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Women in Scientific Research

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Abstract

Achieving each of the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda depends on gender equality in scientific research and STEM fields. A considerable increase in the number of girls and women entering and continuing in STEM jobs is possible because sustainable development also demands more research and scientists. Creating an environment where creativity and innovation may flourish in schools, businesses, hospitals, research institutes, and government agencies requires ensuring that all kids have equal chances. Equalizing the playing field for women in science, technology, engineering, and mathematics (STEM) is crucial for enhancing nations' competitiveness in a global economy where STIs are becoming more and more important. Additionally, women contribute to research and development (R&D) with their unique viewpoints, priorities, and methods, demonstrating that gender equality in scientific research can also promote better science, technology, and innovation. In essence, because gender inequality can result in instruments that are harmful to science, it can have a negative impact on the implementation and strategy of successful policy. This paper is a review of women in scientific research by exploring relevant literature that references the involvement of women in scientific research and offers possible solutions to bridge the gender gap in scientific research.

Keywords: Women, Gender, Science, STEM, Research.

E. O. Nwaichi and F. O. Nduka (eds.), *Proceedings of the 6th Biennial International Conference for Organization for Women in Science for the Developing World Nigeria (OWSD 2023)*, Advances in Biological Sciences Research 37,
https://doi.org/10.2991/978-94-6463-306-1_12

Introduction

Scientific innovation is essential for national security, quality of life, and economic competitiveness in today's globalized world. Future job development in Nigeria will be largely concentrated in the fields of Science, Technology, Engineering, and Mathematics (STEM). Given the tiny number of local students entering these professions and the high attrition rate (commonly referred to as the "leaky pipeline"), this raises questions about Nigeria's readiness for STEM careers. The underutilized human capital of women could improve the STEM workforce. The world today has witnessed an enormous under-representation of girls and women in science. Studies have shown that males are more likely to opt to study science, engineering and technology at the school and university levels (Rees, 2001; Roberts, 2002). Women and girls are less likely to develop careers in science after graduation and then when they do face challenges to promotion (European Commission, 2006).

These numbers are the result of a variety of causes (Greenfield, 2002), but the media may have a significant role in either supporting or opposing gender segregation and inequality. The media can be a significant source of "role models" for aspiring scientists and helps to define the public's perception of normalcy that is taken for granted (Eldridge et al., 1997, Phillips and Imhoff, 1997: 35). A sort of symbolic annihilation might result from inaccurate or absent depiction (Tuchman, 1978; Lafky, 1995; Macdonald, 1995). The issue is that female scientists have historically been underrepresented in the media. In the past, at least, the media rarely featured women in science, engineering, and technology, and when they did, the representations were frequently problematic.

What causes gender differences in STEM fields? Research suggests many solutions at various developmental stages. Gender differences in early adulthood or early-to-middle adulthood have different causes than those in childhood and adolescence. Multiple stages of the developmental trajectory need to be targeted by interventions intended to close the gender gap. The three developmental phases that are the subject of this article's attention and the challenges they present are (a) childhood and adolescence, (b) emerging adulthood, and (c) young-to-middle adulthood. Each of the sections below discusses how gender disparities in STEM interest, achievement, and perseverance are caused by factors such as learning settings, peer relationships, and family traits.

It goes beyond simple justice to promote gender equality in innovation, research, and technology. A more equal gender distribution is thought to improve the hiring of the most competent individuals, regardless of gender (European Commission, 2008a), tapping a partially underutilized resource. It is believed that an inclusive workforce will be more creative and productive than one that is not (National Academy of Sciences, 2006). Better scientific and technological outcomes and the best application of those outcomes are guaranteed by the presence of scientists and engineers from a variety of backgrounds, interests, and cultures (Lane, 1999). Instead of just increasing opportunities for women, gender equality is seen as a way to advance scientific and technological excellence.

The unrealized talent of fully qualified and credentialed women who may be interested in STEM but decide against pursuing degrees in these subjects or change occupations as a result of real or perceived barriers represents a significant missed opportunity for both women and society at large. Women's career barriers deprive societies of valuable human resources, harming their ability to compete and advance. To pinpoint the underlying reasons for gender gaps in these sectors and to create effective policy solutions, more investigation is required.

