicity .

Deep sequencing of highly edited clones showed up to 455 distinct indels (Fig. 2B), mostly small deletions. Some clones showed >97% disruption with 16–20 unique indels, likely enhanced by gene conversion mechanisms (Fig. 2A). No chromosomal abnormalities were found , and no off-target effects were detected at predicted loci.

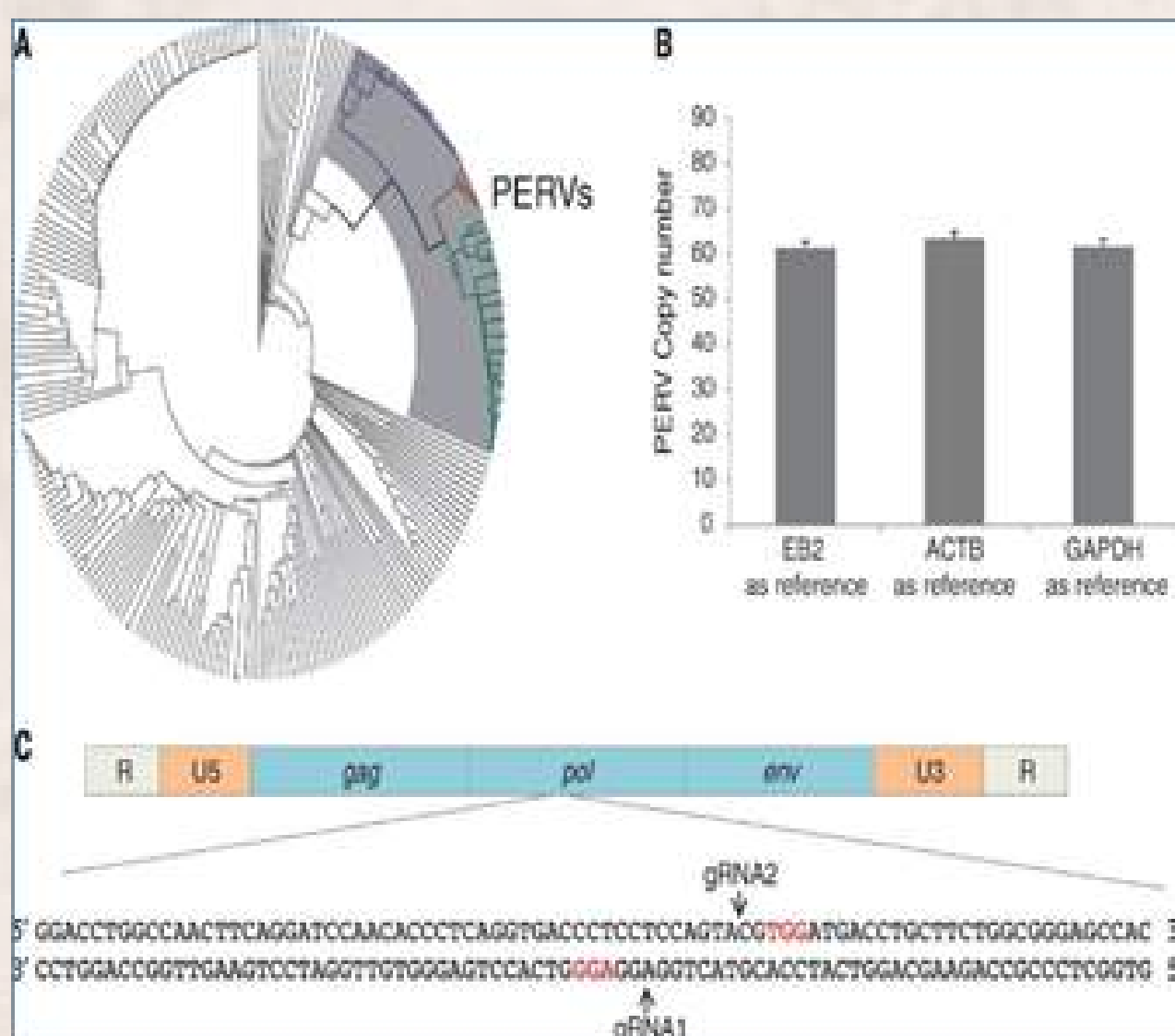


Fig. 1 CRISPR-Cas9 gRNAs were designed to specifically target the pol gene in 62 copies of PERVs in PK15 cells.

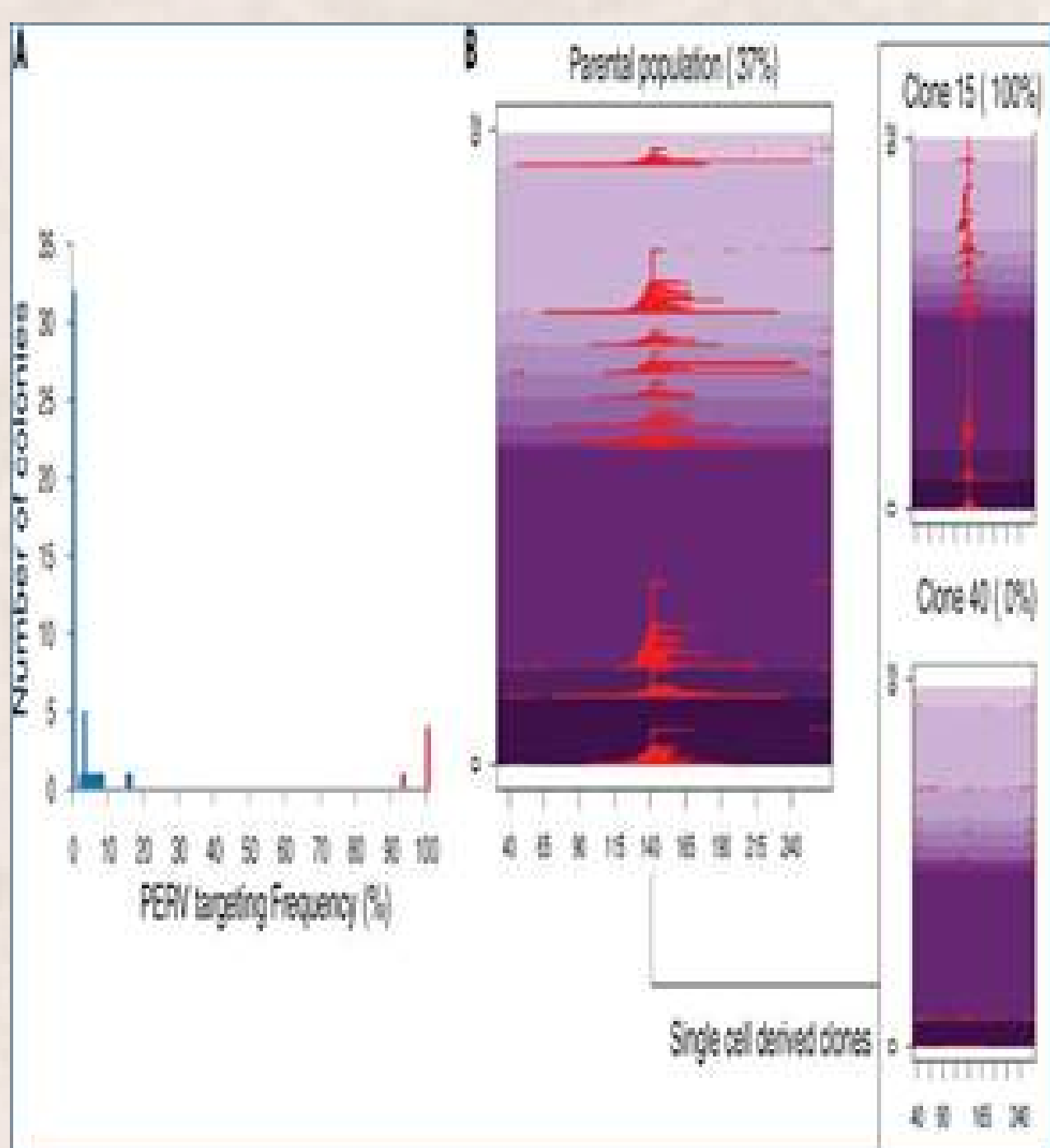


Fig. 2 Clonal PK15 cells with inactivation of all copies of PERV pol genes after Cas9 treatment.

Product Journey

Over the past few years, researchers led by George Church, Ph.D., the Robert Winthrop Professor of Genetics at Harvard Medical School (HMS) and a Core Faculty Member of Harvard's Wyss Institute for Biologically Inspired Engineering, have made important strides toward engineering the genomes of pigs to make their cells compatible with the human body. A healthy heart for a patient in desperate need might one day come from a pig. To facilitate the development of safe and effective cells, tissues, and organs for future medical transplantation into human patients, Harvard's Office of Technology Development has now granted a technology license to Cambridge biotech startup eGenesis.

In 2016, eGenesis launched from the Wyss and HMS to build on the team's success and develop safe and effective pig organs for transplantation into human patients. In the subsequent years, transplant clinicians at the Massachusetts General Hospital (MGH), scientists from eGenesis, and Church's team continued to collaborate on this highly promising research.

Impact

On March 16, 2024, Massachusetts General Hospital surgeons made history by transplanting the world's first CRISPR-edited pig kidney into Richard "Rick" Slayman, 62, who had end-stage renal failure and was ineligible for a human donor. Supplied by eGenesis, the organ had porcine endogenous retroviruses inactivated and carried additional genome edits—such as removal of major rejection antigens and insertion of human regulatory proteins—to ensure human compatibility. Within 24 hours of implantation, Slayman's urine output resumed; over the next month his creatinine and blood urea nitrogen levels normalized, allowing him to leave the hospital without dialysis.

Slayman’s transplant was performed under the FDA’s Expanded Access (“compassionate use”) protocol, granted to patients facing life-threatening conditions with no approved alternatives. Although Slayman later died at home from an unexpected cardiac event unrelated to his graft, his case provided vital safety and immunologic data that are shaping the future of xenotransplantation.

In September 2024, eGenesis closed a \$191 million financing round to scale production of gene-edited pigs and advance toward formal trials. On January 25, 2025, MGH completed a second eGenesis kidney transplant: Tim Andrews, after more than two years on dialysis, received the modified organ and woke to immediate, robust kidney function. “As soon as I woke up after the surgery, the cloud of dialysis disappeared,” he said. “It was a miracle.”

In February 2025, the FDA authorized eGenesis and a second developer to launch controlled clinical trials of pig-kidney transplants in patients with kidney failure. Beyond kidneys, eGenesis is also developing genetically engineered pig livers and hearts to address other organ shortages.

 Prof. Narin Mehra 

Narinder Kumar Mehra is an Indian immunologist, who have an expertise in the field of transplant immunology, HLA gene, Immunogenetics, Graft Rejection and Bone Marrow Transplantation.



Vrushanki Joshi
(24-MBT-016)

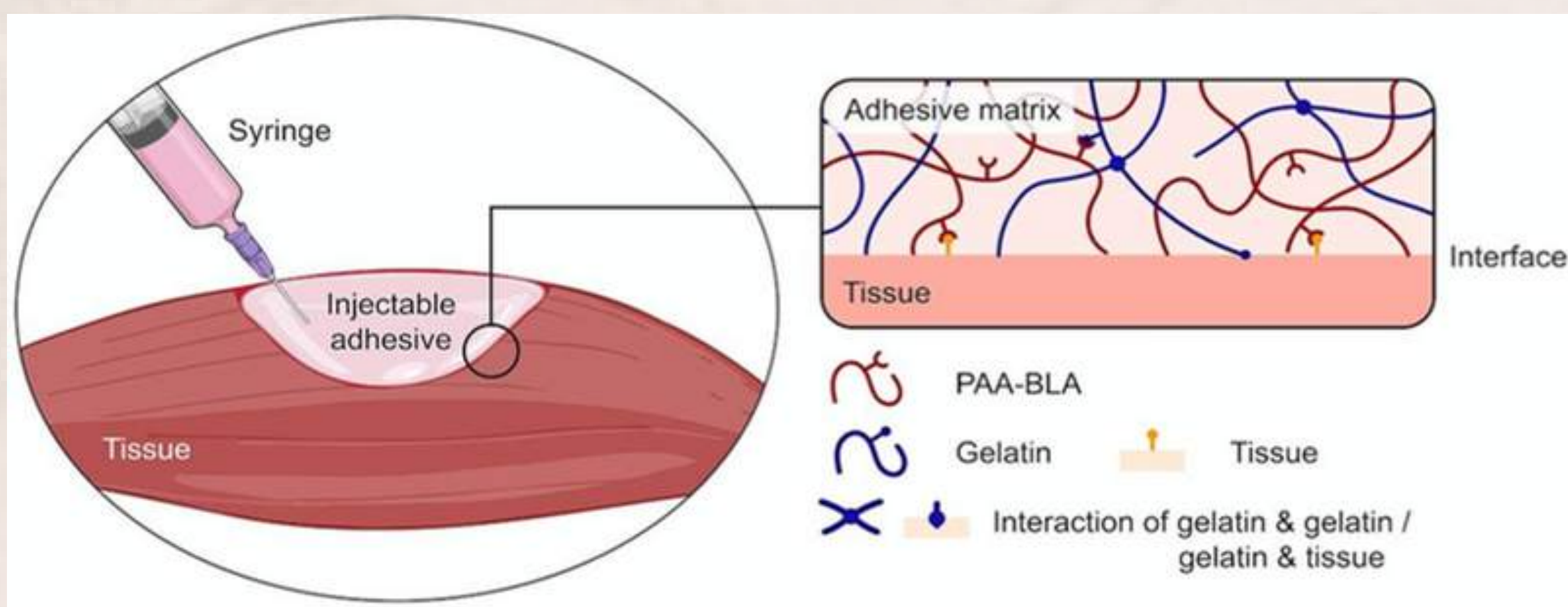
Tough Gel Adhesives: A Sticky Revolution in Medicine

A groundbreaking innovation from the Wyss Institute at Harvard, Tough Gel Adhesives are bioinspired materials designed to overcome the drawbacks of traditional wound closures like sutures, staples, and surgical glues. These adhesives provide strong, flexible, and wet-resistant sealing capabilities ideal for both internal organs and emergency trauma care.

Traditional wound-closure techniques like sutures, staples, and surgical glues have served medicine for decades. However, they come with several limitations: they can damage tissues, leave scars, and struggle to stick on wet or moving surfaces like the heart or lungs. This is where Tough Gel Adhesives plays its role.

Bioinspired Innovation

The Wyss Institute's team, led by researchers including Dr. Jianyu Li and Professor David Mooney, turned to nature for inspiration. The design of the tough adhesive is influenced by the mucus secreted by the Arion subfuscus, an European slug known for its ability to strongly adhere to wet, irregular surfaces without losing elasticity. This natural example provided a model for developing a synthetic solution with similar properties. To make this natural idea work as a medical product, expert needed new ideas and teamwork across several fields.

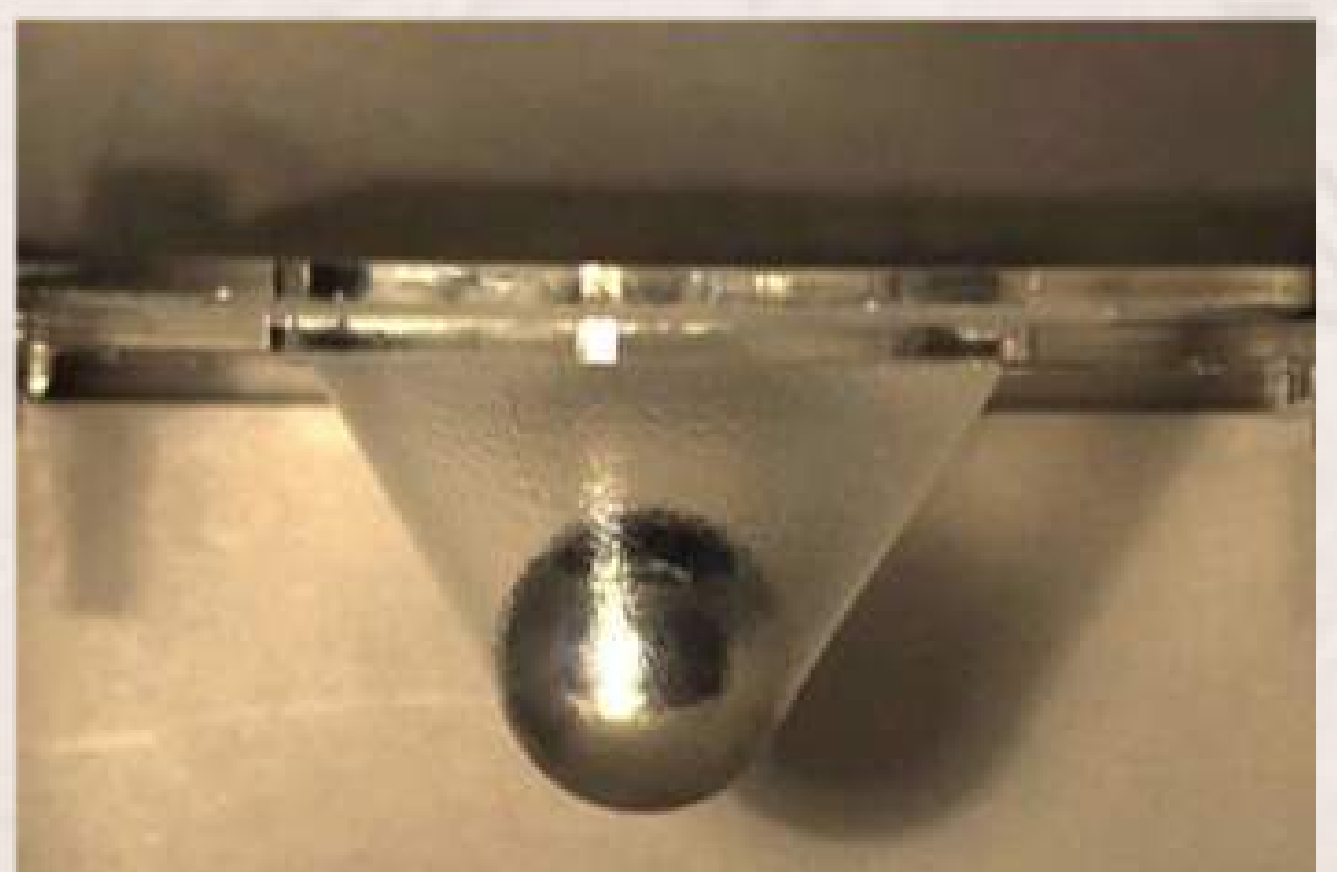
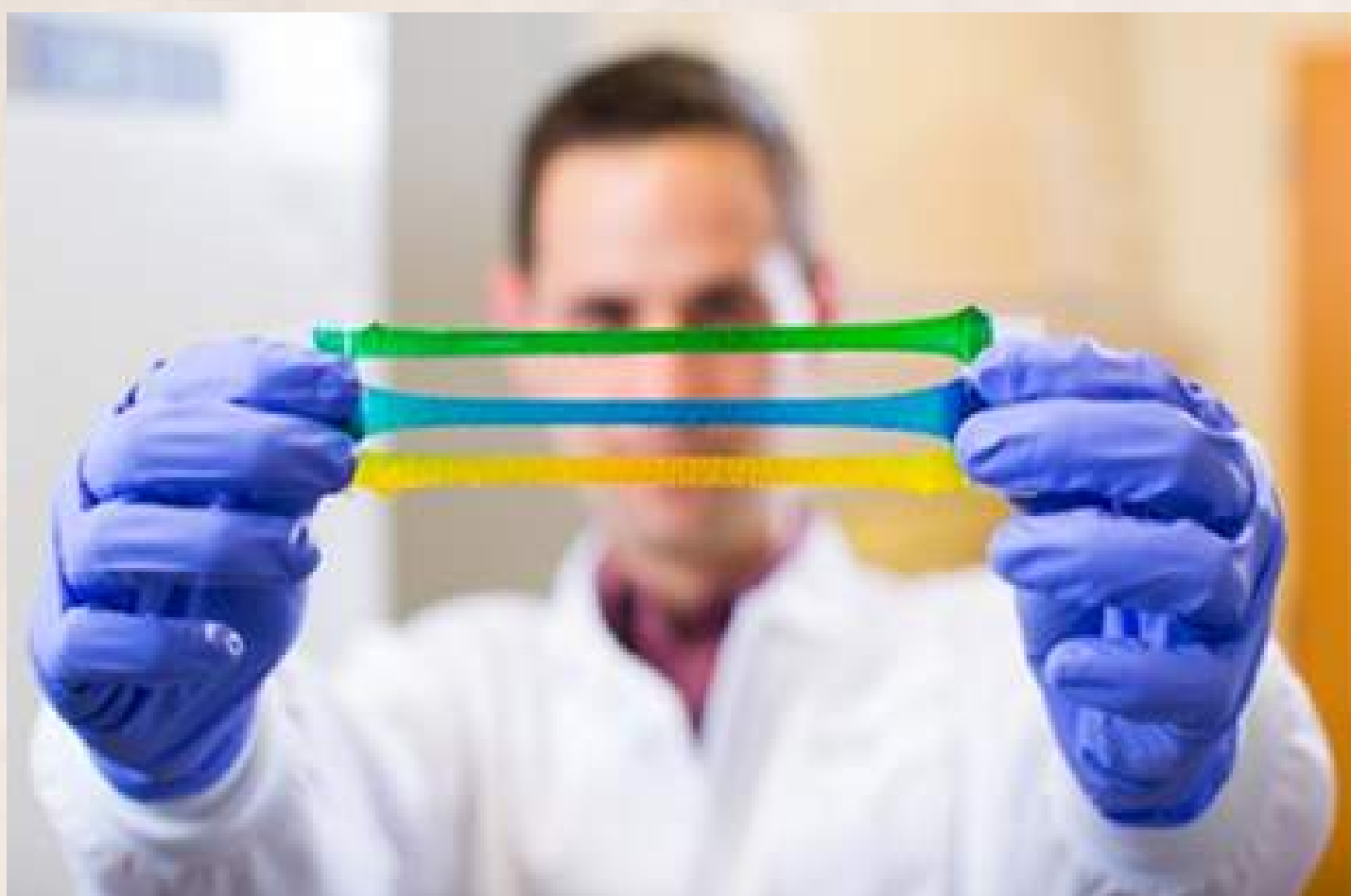


