ROLE OF WOMEN IN SCIENCE AND TECHNOLOGY RESEARCH

Rajeshri R Itkarkar
E & TC Engineering, AISSMS COE, Pune, Maharashtra, India.
Dr. Vidya N Patil
Civil Engineering, AISSMS COE, Pune, Maharashtra, India.
Dr. D S Bormane
E & TC Engineering, AISSMS COE, Pune, Maharashtra, India.

Article history:
Published: 10th March 2022

Abstract:
Women in the era of 2022 is very well recognized internationally in every field. She has her own identity as an individual and in a team. Women should be more recognized as an entrepreneur, a leader, Officer, researcher etc. Women in research has made a great impact in the society. Her contribution in the field of science and technology has helped to change the world. This paper presents the contribution of women in research in science and technology field. Women are required in research, as the gender discrimination has been a challenge and a barrier for women working in science and technology. Though women has leaded and worked in many professions, she holds a lower position. Women needs to contribute more in science and technology and held higher positions than Men. Women and Girls should be empowered not to only participate but also lead in the profession of science and technology. This paper presents the contribution of women in the science and technology field and different schemes available which can empower her especially in science and technology.

Keywords: Women in science and technology; women empowerment, women contribution

1. INTRODUCTION

For centuries, universities refused to grant science degrees to women. The most prestigious scientific society (America), the Royal Society (UK), didn't allow women to join until the 20th century. But women continued to practice in chemistry, physics, biology, and astronomy, making revolutionary contributions to science.

In today's era women play an important role in research and science. Women are contributing in areas of information and technology, space technology, biotechnology etc. The role of the women and her involvement in research and technology is very essential. As per the data provided by the department of science and technology India [1] , women as science leaders has increased by 4 percent over two years. Extramural Research (EMR) support received by women principal investigator was 28% in 2018-19 and 24% in 2016-17. From this support 64% of projects were sanctioned to 8 states such as Tamil Nadu, Delhi, Karnataka, Kerala, Maharashtra, Telangana, Uttar Pradesh, and West Bengal. The 22 Indian Institute of Technologies (IITs) combined received 822 projects – the maximum number, with highest financial support of Rs. 449.25 Crore, followed by 26 National Institute of Technology (NITs) combined, which received 191 projects with financial support of Rs. 55.83 Crore.

A good compilation about the Indian women in the field of Science & Technology was planned with this paper. With this a discussion of what is the contribution of women in science and technology research and what is possible is presented in this paper. I read one book named 'Vidushi': The Indian Women in Science & Technology which was published by National Council of Science Museum (NCSM). NCSM is providing every possible publication under support of Ministry of Culture, Government of India. Different media of publications, activities like training program, workshops, lectures, and different resources are available with website of NCSM. Around 1857 few records were maintained. Post-Independence day many records are managed with different publications which are great women's contributions in different fields of science and technology research. This is motivating the coming generation in developments. Every contribution discussion is not possible in this paper but few science and technology research examples included from ancient time till today.

