Indian Women in Science



Shraddha Nayak for TLoS

Who?
UMA RAMAKRISHNAN

What?
Ecologist

Where?
National Center for Biological Sciences - TIFR, Bengaluru



Vinay Sagar

Uma studies the **tiger**, among other Indian **mammals.** She looks at **genetic diversity** to understand if species are under threat of **extinction.** She has tracked the **genetic history** of Indian tigers and performed several **tiger counts** in **national parks** by setting up cameras and sampling tiger poop. Uma combines molecular tools with computer programs to analyze both modern animal **DNA** as well as DNA of animals obtained from museums. This evolution expert campaigns vigorously for the use of **science-based protection policies** to save the tiger from **extinction.**

In 2016, she became the first Indian to be presented with the prestigious Parker-Gentry Award by the Field Museum, Chicago, for her contributions to the field of **conservation biology.**

She grew up in Bangalore and did her PhD and postdoctoral work in the USA, returning home in 2005. "I was obsessed with coming back, from the day I landed (in the USA)" she said. For Uma, **on-ground impacts** are far more satisfying than publishing scientific papers in well-known journals.

"Our research helps interpret and deconstruct the mysteries of nature and narrates it as a story. Therefore, our papers are read more by non-scientists than they are by scientists."

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Indian Women in Science



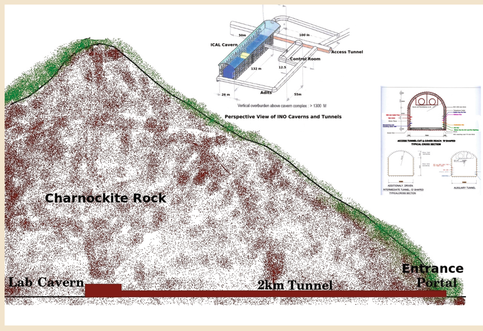
TLoS

Who?
D INDUMATHI

What?
Particle Physicist

Where?
The Institute of Mathematical Sciences, Chennai

Indumathi is a **theoretical physicist** who studies the smallest and most abundant particles in the universe—**neutrinos**. She wants to understand the physics of how **elementary particles** interact with each other to yield the world we see around us. Neutrinos are known to come in three types, called **"flavours".** These are **electron, muon and tau neutrinos.** The interactions between neutrinos, and their individual masses, are still little understood.



M V N Murthy

Schematic of the proposed observatory

When she was growing up, Indu wanted to be a cricketer. She ended up pursuing physics as a career when an injury forced her out of the team.

Her research focuses on how theories of the properties of **sub-atomic particles** can be verified or extended by suggesting experiments that can test these theories. Often these tests are carried out at **experimental facilities** abroad. Indumathi is deeply involved in a proposal to build such a facility right here in India: the **India-based Neutrino Observatory (INO)**, a large experimental science project aiming to study the fundamental physics of neutrinos. Indu is also committed to **science popularization**, working with the Tamil Nadu Science Foundation in bringing out a regular science magazine, ***Jantar Mantar.***

"In the INO we have a fully Indian experiment where we have the chance to determine our own physics goals and ideas, our own experiments and our equipment".

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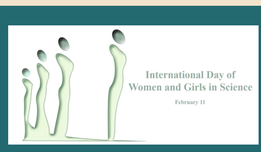


Indian Women in Science

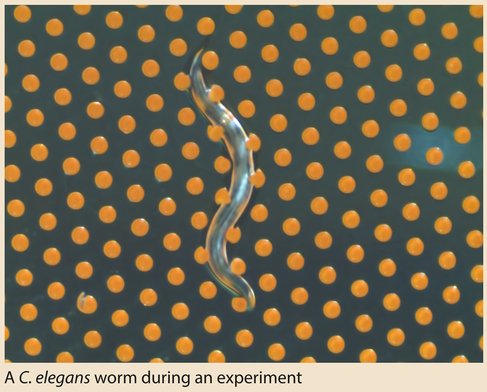


Cyrus Khan for TLoS

Who?
SANDHYA KOUSHIKA

What?
Neurobiologist

Where?
Tata Institute of Fundamental Research, Mumbai



Sandhya Koushika

A *C. elegans* worm during an experiment

Sandhya's research focuses on **cargo transport in nerve cells** or **neurons.** These cells must transport biological materials from their main body where they are made, all the way to their ends. This happens along long cellular paths called axons. It is this **'information highway'** that Sandhya studies. **Cargo** zooms across in both directions on tiny **molecular motors** that move along even tinier fibers inside the axon. Mistakes in these processes might reflect **neurodegenerative diseases** like **Alzheimer's Disease**, which is why we need to understand them better. She uses one of the classic model animals, **roundworms** or ***C. elegans*** for her experiments.