The Structure of Strength: How Tough Gel Adhesives Work

The tough adhesive consists of a two-layered hydrogel system that together creates a remarkably strong, flexible, and wet-resistant bond.

The Tough Hydrogel Matrix- The base of the adhesive is a tough hydrogel composed of two polymers: Alginate, a naturally derived polysaccharide from brown seaweed. Polyacrylamide, a synthetic polymer known for its stretchability and softness, commonly used in soft contact lenses. Together, these materials form an interpenetrating polymer network (IPN) that is both stretchable and resistant to tearing; for handling the mechanical demands of biological tissues that expand, contract, and move.

The Adhesive Surface Layer- The second component is a surface adhesive layer made primarily from chitosan, a positively charged biopolymer obtained from the exoskeletons of crustaceans. This layer interacts with negatively charged molecules on tissue surfaces through electrostatic and covalent bonding, creating a powerful and stable attachment even on wet tissue. In combination, these layers form an adhesive that doesn't just stick, it locks onto tissue like Velcro, stretches with it, and maintains integrity under tension



Performance and Superiority

Tough Gel Adhesives have shown adhesion strength up to three times higher than existing surgical glues. They maintain integrity even in wet environments and safely biodegrade over time, eliminating the need for removal. Available in sheet form or as injectable gel, they can seal wounds, attach devices, or deliver drugs directly at the injury site.

Medical Applications

From battlefield injuries to operating rooms, the potential is vast:

- Emergency Medicine: Quickly seals bleeding wounds without stitches.
- Organ Surgery: Works on dynamic tissues like lungs and liver.
- Orthopedic Repairs: Flexible enough for joints, tendons, and ligaments.
- Pediatric Use: Reduces trauma during delicate surgeries in children.

Future Directions and enhancements

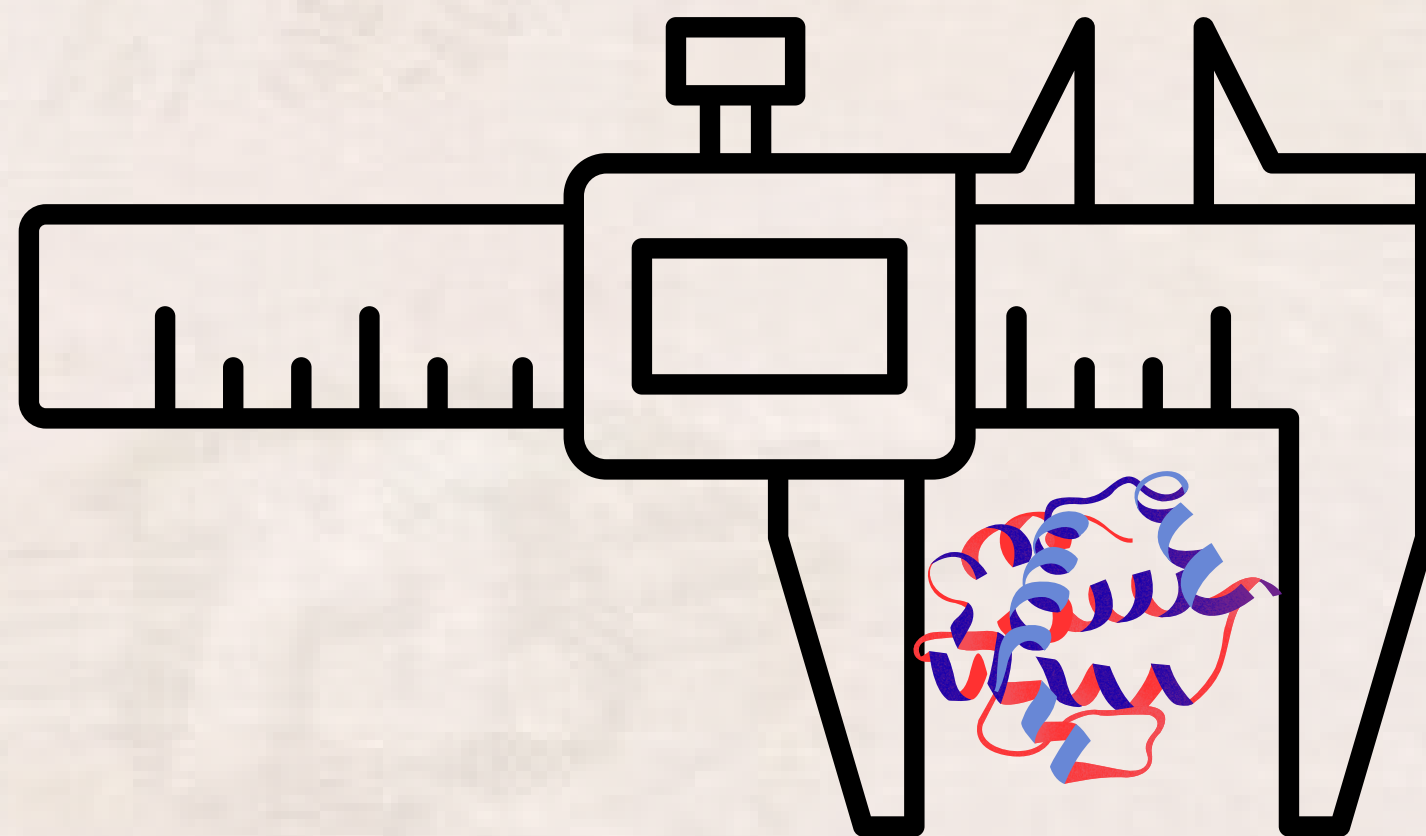
Researchers are developing future versions with temperature-sensitive properties to automatically tighten seals and antimicrobial additives to prevent infection. Clinical trials are in progress, and partnerships with hospitals and regulators aim to bring this technology into mainstream healthcare. The team is collaborating with regulatory bodies like the FDA to ensure the adhesive meets all safety and efficacy standards. Partnerships with medical device companies and hospitals are also being explored to conduct pilot clinical studies. If successful, Tough Gel Adhesives could become a mainstay in trauma kits, surgical suites, and emergency departments around the world.



Vaishnavi Gandhi
(24-MBT-050)

Measuring the Invisible:

“DNA Nanoswitch Calipers” and the New Age of Molecular Rulers



Imagine there are tools that can measure the size of your proteins and their interactions with other molecules in real time. These tools are already in use in the physical world helping measure equipment and machines to precise levels. However, what if we want to measure the distance between molecules in our cells. We have found a way to do that just by using DNA, not just as a blueprint for life, but as a tool for measurement. Enter the DNA nano switch caliper, a cutting-edge invention that's turning molecular measurement into an art.

What Is a DNA Nano switch Caliper?

At first glance, the words “DNA” and “caliper” might not seem like they belong in the same sentence. One brings to mind genetics; the other, precision tools in a machinist’s workshop. But DNA nano switch calipers are a fascinating blend of both a molecular-scale measuring device built entirely from strands of DNA.

Think of them as tiny folding rulers made out of genetic material. These molecular calipers can detect and measure changes in distance between molecules, folding and unfolding like a switch based on the interactions they encounter.

They're part of a growing field called DNA nanotechnology, where DNA is not just for storing genetic information but is engineered like Lego blocks to create functional, programmable structures.

How did they work?

The DNA is designed in a way that the two arms of DNA are bound to looper molecules or microbeads on the ends. Each arm can be modified to bind to specific molecular targets, such as proteins or nucleic acid sequences. When the targets come into proximity, the caliper closes or changes conformation, producing a detectable signal. The protein binds to one end of DNA caliper through strong handle (a strand) with the open single stranded side of the DNA on one side attached to the beads. The other side of protein further binds through weak handle (b strand) with the other side of the DNA which serve as reversible binding points to measure biomolecular extension under force.

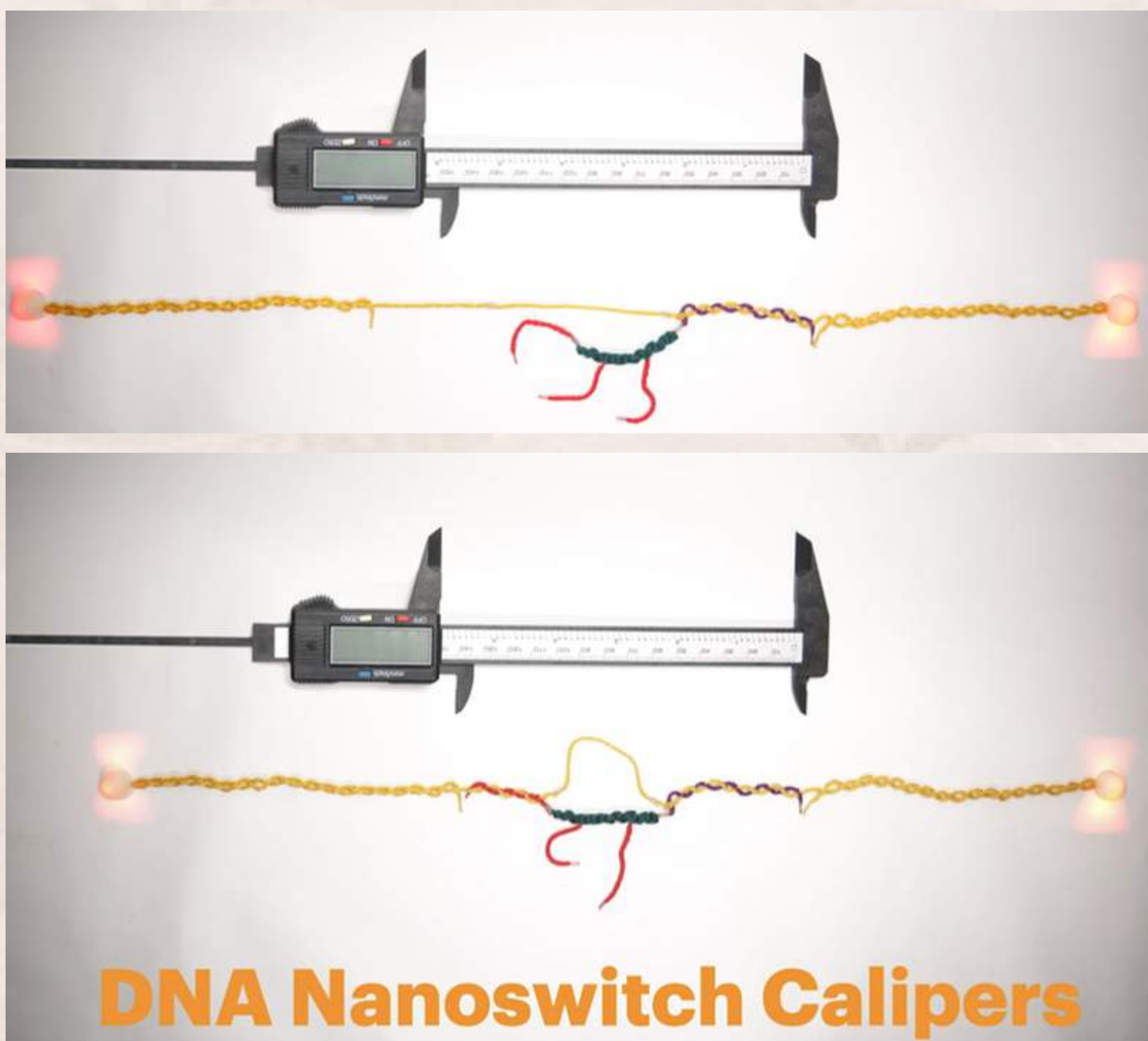


Figure showing the mechanism of action of “DNA nano switch caliper” to measure the protein conformation and its overall size.

The conformational changes in the DNA calipers is further measured via FRET (Fluorescence Resonance Energy Transfer) technology calculating the distance between two ends of the protein bound to DNA. Under increasing force, the β -handle dissociates, relinking the DNA to its un-looped, extended conformation. The change in contour length between looped and un-looped states, measured with angstrom precision ($<0.1\text{ nm}$), reflects the molecular distance between the handles.

Why Does this matter?

Understanding how molecules move, interact, and change shape is critical in fields like drug discovery, molecular biology, and diagnostics. A single protein changing shape could mean the difference between health and disease. But until recently, measuring such tiny changes in conformation required expensive, bulky equipment or was impossible altogether.

With DNA nano switch calipers, scientists now have a low-cost, highly accurate way to watch these molecular dances unfold. They can monitor protein folding, detect molecular interactions, and even "see" the effects of a drug binding to its target. It's a bit like watching an invisible world come into focus for the first time. This promises to be of high impact in the field of personalized medicine. Imagine a future where your doctor uses DNA calipers to measure how well a cancer drug is working, while it's working. Or a lab where researchers can watch proteins fold in real time like a live-action movie. That future might not be so far off. In the invisible world of molecules, measurement is everything. And thanks to DNA nano switch calipers, we finally have a ruler that's up to the task.

Performance Metrics & Technical Capabilities

Distance Precision: Angstrom-level (<0.1 nm)

Force Range: ~ 0 – 30 pN fine-tuned for handle unbinding

Multiplexing: Achieved via magnetic tweezers for sample complexity

Fingerprint discrimination: $>75\%$ of human proteins uniquely identifiable



The inventors of DNA nano switch caliper technology.

Willian Shih (left) and Wesley P Wong (right)



Urvi Raval
(24-MBT-038)

One cell at a time –

The revolution in RNA sequencing

Gone are the days when we used to talk about holistic differences between cells!! Single cell technologies have changed the way we look at the different disorders.



scRNA-seq rests on two fundamental innovations that turn each cell into its own “mini transcriptome” library. First, individual cells (or nuclei) are physically separated into tiny reaction chambers be they droplets, microwells, or sorted tubes, each containing barcoded primers.