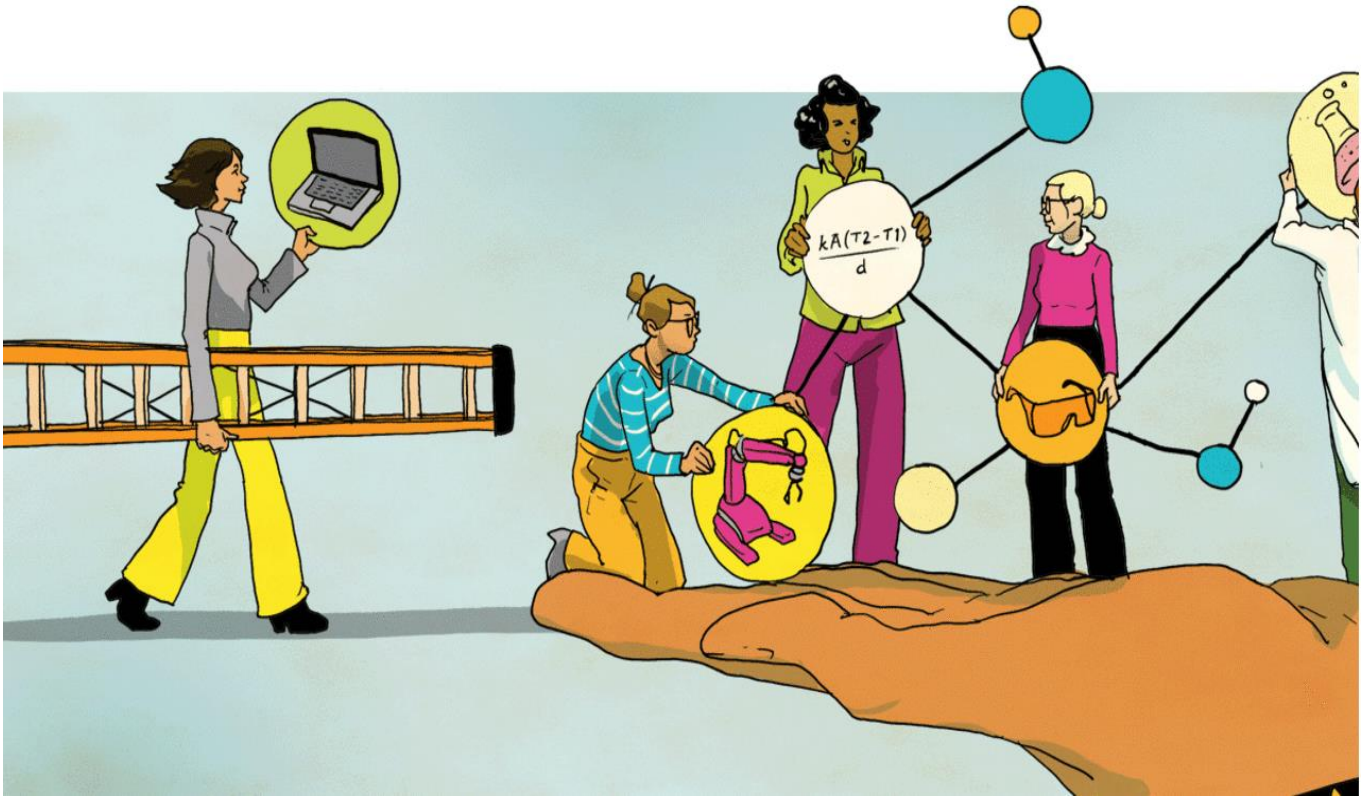

Fig1. Women Role in Science and Technology

2. LITERATURE SURVEY

The presence of women in science spans the earliest times of the history of science wherein they have made significant contributions. Here is a survey of women's contribution in science and technology.

A woman who has discovered new radioactive elements, including polonium and radium, was **Madame Curie.** She won the Nobel Prize for Chemistry in 1911. She was the first woman to win a Nobel Prize, and the first person to win the award in two different fields [3].

In 1895, **Henrietta Swan Leavitt**, made breakthrough discoveries in astronomy, including the identification of over 2,400 variable stars.

In the 1950s **Rosalind Franklin** held a Ph.D. in physical chemistry from Cambridge University and worked on X-ray crystallography. She successfully photographed the structure of DNA on a machine she refined after 100 hours of X-ray exposure.

Alice Ball revolutionized the treatment for leprosy in the early 20th century. After earning graduate degrees from the University of Washington and the University of Hawaii, Ball became one of the first female chemistry professors in the U.S.

Caroline Herschel was not only the first woman to discover a comet and the first woman to receive a salary for her scientific work, but she was also the first woman to be granted honorary membership in the Royal Society before the prestigious society admitted women.

Katherine Johnson is best known for her work as a "computer" at NASA. Specifically, it was her mathematical calculations that helped the U.S. send people into orbit around Earth and, later, to the moon.

Lovelace is regarded as the first computer programmer — long before modern computers were invented. Her notes on Charles Babbage's proposed analytical engine (a programmable, general-purpose computer), is considered to be the very first computer algorithm.

Janaki Ammal, India's first female plant scientist, Ammal developed several hybrid species still grown today. She also advocated for protecting the biodiversity of India.

Kadambini (Basu) Ganguly was not only the first female graduate of the British Empire but she was also the first female physician of South Asia to be trained in western medicine.

