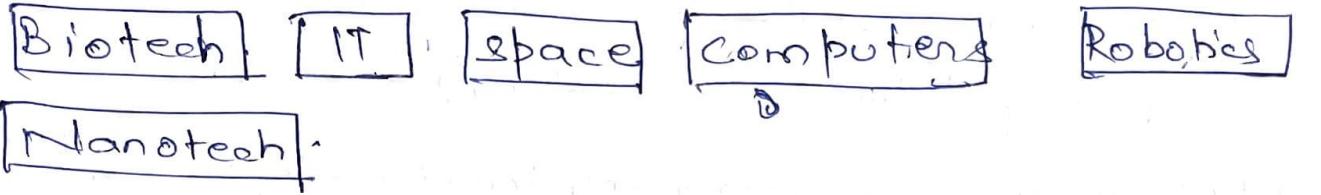


# Technologies



## ① Agriculture!

Development of supply chain.

- Better maintenance of land records. (Blockchain).
- Supply chain monitoring (specially for perishables). (AI)
- Integration of Ag. market. e-NAM.
- Agricultural robotics (to tackle labour challenges)
- predictive analytics.
- Monitoring of weather, pests (e.g. locust attacks)
- Better information dissemination to farmers. (e.g. Gemini)
- Monitoring moisture and fertilizer Application & levels (through sensors).
- Better management of farm insurance. (timely claims).
- Making agriculture resilient.
- Monitoring of climatic extremes.
  - increasing efficiency of irrigation (AI)
  - increasing yield, better resilience to pest & climate change (Biotech)
- improvement in food processing
  - Variety,
  - Quality,
  - longevity.

- ② Health:
- National Health Stack (NPHM)
- Better maintenance of Health records
  - Targeted drug delivery (nanotech)
  - Robotics in surgery → minimum incision, better targeting
  - Discovery of new drugs and therapy treatment (eg proton therapy)
  - Better analysis of diseases and effect especially mental health - difficult to discern.
  - efficacy of drugs increases (nanotech)
    - area increase
  - Stem cell therapy (Biotech) - devt. of organs.
  - treatment of genetic diseases. (better R&D).
  - containing spread of diseases through better info. dissemination (AI).
  - Integrated disease surveillance programme
    - Real time monitoring of medicines, vaccines and supplies such as medical oxygen.
  - Development of Prosthetics and Bionics. (Biotech)
    - Jaipur foot
    - artificial devices that replaces body parts
    - + biologically inspired engineering.
  - Helps in policy making:
    - (predicting epidemics & demand of medicines),
  - Tele-health prospects.
    - medicines → increases accessibility.
  - Early detection (Fitbit watches)

### ③ Education:

- Tele-education, online education (increase accessibility)
- Smart classrooms (eg. Swayam prabha).
- Automation of repetitive tasks.
- Practical usings AR & VR (eg. done by Hyderabad based firm)
- Counselling sessions using chatbox (AI enabled).
- better curriculum design, continuous objective evaluation of students - special attention to weaker areas.
- Better record maintenance
- Secured examination environment (online assessment).

### ④ Services:

→ less tax evasion, fraud detection

- diversity in financial services → GPS services
  - real time
- better quality of services
- less wastage, leakages, corruption, better inclusivity and accessibility.

### ⑤ Better management of cities → Smart City concept,



- Energy: fault prediction, Anti-theft technology, better grid management.
- Security: CIBMS, surveillance (drones), anti-infiltration system.
- Environment: Tracking wildlife, survey of arenas through drones, tracking levels of pollution, Climate predictions.
- Law enforcement: face recognition, speech recognition.
- Manufacturing: Quality checks, less equipment failure, better efficiency, real time checks, Additive manufacturing, specific customised design.
- Cyber security: blockchain.
- cost effective manufacturing, reducing C. footprint.

# Science & tech

2020

- Nanotech in Health
- Science in lives, changes in Ag.
- Tech. & impact of COVID
- Solar energy.

2019

- M. Visvesvaraya, M. S. Swaminathan
- India's plan own space station.
- Biotech in Ag

2018

- Bose Einstein Statistics
- biotech, Bio pharma
- India's nuclear programme

2017

- Stem cell therapy.
- Manned missions of ISRO - issues.
- Nuclear S&T FBR.

2016

- India's achievements in space
- Nanotech.