Sandhya earned her bachelors and masters degrees from MS University, Baroda and her PhD from Brandeis University. In 2012, Sandhya was the first Indian working in India to be awarded an **International Early Career Scientist award** from the Howard Hughes Medical Institute, USA. These awards are given to scientists who are expected to be **among the scientific leaders of their country.** Sandhya takes mentorship very seriously and the all-round training of young scientists is very important to her.

"Love." (when asked "Why Science?")

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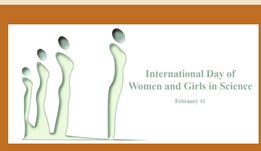


Indian Women in Science

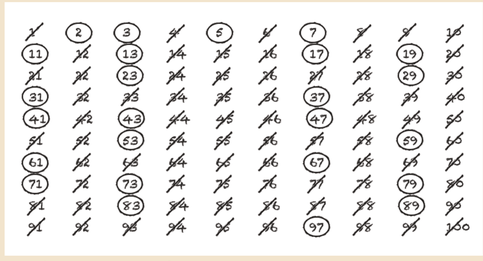


TLoS

Who?
KANEENIKA SINHA

What?
Number theorist

Where?
Indian Institute of Science Education and Research, Pune



Distribution pattern of prime numbers

Kaneenika works in the area of **analytic number theory and arithmetic geometry.** Her research looks at the **distribution of special numbers** like **prime numbers** across the number system. Prime numbers — those that have no factors other than 1 and themselves — are the atoms of arithmetic and have fascinated mathematicians since the time of **Euclid**, who proved more than 2,000 years ago that there are **infinitely many of them.**

The hunt for patterns has been met with limited success as far as prime numbers are concerned, but mathematicians are finding tantalising clues everyday and these developments are keeping Kaneenika on her toes.

Trained largely in Canada by renowned **number theorist** M. Ram Murty, Kaneenika is now part of a strong team of young mathematicians at **IISER Pune.** She is an active **math communicator** with articles in publications like the Hindu, the Indian Express and Swarajya. She has also been writing a **popular blog** for more than seven years, where she writes about mathematics and the joys and challenges of a life in academia.

"The reason special numbers are interesting is that their distribution patterns match distribution patterns seen in physics and other phenomena."

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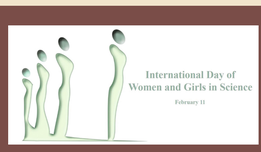


Indian Women in Science



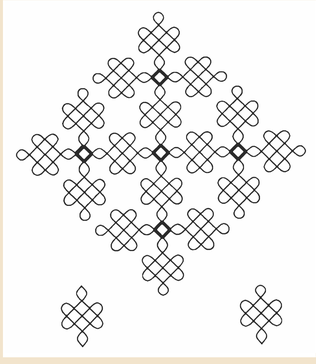
Narayan Kumar

Who?
RANI SIROMONEY

What?
Computer Scientist

Where?
Chennai Mathematical Institute

Rani is a leading Indian theoretical computer scientist with over five decades of work in the fields of **formal languages** and **automata theory.** Most of her professional life was spent in Chennai at the 180-year old Madras Christian College where she began as a lecturer in 1951. She retired as Professor Emeritus from the Department of **Computer Science.** She led the setting up of MCC's Kibble Computer Centre at the College in 1993 and also was responsible for establishing its Department of Computer Science.