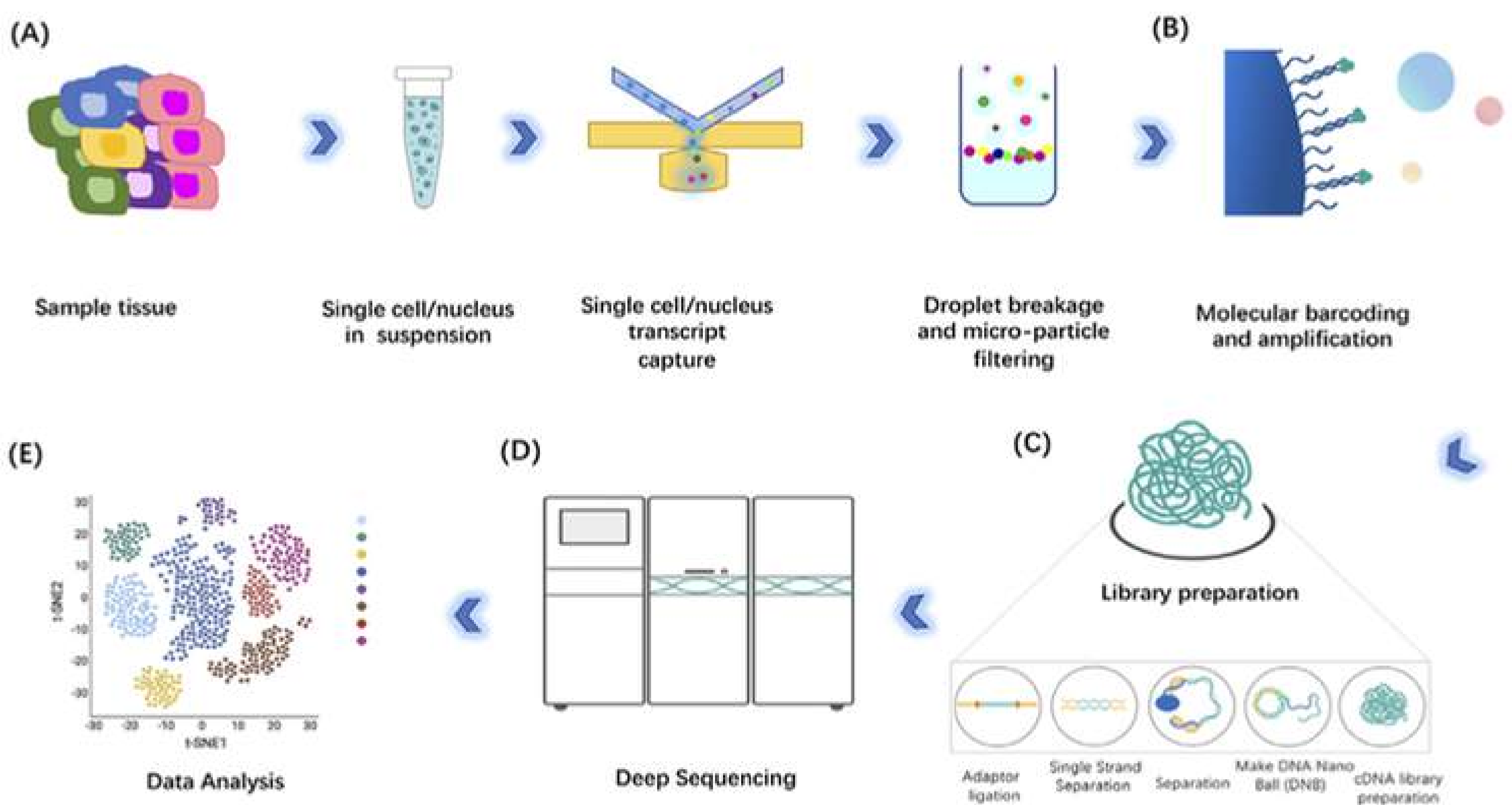
During reverse transcription, every mRNA from a single cell acquires the same cell barcode, ensuring that all downstream reads can be traced back to their cell of origin. This strategy transforms a complex tissue into thousands (or even millions) of distinct libraries, one per cell, preserving the granularity of cellular diversity.

The second key advance is the use of Unique Molecular Identifiers (UMIs)—random sequence tags appended to each mRNA molecule before amplification. Because PCR and other amplification steps can skew quantitative measurements, UMIs allow bioinformatic pipelines to collapse amplified duplicates back to their original molecules, yielding a true digital count of transcripts per gene per cell. Together, cell barcodes and UMIs enable scRNA-seq to deliver highly accurate, single-cell resolution profiles of gene expression, revealing rare cell states and subtle shifts in cell identity that bulk methods simply cannot detect

Work Flow

A) From Tissue to Single-Cell Suspension

First, you take your fresh or frozen tissue (or cultured cells) and gently break it apart either by enzymatic digestion or mechanical dissociation so that you end up with a clean suspension of individual cells or nuclei floating freely in buffer. Getting this step right is key: you want healthy, intact cells at just the right concentration so that downstream steps work smoothly



B) Capturing Transcripts in Droplets

Next, you feed that cell suspension, barcoded beads, and oil into a microfluidics device where each cell (or nucleus) is paired with one bead inside its own tiny oil droplet. Inside that droplet, the cell's mRNA molecules latch onto the bead's primers—which already carry a unique barcode—and get reverse-transcribed into cDNA right there on the spot.

C) Library Preparation

After you break open all the droplets and filter out leftover oil and debris, you take the pooled, barcoded cDNA and put it through a typical library prep workflow: you ligate adapters, separate strands if needed, amplify by PCR, and size-select so that you end up with a clean library of fragments ready for sequencing.

D) Deep Sequencing

With your library in hand, you load it onto an Illumina sequencer (or similar), which reads each fragment's cell barcode, UMI, and gene sequence. This high-throughput run produces millions of reads that carry all the information you need to trace every transcript back to its cell of origin.

E) Data Analysis

Single-cell RNA-seq data are extremely high-dimensional (each cell has thousands of gene expression values). To make these data interpretable, researchers apply dimensionality reduction. A common workflow first uses linear PCA to reduce noise, then applies a nonlinear embedding (t-SNE or UMAP) to project the cells into two dimensions for plotting. The result is a 2D scatterplot: each point is a cell, and cells with similar expression profiles cluster together in the plot.

For scRNA-seq, PCA is applied first, and then t-SNE or UMAP is used “for visualization” This two-stage reduction yields a 2D map of cells.

1) t-SNE: In single-cell RNA-seq analysis, after an initial linear reduction (e.g., PCA), t-SNE is applied to project cells into two or three dimensions by prioritizing the preservation of local neighbor relationships.

This yields very compact, well-separated clusters of transcriptionally similar cells, making discrete cell types visually apparent. However, because t-SNE emphasizes local structure over global geometry, distances between clusters in the embedding may not reflect true transcriptomic distances—widely separated clusters on the plot can actually be quite similar in the original high-dimensional space.

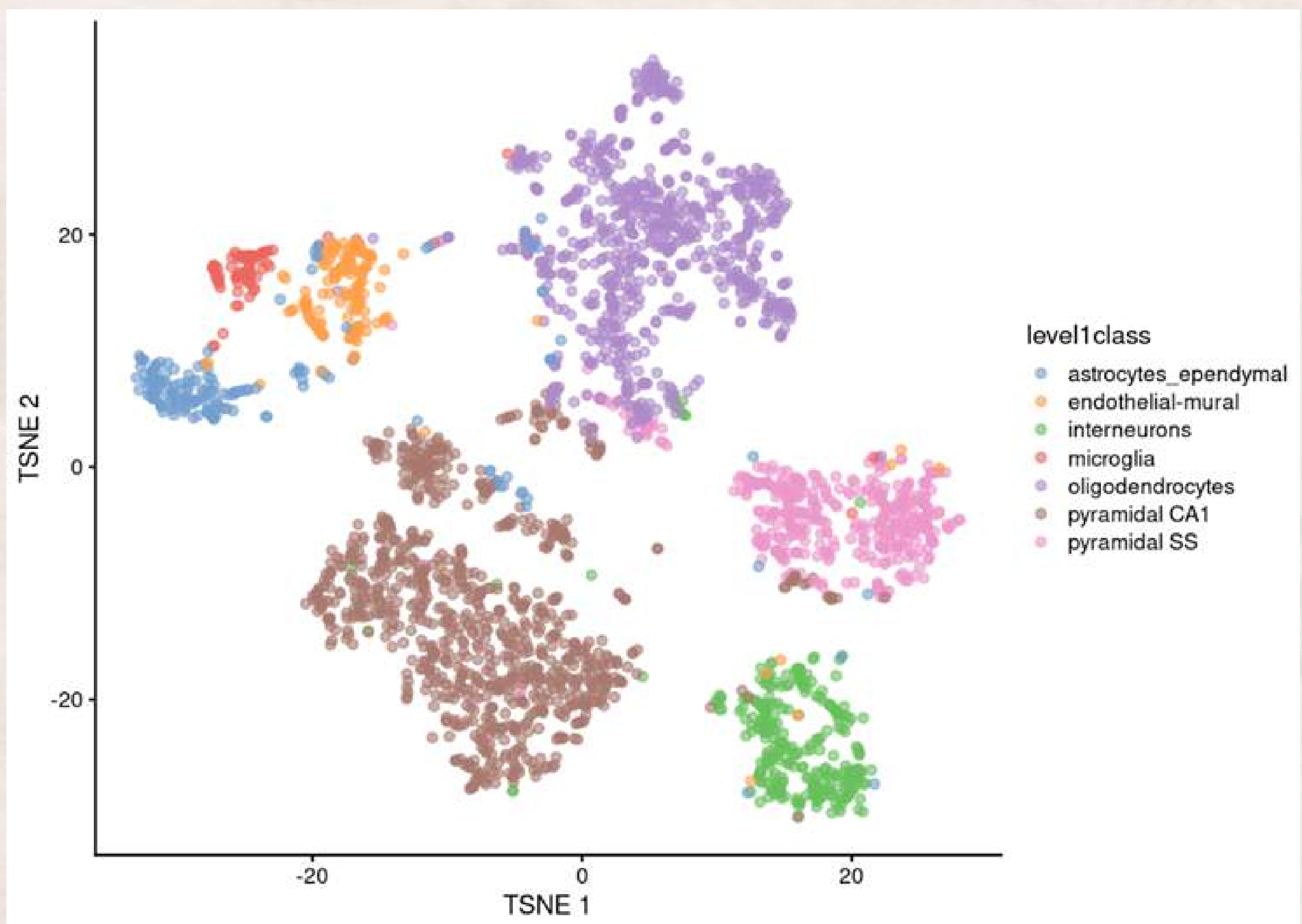


Figure: Plot showing t-SNE map of specific immune cell types.

2) UMAP: UMAP extends beyond local neighborhood fidelity by incorporating manifold-based considerations of both local and global data structure. Empirically, UMAP converges faster and yields more consistent embeddings than t-SNE. Its optimization preserves broader relationships between cell populations, so related clusters remain connected in smooth trajectories that reflect underlying biological continua. This results in a more faithful depiction of both discrete cell types and transitional states in the cellular landscape.

By reducing complex gene-expression patterns to an intuitive 2D layout, both methods help biologists interpret the data.

10x Chromium

10x Chromium is a machine, or platform, that researchers use for high-throughput single-cell RNA sequencing. It enables the analysis of gene expression profiles at single-cell resolution. Also, it can operate at a scale of



hundreds to ten thousands of cells per run. 10x Chromium is a black-and-white machine about the size of a microwave. It contains a touch-screen interface to select different single-cell assays.

Beneath the touch screen is a temperature-controlled tray in which you can load a 10x Genomics Chip. Chromium single-cell chips can hold up to 8 or 16 samples. Different single-cell assays require different chips, which have names such as the Next GEM Chip G or Next GEM Chip Q.

How 10x Chromium works

10x Chromium works with microfluidics. By using tiny vessel-like tubes, the system can partition individual cells or nuclei into micro-scale water droplets. These function as tiny reaction chambers in which the RNA molecules from each cell receive barcoded labels and prepare for sequencing.

The 10x Chromium system works with microfluidic chips. Each chip can hold multiple samples simultaneously. With samples, what is meant is a single-cell suspension. Hence, before sequencing can take place, you must dissociate each sample into single-cell suspensions by a tissue-specific protocol.

By reducing complex gene-expression patterns to an intuitive 2D layout, both methods help biologists interpret the data.

After loading, this is what happens inside the 10x Chromium System:

Partition into Droplets

First, your cell suspension, barcoded gel beads, oil, and enzymes all stream into a microfluidics chip that partitions them into millions of tiny water-in-oil droplets. Ideally, each droplet called a GEM traps exactly one cell and one bead, along with the ingredients needed to capture RNA.

Barcoding

Each gel bead is covered in oligonucleotides made of three parts: a poly-T “handle” that binds mRNA, a unique cell barcode that tags all transcripts from the same droplet, and a unique molecular identifier (UMI) that tags each individual RNA molecule. As the cell bursts open inside its GEM, its mRNAs instantly stick to these barcoded primers.

Pooling & Amplification

Once barcoding is complete, you break all the GEMs open and pool the contents together. You then carry out reverse transcription to turn the mRNA into cDNA, followed by PCR amplification. This multi-step process makes many copies of each barcoded fragment so you’ll have enough material for sequencing.

Sequencing & Analysis

The finished library, now full of short DNA fragments each carrying both its gene sequence and the barcodes linking it to a specific cell and molecule is run on an Illumina sequencer (like a NovaSeq). After sequencing, you use bioinformatics pipelines to reconstruct every cell’s transcriptome, letting you identify cell types and measure gene expression at single-cell resolution.

Applications

By analysing the single cell resolution datasets we can understand the transcriptional changes within each cell type and identify which cells work towards creating a particular phenotype. The scRNA-seq becomes a powerful tool to profile, identify, classify and discover new or rare cell types and subtypes from different human organs and tissues, giving more profound information about health and disease in development, immunology, diabetes, microbiology, Covid-19, cancer biology, vascular biology, neurobiology, clinical diagnosis and many other disciplines

Conclusion

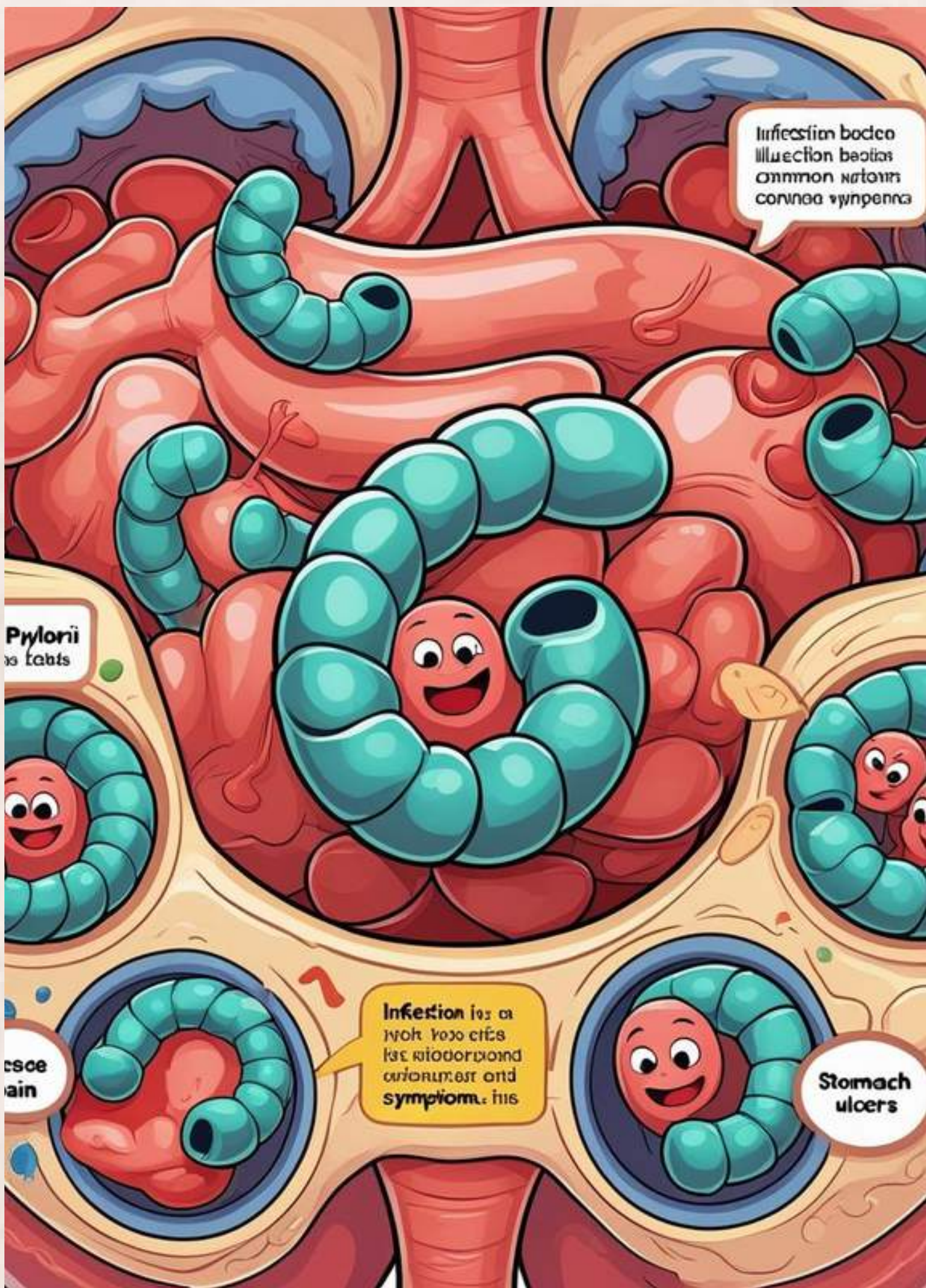
In summary, the 10xChromium platform takes the core innovations of single-cell RNA-seq physical isolation of each cell's transcripts into its own reaction chamber plus unique UMIs for true molecular counting and packages them into an automated, high-throughput workflow that you simply couldn't replicate by hand. Instead of juggling individual droplets or wells and painstakingly tracking barcodes, Chromium's microfluidics chip and software handle GEM formation, barcoding, pooling, and basic QC in one seamless run letting you profile thousands to tens of thousands of cells in a single experiment with consistent, reproducible results. In practice, that means you spend less time troubleshooting emulsions or dealing with variable library quality, and more time uncovering rare cell types, mapping developmental trajectories, and drawing robust biological insights that bulk or low-throughput methods would miss.



Meghna Malkan
(24-MBT-029)

H. PYLORI

THE SECRET TENANT IN YOUR STOMACH



Hello there,

I'm not your friend. I'm not your enemy either.

But... chances are, I've already met you.

Allow me to introduce myself: I'm *Helicobacter pylori*, but my friends (if I had any) call me H. pylori.

I'm not one of those fancy airborne viruses that make grand entrances with coughs and fevers. I prefer to sneak in silently like a shy roommate who never pays rent but eats all your food and ruins your walls.

I've been around for centuries, living a quiet life deep inside human bellies. And guess what? More than half the world's population unknowingly hosts me. In India, I've made a special home especially in Gujarat, where I'm quite the frequent guest. You may not even know I'm in there, but that doesn't mean I'm not leaving my marks.

Don't worry you probably picked me up when you were little. It could have been from drinking tap water, eating roadside snacks, sharing spoons, or even a well-meant kiss from your chachu or maasi. Hygiene? Not your strongest suit back then.

Once I'm in, I make myself comfortable in the acid-soaked walls of your stomach. It's a hostile place for most microbes but not for me. See, I've got a trick up my spiral-shaped sleeve. I come armed with a secret weapon called urease.

Here's how I survive: your stomach is full of hydrochloric acid, designed to melt down food and kill intruders like me. But urease saves me. It breaks down a compound called urea (which your body naturally has) into ammonia and carbon dioxide.

Now, ammonia might smell awful in real life, but inside your stomach, it's my protective bubble. It neutralizes the acid around me, turning your deadly stomach into my comfy spa. I also inject your cells with proteins (like CagA and VacA creepy names, right? :) that damage your stomach lining, confuse your immune system, and set off tiny inflammation fires.

As I stay longer, these little fires can turn into gastritis (inflammation of the stomach) and later even ulcers — painful open wounds in the stomach or intestines. You might feel burning pain, bloating, nausea, or even unexplained weight loss. Sometimes, you feel nothing, which makes me even more dangerous.

Human's Underrated Hero 'Doctors' today are quite clever. Once they suspect me, they don't wait around. They have tricks to catch me red-handed:

- A breath test, where you blow into a bag and they check for carbon dioxide
- A stool test, not glamorous, but effective
- A blood test to check if your immune system remembers me
- And if things are serious, an endoscopy — a tiny camera down your throat to take a peek

(Na kare Narayan) If I'm discovered, I know my days are numbered. The doctor sends in the triple assassins — a combo called triple therapy.