2015

- GPS CRPS
- IRNSS

2014

- S&T research
- IPR

2013

- Patents
- IPR regime
- India world
- WTO

India's 3 stage Nuclear program:

Stage 1

Natural  
 $U-238$

↓  
Plutonium  
 $^{239}Pu$

PHWR

Stage 2

Processed Plutonium- $^{239}Pu$   
Mixed oxide fuel -  
 $Pt-239$

FBR

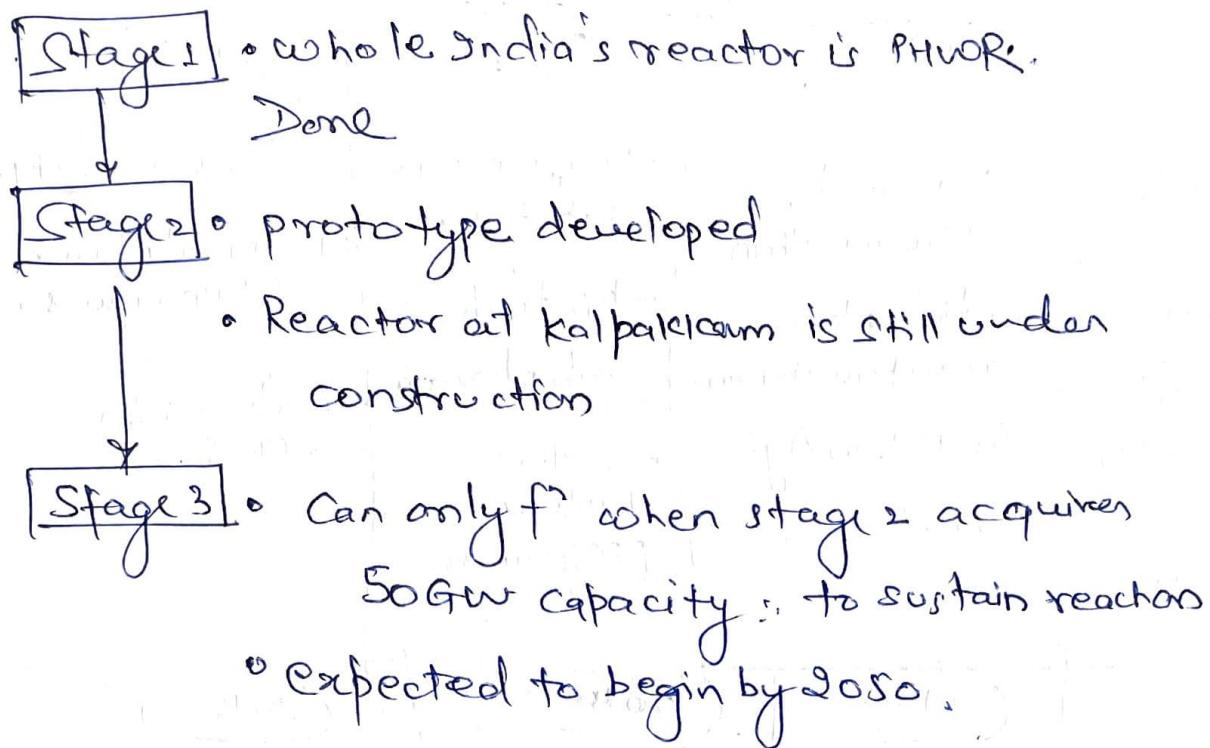
gives more  
plutonium than  
input = "Breeds" plutonium

Stage 3

Thorium based reactors

$Th-232 + U-233$   
 $U-233$  (transmuted  $p-231$ )  
makes Thorium  
fisile  
→ self sustainable

## Progress



**Soln** - Stockpile of Pt - we can expedite ours from Europe, Russia. 2<sup>nd</sup> stage program

→ But Pt can be used to make bomb ... we need NSG membership (easy access to tech & fuel)

→ Civil Nuclear deal

france, Japan, US, Aus.

- Limited U reserve but huge

Thorium itself is not a fissile material. It requires transmutation

to  $\text{U}^{233}$  in a reactor fuelled by other fissile material

→ That's why we need 3 stage Nuclear prog

Intro

- 3 stage nuclear prog

Head - Dr J. R. D. Tata,  
father of Indian nuclear  
prog.