Kolam figures grouped into families attracted the interest of theoretical computer scientists

She is currently Adjunct Professor at the **Chennai Mathematical Institute.** Over the years, she has trained and built up a community of dedicated teachers and researchers in her fields of work. She initiated a new research direction with the study of **matrix grammars** and **picture languages** which have wide applications such as in modelling the **kolams of Tamil Nadu**, and in **cryptography, machine learning and DNA computation.**

Rani has served on the **editorial board** of several international journals such as Theoretical Computer Science, International Journal of Foundations of Computer Science and Languages of Design. She has received several awards including one from the Federation of Indian Chambers of Commerce & Industry (FICCI) and the Tamil Nadu State Council of Science and Technology.

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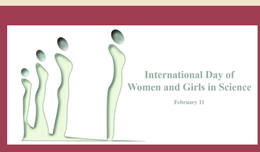


Indian Women in Science



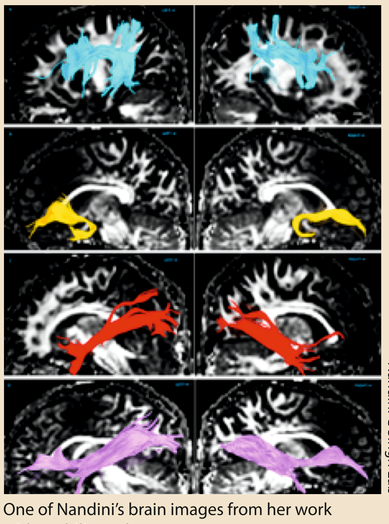
TLoS

Who?
NANDINI CHATTERJEE SINGH

What?
Neuroscientist

Where?
National Brain Research Centre, Haryana and UNESCO MGIEP

Nandini started research as a **physicist** in India studying **non-linear dynamics** during her PhD at Pune University. At that time, in the late 90s, science was becoming increasingly **inter-disciplinary** and Nandini changed her field of study to neurobiology. She became interested in bird brains and patterns in **bird calls**. She studied **mathematical representations of sound** and analysing **neuronal data** from the brain. Now, stationed at a brain institute in India and working in a state-of-the-art **fMRI lab** that she set up, Nandini is an expert on how the human brain responds to **music** as well as its ability to deal with **multilingualism.**



Nandini C Singh Lab

One of Nandini's brain images from her work with multilinguals

She also studies how the brain differs in **people with autism** and **learning disorders.** She has to her credit the development of a test called **Dyslexia Assessment for languages of India (DALI)**, the only system in the world that helps assess dyslexia, the condition of difficulty in reading, in native Indian languages.

"There is so much neuroscience research to do in India. There is a treasure trove of stimuli to study the brain with. Imagine the possibilities of gustatory work – on different tastes, or with pashmina and silk – to understand how people learn to develop sensitivity in what is called the somatosensory cortex or the touch system. The language systems in which our children grow up… oh it's just fabulous!"

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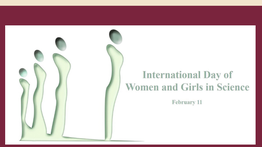


Indian Women in Science

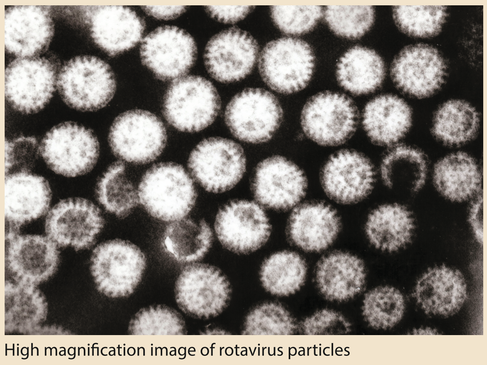


Infosys Science Foundation

Who?
GAGANDEEP KANG

What?
Translational and Clinical Scientist

Where?
Translational Health Science and Technology Institute, Faridabad and CMC Vellore



High magnification image of rotavirus particles

Gagandeep has made pioneering contributions in understanding the **natural history** of **rotavirus infection** which causes severe diarrhoea. Such infections are an important factor behind India's high **infant mortality rate.**

Trained as a doctor at CMC Vellore, Gagandeep investigates the history and the different modes of transition of **gut infections** in people in **developing nations** like India. She successfully merged **epidemiological studies** with intensive laboratory-based investigation to reveal that Indians are more **susceptible** to rotavirus infections than people from other countries. Her studies have helped develop indigenous **rotavirus vaccines** and shape **national policies on health and vaccination.** Her contributions have resulted in a better understanding of why some interventions for diarrhoea don't work. She has also helped contribute to our understanding of the transmission and spread of the **polio virus.**

Gagandeep is a Fellow of the Royal College of Pathologists and the American Academy of Microbiology. She serves on several of the **World Health Organization's** advisory committees. She has received many awards including the **Woman Bioscientist of the Year** (2006) and the **Infosys Prize** (2016).