Anandi Gopal Joshi started her hospital in Pune. She contributed to the medical wing till February 26, 1887. In the year 1886 another woman from India also obtained a degree in Western medicine but she graduated from Women's Medical College in Philadelphia, USA and thus became the first Indian to study medicine from abroad.
Anna Mani made significant contributions in the field of meteorological instrumentation upto 16 August 2001. She was former Deputy Director General of the Indian Meteorological Department and was an Indian physicist and meteorologist. She completed her study in meteorological instruments at Imperial College London in 1948 and she joined the Meteorological department in Pune. She conducted research and published numerous papers on solar radiation, ozone and wind energy measurements remarkable highlighted work in science and technology around 1950 -1960.
Rajeswari Chatterjee: She is the first Woman Scientist to pioneer the Field of Microwave Engineering and Antennae Engineering in India. She took and MS degree in Electrical Engineering from Michigan University, USA in 1949. Around 60 years ago, she was the only woman on the faculty in the Indian Institute of Science. She retired as Professor and Chairperson of the Department of Electro-Communication Engineering, Indian Institute of Science, Banglore.
Dr. Indira Hinduja: She is the first Indian women who delivered a test tube baby on August 6, 1986. She has also pioneered the Gamete Intra Fallopian Transfer (GIFT) technique resulting in the birth of India's first GIFT baby on 4 January 1988.
Kiran Mazumdar Shaw is the Chairman & Managing Director, Biocon Limited, a biotechnology company based at Bangalore. She is on the Forbes list of the world's 100 most powerful women and in the business list on top 50 women released by the Financial Times'.
Dr. Aditi Pant: She is an oceanographer by profession and is one of the first Indian women to visit the icy continent Antarctic. She was a part of the third Indian expedition to Antarctica in 1983-84 and was honored with the Antarctica Award along with Sudipta Sengupta, Jaya Naithani and Kanwal Vilku for their outstanding contribution to the Indian Antarctic programme. She did her MS in Marine Sciences from the University of Hawaii and obtained doctorate from the London University in the Physiology of Marine Algae. She worked in The National Institute of Oceanography (Goa) and the National Chemical Laboratory (Pune).
Madhuri Mathur, about 40 years back she along with her engineer husband devised Summet mixer grinder. It became a revolutionary kitchen helper that could blend, chop, and mince at a touch of a button was just a dream for millions of Indian women.
Dr. Suman Sahai: She is the founder of the Gene Campaign in India. She is the voice of millions of farmers all across the country. Her campaign is currently running in 17 states across the country. Dr Sahai is the brains behind the patent campaign for Azadirachta indica (Neem) and Turmeric (Haldi).
Kalpana Chawla: (March 17, 1962– February 1, 2003) She was the first Indian-American astronaut and first Indian woman in space. She first flew on Space Shuttle Columbia in 1997 as a mission specialist and primary robotic arm operator. The NASA chief called her a "Terrific astronaut".
Shubha Tole is well known for her contribution in the field of neuroscience. She discovered a master regulator gene which controls the development of the brain's cortex. She was a recipient of Shanti Swarup Bhatnagar prize in 2010 and currently works at Tata Institute of Fundamental Research, Mumbai.
Tessy Thomas is known as the 'Missile lady' due to the successful launch of Agni series of missiles. She was the Project Director for the Agni-IV and Agni-V missile in Defense Research and Development Organization and is the first Indian woman scientist to have headed a missile project. She is also a recipient of the Lal Bahadur Shastri National Award.