→ 25% of  
Thorium

## 1. CV Raman



Chandrasekhara Venkata Raman won the Nobel Prize for Physics in 1930 for his pioneering work on scattering of light. Born in Tiruchirapalli on November 7, 1888, he was the first Asian and first non-White to receive any Nobel Prize in the sciences. Raman also worked on the acoustics of musical instruments. He was the first to investigate the harmonic nature of the sound of the Indian drums such as the tabla and the mridangam.

He discovered that, when light traverses a transparent material, some of the deflected light changes in wavelength. This phenomenon is now called the Raman scattering and is the result of the Raman effect.

In October 1970, he collapsed in his laboratory. He was moved to a hospital and the doctors gave him four hours to live. He survived and after a few days refused to stay in the hospital as he preferred to die in the gardens of his Institute (the Raman Research Institute in Bangalore) surrounded by his flowers. He died of natural causes on 21 November 1970.

Before dying, Raman told his students,

Do not allow the journals of the Academy to die, for they are the sensitive indicators of the quality of Science being done in the country and whether science is taking root in it or not.

## 2. Homi J. Bhabha



Born on October 30, 1909 in Bombay, Homi Jehangir Bhabha played an important role in the Quantum Theory.

He was the first person to become the Chairman of the Atomic Energy Commission of India. Having started his scientific career in nuclear physics from Great Britain, Bhabha returned to India and played a key role in convincing the Congress Party's senior leaders, most notably Jawaharlal Nehru, to start the ambitious nuclear programme.

Bhabha is generally acknowledged as the father of Indian nuclear power. But few people know that he was absolutely against India manufacturing atomic bombs, even if the country had enough resources to do so. Instead he suggested that the production of an atomic reactor should be used to lessen India's misery and poverty.

He died when Air India Flight 101 crashed near Mont Blanc on 24 January 1966. Many possible theories of the crash came up including a conspiracy theory in which

the Central Intelligence Agency (CIA) is involved in order to paralyze India's nuclear program.

### 3. Visvesvaraya



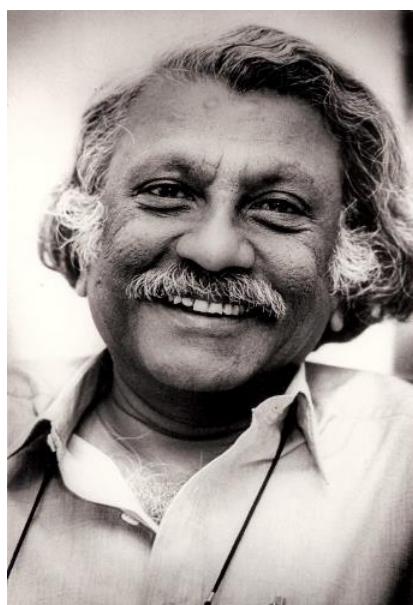
Born on 15 September 1860, Sir Mokshagundam Visvesvaraya was a notable Indian engineer, scholar, statesman and the Diwan of Mysore during 1912 to 1918. He was a recipient of the Indian Republic's highest honour, the Bharat Ratna.

Sir M V suggested that India try to be at par with industrialized nations as he believed that India can become developed through industries.

He has the credit of inventing 'automatic sluice gates' and 'block irrigation system' which are still considered to be marvels in engineering. Each year, his birthday 15 September is celebrated as Engineer's Day in India.

Since river beds were costly, he came up with an efficient way of filtering water through 'Collector Wells' in 1895 which was rarely seen anywhere in the world.

### 4. Venkatraman Radhakrishnan

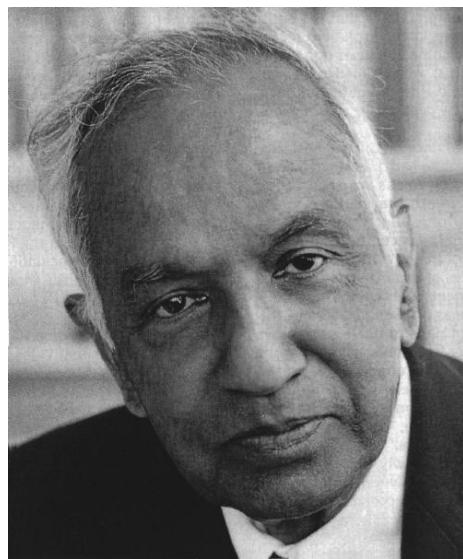


Venkatraman Radhakrishnan was born on May 18, 1929 in Tondaripet, a suburb of Chennai. Venkataraman was a globally renowned space scientist and a member of the Royal Swedish Academy of Sciences.