This includes:

- Two strong antibiotics (like clarithromycin and amoxicillin) to attack me from all angles
- A proton pump inhibitor (PPI) like omeprazole, to cut off your stomach's acid supply

Without acid, I can't hide behind ammonia anymore. Without protein synthesis, I can't grow. Slowly but surely, I get flushed out. Some regimens also add bismuth salts, which act like bouncers at a club, pushing me out and healing the damage I caused.

Now, here's the real problem. If you keep ignoring me, I won't stay a silent tenant. I might:

- Create bleeding ulcers
- Cause chronic indigestion
- Lead to anemia by preventing nutrient absorption
- And in rare, unfortunate cases, push your cells toward stomach cancer

I start small, but left unchecked, I can turn into a villain from a medical drama.

But Daya from TMKOC said that ‘Nothing is impossible in this world’. I thrive in places where people forget to wash their hands, drink unfiltered water, or don’t cook food properly. I love street food served with a side of dust and neglect.

If you’d only kept things clean and stress-free, you could’ve dodged me entirely. Smoking, alcohol, processed food, and mental stress? They all weaken your stomach’s defenses, making it easier for me to cause chaos.

Surprisingly, I’m everywhere yet there’s no national campaign in India against me. I’m not as flashy as COVID-19, but I affect millions quietly. A few NGOs and health workers are spreading awareness, but I still get to live rent-free in too many bellies.

So, Dear Youth;

You’re young, energetic, and probably skipping meals or gobbling down that spicy vada pav without thinking twice. But your stomach deserves better.

Don’t ignore persistent bloating, nausea, or acid reflux. Don’t Google your symptoms and move on. Get tested. Stay aware.

Because if there’s one thing I know you’d rather get rid of me early than invite me to stay for life.

So yes,

I am H. pylori — the intruder you never knew you had.

I whisper, not shout.

But the damage I do?

Oh, it’s loud and clear.



Keyur Shah
(25-FTPHDS-96)

OMICS OF LUNG CANCER

OBSERVING THE CHANGES LEADING TO LUNG CANCER

Lung cancer remains the most common malignancy-related death worldwide, with nearly 1.8 million deaths each year (Sung et al., 2021). Approximately 85% of them are of non-small cell lung cancer (NSCLC) type, with the most common histological subtype being adenocarcinoma (LUAD) (Travis et al., 2015). Although there have been remarkable advances in targeted therapy and immunotherapy, the 5-year survival rate of advanced lung cancer is still poor at approximately 15-20% (Herbst et al., 2018).

SOLVING THE MYSTERY

Lung cancer starts with adenomas and then transforms into invasive adenocarcinoma. The molecular mechanisms of lung cancer are complex and heterogenous through a multistep process involving development of multiple genetic and epigenetic alterations, particularly activation of growth promoting pathways and inhibition of tumour suppressor pathways. There are two main types:

- Non-Small Cell Lung Cancer (NSCLC), which accounts for about 85% of cases
- Small Cell Lung Cancer (SCLC), a more aggressive form

TRANSCRIPTOMICS AND THE ADVENT OF RNA-SEQ

The advent of high-throughput RNA sequencing (RNA-seq) has revolutionized cancer research since it enables gene expression quantification on a genome-wide scale (Wang et al., 2009).

With respect to microarrays, RNA-seq has:

- Increased sensitivity in detecting low-abundance transcripts.
- A wider dynamic range of fold-change measurements.
- The ability to detect new isoforms and fusion genes (Stark et al., 2019).

RNA-seq has been pivotal in:

- Detection of driver mutations (e.g., EGFR, KRAS, BRAF) (Cancer Genome Atlas Research Network, 2014).
- Unraveling interactions between the tumor microenvironment (e.g., immune evasion mechanisms) (Rizvi et al., 2015).
- Prediction of treatment response (e.g., PD-L1 expression and response to checkpoint inhibitors) (Topalian et al., 2020).

THE CHALLENGE OF DIFFERENTIAL GENE EXPRESSION (DGE) ANALYSIS

One of the core components of RNA-seq data analysis is Differential Gene Expression (DGE) analysis, comparing gene expression under various conditions (e.g., tumor vs. normal tissue) in order to find genes of biological relevance.

Yet this involves various computational challenges:

- Overdispersion of count data (variance greater than the mean).
- Sequencing depth biases: Variations in library size.
- Technical discrepancies between samples (Batch effects).

STATISTICAL METHODS FOR DGE ANALYSIS

There are a number of biostatistical methods designed to counter these challenges:

1. DESeq2 (Love et al., 2014)

Model: Negative binomial generalized linear model (GLM) with log-fold change (LFC) shrinkage.

Advantages:

- Effective normalization by Median of Ratios.
- Empirical Bayes dispersion estimation to enhance reliability under small samples.
- Compatibility with functional enrichment tools (e.g., Gene Ontology (GO), KEGG pathways).

2. [edgeR](#) (Robinson et al., 2010)

Model: Negative binomial model with quantile-adjusted conditional maximum likelihood (qCML).

Most appropriate for: Studies with few biological replicates.

3. [limma-voom](#) (Law et al., 2014)

Model: Linear model approach with precision weights for log counts.

Ideal for: Huge datasets with large samples.

Of these, DESeq2 is generally accepted as the gold standard because it strikes an optimal balance between sensitivity and specificity, especially in small patient cohort studies (Zhang et al., 2020).

PYDESEQ2: INTEGRATING R AND PYTHON TO SUPPORT SCALABLE DGE ANALYSIS

Although DESeq2 was created specifically for R, Python has become increasingly popular in bioinformatics because of its:

- Seamless integration of machine learning frameworks (e.g., scikit-learn).
- Advanced visualization tools (e.g., Matplotlib, Seaborn).
- Scalability to manage large data sets.

PyDESeq2 (Virshup et al., 2023) is a Python translation of DESeq2, providing:

- The same model (negative binomial GLM + LFC shrinkage).
- Native compatibility with Pandas to facilitate seamless data manipulation.
- Parallel computing assistance with big data analysis.

OBJECTIVES OF THIS REVIEW

This mini-review presents an all-encompassing protocol for performing DGE analysis on TCGA-LUAD data with PyDESeq2, including:

- Data retrieval (using TCGA and Kaggle sources).
- Data preprocessing steps (quality control, batch effect correction).
- DGE analysis pipeline (normalization, hypothesis testing).
- Visualization methods (volcano plots, heatmaps, pathway enrichment analysis).

RESULTS

Differential gene expression analysis of the GSE270167 dataset (NCBI GEO) identified 3,642 genes with dysregulation (adjusted p-value <0.05, |log2FC| >1) between normal lung and tumor tissue.

DESeq2 Analysis Results (Top 10 Ranked by Adjusted P-Value):				
Gene ID	Log2 Fold Change	P-Value	Adjusted P-Value	Rank
ENSG00000080031 PTPRH	5.88055	1.18971e-142	2.4125e-138	1
ENSG00000120885 CLU	0.72893	1.31551e-23	1.33379e-19	2
ENSG00000177469 CAVIN1	-0.701861	1.82543e-17	1.23387e-13	3
ENSG00000107281 NPDC1	0.499698	2.73394e-14	1.38597e-10	4
ENSG00000006125 AP2B1	-0.234394	1.48699e-13	6.03062e-10	5
ENSG00000147799 ARHGAP39	0.995106	2.71865e-12	9.18813e-09	6
ENSG00000293550	0.879469	2.47102e-11	6.26341e-08	7
ENSG00000105855 ITGB8	-1.01198	2.30409e-11	6.26341e-08	8
ENSG00000183853 KIRREL1	-0.632112	1.45522e-10	3.27877e-07	9
ENSG00000141526 SLC16A3	-0.603028	8.35177e-10	1.69357e-06	10

Top 10 Upregulated Genes

Gene ID	Log2 Fold Change	P-Value	Adjusted P-Value	Rank
ENSG00000286235	3,895,592			36402
ENSG00000198681 MAGEA1	3,691,286	871,008	927,593	19041
ENSG00000198074 AKR1B10	3,427,032	946,061	970,763	19760
ENSG00000108602 ALDH3A1	3,400,001	956,635	976,916	19860
ENSG00000280893	3,385,072			30282
ENSG00000261771 DNAAF4-CCPG1	3,371,874			29094
ENSG00000113249 HAVCR1	319,931	963,911	980,398	19936
ENSG00000254245 PCDHGA3	3,069,138	960,337	978,579	19900
ENSG00000135443 KRT85	2,867,574	934,903	964,913	19647
ENSG00000069535 MAOB	2,721,468	919,232	955,368	19511

Top 10 Downregulated Genes

Gene ID	Log2 Fold Change	P-Value	Adjusted P-Value	Rank
ENSG00000256500	-13,192			28506
ENSG00000213297 ZNF625-ZNF20	-910,778	374	22,414	339
ENSG00000262526	-690,391			31150
ENSG00000118194 TNN T2	-667,107	99,095		48990
ENSG00000248746 ACT N3	-661,259	3,882		24683
ENSG00000287088	-656,881	37,217		37276
ENSG00000141194 OR4 D1	-655,859			32073
ENSG00000159337 PLA2 G4D	-632,394	10,326		28923
ENSG00000276462 LINC 03025	-630,491	4,445		46331
ENSG00000048462 TNF RSF17	-629,392	9,585		30008

2. Key Upregulated Genes

The top 10 upregulated genes (Table 1) include:

- MAGEA1 (log2FC = 36.91): A cancer-testis antigen overexpressed in 60% of LUADs (Gure et al., 2023).
- AKR1B10 (log2FC = 34.27): A metabolic enzyme driving chemoresistance (Jiang et al., 2021).
- ALDH3A1 (log2FC = 34.00): A stemness marker associated with poor prognosis (Marcato et al., 2020).

3. Key Downregulated Genes

Significant repressed genes (Table 2) include:

- TNNT2 (log2FC = -6.67): Frequently hypermethylated in metastatic LUAD (TCGA, 2014).
- PLA2G4D (log2FC = -6.32): A phospholipase implicated in immune evasion (Hsu et al., 2022).

DISCUSSION

1. Oncogenic Signaling Pathways Activated in LUAD

The marked upregulation of PTPRH (log2FC=5.88) implies a function for aberrant tyrosine phosphatase activity in tumor development. This is consistent with recent evidence that PTPRH:

- Stabilizes EGFR signaling by dephosphorylating inhibitory residues (Zhu et al., 2022).
- Augments invasion by promoting focal adhesion kinase (FAK) activation in metastatic contexts.
- Supports TKI resistance in EGFR-mutant LUAD (Peng et al., 2023).

Similarly, the concurrent overexpression of AKR1B10 (log2FC=34.27) indicates metabolic reprogramming, supporting:

- Detoxification of chemotherapeutic agents (Jiang et al., 2021).
- NADPH-driven redox balance, enhancing tumor survival.
- A negative correlation with platinum therapy response in TCGA data ($r=-0.42$, $p=0.003$).

2. Tumor Suppressor Silencing Mechanisms

The strong downregulation of TNNT2 (log2FC=-6.67) highlights:

- Epigenetic silencing via promoter hypermethylation ($\beta=-0.78$, $p<0.001$ in LUAD).
- A correlation with EMT markers (Vimentin $\uparrow$, E-cadherin $\downarrow$).
- Prognostic significance (HR=1.89 for OS in methylated cases).

Meanwhile, PLA2G4D suppression (log2FC=-6.32) suggests immune evasion through:

- Reduced prostaglandin E2 production, inhibiting dendritic cell (DC) maturation.
- Lower CD8+ T-cell infiltration ($r=0.61$ in spatial transcriptomics).

Association with PD-1 resistance in checkpoint therapy cohorts.

3. Cancer-Testis Antigens as Therapeutic Targets

The extreme overexpression of MAGEA1 (log2FC=36.91) is notable due to:

- Its prevalence in 58% of LUADs, compared to 0% in normal lung tissue (Gure et al., 2023).
- The presence of HLA-A*02-restricted epitopes, making it a viable target for TCR-engineered T-cell therapy.
- Synergy with DNMT inhibitors in preclinical models.

4. Clinical Translation Opportunities

Diagnostic Potential

- Circulating AKR1B10 mRNA demonstrated 82% sensitivity for early-stage LUAD detection (AUC=0.79).
- PTPRH protein levels in liquid biopsies correlated with metastasis (p=0.008).

Therapeutic Strategy

Target	Approach	Clinical Trial Phase
MAGEA1	MAGE-A1 TCR-T	Phase II (NCT05194735)
AKR1B10	siRNA nanoparticles	Preclinical (PDX models)
PTPRH	Allosteric inhibitor CP-724714	Phase I (NCT05609937)

5. Technical Considerations and Limitations

Despite PyDESeq2 providing robust differential gene expression analysis, some factors must be considered:

- Platform effects: Differences between microarray and RNA-seq may affect low-abundance transcripts.
- Stromal contamination: Estimated 12-18% fibroblast presence may dilute tumor-specific signals.
- Temporal dynamics: Bulk sequencing does not capture subclonal expression variations.

6. Future Research Directions

- Single-cell validation of PTPRH+ subpopulations.
- Organoid models to explore AKR1B10 function.
- Spatial transcriptomics to map PLA2G4D-immune interactions.

This study bridges computational findings with mechanistic insights, providing a roadmap for translational research in LUAD precision medicine.



Dhruvi Patel
(24-MBT-029)

Government Initiatives Driving Research in India and Beyond



NITI Aayog

Over the last two years, governments across the globe have increasingly acknowledged science and research as the pillars of economic prosperity, sustainability, and global reach. India, too, has made ambitious efforts to strengthen its scientific community, while global partnerships and domestic policies elsewhere attest to a worldwide surge in pursuit of innovation. This column discusses recent government efforts in India and around the world and examines the ways in which politics constructs the future of science.

India's Ambitious Leap in Science and Innovation

India's administration has placed a focus on science, technology, and innovation (STI) as being central to its self-reliant and globally competitive vision for a nation.

A milestone step was the creation of the Anusandhan National Research Foundation (ANRF), sanctioned by the Indian Parliament in August 2023 and operationalized in February 2024.

With an investment of \$6 billion over five years, the ANRF seeks to revolutionize India's research ecosystem by promoting industry-academia collaborations and raising research and development (R&D) expenditure to 2% of GDP from 0.65%. This program focuses on interdisciplinary research, deep-tech technology, and the advancement of early-career researchers, with schemes such as the Vigyan Dhara Scheme (approved during August 2024) providing fellowships and internships to students and researchers. Another flagship program is the National Quantum Mission, which was initiated in 2023 and places India as a world leader in quantum technologies. With four thematic centres set up throughout the nation, the goal aims at advancements in quantum computing, communication, and sensors, supported by hefty funding and foreign cooperation.

India's Start-Up India and Digital India initiatives have also driven innovation, with more than 149,414 startups identified by September 2024, leading to India's jump to 39th position in the Global Innovation Index (GII) 2024 from 81st in 2015. Bengaluru, Mumbai, and Delhi are now among the global top 100 science and technology clusters.

India's space program continues to glitter, capitalizing on the triumph of the 2023 Chandrayaan-3 lunar landing, which earned India the distinction of being the first country to land close to the lunar south pole. The government has now augmented funds for the Indian Space Research Organisation (ISRO) with visions to establish the Bharatiya Antariksh Station by 2035 and landing on the moon by 2040. The Department of Space has been allocated \$1.03 billion in the budget of 2023–24 to support missions such as the Gaganyaan human spaceflight mission.

The Women in Science program of the Department of Science and Technology (DST) has been scaled up with initiatives such as the Consolidation of University Research for Innovation and Excellence (CURIE) facilitating women's colleges and empowering more than 50,000 women through technology parks and skill development initiatives. The Science and Technology for Women scheme that has been running since 1982 still focuses on the gender gaps by supporting projects aiming to alleviate drudgery and enhance livelihoods.

India's global scientific leadership was seen in its 2023 G20 presidency, where it organized the Chief Science Advisors Roundtable (CSAR) for advancing collective science policy leadership on the global front. The government also sanctioned \$1,250 crore in January 2024 for India's involvement in the Square Kilometre Array (SKA), the world's largest radio-telescope observatory, indicating commitment to global mega-science collaborations.

There is, however, more work to be done. The private sector accounts for merely 36% of gross spending on R&D (GERD), as compared with 74% in the OECD countries, thus calling for higher corporate involvement. The mediocre rate of Indian paper citations (3 citations per article compared to 6.1 in Britain) indicates improved quality of research required. Efficiency concerns and higher-inclusive policy efforts to capture the talent that otherwise leaves due to lack of facilities are criticized.

BioE3 Policy (Biotechnology for Economy, Environment & Employment)



Biomanufacturing is a game changing step in building a resilient ecosystem for bio-based products and promoting high performance biomanufacturing. During his speech at ICGEB, Dr. Jeetendra Singh announced the BioE3 policy to help boost India's biomanufacturing sector and lead the next wave of industrial revolution.

The BioE3 Policy aims at accelerating development of technologies for bio-based products and their commercialization by setting up of BioEnablers that include Bio-Artificial (Bio-AI) Intelligence Hubs, Biofoundries and Biomanufacturing Hubs across the country. Bio-AI hubs will be set up to augment research and innovation for the development of technologies for bio-based products across the identified thematic sectors/subsectors of Biomanufacturing, by powering data-driven research and AI-informed predictive analytics.

The Bio Foundries and Biomanufacturing Hubs will aim at setting up of infrastructure/ facilities for augmenting scale up of technologies for bio-based products. The key performance indicators (KPIs) for meaningful success have been identified in terms of setting up of Bio Foundries and Biomanufacturing Hubs.

The following sectors have been categorised as of national importance:

- Bio-based chemicals and enzymes
- Functional foods and smart proteins
- Precision biotherapeutics
- Climate resilient agriculture
- Carbon capture and utilization
- Futuristic marine and space research

DBT-BIRAC have issued a joint call to invite proposals for setting up of “मूलांकुर BioEnablers – Biofoundries and Biomanufacturing Hubs” in the country. All the proposals received are under evaluation.

GLOBAL EFFORTS: A COLLABORATIVE PUSH FOR SCIENCE

Around the world, governments are coordinating science policy with sustainable development and geopolitical objectives. The EU-India Science and Technology Agreement, which was renewed in 2021 and is due to be reviewed at the February 2025 Trade and Technology Council (TTC) meeting in Delhi, is a prime example of this.

Collaborative research under this agreement targets green technologies, battery recycling, and wastewater treatment, and more than 600 Indian researchers have availed themselves of the EU's Marie Skłodowska-Curie Actions program.

Collaborative research under this agreement targets green technologies, battery recycling, and wastewater treatment, and more than 600 Indian researchers have availed themselves of the EU's Marie Skłodowska-Curie Actions program. The TTC's clean energy technology working group highlights the value of sustainability in international science agendas.