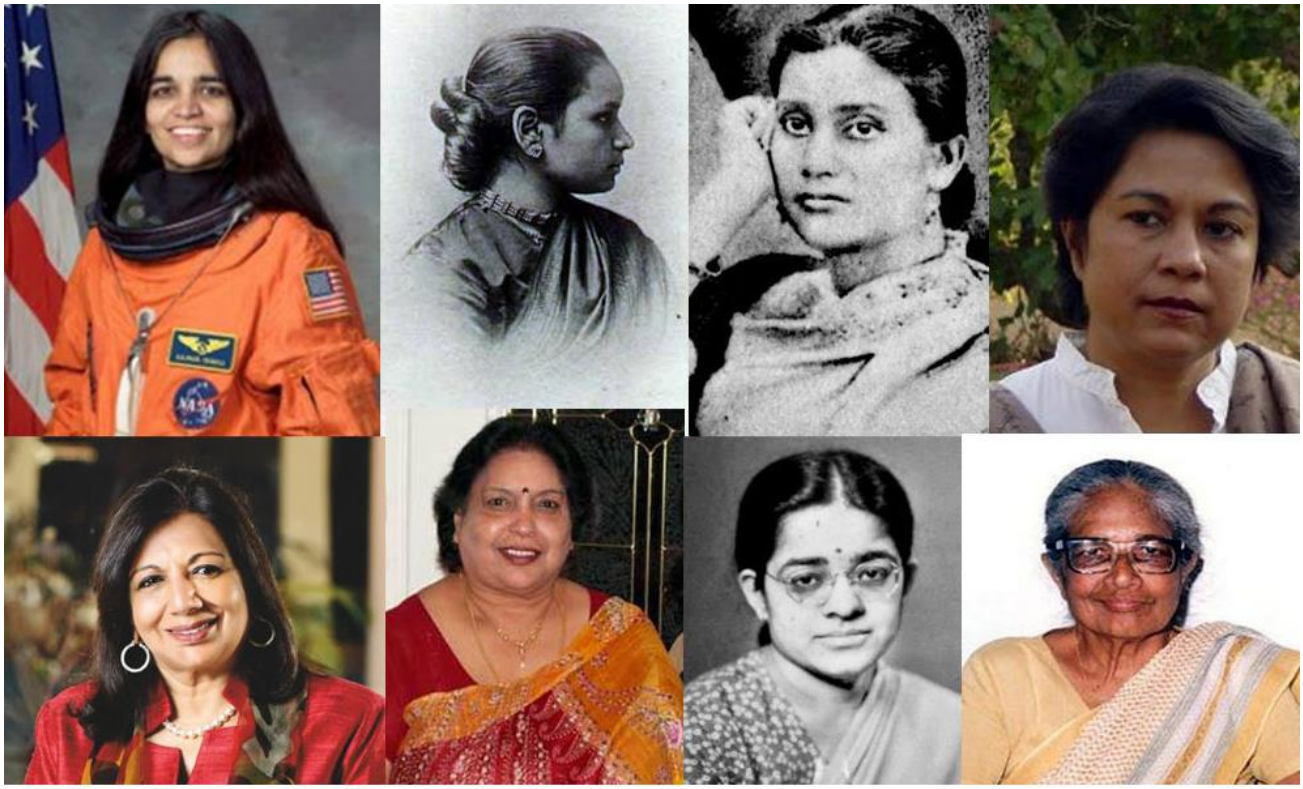

Fig.2 Renowned Women in Field of Science and Technology

3. WOMEN'S CONTRIBUTION AND NEED IN THE FIELD OF SCIENCE AND TECHNOLOGY.

While the number of female scientists today is far higher than it was just a century ago, women still have a long way to go. UNESCO reports that women make up less than 30% of researchers around the world.

Gender roles were largely deterministic in the eighteenth century and women made substantial advances in science. During the nineteenth century, women were excluded from most formal scientific education, but they began to be admitted into learned societies during this period. In the later nineteenth century, the rise of the women's college provided jobs for women scientists and opportunities for education.

Forty women have been awarded the Nobel Prize between 1901 and 2010. Seventeen women have been awarded the Nobel Prize in physics, chemistry, physiology or medicine [2]. Marie Curie was the first woman to receive a Nobel Prize in Physics and became the first person to receive a second Nobel Prize in Chemistry [3].

Women appear to do less well than men (in terms of degree, rank, and salary) in the fields that have been traditionally dominated by women, such as nursing. In 1991 women attributed 91% of the PhDs in nursing, and men held 4%.

Women are also under-represented in the sciences as compared to their numbers in the overall working population.

Women tend to earn less than men in almost all industries, including government and academia.

The data showing the differences in salaries, ranks, and overall success between the genders is often claimed

For many women, financial independence is the only means through which they can determine how they want to live, and yet it often comes at the expense of being the primary care-giver and having the lion's share of domestic duties at home.

Women should have the same opportunities and freedom to be as financially independent as men, and this starts with having equal opportunity to be self-sufficient.

There has been a lot of discussion about the fact that female-led countries performed better than male-led ones, which was better observed during the height of the first Covid-19 wave.

Data has shown that in countries where there is more gender parity, poverty drops and economies grow, while new research has shown that companies who foster female leadership perform better and increase profits.