He was an internationally acclaimed Astrophysicist and also known for his design and fabrication of ultralight aircraft and sailboats.

His observations and theoretical insights helped the community in unraveling many mysteries surrounding pulsars, interstellar clouds, galaxy structures and various other celestial bodies. He died at the age of 81 in Bangalore.

## 5. S. Chandrashekhar



Born on October 19, 1910 in Lahore, British India, he was awarded the 1983 Nobel Prize for Physics for his mathematical theory of black holes. The [Chandrasekhar limit](#) is named after him. He was nephew of CV Raman. Chandra became a United States citizen in 1953.

His most celebrated work concerns the radiation of energy from stars, particularly white dwarf stars, which are the dying fragments of stars. He died on August 21, 1995, at the age of 82 in Chicago.

## 6. Satyendra Nath Bose



Born on January 1, 1894 in Calcutta, SN Bose was an Indian physicist specialising in quantum mechanics. He is of course most remembered for his role played in the class of particles '[bosons](#)', which were named after him by Paul Dirac to commemorate his work in the field.

Bose adapted a lecture at the University of Dhaka on the theory of [radiation](#) and the [ultraviolet catastrophe](#) into a short article called "Planck's Law and the Hypothesis of Light Quanta" and sent it to Albert Einstein. Einstein agreed with him, translated Bose's paper "Planck's Law and Hypothesis of Light Quanta" into German, and had it published in [Zeitschrift für Physik](#) under Bose's name, in 1924. This formed the basis of the [Bose-Einstein Statistics](#).

In 1937, Rabindranath Tagore dedicated his only book on science, Visva-Parichay, to Satyendra Nath Bose. The Government of India awarded him India's second highest civilian award, the Padma Vibhushan in 1954.

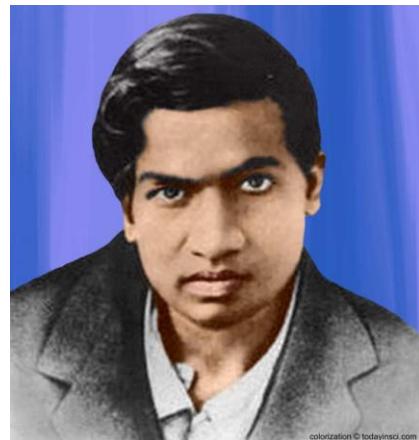
## 7. Meghnad Saha



Born on October 6, 1893 in Dhaka, Bangladesh, Meghnad Saha's best-known work concerned the thermal ionisation of elements, and it led him to formulate what is known as the [Saha Equation](#). This equation is one of the basic tools for interpretation of the spectra of stars in astrophysics. By studying the spectra of various stars, one can find their temperature and from that, using Saha's equation, determine the ionisation state of the various elements making up the star.

He also invented an instrument to measure the weight and pressure of solar rays. But did you know, he was also the chief architect of river planning in India? He prepared the original plan for the Damodar Valley Project.

## 8. Srinivasa Ramanujan



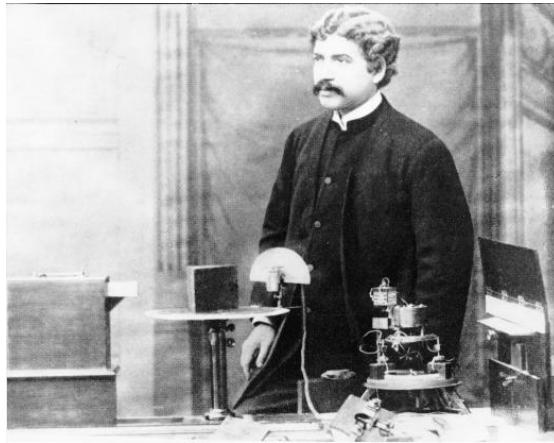
Born on December 22, 1887 in Tamil Nadu, Ramanujam was an Indian mathematician and autodidact who, with almost no formal training in pure mathematics, made extraordinary contributions to mathematical analysis, number theory, infinite series, and continued fractions.

By age 11, he had exhausted the mathematical knowledge of two college students who were lodgers at his home. He was later lent a book on advanced trigonometry written by S. L. Loney. He completely mastered this book by the age of 13 and discovered sophisticated theorems on his own.