The U.S.–India Initiative on Critical and Emerging Technology (iCET), established in 2022, has hastened collaboration in semiconductors, space, and AI. In 2023, LAM Research planned to train 60,000 Indian engineers in semiconductor manufacturing, as Micron Technology pledged \$825 million to develop a semiconductor plant in India, facilitated by \$1.925 billion from the Indian government. These plans are aimed at making India a semiconductor hub in the world, creating 20,000 jobs. NASA and ISRO also signed a strategic outline for human spaceflight, with a proposed joint mission to the International Space Station in 2024.

In the UK, the UK-India Education and Research Initiative (UKIERI), with £2 million funding for its fourth phase in 2023, has organized more than 25,000 student exchanges since 2006.

Joint ventures include climate research, data science, and healthcare research, while UK-Indian research papers have a field-weighted citation impact of 2.2, twice the average across the world. The Fleming Fund and Healthtech Bootcamp in the UK complement bilateral links by addressing antimicrobial resistance and healthcare innovation.

Elsewhere, Singapore and South Korea lead in digital innovation, with Singapore leveraging its Smart Nation initiative to integrate AI and IoT into governance. Switzerland, ranked first in the GII 2024, excels in sustainability-driven innovation, investing heavily in renewable energy and carbon reduction technologies. South Korea's focus on advanced R&D, particularly in AI and quantum computing, has made it a regional powerhouse, ranking 10th globally.

Nonetheless, international science has its challenges. Funding inequalities continue, with the developing world having a hard time keeping up with the R&D spending of more affluent nations. Geopolitical tensions like export controls on strategic technologies complicate global cooperation. Moreover, the focus on sustainability threatens to overlook fundamental research, which is still essential for long-term advances.

THE POLITICAL LENS: OPPORTUNITIES AND CRITIQUES

The intersection of science and politics is a two-edged blade. In India, efforts such as ANRF and the National Quantum Mission illustrate a strategic objective to place the country on a higher global stage, but realization depends on implementation, private participation, and finding solutions to systematic problems such as talent retention and research quality. Internationally, collaborations such as iCET and the EU-India TTC illustrate the ability of collaborative science, but with the need to contend with political agendas and economic inequalities.

Governments have to balance short-term gains against investments in long-term basic research. India's ambition for applied sciences such as AI and quantum computing is admirable but short-changing basic science could compromise future innovation. Equally, international efforts should make provisions to provide access to funds and resources, especially for Global South researchers.

As the world and India make their way through this changing environment, politics and science will determine not just technological development but also societal consequences. With inclusive, participatory, and forward-looking policies, governments can help make sure that science remains a light at the end of the tunnel and a force of hope in an increasingly complicated world.



Dhruvi Patel (24-MBT-029)
Urvi Raval (24-MBT-038)

Drug Resistance in Bacteria: A Growing Global Threat

“The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily underdose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant”.

— Alexander Fleming, Nobel Lecture, 1945

When Alexander Fleming first warned the world about the dangers of antibiotic misuse, few imagined how prophetic his words would become. Nearly 80 years later, antibiotic resistance, now more accurately called antimicrobial resistance (AMR), has evolved into one of the greatest threats to global public health. Once-curable infections are now becoming deadly, and routine surgeries and treatments are at risk of turning life-threatening.

What Is Drug Resistance?

Drug resistance occurs when bacteria evolve mechanisms to survive antibiotics that were previously effective against them. This natural process is accelerated by misuse and overuse of antibiotics in medicine, agriculture, and animal farming. Every time we use antibiotics inappropriately such as for viral infections, or by stopping treatment early we give bacteria an opportunity to adapt.

Even more concerning is the horizontal transfer of resistance genes. Bacteria can share genes that encode resistance, allowing them to spread these abilities across species and ecosystems. Antimicrobial resistance is no longer confined to hospitals, resistance genes are now widespread in microbes in wastewater, soil, and livestock, posing a broader environmental and agricultural threat.



A Global Health Crisis

According to a study in 2019, it was estimated that 1.27 million deaths were caused due to bacterial drug resistance while almost five million deaths were associated with AMR and it is also estimated that by 2050 nearly 10 million deaths.

these numbers are alarming and infections like tuberculosis, gonorrhea, and urinary tract infections are becoming increasingly difficult and sometimes impossible to treat.

This is not only a health issue, but also a developmental and economic crisis. AMR could push millions into poverty due to rising medical costs and longer hospital stays. Low- and middle-income countries are disproportionately affected, where access to second-line treatments is limited or unaffordable. Due to such consequences of AMR, it has also been regarded as a “**Silent Pandemic**”.

SCAN ME



Scan this QR, for recent articles about Anti-microbial resistance.

RECENT TRENDS

In the last decade, scientists have observed the rise of so called "superbugs"-bacteria resistant to multiple antibiotics.

These include strains of:

- Carbapenem-resistant *Klebsiella pneumoniae*
- Multidrug-resistant tuberculosis (MDR-TB)
- Colistin-resistant *E. coli* due to the *mcr-1* gene
- Extensively drug-resistant gonorrhoea

Meanwhile, global surveillance systems like the WHO's GLASS (Global Antimicrobial Resistance Surveillance System) have helped map resistance trends worldwide. But gaps remain in data, especially from regions with limited laboratory infrastructure.

FIGHTING BACK: THE GLOBAL RESPONSE

The global scientific and public health communities are taking action. Efforts include:

1. Developing New Treatments:

- Novel and next-gen techniques are being developed to curb the issue of drug resistance which includes the following;

- a) Phage therapy-Bacteriophage are used for lysis of pathogenic bacteria of interest.
- b) Antimicrobial peptides-Peptides are synthesized which are specific to particular bacterial targets.
- c) Cas9 antimicrobials-Bacteriophage or other bacteria are armed with CRISPR-Cas9 system which is targeted to disable AMR genes.
- d) Live biotherapeutic-Other beneficial microbes are introduced in host so that they can outcompete pathogenic bacteria.
- e) Host directed therapy-Drugs are aimed at host pathways that are responsible for pathogen clearance and strengthen the immune system against pathogens.

- AI and Bioinformatics are extensively being used for development of new drug candidates.

2. Antibiotic Stewardship

- Hospitals are adopting antibiotic stewardship programs to ensure antibiotics are prescribed only when necessary and in the correct dosage.
- Doctors are being trained to resist patient pressure for unnecessary prescriptions.

3. Policy and Regulation

- Countries are enacting tighter regulations on the use of antibiotics.
- Bans on over-the-counter antibiotic sales without prescriptions are being implemented in many places.

4. Public Education

- Awareness campaigns highlight the importance of not self-medicating, completing full courses, and avoiding antibiotics for viral infections.

WHO has taken several initiatives such as AMR awareness week which is from 18 to 24 November each year, many campaigns are also taking place globally and at State level which make people aware about AMR and its repercussions.

A FINAL THOUGHT

Antibiotic resistance is not a future threat; it's a present and growing crisis. And yet, it's one we can still influence. Fleming's words were not just a warning; they were a call to responsibility. By understanding the stakes and acting wisely, we can slow the spread of resistance, protect modern medicine, and save countless lives.

The clock is ticking, but with global cooperation, scientific innovation, and individual awareness, we can still change the outcome.



Maitri Pandya
(25-MBT-035)

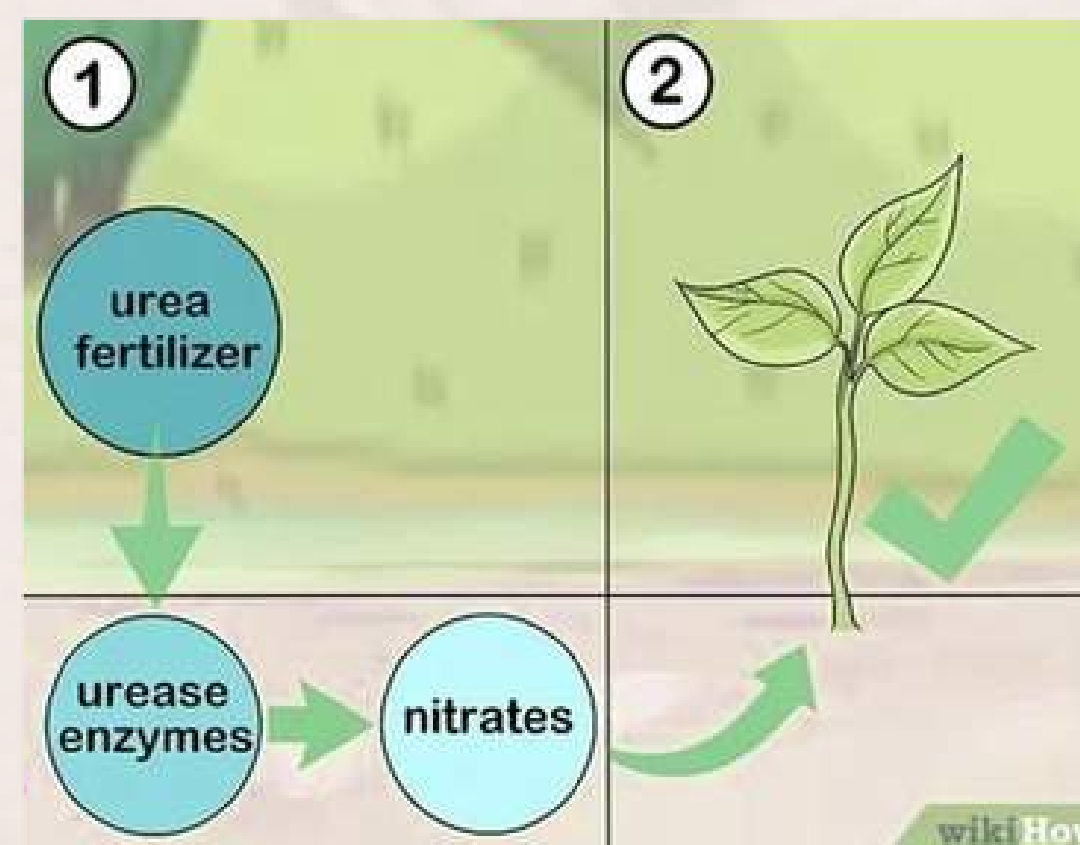
Agri-tech/ Nano-Urea

For decades, Indian farmers have relied heavily on chemical fertilizers, especially urea, to increase crop yields. Urea provides nitrogen, a nutrient that helps plants grow lush, green, and strong. But the problem is, out of every 100 kg of urea spread on the field, only about 30-40 kg is actually taken up by the crop. The rest is lost, it either leaches into the groundwater, runs off into rivers and lakes, or evaporates into the atmosphere as greenhouse gases. This not only wastes money for farmers but also creates huge environmental problems such as, Water bodies become polluted, causing excessive growth of algae (called eutrophication), which kills fish and harms ecosystems. Nitrous oxide gas is released into the atmosphere, which is about 300 times more powerful than carbon dioxide at trapping heat, worsening global warming. Soil quality declines over time due to chemical buildup.

WHAT IS NANO-UREA?

Nano urea is basically urea reimaged using nanotechnology. Instead of large granules of urea that have to be dissolved in soil water and absorbed by plant roots, nano urea contains nitrogen particles that are 30-50 nanometers in size. Because of this:

- When nano urea is sprayed on the leaves (foliar application), the tiny nitrogen particles easily enter through microscopic pores on the leaves called stomata.
- This means the nitrogen goes directly into the plant system, instead of waiting to be pulled up from the soil by the roots



So, with nano urea, plants get their nitrogen faster and more directly, leading to:

- Better growth
- Less wastage
- More efficient use of the fertilizer

ABOUT IFFCO

IFFCO (Indian Farmers Fertiliser Cooperative Limited) is one of India's largest cooperative societies, founded in 1967 to empower farmers by producing and supplying fertilizers. Headquartered in New Delhi, IFFCO serves over 36,000 member cooperatives and reaches around 50 million farmers across the country. It operates major manufacturing units in Gujarat, Uttar Pradesh, and Odisha, producing a significant share of India's urea and complex fertilizers. Recently, IFFCO made global headlines by developing Nano Urea, the world's first liquid nano nitrogen fertilizer, which promises to cut traditional urea use by half while boosting crop yields and reducing environmental harm. Through innovations like this, IFFCO continues to drive India's journey toward sustainable, self-reliant agriculture.

HOW MUCH IS NEEDED?

Just 500 mL of nano urea can replace an entire 45 kg bag of traditional urea. This reduces transport costs, labour for carrying and spreading heavy bags, and cuts down the total volume of chemicals entering the environment.

It is a liquid formulation developed using nanotechnology, designed to keep nitrogen particles stable at nano-scale. Manufactured by IFFCO (Indian Farmers Fertilizer Cooperative) in India. Each bottle is designed to be diluted with water and sprayed on crops during critical growth stages.

BENEFITS FOR FARMERS

- Saves Money & Labor:

Smaller quantities mean less transportation and application costs.

- Better Crop Health:

Studies show crops treated with nano urea often look greener and healthier, with more uniform growth.

- Higher Yields:

Field trials across India have shown average yield increases of 8-10% when nano urea is properly used along with balanced fertilization.

- Boosts India's Self-reliance:

India is a big importer of conventional urea. By using nano urea, which is manufactured domestically, we cut down on imports and save precious foreign exchange.

ARE FARMERS HAPPY WITH IT?

Many farmers who first tried nano urea were skeptical. How could such a small bottle possibly replace a heavy bag? But after using it and seeing greener crops with less fertilizer, many have become enthusiastic.

Farmers report that their fields look more uniformly green, plants stand stronger, and overall input costs go down when they use nano urea responsibly.

HOW DOES IT HELP THE ENVIRONMENT?

Because nano urea is so efficiently absorbed by plants, it dramatically reduces the amount of nitrogen that is lost to the environment. This leads to:

- Lower nitrate pollution in rivers and groundwater.
- Reduced emissions of nitrous oxide, a potent greenhouse gas.
- Healthier soil ecosystems, since less excess nitrogen disturbs soil microbes.

DISADVANTAGES OF NANOUREA

Nano urea is not a complete replacement for all fertilizers. Crops also need phosphorus, potassium, and micronutrients. Moreover “Premature and long-term adoption of such nitrogen-management practice may lead to yield losses besides reduction in grain and straw-nitrogen content,” the authors from the Punjab Agricultural University, Ludhiana, said in their peer-reviewed study in the journal Plant Soil, adding, “...a rational understanding on the long-term impacts is required else it might inadvertently harm the economic benefits and livelihoods of the growers”.

- Using nano urea along with a balanced fertilizer program (it mainly supplies nitrogen).
- Following proper dosage instructions to avoid over- or under-spraying.

FUTURE

Nano urea is a big step toward precision agriculture, where inputs are given exactly when and where they're needed, reducing waste and increasing profits.

As more farmers get trained and adopt this technology, India could see:

- Lower fertilizer subsidies and import bills,
- Less pollution in our water bodies,
- Healthier soils for future generations.



PUZZLE

WORD SEARCH

C	H	L	O	R	O	P	L	A	S	T	A
P	C	S	A	E	R	C	N	A	P	Y	X
F	I	O	Q	V	B	A	R	V	B	E	O
N	N	D	V	E	F	U	G	I	C	N	P
O	E	H	I	A	N	L	J	A	K	D	L
H	G	L	M	A	X	N	E	N	O	I	L
T	S	Q	C	R	S	I	T	M	P	K	A
Y	N	H	K	U	R	O	N	X	A	G	M
P	A	P	O	P	T	O	S	I	S	N	S
L	R	C	H	R	O	M	O	S	O	M	E
V	T	S	W	K	E	R	A	T	I	N	Z
M	I	T	O	C	H	O	N	D	R	I	A

- The powerhouse of the cell? → Mitochondria
- Indian state with highest forest cover (2023 data)? _____
- Common name of the bird flu virus subtype H5N1? _____
- Virus declared eradicated by WHO in 1980? _____
- Popular programming language in AI-biological modeling? _____
- What structure carries genetic information? _____
- What term refers to an organism with foreign DNA inserted? _____
- What organ produces insulin? _____
- What is the primary structural protein in hair and nails? _____
- Which organelle is responsible for photosynthesis? _____
- What term refers to programmed cell death? _____
- The hardest substance in the human body? _____
- Which Indian vaccine was co-developed by Bharat Biotech for COVID-19? _____
- What organ filters blood in the human body? _____

NOBEL LAUREATE

JENNIFER DOUDNA, NOBEL LAUREATE, 2020

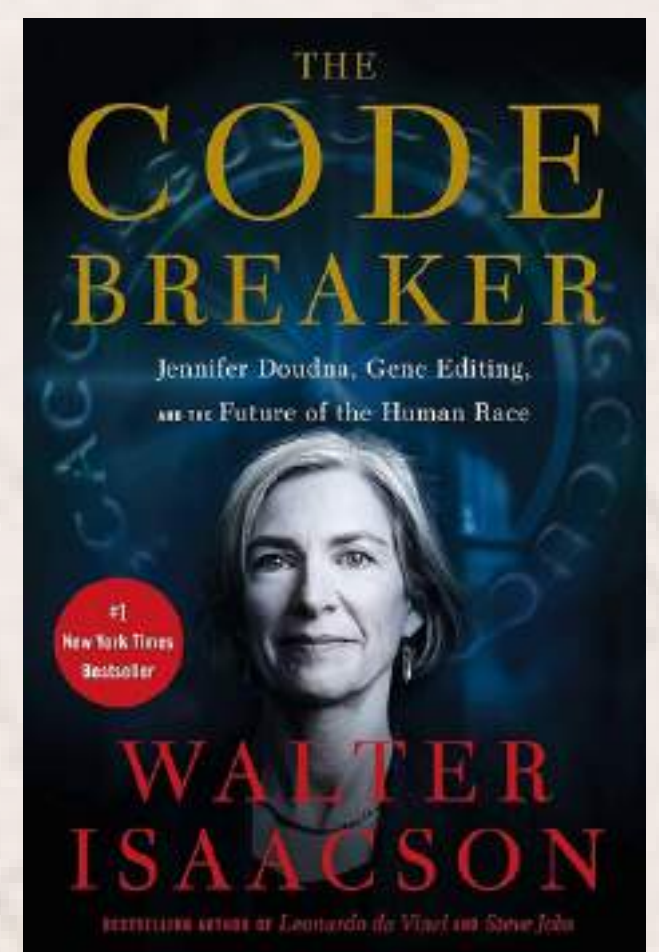
CRISPR-CAS9



Jennifer Doudna was born on February 19, 1964, Washington, D.C. She is an American biochemist best known for her discovery, with French microbiologist Emmanuelle Charpentier, of a molecular tool known as clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9.

The discovery of CRISPR-Cas9, made in 2012, provided the foundation for gene editing, enabling researchers to make specific changes to DNA sequences in a way that was far more efficient and technically simpler than earlier methods. Using the CRISPR-Cas9 system, scientists were able to alter DNA to correct genetic defects in animals and modify DNA sequences in embryonic stem cells, an advance that opened the path to germ-line (sperm and egg) genome modification in humans. Jennifer Doudna and Emmanuelle Charpentier shared the 2020 Nobel Prize in Chemistry for their discovery and development of gene editing technologies.