Majority of the literature on gender gaps in STEM and the policies intended to address them is focused on the United States and Europe, even though emerging nations are beginning to recognize the significance of the issue. In addition to being underrepresented in STEM disciplines globally, women are also under-measured, which has made it difficult for researchers to fully grasp the causes of this discrepancy. Additionally, it has hindered the ability of Latin American policymakers to create efficient policies.

The biological disparities between men and women that can affect their representation in research have received a lot of attention recently. There is substantial evidence that general IQ does not differ between men and women, but there is an ongoing debate about whether or not some cognitive abilities are different (American Sociological Association Council, 2005; Spelke, 2005). Moreso, there is not a perfect set of cognitive skills needed to be a scientist; deductive reasoning capabilities, verbal ability, quantitative reasoning, intuition, and social skills are necessary for success in science.

Although there may be some abilities that men and women generally possess differently, we cannot use these differences to predict success in science because varied combinations result in a variety of successful approaches and styles. Second, there is no solid proof that the lack of women in science is due to natural talent. The percentage of Ph. D.s awarded to women in engineering increased thirtyfold between 1970 and 2003 (a period too short for discernible changes in innate ability). This period saw a radical shift in gender attitudes and laws, which is compelling proof of the structural and cultural barriers faced by women. It is necessary to investigate the causes of the gaps and make an effort to address them since it is morally and legally required to offer equal opportunity. The effect that fairness will have on the calibre of our colleges and the competitiveness of our country is equally compelling. Universities benefit fundamentally from the student, professor, and staff heterogeneity (Chang et al, 2003). In comparison to homogeneous groups, heterogeneous groups come up with more creative problem-solving approaches and apply more critical thinking to their judgments (McLeod, 1996; Nemeth, 1985). Additionally, workplaces that accept women promote a more positive environment for all community members (Miner-Rubino and Cortina, 2004).

The ADVANCE Institutional Transformation Program was established by the National Science Foundation (NSF) to examine the effects of interventions on PhD candidates. They are not encouraged to do so, doubt their abilities to succeed, or lack female role models who would help them see themselves as faculty, excellent women scientists may choose not to pursue academic positions. Women's reservations and worries may be interpreted by well-intentioned advisors as a lack of interest, and they may fail to encourage their female students to think about pursuing academic professions. It will be easier to close the gap if outstanding doctoral candidates are explicitly encouraged to become professors. Programs given by numerous professional associations, universities, and private organizations, which are intended to educate students to become teachers, can give students access to role models and may boost their confidence and dedication (Fox, 2003). Women need excellent advice on how to make the most of their time as junior faculty members if they want to continue rising through the ranks to senior positions. More commonly than men, women are requested to serve on university committees, give speeches, and mentor students (Spark, 1996).

WOMEN Ph.D.'s AND FACULTY, TOP 50 DEPARTMENTS IN SELECTED DISCIPLINES*

Discipline	Career level (% women)			
	Ph.D.	Asst. Prof.	Assoc. Prof.	Full Prof.
Biology	45.89	30.20	24.87	14.79
Physical Science	24.68	16.13	14.18	6.36
Astronomy	22.88	20.18	15.69	9.75
Chemistry	33.42	21.47	20.50	7.62
Computer Science	15.27	10.82	14.41	8.33
Math & Statistics	26.90	19.60	13.19	4.56
Physics	14.78	11.15	9.41	5.24
Engineering	15.34	16.94	11.17	3.68
Electrical	12.13	10.86	9.84	3.85
Civil	17.90	22.26	11.50	3.52
Mechanical	10.93	15.65	8.89	3.17
Chemical	24.98	21.38	19.19	4.37

*Data on Ph.D.'s and faculty come from the same "Top 50" departments for each discipline; departments are ranked by NSF according to research expenditures in that discipline. Top 50 departments detailed at (*23*). Ph.D. data (*24*) are from 2001 to 2003; faculty data (*23*) are from 2002 except Astronomy (2004) and Chemistry (2003).

Effect of Academic Climate on Women's Participation in Scientific Research

Many women blame hostile colleagues and the frigid campus environment for leaving academia (Seymour and Hewitt, 1997). According to polls, many males describe a better climate for women than women report experiencing, making this milieu invisible to them. Campus-wide initiatives to inform community members can assist identify and eradicate sexual harassment, employment and promotion discrimination, and other illegal behaviours (6, 15). Faculty members can help by learning about these practices, taking action to deter them, and supporting female students who raise concerns about illegal behaviour.