Salary Level and Gender Wage Gap (Score)

	Country	Score
1.	Singapore	100.0
2.	Norway	98.0
3.	Switzerland	95.9
4.	Sweden	95.7
5.	Iceland	95.6
6.	Denmark	94.9
7.	Germany	94.8
8.	Slovenia	94.8
9.	Finland	94.6
10.	USA	94.5

India ranks #97 out of 100 for Salary Level and Gender Wage Gap

Female Access to Education (Score)

	Country	Score
1.	Japan	100.0
2.	Czechia	99.5
3.	Canada	99.5
4.	Israel	98.7
5.	Lithuania	98.2
6.	Sweden	97.1
7.	UK	96.9
8.	New Zealand	96.2
9.	Norway	96.1
10.	Georgia	95.9

India ranks #85 out of 100 for Female Access to Education

So, in order to achieve full and equal access to and participation in science for women and girls, and further achieve gender equality and the empowerment of women and girls, the United Nations General Assembly declared 11 February as the International Day of Women and Girls in Science in 2015.

Total Women in Government (Score)

	Country	Score
1.	Rwanda	100.0
2.	Spain	99.3
3.	Finland	99.1
4.	Sweden	98.4
5.	Costa Rica	97.7
6.	Austria	97.6
7.	South Africa	97.6
8.	France	97.2
9.	Ethiopia	96.3
10.	Mexico	96.2

India ranks #88 out of 100 for Total Women in Government

Women in Management (Score)

	Country	Score
1.	Sweden	100.0
2.	Iceland	99.9
3.	Finland	99.0
4.	Canada	99.0
5.	Norway	98.9
6.	Spain	98.8
7.	Portugal	98.6
8.	UK	98.5
9.	Latvia	97.6
10.	Australia	97.5

India ranks #94 out of 100 for Women in Management

Data courtesy blog by Adrienne Gormley

The number of women in India who have opted for Science, Technology, Engineering and Mathematics (STEM) as a field of study has increased by 53,388 in the last three years — from 10,02,707 in 2017-18 to 10,56,095 in 2019-20.

Especially technology field is interesting in developments of Nation which is not possible without science and mathematical background. Currently everyone is eager to buy new products like new models of car, mobile, Television,

drones, satellites, different machineries, cranes, lifts etc. Engineers from civil, electrical, mechanical, computer, electronics and chemical are making this possible with spectacular developments in the nation. We have to note women's contribution in these fields in terms of service to national developments. Few examples along with their roles are listed below in table 1.

Table 1 Recent Contribution of Women in leading positions in field of science and Technology

Sr No	Name Of The Renowned Women	Her Contribution
1.	Dr. Ritu Karidhal Srivastava	Indian Space Research Organization (ISRO) Deputy Operations Director To India's Mars Orbital Mission, Mangalyaan.
2.	Sudha Murty	Indian Businesswoman
3.	Soumya Swaminathan	Chief Scientist, World Health Organization (WHO)
4.	Suchitra Ella	Co-Founder And Joint MD, Bharat Biotech International Ltd
5.	Arundhati Bhattacharya	Chairperson & CEO, Salesforce India
6.	Rekha M. Menon	Chairperson And Senior MD, Accenture In India
7.	Leena Nair	Chief Human Resources Officer, Unilever
8.	Mallika Srinivasan	Chairman And MD, Tractors And Farm Equipment (TAFE)
9.	Aparna Bawa	COO And Interim Chief Legal Officer, Zoom Video Communications
10.	Sunita Sarawagi,	Professor, Computer Science & Engineering, IIT-Bombay
11.	Vidita Vaidya	Professor, Tata Institute Of Fundamental Research
12.	Farah Ishtiaq	Senior Scientist, Tata Institute For Genetics And Society
13.	Kalika Bali	Principal Researcher, Microsoft Research
14.	Muthayya Vanitha & Ritu Karidhal	Senior Scientists At ISRO. Vanitha Was Project Director, & Karidhal Was Mission Director Of Chandrayaan-2
15.	Aditi Sen De	Professor, Harish Chandra Research Institute, Allahabad
16.	Vartika Shukla	Chairperson & Managing Director, Engineers India Limited (EIL)
17.	Er. Bhagyashri Jyotiba Patil	Assistant Engineer(Grade 1), Irrigation Department, Maharashtra
18.	Er. Smita Chetan Mane	Executive Engineer, Irrigation Department, Maharashtra
19.	Er. Shilpa Magdum	Executive Engineer, Irrigation Department, Maharashtra
20.	Renuka Ravindran	The First Woman To Be The Dean Of The Indian Institute Of Science.
21.	Priya Balasubramaniam,	Vice President Of Iphone Operations, Apple
22.	Nandini Ramani,	Vice President Of Engineering, Twitter
23.	Anjali Joshi,	Vice President Of Product Management, Google
24.	Komal Mangtani	Head Of Data Intelligence, Uber
25.	Aparna Ramani	Director Of Engineering, Facebook