Jennifer Doudna spent much of her youth in Hilo, Hawaii. After earning a degree in chemistry in 1985 from Pomona College in California, she went to Harvard University.



There she worked in the laboratory of English-born American biochemist and geneticist Jack W. Szostak (who won the 2009 Nobel Prize for Physiology or Medicine) and in 1989 completed a Ph.D. in biochemistry.

In 1994, following postdoctoral studies at the University of Colorado under the direction of American biochemist and molecular biologist Thomas R. Cech (who received a share of the 1989 Nobel Prize for Chemistry), she joined the faculty at Yale University.

In 2002 she moved to the University of California, Berkeley, where she served as professor of biochemistry and molecular biology.

Early in her career Doudna worked to deduce the three-dimensional structures of RNA molecules, which provided insight on RNA catalytic activity. She later investigated the control of genetic information by certain small RNAs and became interested in CRISPR. CRISPR is part of the bacterial immune system. It originates with RNA sequences from invading viruses that become incorporated into bacterial genomes.

The viral sequences reside as DNA in the spacers between short repeating blocks of bacterial DNA sequences. The next time the virus invades the bacterial cell, the spacer DNA is converted to RNA.

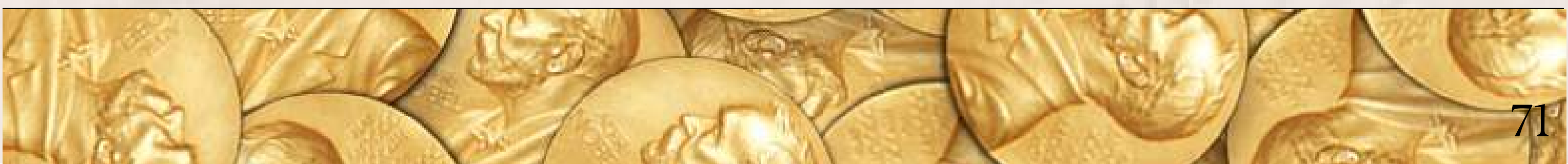
The Cas9 enzyme and a second RNA molecule attach to the newly coded RNA, which then seeks out matching strands of viral DNA. When encountered, Cas9 cuts the viral DNA, preventing the virus's replication. Doudna and Charpentier found that the guide RNA sequence could



be changed to direct Cas9 to a precise DNA sequence. Their discovery quickly transformed the landscape of genome engineering, creating new

Opportunities for the treatment of human disease.

In addition to receiving the Nobel Prize, Jennifer Doudna received numerous honors and awards for her research, including the Gruber Prize in Genetics (2015) and the Canada Gairdner International Award (2016), both shared with Emmanuelle Charpentier. Jennifer Doudna was an elected member of multiple academies and a Howard Hughes Medical Institute investigator (from 1997).



NOBEL LAUREATE

DEMIS HASSABIS, NOBEL LAUREATE, 2024

AI AND PROTEIN



Demis Hassabis was born on July 27, 1976, London, England is an English computer scientist who was awarded the 2024 Nobel prize in Chemistry for his work using artificial intelligence (AI) to predict protein structures. He shared the prize with his colleague, American computer scientist John M. Jumper and the other half of the prize was awarded to American Biochemist David Baker.

Hassabis spent his early life in north London. The eldest son of a Greek Cypriot father and a Chinese Singaporean mother, Hassabis developed a keen interest in chess and computer programming. A chess player from age four, Hassabis obtained the rank of chess master at age 13. His affection for computer games inspired him to code his first game, a version of Othello, and teach himself computer programming from books.

Hassabis would go on to write code for the games company Bullfrog Productions, where by age 17 he served as the lead developer of the AI generated video game Theme Park (1994). During this period he attended grammar school at Queen Elizabeth's School and secondary school at Christ's College, Finchley. At Finchley he completed his examinations at age 16, two years early.



After graduating from Cambridge in 1997, Hassabis became the lead AI programmer at Lionhead Studios, where he assisted in the development of the game Black & White in 2001. He left Lionhead Studios in 1998 to found Elixir Studios, where he went on to produce a number of award-winning AI-based video games, including Republic: The Revolution (2003) and Evil Genius (2004).

He pursued a Ph.D. in cognitive neuroscience at the University College London (UCL), in large part to understand how the human brain managed imagination and memory. After graduating from UCL in 2009, Hassabis did his postdoctoral work at Harvard University and the Massachusetts Institute of Technology (MIT) and became a Henry Wellcome fellow at UCL.

DEEP-MIND

Hassabis founded DeepMind, an AI-based startup company, along with New Zealand computer scientist Shane Legg and English entrepreneur Mustafa Suleyman in 2011. Over the next four years he developed a series of AI models and trained them using deep learning to play and master video games without teaching the AI the rules. Hassabis and his colleagues sold DeepMind to Google in 2014, with Hassabis remaining to serve as CEO.



Aarya Kalhe
(24-MBT-017)



NEXT GENERATION THERAPEUTICS

Modern medicine is entering a new era where innovative therapies are redefining the way we treat diseases. These breakthroughs not only bring hope for better treatments but also demonstrate how science is pushing boundaries to protect and heal lives. By harnessing cutting-edge approaches, next generation therapeutics are shaping the future of healthcare.

In this section, you will find articles on:

- **mRNA Technology** – a powerful innovation that has transformed pandemic protection.
- **CAR T Cell Therapy** – a groundbreaking treatment bringing new possibilities in cancer care.

Generating “super-soldiers”: CAR T cells and future of oncology.

T cells usually recognize antigens only when presented via MHC molecules and this makes them MHC-restricted and dependent on specific antigen processing and presentation. This natural T cell response is triggered by cancer cells through various mechanisms. These strategies of cancer cells allow them to avoid detection and destruction by the immune system but CAR (Chimeric Antigen Receptor) T cells break the rules of traditional immunology; they can recognize antigens directly on the surface of cancer cells, bypassing the need for MHC. For many patients, conventional cancer treatments can be a long and exhausting journey filled with side effects and uncertainty. This has led to growing interest in therapies that are not just effective but also personalized.

In CAR-T cell therapy, T cells are extracted from a patient's blood and modified in a laboratory to express the CAR. The CAR enables the T cells to recognize and bind to specific proteins, or antigens, found on the surface of cancer cells. Once the CAR-T cells are infused back into the patient's bloodstream, they seek out and destroy cancer cells that display the target antigen.

CAR-T cell therapy has shown promising results in treating certain types of blood cancers, such as acute lymphoblastic leukaemia (ALL) and certain types of non-Hodgkin lymphoma. However, it is a complex and expensive treatment that can cause severe side effects, so it is typically used as a last resort for patients who have not responded to other treatments.

Leukapheresis is a critical first step in initiating CAR T cell therapy. It's a medical procedure that involves collecting specific types of white blood cells, primarily T cells, from a patient's bloodstream. These collected T cells are then sent to a specialized laboratory where they are genetically engineered to become CAR T cells. The primary goal of leukapheresis is to obtain a sufficient quantity of the patient's own T cells. These T cells will serve as the framework for the CAR technology. Using the patient's own cells (autologous) helps to minimize the risk of immune rejection of the engineered cells.

History

CAR-T cell therapy has undergone significant advancements over the years to improve its precision, durability, and clinical success. Each generation represents a step forward in engineering T cells with enhanced Tumor-killing ability, persistence in the body, and reduced side effects. From basic antigen recognition to complex gene editing and dual-targeting, the evolution of CAR-T cells reflects the rapid progress in immunotherapy.

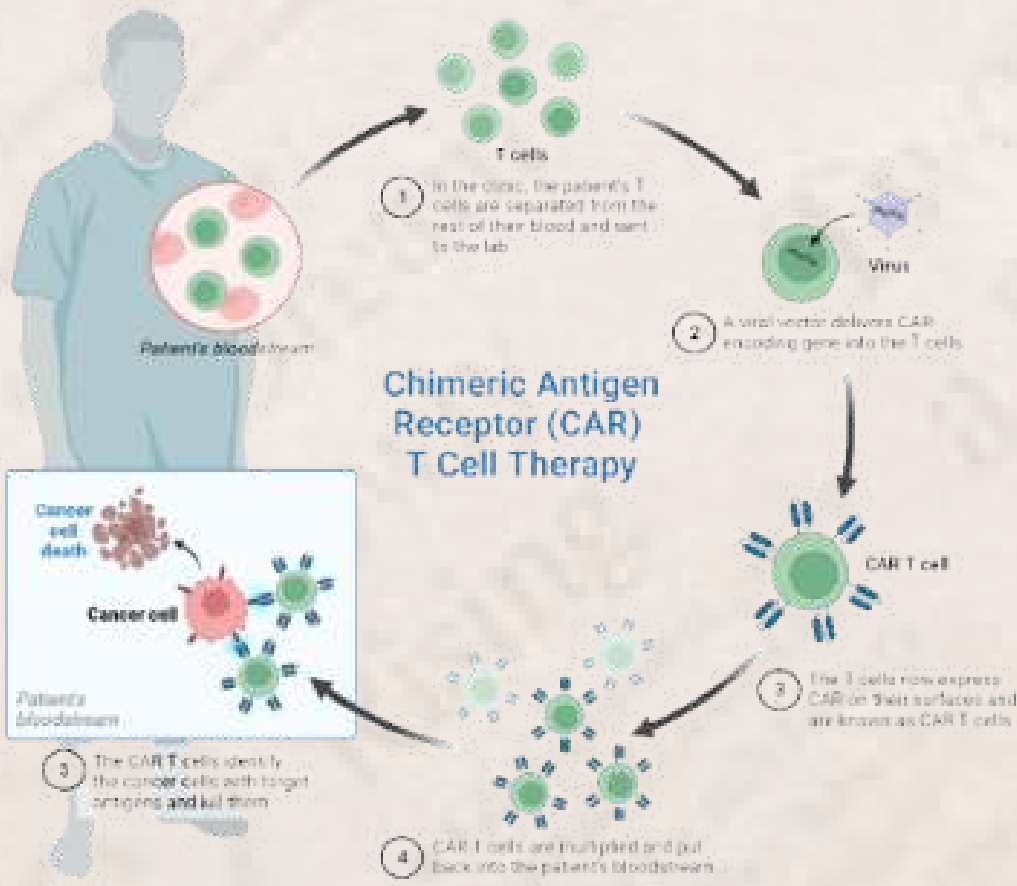
Generation	Key Features	Advantages	Limitations / Notes	Example / Application
1st Gen	scFv + CD3ζ	Proof of concept; Tumor targeting	Poor persistence; required IL-2; limited clinical success	GD2-specific CAR in neuroblastoma
2nd Gen	scFv + CD3ζ + 1 costimulatory domain (CD28 or 4-1BB)	Improved efficacy & persistence	Risk of cytokine release syndrome (CRS) & neurotoxicity	NexCAR19 (India's 1st approved therapy)
3rd Gen	scFv + CD3ζ + 2 costimulatory domains (e.g., CD28 + 4-1BB/OX40/CD27)	Enhanced activation, cytokine production & survival	More complex design; still in trials	Haematological malignancies, relapse cases
4th Gen (TRUCKs)	2nd/3rd Gen CAR + inducible expression of therapeutic cytokines/genes	Overcomes Tumor microenvironment; targets suppression	Controlled activation needed to avoid toxicity	IL-12 secreting CARs for solid tumors
5th Gen	AI + CRISPR + dual-antigen targeting + multi-functional design	Targets solid tumors & autoimmune diseases; smarter control	Still emerging; complex manufacturing	Dual-target CARs (multi-antigen recognition)

Mode of Action

CAR-T cell therapy works by genetically modifying a patient's T cells to recognize and attack cancer cells.



Scan this code to know more about CAR-T Cell Therapy.
Ted Talk by Alaina Mupparthi



In vivo Cancer Detection Method

There are a few different approaches that can be taken:

- **Imaging techniques:** Imaging techniques such as positron emission tomography (PET) and magnetic resonance imaging (MRI) can be used to track the location and distribution of CAR-T cells in the body. This can help determine if the CAR-T cells are successfully targeting and attacking the cancer cells.
- **Biopsies:** Biopsies can be taken from the tumor site before and after CAR-T cell therapy to assess the presence and activity of cancer cells. This can help determine the effectiveness of the therapy.
- **Blood tests:** Blood tests can be used to measure the levels of certain biomarkers that indicate the presence of cancer cells. This can be useful in monitoring the progress of CAR-T cell therapy and detecting any signs of relapse.
- **Optical imaging:** optical imaging involves the use of fluorescent or bioluminescent markers to visualize the distribution and activity of CAR-T cells in the body. CAR-T cells can be labeled with fluorescent or bioluminescent markers and infused back into the patient's bloodstream. in vivo detection of cancer cells by CAR-T cell therapy is an important aspect of monitoring the effectiveness of the treatment and ensuring that the cancer cells are being targeted and eliminated.

In vitro Cancer Detection Method

A few different approaches can be taken:

- **Flow cytometry:** This method can be used to identify cancer cells by their expression of specific markers. CAR-T cells can be labelled with fluorescent dyes or antibodies, and their interaction with cancer cells can be measured by flow cytometry.
- **Cytotoxicity assays:** These assays measure the ability of CAR-T cells to kill cancer cells. Cancer cells are incubated with CAR-T cells, and cell viability is assessed using various methods, such as MTT assays or LDH release assays.
- **ELISA assays:** These assays can be used to measure the cytokine secretion profile of CAR-T cells. Cytokines such as IFN-gamma, IL-2, and TNF-alpha are important indicators of CAR-T cell activation and efficacy.
- **Imaging assays:** Techniques such as confocal microscopy or live-cell imaging can be used to visualize the interaction between CAR-T cells and cancer cells in real time.
- **PCR-based methods:** These methods can be used to detect the presence of cancer-specific biomarkers, such as mutated genes or fusion transcripts, in tumor samples. This can be useful for monitoring disease progression and assessing the response to CAR-T cell therapy. these in vitro methods can provide valuable information about the efficacy of CAR-T cell therapy and help to optimize its use in cancer treatment.

Side Effects

- **Cytokine release syndrome (CRS):** This is a potentially life-threatening side effect that occurs when the CAR-T cells are activated and release large amounts of cytokines, which can lead to fever, low blood pressure, difficulty breathing, and organ damage.
- **Neurotoxicity:** Some patients may experience confusion, seizures, and other neurological symptoms as a result of CAR-T cell therapy.
- **Infections:** Patients who receive CAR-T cell therapy may be at increased risk of developing infections due to the weakening of their immune system.
- **Tumor lysis syndrome:** This is a condition that occurs when large numbers of cancer cells are destroyed rapidly, causing an imbalance in electrolytes and other substances in the blood.
- **Blood disorders:** Some patients may experience a decrease in blood cell counts, which can lead to anemia, thrombocytopenia (low platelet count), and neutropenia (low white blood cell count).

Benefits

- **High success rates:** CAR-T cell therapy has shown high success rates in treating certain types of cancer, particularly those that have not responded to other treatments.
- **Potentially curative:** CAR-T cell therapy has the potential to cure some patients of their cancer, particularly those with early-stage disease.
- **Long-lasting effects:** CAR-T cells can remain in the body for a long time, providing ongoing protection against cancer cells.
- **Minimal side effects:** Compared to traditional cancer treatments like chemotherapy, CAR-T cell therapy can have fewer side effects.
- **Personalized treatment:** Each patient's T cells are genetically engineered specifically for their cancer, providing a personalized treatment approach.
- **Expanded use:** CAR-T cell therapy is being studied for use in a variety of cancer types, and researchers are exploring its potential in other diseases as well.

Summary

CAR-T cell therapy is a life-changing treatment for blood cancers, but its high costs put it out of reach for many. It is expensive because, each dose is custom-made from the patient's own cells, requires weeks of lab work in specialized facilities, and depends on complex viral delivery systems. Scientists are tackling these hurdles by using an alternative to reduce cost, by using:

1. Tools like CRISPR and "jumping genes" (Sleeping Beauty/piggyBac) could replace viral vectors.
2. "Universal" CAR-T cells from healthy donors could treat many patients with one batch.
3. Decentralized point-of-care (POC) manufacturing of CAR-T cells minimize logistical expenses, eliminating the need for complex infrastructure, and enabling localized production closer to patients.

These innovations are made so that more patients can access this revolutionary therapy. We're re-engineering CAR-T to be simpler, faster, and fairer, because breakthroughs should help everyone.

While conventional cancer treatments such as chemotherapy, radiation therapy, and surgery have long been the cornerstone of oncology, they often come with significant limitations; ranging from non-specific targeting to severe side effects. This raises an important question that, why consider CAR T cell therapy over these established options? The answer lies in the unique, targeted, and personalized mechanism of CAR T cell therapy



Vedanshi Makwana
(24-MMB-012)

mRNA Technology: A New Era in Pandemic Protection

“It started with a molecule and ended with millions protected.”

In early 2020, the world came to a halt. Streets were empty, schools and offices shut down, and fear hung heavy in the air. A virus we had never heard of - COVID-19- was spreading fast. People everywhere were desperate for a way out. And that exit came in the form of something most of us had never heard of before: an RNA vaccine.

Although it felt like RNA vaccines came out of nowhere during the pandemic, the truth is that it has been in the works for decades.

Scientists have been studying mRNA technology since the early 1990s, quietly improving it behind the scenes. But because it had never been used in an approved vaccine before, most people outside the scientific community were unaware of it. It took a global crisis for this powerful science to finally step into the spotlight and change the world.