The subtle impacts of marginalization from the department community and its decision-making processes, as well as the slights, jeers, and focus on women's sexuality in professional contexts, are far more widespread. Even though these actions may appear harmless when taken separately, their combined impact can be disastrous (Valian, 1999). Campus standards for promoting inclusion can be established by the university administration. Programs to teach department chairmen how to identify and address the isolation that women suffer could change the local climate.

Effect of Bias on Women's Participation in Scientific Research

Even those who adhere to egalitarian ideas and think they are impartial may unintentionally or accidentally act in a prejudiced manner (Dovidio and Gaertner, 2000; Wenneras and Wold, 2010; Trix and Psenka, 2003). When evaluating writing abilities, resumes, journal papers and career prospects, assessors on average gave lower evaluations if they knew the subject was a woman. According to a Swedish Medical Research Council assessment of postdoctoral fellowship recipients, women applicants need significantly more publications to receive the same competency rating as men (Wenneras and Wold, 2010). Considering how to conceal candidate gender may be a good idea for scientists, according to findings in related fields.

Balancing family and work

Majority of women are still responsible for caring for the family's elderly parents and young children. Young women can be inspired by learning about academic initiatives designed to lessen conflicts between personal and professional life, such as dual-career hiring programs, tenure clock extensions for childbirth and adoption, on-campus lactation rooms, and childcare facilities. They can also be inspired by meeting or reading about prominent women scientists who have families. All university students have the power to support such initiatives and to give their co-workers who have family obligations more flexibility.

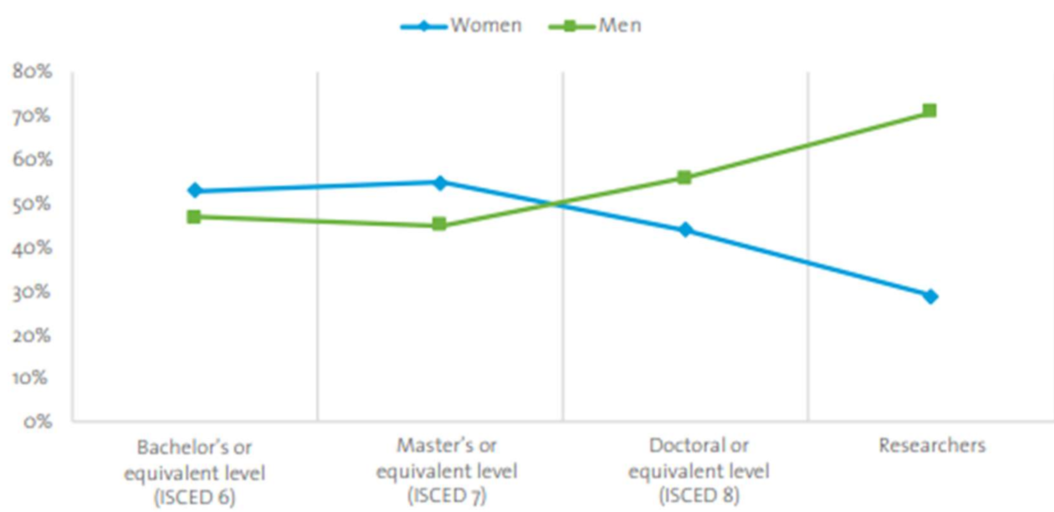
Women will not be heavily encouraged to continue working throughout the first years of child rearing solely out of worry about how withdrawal may affect their intellectual inventiveness. Their worry for their children's growth is at least as intense as for themselves. Up until very recently, it was widely believed that any time a mother and child were separated, it would be disastrous for the child's emotional growth. As a result, many mothers who worked during their children's early years did so with a great deal of worry about how their daily absence would affect their kids. This misconception has only recently been dispelled.

Maternal employment has been demonstrated to have no negative impacts on children, according to a recent volume of about 22 empirical investigations on the employed mother (Seymour and Hewitt, 1997). The mother's motivations for working, the calibre of the child's care in her absence, and her husband's opinions are more significant than employment per se. Social scientists have recently started to emphasize the positive rather than the negative effects of maternal employment (Rosser, 2004)

The Gender Gap in Scientific Research

Despite significant progress over the past few decades, there are still extremely few female scientists working across the globe. According to data available on the national percentage of female researchers, only about 27% of all countries were able to achieve what is referred to as "gender parity," with women making up 45%–55% of all researchers, as of July 2019, according to the UNESCO Institute for Statistics (UIS). The global average percentage of female researchers was 29.3% at that time. While more women are enrolling in higher education globally and essentially in every nation, many still leave school before completing the requirements for jobs in research. Women make up a somewhat higher percentage of graduates with bachelor's degrees (53%) and master's degrees (55%) than males do (UIS, 2018). However, as shown in the traditional gender scissors diagram, the gap becomes apparent at the doctoral level and widens during the transition from school to the workplace, where less than 30% of researchers are women.