"Sticking it out when nothing works is what matters in science today." (Source: India Bioscience)

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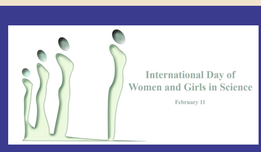
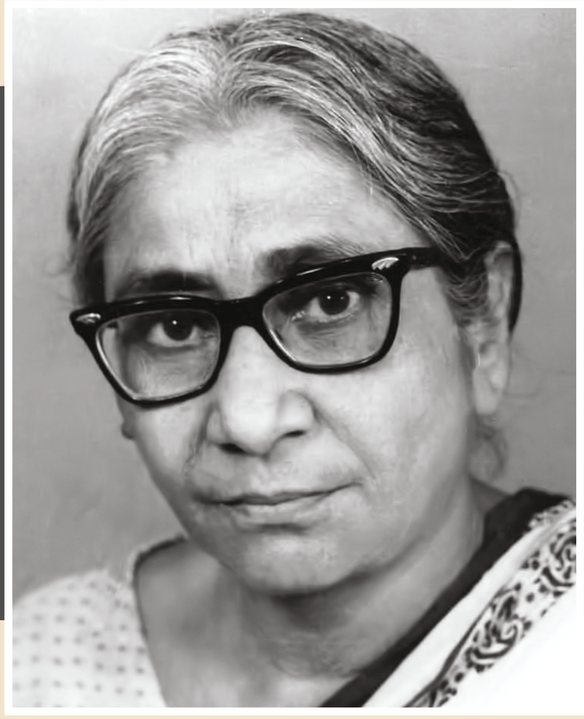


Indian Women in Science



The Indian Scientists, CC BY-NC-SA 3.0

Who?

ASIMA CHATTERJEE

(1917 - 2006)

What?

Chemist

Where?

University of Calcutta



A Google doodle celebrates Asima Chatterjee's contributions to chemistry on her birth centenary

Asima was the first woman to receive a doctoral degree from an Indian University. Her research focused on **chemical compounds produced by plants** native to India. Her research in **phyto-chemistry** led to the discovery of **plant-based medicines** with **anti-malarial, anti-epileptic and anti-cancer** properties. Her extensive work on the chemistry of vinca **alkaloids**, obtained from the Madagascar periwinkle plant, has led to the development of **chemotherapy** drugs for cancer treatment.

For much of her life, she was ahead of her time in **synthesizing new molecules**, without modern technology such as **NMR** to reveal their structure. She was a world-class chemist at a time when this science was a lot harder to do than it is today.

In 1961, Asima became the **first woman** to be awarded the most prestigious science prize in India, the **Shanti Swarup Bhatnagar Prize.** She was conferred the **Padma Bhushan** by the Government of India in 1975 and was also elected as the first woman general president of the **Indian Science Congress.** She was nominated by the President of India to the Rajya Sabha.

"The endeavour of scientists and teachers and all those who are in one way or the other are engaged in the pursuit of science should be to help not only the students but also the people at large to understand the value of such a pursuit."

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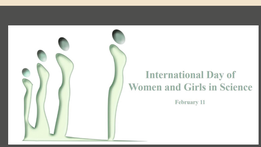

Indian Women in Science



Abel Foundation/Sujatha Ramdorai

Who?
SUJATHA RAMADORAI

What?
Mathematician and Educator

Where?
University of British Columbia, Canada



Srinivasan Ramadorai

Sujatha works in **algebraic number theory**, a branch of **number theory** that uses the techniques of **abstract algebra** to study the **integers, rational numbers** and their generalizations. She is most well known for her work on the **Iwasawa theory**, based on the work of Japanese mathematician Kenkichi Iwasawa. Sujatha did her B.Sc. in Bangalore and worked for many years as a professor at the Tata Institute of Fundamental Research in Mumbai, after doing her PhD there.