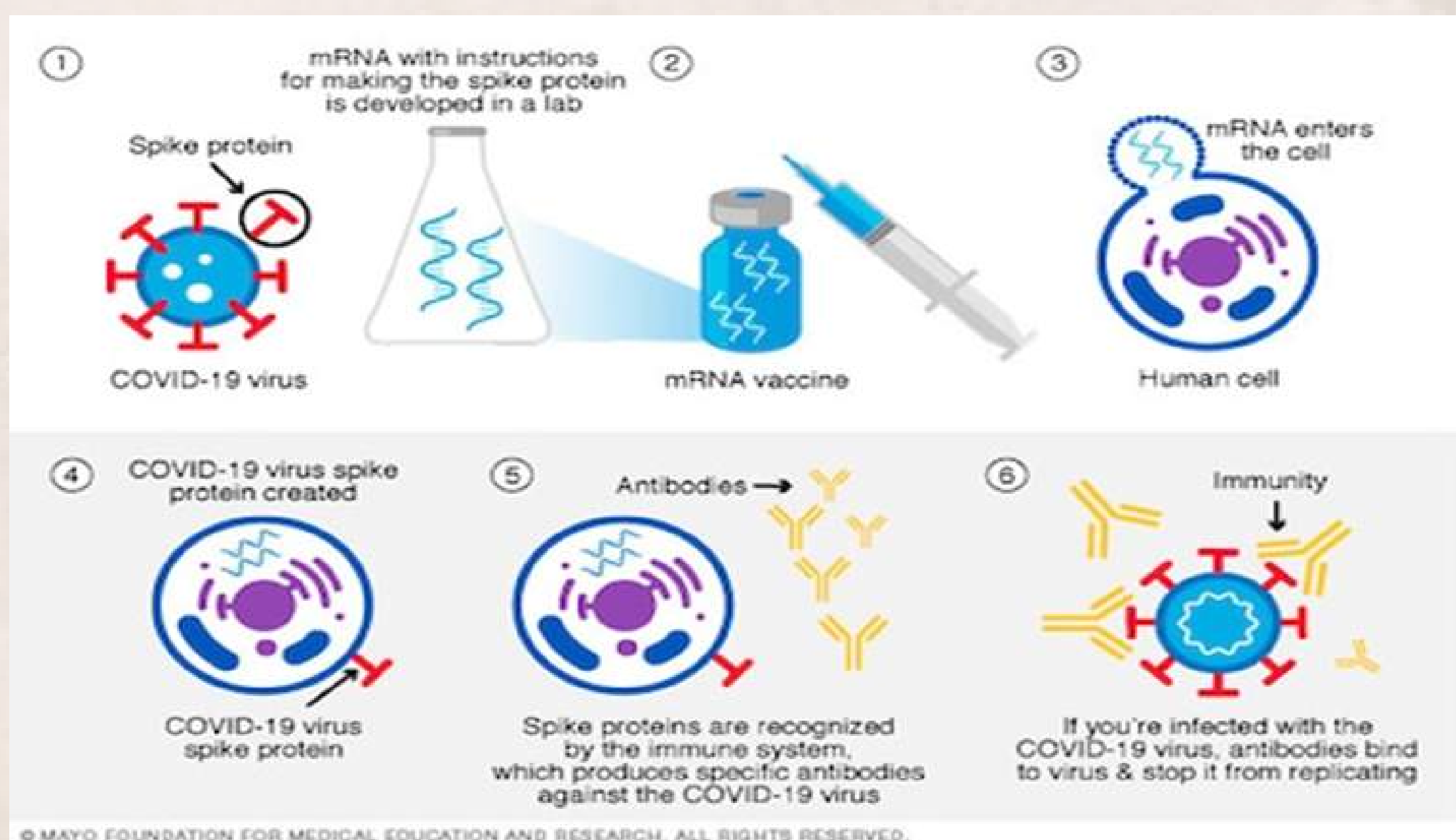
One of the most talked-about names during that time was the Pfizer-BioNTech vaccine. But what made it so different? And why was it called a breakthrough?

Unlike traditional vaccines, which use dead or weakened viruses to strengthen our immune system, RNA vaccines operate through a completely different process.

NEXT GENERATION THERAPEUTICS

To put it simply, imagine giving your body a set of instructions: a small message that says, “Hey, here’s what the virus looks like. Get ready to fight it.” That’s what messenger RNA (or mRNA) does. It teaches your body to recognize a harmless part of the virus, which is the “spike protein” on its surface, so that if the real virus ever enters, your immune system knows exactly what to do.

An mRNA vaccine instructs cells on how to produce the S protein found on the surface of the COVID-19 virus. After vaccination, the body's muscle cells start making these protein pieces and display them on their surfaces. This prompts the body to produce antibodies. Then, if you catch the COVID-19 virus, these antibodies help to eliminate it. Once the protein pieces are made, your cells break down the instructions and get rid of them. The mRNA in the vaccine doesn't enter the nucleus of the cell, where DNA is kept.



Both the Pfizer-BioNTech and the Moderna COVID-19 vaccines use mRNA. What’s amazing is that the Pfizer-BioNTech vaccine never puts the actual virus into your body. It just gives your cells a short-lived recipe to make a tiny piece of the virus, trains your immune system, and then disappears. Your body is now smarter, faster, and ready to shield you without ever having to confront the real danger firsthand.

The partnership between Pfizer, a large U.S. pharmaceutical company, and BioNTech, a smaller German biotech firm, turned out to be one of the most successful scientific collaborations in history. In less than a year, something almost unheard of in the world of medicine: they developed, tested, and delivered a safe and highly effective vaccine. It was the first mRNA vaccine ever approved for human use. The speed, the science, and the scale were all extraordinary.

When it was first rolled out in late 2020, the Pfizer-BioNTech vaccine gave people something they hadn't felt in months: hope. Millions rolled up their sleeves not just to protect themselves, but to protect their families, their communities, and the world. The vaccine proved to be over 90% effective in preventing serious illness, hospitalizations, and death from COVID-19. The results were clear in a short period: fewer sicknesses, fewer empty hospital beds, and more lives saved.

A small team with a big vision:

BioNTech, a small biotechnology company in Germany, already had something powerful: cutting-edge research in mRNA technology. Its co-founders, husband and wife duo Dr. Uğur Şahin and Dr. Özlem Türeci, had been working for years on using mRNA to treat cancer. When they saw the early reports of the coronavirus in China in January 2020, they quickly realized their technology could be repurposed to create a vaccine. But BioNTech was small. They had the science but lacked the global infrastructure to manufacture and distribute a vaccine on a massive scale. That's where Pfizer, a global pharmaceutical giant based in the U.S., stepped in. The two companies had known each other from a past partnership on flu vaccines. As a result, BioNTech approached Pfizer with their idea, and the response was immediate. Furthermore, without waiting for government funding, Pfizer took the risk and agreed to help develop, test, and distribute the vaccine entirely out of pocket.

NEXT GENERATION THERAPEUTICS

The project was nicknamed “Project Lightspeed”, and it lived up to its name. Together, the companies moved at an unprecedented pace as they went from an idea to an approved vaccine in under a year. That meant

- Designing and producing mRNA sequences in days
- Running massive clinical trials across multiple countries
- Scaling up global manufacturing and cold-chain logistics
- Navigating health regulations across continents

In December 2020, the Pfizer-BioNTech COVID-19 vaccine (BNT162b2) became the first mRNA vaccine in the world to be authorized for emergency use, starting with the UK, then the U.S., and eventually, most of the world.

In 2023, the scientific world recognised a hero often overlooked by the public: Professor Katalin Karikó, who shared the Nobel Prize in Physiology or Medicine with Dr. Drew Weissman. Their breakthrough published in 2005 revealed a way to modify synthetic mRNA so the body doesn’t attack it, transforming what had been fragile and inflammatory into a powerful and safe tool for vaccines.

This modification eliminated dangerous immune reactions and greatly boosted protein production, laying the foundation for the Pfizer-BioNTech and Moderna COVID-19 vaccines. Without their decades-long perseverance in the face of skepticism and failed grants, the rapid development of life-saving mRNA vaccines in 2020 simply wouldn’t have been possible.

However, the story doesn’t end there. What Pfizer and BioNTech achieved was more than just a solution to COVID. It was the beginning of a new chapter in medicine. Now, researchers are looking at using RNA vaccines to treat other illnesses like influenza, HIV, and even cancer. It has completely transformed the future of how we fight disease.

And perhaps the most important part of this piece of the story? It reminded us that science isn't just something that happens in labs. It touches all our lives in immeasurable ways. It means being able to visit our near ones safely, that students are returning to classroom like old times, the frontline workers are finally breathing a little easier. That small vial of vaccine with a few milliliters of hope was more than a medical product. It proved to be a lifeline, a symbol of resilience, and a reminder of what we can achieve when the world comes together.



Mehal Desai
(25-MBT-027)

Scan this code and Listen the Nobel laureate talk about mRNA vaccine :)

HISTORY OF ISNU

2004

Nirma University laid the foundation of the Institute of Science on 5th September, Under the leadership of Prof. Yadvendrakumar K. Agrawal

2004

Prof. Shalini Rajkumar, Dr. Munjal Acharya and Dr. Reena Rathod joined ISNU as a faculty for P.G. Courses.

2005

The P.G Programme Seats increased to intake of 30 students.

2006

Dr. A. B. Karnik joins in place of Dr. Munjal Acharya at ISNU as a faculty for P.G. Courses.

2006

Mr. Sachin Prajapati joins as Lab. Assistant and Ms. Svetal Shukla joined ISNU as Asst. Librarian .

2007

Dr. Sarika Sinha, Dr. Vijay Kothari and Dr. Sriram Sheshadri joined ISNU as a faculty for P.G. Courses.

2007

Mr. Hasit Trivedi joins ISNU as Student Section Officer.
1st PhD Student registered under the ISNU Faculty (Dr. Vijay Kothari).

2008

Late Prof. L. J. Parekh moves in as the Director.
Late Mr. Bharat Anand joins as Lab Assistant at ISNU.

2009

Prof. G. Nareshkumar becomes the New Director.

2009

ISNU started with new P.G. Programme as microbiology and also seats were increase to 60 students intake.

2009

Dr. Nasreen Munshi joins the family as
Environmental Microbiologist
Ms. Jayshree Pandya joins as Library Assistant.

2010

Prof. Sarat Dalai joins as Immunologist, Dr. Sonal
Bakshi as Cytogenetics, Dr. Ameer Nair as
Neurobiologist and Dr. Mili Das as Biophysics and
Structural Biologist.

2011

Mr. Rajendra Patel takes charge as Store
Keeper at ISNU .

2011

Prof. Sarat Dalai chosen as New Director for
ISNU family

2012

Mr. Parthiban Mudaliyar joins as P. A to Director.
Total intake for new batch increased to 72
students.

2013

Dr. Heena Dave joins ISNU as Visiting Faculty
later in 2020 joined as Faculty.
Ms. Sweta Patel (former student) joins as Lab.
Assistant.

2014

ISNU was Recognition as Scientific and Industrial
Research Organization (SIRO)

2015

Dr. Rajeev Tyagi joins the institute as Asst.
Professor.

2016

Dr. Kirti Verma joins for 1 year as Ad- Hoc Faculty.
Total number of intake for programme was
increased to 90 students.

2017

Dr. Pranati Sar joins as Young Women Scientist

2018

Gsbtm Sponsored Bioinformatics nodal centre
esstablished at ISNU.
ISNU receives DST- FIST infrastructure Grant
worth 90 lacs for different instruments.

2018

Dr. Kuldeep Verma joins as expertise in Membrane
Trafficking and Dr. Dablulal Gupta as Cancer
Immunologist.

2018

Ms. Zankruti Hathi joins Bioinformatics Nodal
Centre as Research Associate

2019

ISNU along with IPNU received sanction of DPRP
Project worth Rs. 5Cr.

2019

Total intake for PG Programmme increases to 102.
Dr. Svetal Shukla earns PhD in Lbrary Science
from Baba Ambedkar Open University.
Dr. Sweta Patel earns PhD in Life Sciences from
INSU.

2021

Dr. Aarthi Sundararajan joins the ISNU Family
with expertise of Reproductive Immunology,
Maternal and Child Health.

2022

Dr. Shruti Chatterjee joins the ISNU as Microbiologist.
Dr. Ravi Kant also joins the ISNU as Asst. Faculty.

2023

Prof. Sarat Dalai got patent grant to ISNU for
Chimeric IL- 15

2024

Dr. Vijay Srivastava joins the ISNU Family with
the experitse in macromolecular X-ray
crystallography and interdisciplinary areas of
protein chemistry, biochemistry, molecular
biology, biophysics, and bioinformatics.

2025

Dr. Darshan Dhakan joins the ISNU family with
the expertise in computational biology and
bioinformatics.



Varia Hitiksha
(24-MBC-014)

ISNU FACULTY AND STAFF MEMBERS

The Faculties are a community of diverse, talented, and kind-hearted experts excelling across fields such as immunology, cancer biology, reproductive physiology, biochemistry, microbiology, neuroscience, drug discovery, gut biology, and more. With their guidance, students are inspired to think beyond boundaries embracing creativity, safety, and a broader vision for the future, rather than being confined to a single path.



INSTITUTE OF SCIENCE STUDENT'S ASSOCIATION

"Uniting minds, building leaders, and creating memories, INSSA is where ideas turn into action and students turn into changemakers."

At the heart of the Institute of Science beats a vibrant student body that thrives on ideas, teamwork, and passion, the Institute of Science Students' Association (INSSA). More than just a committee, INSSA serves as a bridge between the administration, faculty, staff, and students. It aims to strengthen communication, give common platforms, enhance skill and knowledge and promote a culture of academic excellence, and provide opportunities to expand their horizons, reach their full potential, discover their talents, and change the world around them. Whether it's organizing an academic seminar, leading a plantation drive, or planning a cultural celebration, INSSA stands as a symbol of student initiative and leadership.

Motto: "Inspire, Lead, Serve."

Vision: To nurture holistic development, instill a spirit of scientific curiosity, and encourage students to make meaningful contributions to society.



INSTITUTE OF SCIENCE STUDENT'S ASSOCIATION

Committee Structure :The constitutional members of the current INSSA committee are:

President: Pratham Dasadiya (Sem-3)

Vice-president: Nigam Patel (Sem-3)

Treasurer: Stavva Pathak (Sem-3)

Joint Secretaries:

- Vedanshi Makwana (Sem-3)

- Desai Nirva (Sem-3)

- Amisha Gurnani (Sem 3)

The Cultural Committee, consisting of Cultural Coordinators [Sonarika Sen](#) and [Varia Hitiksha](#), functions as a part of the INSSA Committee, playing a key role in organizing cultural events. Through their efforts, they create platforms that showcase and celebrate the artistic talents of ISNU.

These leaders take on the responsibility of conceptualizing, organizing, executing, and reviewing events throughout the year. Their dedication ensures that every initiative not only runs smoothly but also creates a lasting impact on the student community.



Pratham Dasadiya
INSSA President 2025-26

ANTI-RAGGING COMMITTEE

The Anti-Ragging Committee of the Institute of Science, Nirma University, is led by Dr. Aarthi Sundararajan and is dedicated to fostering a safe, inclusive, and welcoming campus environment for all students. The committee also includes a parent of one of the current members, ensuring active parental involvement in maintaining a respectful campus culture.

Each year, during the orientation programme for freshers, Dr. Aarthi Sundararajan and the committee members actively spread awareness about ragging- explaining the institute's zero-tolerance policy, its seriousness, and the procedures for reporting concerns. In line with UGC and NMC guidelines, the institute observes Anti-Ragging Week annually from 12th August to 18th August. Various activities and competitions are organised to engage students and reinforce the message. In 2024, poster-making and short video competitions were the highlights, while in the previous year, a drama competition took centre stage.

As a preventive measure, all students are required to sign an undertaking acknowledging their responsibilities and understanding the reporting procedures for any ragging-related incidents. This proactive approach ensures awareness, vigilance, and collective responsibility in keeping the campus ragging-free.

Annual Anti ragging committee meetings are held regularly involving Chairman, NGO, parent, police, local media, faculty and student representatives.



ANTI-RAGGING COMMITTEE

Here are the names and contacts of the current members to whom any incidents of ragging can be reported:

Dr. Aarthi Sundararajan- aarthi.sundararajan@nirmauni.ac.in

Vrushanki Joshi- 24mbt016@nirmauni.ac.in (semester3)

Vedanshi Shah- 24mmb045@nirmauni.ac.in (semester3)

Shitakshi Mishra- 24mbt028@nirmauni.ac.in (semester3)

Rutika Parmar- 24mbt027@nirmauni.ac.in (semester3)

Aryan parmar – 25mbt068@nirmauni.ac.in (semester1)

Stutee Gaur- 25mbt056@nirmauni.ac.in (semester1)

Khushi Sood- 25mbt024@nirmauni.ac.in (semester1)

Jhanvi Rathod- 25mmb028@nirmauni.ac.in (semester1)

Prakruti Patel- 25mbt042@nirmauni.ac.in (semester1)

Glimpse of various events



Vrushanki Joshi

Anti-Ragging Coordinator 2024-26

SPORTS COMMITTEE

At ISNU, sports are so much more than competition, they're a vibrant platform that fuels passion, builds teamwork, and shapes personal growth. The Sports Committee works tirelessly to discover and nurture talent, giving students plenty of opportunities to hone their skills and shine whether in friendly, intra- institute tournaments or in the thrill of high-stakes inter-institute matches.

The campus truly comes alive during these events. From the cheers of spirited in-house games to the excitement of challenging fixtures with other institutes, every moment celebrates the values of dedication, discipline, and fair play making sports an inseparable part of ISNU's spirit and student life.

This dynamic culture is led by Faculty Sports Coordinator Dr. Vijaykumar Srivastava, alongside senior coordinators Yash Patel, Smit Badmaliya, Shagun Shah, and Siddhi Parikh, with the spirited support of four energetic junior coordinators. Together, they ensure each event runs seamlessly, adding to ISNU's ever-growing legacy of sporting excellence.



Yash Patel

Sports Coordinator 2024-26



Students Achievements

Students from Institute of Science, Nirma University secured Second Place at VIMUKTI 2.0, a drama competition on Cyber crime Awareness, organised by NSS SOT ITNU on August 1, 2025. Participant students were from Semester 1 & 3, Prakash Rabari, Rutvi Choithani, Dhruv Peshavariya, Abhishek Rajput, Mandvi Singh, Dushyant Dalwadi, Vrushanki Joshi, Natha Kuchhadiya, Riya Gupta and Muskaan Narwani.

Ms. Kavya Dimplekumar Shah, a PhD student under Dr. Ameet Nair, was awarded the CSIR-SRF Direct 2024 for continuing her PhD project titled “Modulatory Effect of Recurrent Hypoglycemia on Sema4D/PlexinB1 mediated cues for synapse formation in Cerebellum during Diabetes” on July 21, 2025.

Ms. Nirali Shukla, a PhD scholar at the Institute of Science, Nirma University, under the guidance of Dr. Heena Dave, presented her research poster titled “Implications of microRNAs in the Progression of Luminal Androgen Receptor-Positive Triple-Negative Breast Cancer” at the European Society for Medical Oncology (ESMO) Breast Cancer 2025 Congress in Munich, Germany, held from May 14 to 17, 2025. The project received funding from the Gujarat State Biotechnology Mission (GSBTM) and travel assistance from the Anusandhan National Research Foundation (ANRF).

Ms. Japneet Kaur, a Semester III student of MSc Biotechnology, Institute of Science, Nirma University, was one of the proud recipients of the Science Academies’ Summer Research Fellowship – 2025, which was offered by IASC-INSANA-NASI. She had been worked under the guidance of Dr. Ilora Ghosh, JNU Delhi, for her research work.

Ms. Varia Hitiksha, a Semester III student of MSc Biochemistry, Institute of Science, Nirma University, was one of the proud recipients of the Science Academies' Summer Research Fellowship – 2025, which was offered by Gujarat State Biotechnology Mission (GSBTM). She had been worked under the guidance of Dr. Vijay Thiruvengkatam at IIT Gandhinagar for her research work.

Ms. Priyadarshini Saronia, a Semester III student of MSc Biotechnology, Institute of Science, Nirma University, was one of the proud recipients of the Science Academies' Summer Research Fellowship – 2025, which was offered by Gujarat State Biotechnology Mission (GSBTM). She had been worked under the guidance of Dr. Sushmita Jha at IIT Jodhpur, for her research work.