4. WOMEN EMPOWERMENT

Women empowerment refers to increasing the spiritual, political, social or economic strength of women in diversified streams. It involves developing confidence in their capacities. It's a multidimensional social process that helps women to gain control over their own lives and contribute to strong nation building by their knowledge and skills in various fields of science and technology. Science and Technology have been an integral part of Indian civilization and culture. Over the years Indian women have overcome the traditional mind-sets and have excelled in professions like teaching, medicine, engineering, information technology, biotechnology, nuclear science, space science and many such specialized fields in the domain of science and technology. Their contribution to socio-economic development as employer and employee, getting recognized and honored in public, private sectors.

Different funding schemes are available in the field of research in science and technology for women. They are made available easily for empowerment of women and strength, in education, research, IPR and next generation developments. India science, technology and innovation, government of India is providing more than 150 schemes in research with highlighted schemes as women schemes. More than 15 different types of funds for research under women schemes are available. They are listed below.

- Women Technology Park (WTP)
- Women Scientist Scheme-A (WOS-A)
- Women Scientist Scheme-B (WOS-B)
- Women Scientist Scheme-C (WOS-C)
- Women Entrepreneurs Quest (WEQ)
- Vigyan Jyoti Scheme
- Technology Development and Utilization Programme for Women (TDUPW)
- SERB – POWER Research Grants
- SERB – POWER Fellowship
- SERB Women Excellence Award
- Science and Technology for Women
- Mobility Scheme
- Knowledge Involvement in Research Advancement through Nurturing (KIRAN)
- Indo-U.S. Fellowship for Women in STEMM
- Consolidation of University Research For Innovation And Excellence in Women (CURIE)
- Biotechnology Career Advancement and Re-orientation Programme (Bio-CARe) for Women Scientists
- Biotechnology Career Advancement & Re-orientation Programme (BioCARe)
- Biotechnology based Programme for Women

These schemes are focused on women as a specific target group with the objectives to promote research, development and adaptation of technology in life improvement, better working conditions; to provide new opportunities for gainful employment of women especially in rural areas; and to increase the contribution of women scientists to technology based development.

Different fellowships and scholarships are available as crucial components of the public funded education system as these provide much-needed support to the school going girl students, college-goers, researchers and scholars based purely on merit. Fellowships, scholarships and awards in the field of science by different Government Ministries and Departments help to retain women talent, promote and nurture it. Detailed information is available with websites about any government scholarship for women or girls i.e. faculty or scientists, Post-Doctoral fellowships, fellowships and scholarships for PhD scholars, college students, school goers related to science. Also Science & Technology awards under National, International and Others category are possible. In the current scenario Atmanirbhar Bharat dream is asking women to think about innovations and startups. The best examples are shared with the table below. These women have proved innovation and startup capacities in terms of the successful women entrepreneurs in India.

5. CONCLUSION

Motivation for women is the key objective of this paper. Women can be empowered by increasing her efficiency to carry out responsibilities and achieve goals in the field of science and technology by education, training, motivating and increasing her self-confidence. Encouraging women in participation and contribution in special programs, giving her more opportunity in the community can build the gap between Men and Women. Even focusing on salary rewards and recognition can motivate women a lot as they are multitaskers and can manage a balanced life between career and domestic responsibilities. By giving women a work-life balance friendly environment can increase productivity.

REFERENCES

1. https://dst.gov.in/sites/default/files/EM_Directory_2018_19_0.pdf
2. https://www.nobelprize.org
3. Rutherford. "Marie Curie." The Slavonic and East European Review, vol. 13, no. 39, 1935, pp. 673–676. JSTOR, www.jstor.org/stable/4203041. Accessed 18 Dec. 2020.
4. https://indiabioscience.org/media/articles/Spoorthi_Timeline_v1.pdf
5. https://www.educationworld.in/eight-women-scientists-of-india-who-made-history/