We hadn't known before that he faced a lot of health problems while living in England due to scarcity of vegetarian food. He returned to India and died at a young age of 32.

Ramanujan's home state of Tamil Nadu celebrates 22 December (Ramanujan's birthday) as 'State IT Day', memorializing both the man and his achievements.

## 9. Jagadish Chandra Bose



Acharya J.C. Bose was a man of many talents. Born on 30 November, 1858 in Bikrampur, West Bengal, he was a polymath, physicist, biologist, botanist and archaeologist. He pioneered the study of radio and microwave optics, made important contributions to the study of plants and laid the foundation of experimental science in the Indian sub-continent. He was the first person to use semiconductor junctions to detect radio signals, thus demonstrating wireless communication for the first time. What's more, he is also probably the father of open technology, as he made his inventions and work freely available for others to further develop. His reluctance for patenting his work is legendary.

Another of his well known inventions is the [crescograph](#), through which he measured plant response to various stimuli and hypothesized that plants can feel pain, understand affection etc.

While most of us are aware of his scientific prowess, we might not be aware of his talent as an early writer of science fiction! He is in fact considered the father of Bengali science fiction.

## 10. Vikram Sarabhai



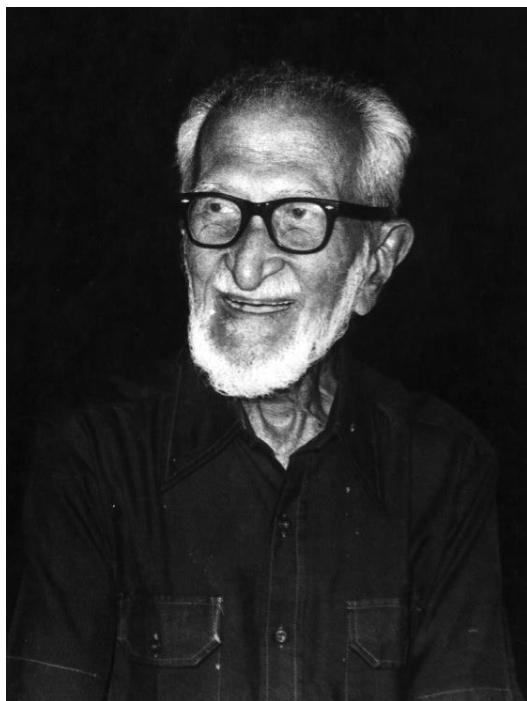
Considered as the Father of India's space programme, Vikram Sarabhai was born on 12 August, 1919 in the city of Ahmedabad in Gujarat. He was instrumental in the setting up of the Indian Space Research Organization (ISRO), when he successfully convinced the Indian government of the importance of a space programme for a developing nation after the launch of the Russian Sputnik, in this quote:

There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the moon or the planets or manned space-flight. But we are convinced that if we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society.

He was awarded the Padma Bhushan in 1966 and the Padma Vibhushan after his

death in 1972. While everyone knows of his primary role in the establishment of ISRO, perhaps many of us do not know that he was also the force behind the establishment of many other Indian institutes of repute, most notably the Indian Institute of Management, Ahmedabad (IIM-A) and the Nehru Foundation for Development.

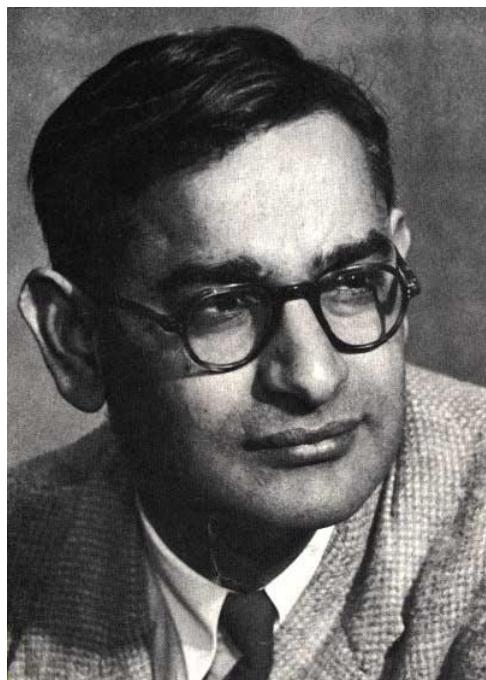
## 11. Salim Ali



Sálim Moizuddin Abdul Ali, born on November 12, 1896 in Mumbai, was an ornithologist and a naturalist. Salim Ali was among the first Indians to conduct systematic bird surveys across India and his bird books helped develop ornithology in the sub-continent.