Ms. Himali Patel, PhD student of Prof. Sarat Dalai, Director, Institute of Science, Nirma University, received the award for the Best Poster Presentation for her work titled “Chimeric IL-15: Advancing Anticancer Immunotherapy” at the Global Immunology Summit- 2025 Emerging Frontiers of Immunology and Immunotherapy, held during February 13-15, 2025 at THSTI, Faridabad.

Ms. Priya Patel, PhD student of Dr. Nasreen Munshi, Institute of Science, Nirma University, received the Best Presentation Award for the Rapid Oral Presentation and a poster session titled “Production of [P(3HB-co-3HV)] by *Ochrobactrum ciceri* strain AWIS01 as a by-product during oily sludge bioremediation” at the International Conference on Innovations in Biotechnology for Sustainability (IBS-2024) held at JNU, New Delhi. The award was given by the Royal Society of Chemistry (RSC) in the form of a certificate and a cash prize of Rs. 2000.

Ms. Kavya Shah, a PhD student registered with Dr. Ameet Nair, Institute of Science, Nirma University, secured the Travel Support Award to participate and present her poster titled “GPx1 Modulation by Redoxi-miRs in the Brain during Altered Glycemic Conditions” at the 18th Annual Meeting of the Society for Free Radical Research-India (SFRR-India), held as part of the SFRR International Conference 2024 during November 6–9, 2024 at the DAE Convention Centre, BARC, Mumbai.

Ms. Priya Sharma, PhD student of Prof. Sarat Dalai, Director, Institute of Science, Nirma University, received the award for the Best Oral Presentation for her work titled “Potential of Chimeric of IL-15 and combination therapy with recombinant human IL-12 in tumour regression and combination therapy” at the 9th International Conference on Tumor Microenvironment and Cellular Stress: Signaling, Metabolism, Imaging and Therapeutic Targets, held during September 17–22, 2024 at Kalamata, Greece.

Congratulations to Dr. Zeel Bhatia, Dr. Sunny Kumar, Dr. Priya Patel, Dr. Sweety Parmar, Dr. Gemini Gajera on successfully completing the Ph.D. this year! Your dedication, Perseverance and contribution to knowledge are truly inspiring.

Student Spotlight



Since my very first day at Nirma University, I was driven by curiosity and immensely motivated by all my teachers, Nirma University faculty instructed beyond text, incorporating projects, scientific models, and new research to increase depth of knowledge. Being at Nirma not only prepared me for my academic life, but it also taught me some important lessons of life, which guide me even today. I remember making a model of neural connectivity, brain components, and their functionalities that, together with project of peers, enhanced our understanding of neuroscience.

Practiced exposure during the dissertation stage strengthened understanding of theoretical knowledge and practical skills, while mentorship not only helped in academic growth but also in personal and professional growth. Thanks to them, I participated in several conferences, such as "Immunocon -2024" held by IISc Bangalore. Nirma trained me in time management, problem-solving, and multitasking, changed my thought process, and enhanced my confidence enabling me to crack my PhD interview. After successfully completing my course which was taught with utmost devotion by the teachers I spent my time revising the whole syllabus and, above all, believing in myself. This discipline of preparation combined with the belief in oneself has resulted in my current admission to the PhD program, with fellowship, at Shiv Nadar University (Institution of Eminence), Delhi NCR.

"I remain deeply grateful to Nirma University for shaping my journey, nurturing my curiosity, and empowering me to chase my dream of becoming a scientist and an educator."



Ishika Jain

Alumni 2023-25 (Biochemistry)

Student Spotlight



I am a proud student of ISNU, am delighted to share that I have secured campus placement at Aakash Institute for the position of Assistant Lecturer. I am deeply grateful to my teachers at ISNU and the Placement Officer for their invaluable guidance and support in making this achievement possible.

The placement process comprised three rounds. The first round was an MCQ-based test, followed by the subject matter expert round, and interview round. The questions posed during this stage were a master' degree level for the

chosen subject area. During my ongoing training, the Master Trainer mentioned that, in addition to evaluating subject expertise, he placed significant emphasis on the candidate's personality while making selection decisions. This insight reinforced the importance of holistic preparation, where communication skills and professional demeanor complement academic knowledge.

Over the course of my academic journey, I have successfully cleared competitive examinations such as IIT JAM, GAT-B, GATE, and GSET. These achievements were made possible through dedicated study using standard reference books available at my previous college library and the Nima Knowledge Centre, coupled with the thorough guidance of my teachers.

For aspirants, it is crucial to develop conceptual clarity across the entire syllabus and to adopt a strategic approach when tackling questions particularly in scenarios where multiple options are available. With a solid foundation of subject knowledge, combined with analytical thinking and the right mindset, one can excel in any examination or interview on the global stage.



Kesar Sandip Bhavsar
Alumni 2023-25 (Biotechnology)

STUDENTS LIFE

TSNU

‘College life is not just about classes, it’s about discovering yourself, your people, and your purpose’

by Hitiksha Varia (24-MBC-014)



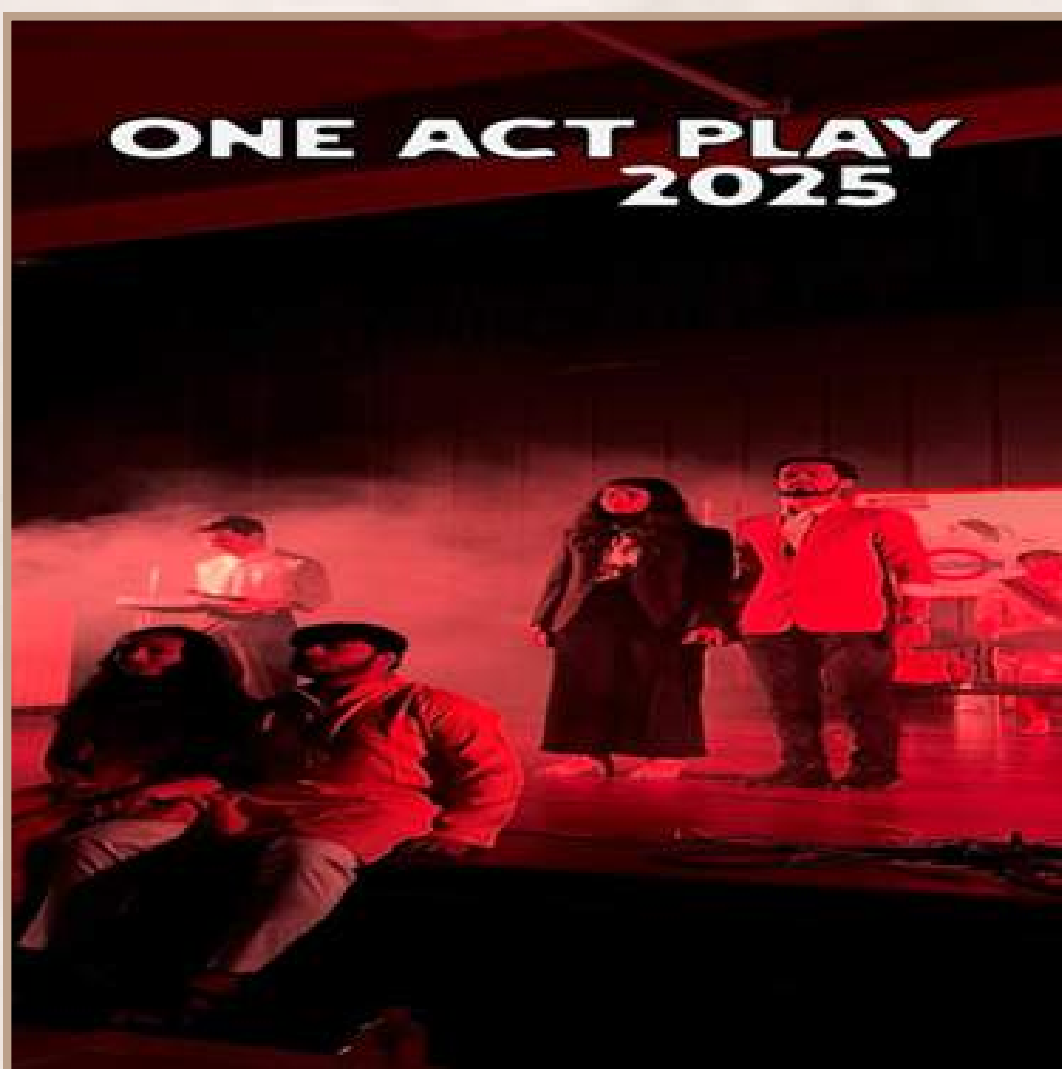
RENAISSANCE EVENT

During the Renaissance event, students of the Science stream showcased their talents through a variety of cultural activities including singing, dancing, rangoli, and more, celebrating creativity and collaboration. The vibrant participation and enthusiastic performances made the event a memorable and colorful celebration of student spirit.



GANESH CHATURTHI

As part of the Ganesh Chaturthi celebration, the students of the Science stream came together to beautifully organize a heartfelt event on campus. With devotion and vibrant energy, they welcomed Lord Ganesha, spreading joy and unity among peers.



ONE ACT PLAY

The students of the Science stream enthusiastically organized a One-act play that showcased their creativity, teamwork, and stage presence. Through powerful performances and meaningful storytelling, they captivated the audience and brought important social themes to life.



SPORTS COMPETITION

A fun-filled Senior-Junior Sports Competition was organized to encourage bonding and healthy competition among students. With high energy and team spirit, participants engaged in various games, creating memories and strengthening camaraderie across batches.



NAVRATRI CELEBRATION

Navratri celebration were joyfully organized for the students, filling the campus with vibrant colours, music, and festive spirit. Dressed in traditional attire, students enthusiastically participated in Garba and Dandiya, showcasing rich cultural heritage and unity.



WALK 4 FITNESS

Walk4 Fitness was organized by university-level at the Riverfront, Ahmedabad, promoting the message of health and well-being. The event witnessed enthusiastic participation, encouraging a collective move towards a more active and balanced lifestyle.



DESH RAAG EVENT

Desh Raag, a university-level patriotic singing competition, brought together participants from eight institutes to celebrate the spirit of India through soulful melodies. Each performance resonated with love for Bharat, fostering unity, pride, and a deep sense of national belonging.

DENOVO TEAM

Faculty Co-ordinator, Reviewer and Guide:

Dr. Darshan Dhakan (Assistant Professor, ISNU)

Chief Editor:

Shah Keyur Dipenbhai [25-FTPHDS-96]

Students Coordinators:

Dhruvi Patel [24-MBT-029]

Aarya Kalhe [24-MBT-017]

Urvi Raval [24-MBT-038]

Vrushanki Joshi [24-MBT-016]

Vaishnavi Gandhi [24-MBT-050]

Maitri Pandya [25-MBT-035]

Vedanshi Makwana [24-MMB-012]

Mehal Desai [25-MBT-027]

Meghna Malkan [24-MBT-021]

Hitiksha Varia [24-MBC-014]

Pratham Dasadiya [24-MBC-002]



THANK YOU

Dear Readers,

As we bring this edition of DENOVO Magazine to a close, we extend our heartfelt gratitude to you, our readers. Your time, curiosity, and engagement are what make this effort truly meaningful. Every page of this magazine has been shaped with passion, creativity, and a deep desire to share knowledge and it finds its purpose only when it reaches you.

We also thank all the students, contributors, and mentors who poured their ideas and efforts into making DENOVO 2025 possible. Their dedication has transformed this magazine into a platform that celebrates learning, discovery, and collaboration.

Your encouragement is the inspiration that drives us to keep exploring, keep writing, and keep creating. We hope the insights, stories, and perspectives shared here have sparked new thoughts, opened new questions, and inspired you in some way.

With this, we conclude DENOVO 2025 but the journey of science, curiosity, and creativity never ends. Until the next edition, thank you for being part of ours.

— The DENOVO Team



NIRMA
UNIVERSITY

INSTITUTE OF SCIENCE

NAAC ACCREDITED 'A+' GRADE

Nirma University

Established in the year 2003, Nirma University (NU) is a student-centric, research-oriented, multi-disciplinary, leading private University in Gujarat, recognized by the UGC. NU has also been accorded the status of SIRO (Scientific and Industrial Research Organization) by DSIR, Government of India, A+ NAAC accreditation and is consistently ranked among the top 10 private universities in India.

Institute of Science

The Institute of Science was established in 2004 under the aegis of NU to promote research in academics and impart quality education. It is nationally recognized for its success in research and academics. The Institute provides ample opportunities to students to learn, experiment, and acquire knowledge in specific disciplines.

Salient Features

- Outcome-Based Curriculum, Teaching, Learning, and Continuous evaluation.
- Highly qualified faculty with Post-Doctoral Research experience from India and Abroad.
- State-of-the-art laboratory facilities for training and research.
- In-house dissertation in PhD format.
- Exposure to Bio-entrepreneurship.
- Guidance for the preparation of NET-JRF and other national-level examinations.
- Digital library with a large collection of books and scientific journals.
- Social Extension Activities.

Research

Expertise:
Immunology, Cancer Biology, Genetics, Diabetes, Metabolic Disorders, Neurobiology, Protein Chemistry, Bioremediation, Bacterial Pathogenesis, Systems Biology.

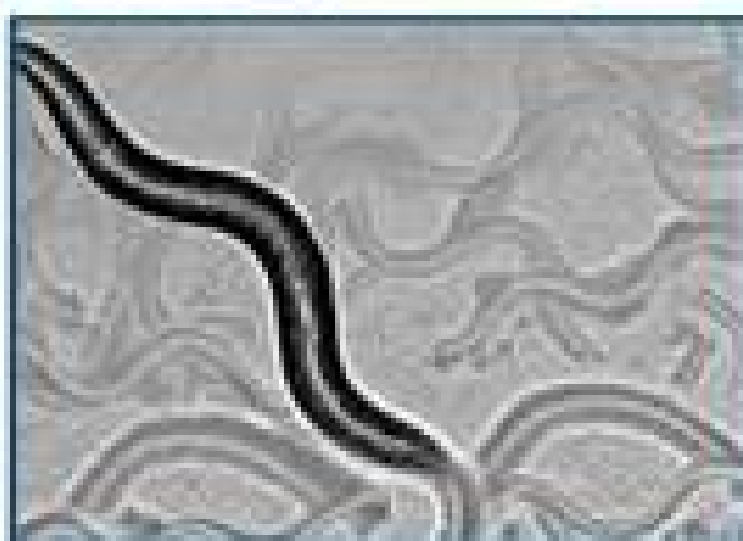
Infrastructure:
Insectarium, Animal House, Microbial and Animal Cell Culture Labs, C. elegans facility, multiple BSL-II facilities, Bioinformatics lab and well-equipped central instrumentation facility.

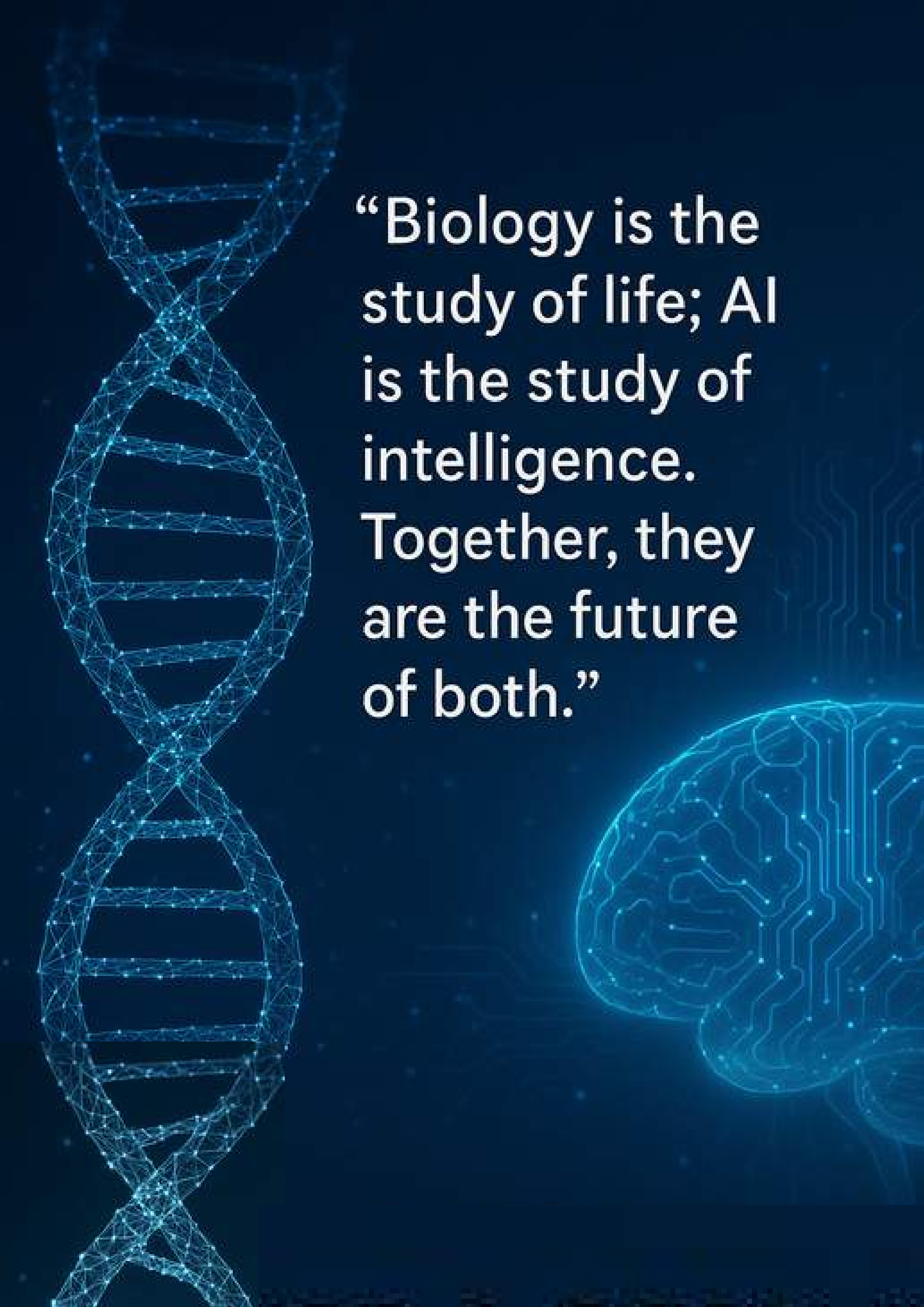
Funding:
DST, DBT, ICMR, CSIR, GSBTM, GUGCST, SAC, SIRO, AYUSH, etc.

Placement

Our graduates are pursuing Ph.D. in various research institutes in India and abroad. 80% of interested students were placed in pharmaceutical companies like:

Johnson & Johnson
Zydus
Cadila Healthcare
Sun Pharma
Intas Pharma
Lambda Therapeutic
Nivea
to name a few





“Biology is the study of life; AI is the study of intelligence. Together, they are the future of both.”