In 2016, she became the first Indian to win the prestigious **ICTP Ramanujan Prize.** She has also been awarded the **Shanti Swarup Bhatnagar Prize.** She was appointed a member of the National Knowledge Commission and the Prime Ministers Scientific Advisory Council.

Today, Sujatha is increasingly involved with **education and policy issues.** She founded the Gyanome Foundation, a non-profit organisation that aims to make math, science and English education **more accessible to children in rural areas** and in the **public education system** in India. One of its initiatives is the **Ramanujan Math Park**, which was inaugurated in 2017 in Kuppam. She envisions the project to evolve into a unique outdoor and indoor interactive, **immersive experience in Mathematics.**

"It is ceaselessly wondrous how this abstract language can so precisely give meaning to so many things in real life, it is humbling to be confronted by that aspect and I find it ineffable."

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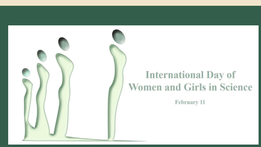

Indian Women in Science



Rama Govindarajan

Who?
RAMA GOVINDARAJAN

What?
Engineer-physicist

Where?
International Centre for Theoretical Sciences - TIFR, Bengaluru



Wikimedia Commons/PlaneMad

Her love for understanding how fluids flow brought Rama from **chemical engineering**, which she studied as an undergraduate at IIT Delhi, to **aero-nautical engineering**, about three decades ago. Rama worked on the important problem of fluid **turbulence** for many years. Rama is fascinated by the details of what goes on inside clouds, specifically how **droplets** grow to form **raindrops in clouds** so quickly. She does this by writing down equations describing this problem and solving them, either with pen and paper or through complex computer simulations. Rama is currently part of an effort to model a very unique phenomenon that directly affects more than a billion people, **the Indian monsoon.**

In 2007, Rama won the **Shanti Swarup Bhatnagar Prize** for her "original contributions to the understanding of **instabilities** in **shear and non-parallel flows, flow entrainment, turbulent transition** and small-scale **hydraulic jumps.**" She was the **first, and one of only two women**, to win this prize in the Engineering Sciences category.

***"If you are young, please dream your own dream. Also, please, please dream big."* (Source: Lilavati's Daughters)**

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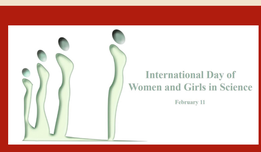


Indian Women in Science



John Innes Archives/Wikimedia Commons

Who?

JANAKI AMMAL

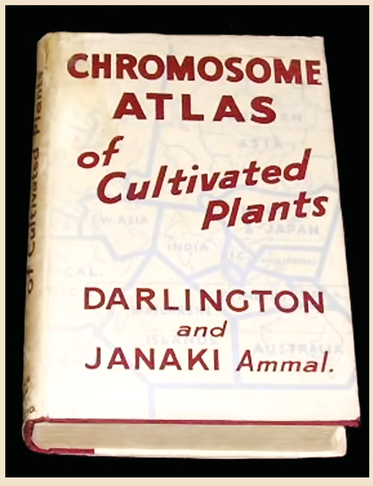
(1897 - 1984)

What?

Botanist

Where?

University of Madras



Janaki was one of the **first women scientists** of modern India. Born in Kerala, she studied and taught **botany** in Madras for many years and was possibly the first woman to earn a doctorate in Botany in the USA in 1931. After her doctorate, Janaki returned to India to work in Trivandrum and Coimbatore. She is credited with creating new **hybrid sugarcane** varieties suitable for Indian conditions, a brinjal named 'Janaki Brengal' and a longer lasting flower named **Magnolia Kobus Janaki Ammal.**

Hindered by gender and caste-based discrimination, Janaki relocated to London in 1940, to work as a **horticulturist.** On the invitation of Pandit **Jawaharlal Nehru**, she returned to India in 1951 to reorganise the **Botanical Survey of India**, championing **ethnobotany** and **plant geography.** She documented many **indigenous varieties of medicinal plants** and the culture surrounding their use, from different parts of India. Towards the end of her life, she lived and worked in the University of Madras Field Laboratory at Maduravoyal until she passed away in 1984.