This Birdman of India was the key figure behind the Bombay Natural History Society after 1947 and used his personal influence to garner government support for the organisation. He was awarded India's second highest civilian honour, the Padma Vibhushan in 1976.

## 12. Har Gobind Khorana



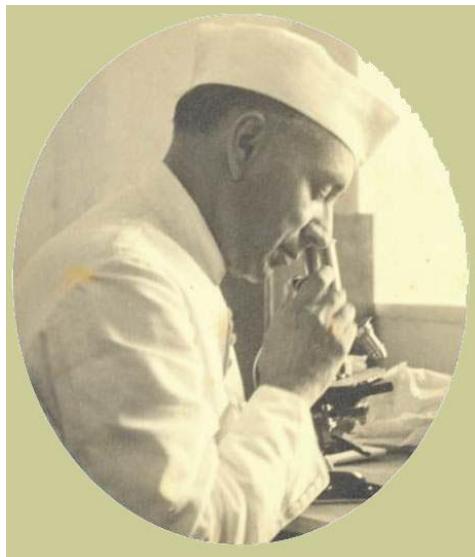
Born on January 9, 1922 at Raipur village in West Punjab (now in Pakistan), Khorana was an Indian-American biochemist who shared the 1968 Nobel Prize for Physiology or Medicine with Marshall W. Nirenberg and Robert W. Holley for research that helped to show how the order of nucleotides in nucleic acids, which carry the genetic code of the cell, control the cell's synthesis of proteins.

In 1970, Khorana became the first to synthesize an artificial gene in a living cell. His work became the foundation for much of the later research in biotechnology and gene therapy.

How many are aware that the University of Wisconsin-Madison, the Government of India (DBT Department of Biotechnology), and the Indo-US Science and Technology Forum jointly created the Khorana Program in 2007? The mission of the Khorana Program is to build a seamless community of scientists,

industrialists, and social entrepreneurs in the United States and India. Khorana died of natural causes on November 9, 2011 at the age of 89.

## 13. Birbal Sahni



Born on November 14, 1891 in West Punjab, Sahni was an Indian paleobotanist who studied the fossils of the Indian subcontinent. He was also a geologist who took an interest in archaeology. His greatest contributions lie in the study of the plants of India in the present as well as the historical context.

He was elected a Fellow of the Royal Society of London (FRS) in 1936, the highest British scientific honor, awarded for the first time to an Indian botanist.

He was a founder of The Paleobotanical Society which established the Institute of Palaeobotany on 10 September 1946 and which initially functioned in the Botany Department of Lucknow University. Sahni died on 10 April 1949 due to a heart attack.

## 14. APJ Abdul Kalam



Avul Pakir Jainulabdeen Abdul Kalam, born on October 15, 1931 is an Indian scientist who worked as an Aerospace engineer with Defence Research and Development Organisation (DRDO) and Indian Space Research Organisation (ISRO).

Kalam started his career by designing a small helicopter for the Indian Army. Kalam was also part of the INCOSPAR committee working under Vikram Sarabhai, the renowned space scientist. In 1969, Kalam was transferred to the Indian Space Research Organization (ISRO) where he was the project director of India's first indigenous Satellite Launch Vehicle (SLV-III) which successfully deployed the Rohini satellite in near earth's orbit in July 1980.

He also served as the 11th President of India from 2002 to 2007. Kalam advocated plans to develop India into a developed nation by 2020 in his book India 2020. He has received several prestigious awards, including the Bharat Ratna, India's highest civilian honour. Known for his love for children, did you know that Kalam had set a goal of meeting 100,000 students in the 2 years after his resignation from the role of scientific adviser in 1999? May he continue to inspire millions.

## **15. M.S Swaminathan**

### **Swaminathan and Agriculture Science**

- In 1960, when India was facing mass shortages of food, M S Swaminathan along with Norman Borlaug and other scientists developed the HYV (high yielding variety) of wheat and rice and introduced to farmers under the “Green Revolution”. It helped making India self sufficient in food grains.
- As the director general of the Indian Council of Agricultural Research (ICAR), he also mentored Young agri scientist and expanded the network of Krishi Vigyan Kendras.
- He has been awarded Padma Shri and Padma Bhushan for his services.