In 2000, the government set up the **E. K Janaki Ammal National Award of Taxonomy** in her honor. She was awarded the **Padma Shri** in 1977.

"My work is what will survive."

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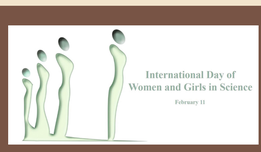


Indian Women in Science



Infosys Science Foundation

Who?

SANGHAMITRA BANDYOPADHYAY

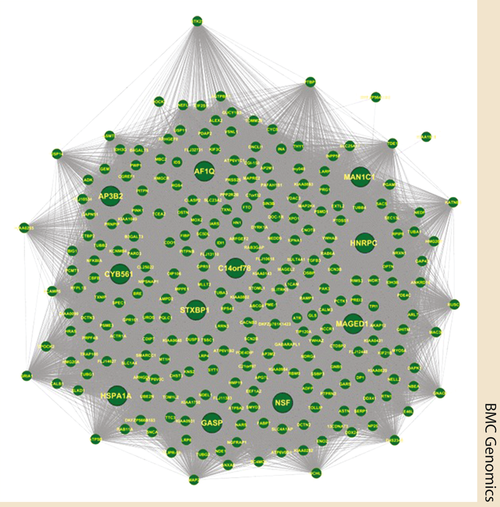
What?

Computer Scientist

Where?

Indian Statistical Institute, Kolkata

Scientific technology used in research today produces **massive amounts of data.** This trend can only intensify, making Sanghamitra's work crucial in the **big data era.** Her research involves **developing computer algorithms** that help to recognise patterns in these large data sets. The algorithms she developed are extremely useful in the **field of health and social sciences.** They have been used in **image analysis** to help detect water contamination and **biomedical researchers** are using them to **predict regulation and disease mechanisms** in **HIV** and **Alzheimer's Disease.**



BMC Genomics

A gene co-expression network

Born in Calcutta, Sanghamitra completed her PhD from the Indian Statistical Institute, Kolkata. She is now the Director there. She was very recently awarded the **Infosys Prize** in Engineering Science (2017) for developing special **evolutionary algorithms.** She was awarded the **Shanti Swarup Bhatnagar Prize** in 2010.

"Interacting with students is undoubtedly the most enjoyable aspect of my life in science... some of their questions have opened up new research directions for me."

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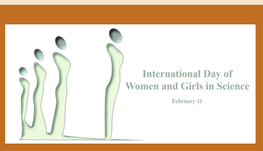

Indian Women in Science



Rahul M for TLoS

Who?
KRISHNAVENI V GHATTU

What?
Epidemiologist

Where?
CSI Holdsworth Memorial Hospital, Mysuru

A medical doctor trained in Mysore Medical College, Krishnaveni had intended to pursue a career in **public health.** A short stint as a medical officer for a research project was a turning point in her career.



Rahul M

Saliva samples from her studies

Today, she is one of the country's experts on how **improper nutrition** in the womb can lead to **non-communicable diseases.** She has recently extended her studies to look at the effects of stress on young adults. She devises tests to figure out if **stress** can contribute to how children develop **chronic diseases** when they get older.

For this, she has been tracking a **cohort** of 600 subjects for the past two decades. This work began while these 600 were still in their mother's wombs. Krishnaveni was just out of medical school then.

Her work is providing important leads towards better **preventive strategies** for non-communicable diseases in **susceptible individuals** across the world. She is also developing multiple **interventions for youth** vulnerable to stress. Krishnaveni is a Senior Fellow of the **Wellcome-DBT India Alliance.**

"Research encourages me to think critically, to question the existing theories and develop my own ideas and concepts... a refreshing change from the traditional system of believing whatever was in the textbooks."
(Source: Wellcome DBT)

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This poster is a part of a series featuring Indian Women in Science, brought out by **The Institute of Mathematical Sciences** (www.imsc.res.in) in collaboration with **The Life of Science** (thelifeofscience.com) to mark **11th February, the International Day of Women and Girls in Science in 2018.**