Proportion of female and male graduates in tertiary education by programme level and those employed as researchers, global estimate, 2017 or latest year available.

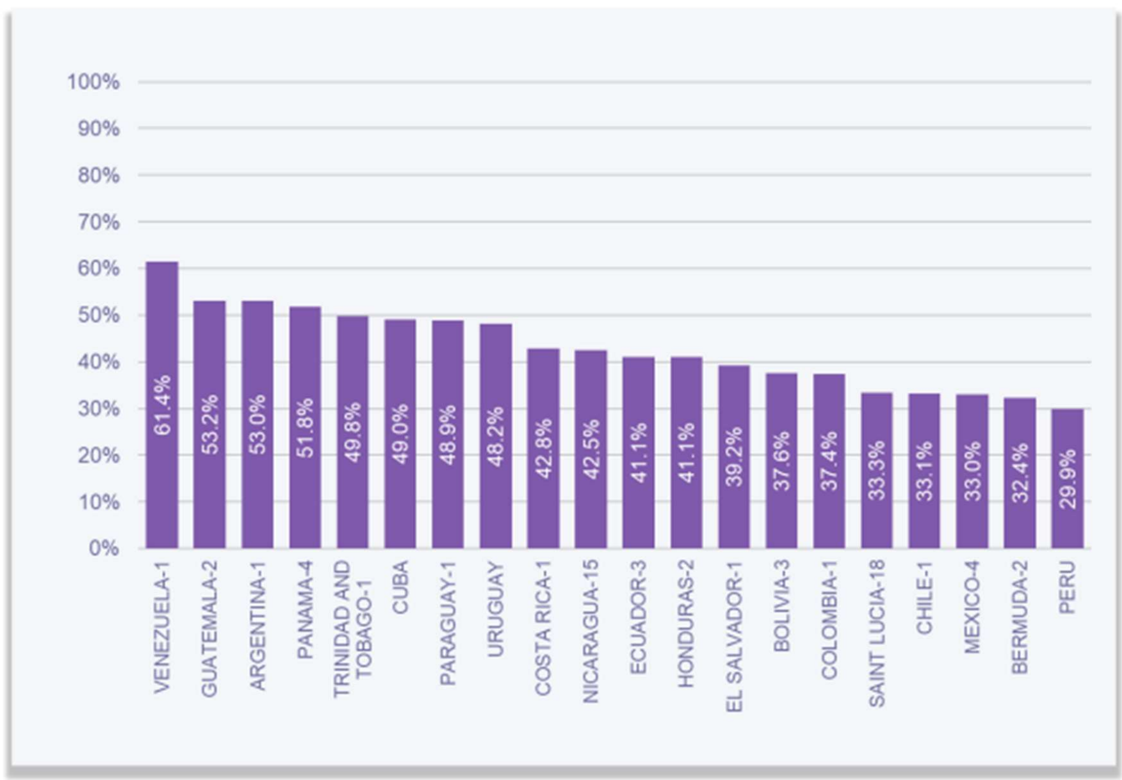


Source: own elaboration based on the UNESCO Institute for Statistics- UIS data (UIS, July 2019)

In addition, women make up a small percentage of researchers worldwide. The availability of national data and its application to the government are frequently still limited, despite the rising demand for internationally comparable information on women in science. The graphs below depict worldwide and regional profiles, highlighting areas where women are overrepresented and areas where they are underrepresented in this industry. Professionals working in the conception or creation of new information are known as researchers. Within the framework of R&D projects, they carry out research and enhance or develop concepts, theories, models, techniques, instrumentation, software, or operational methods.

The majority of data are presented as headcounts (HC), which represent the total number of people working in research and development. This covers both full-time and part-time employees. Based only on data that is currently available, the regional averages for the percentage of female researchers in 2016 are 48.2% for Central Asia 45.1% for Latin America and the Caribbean 39.3% for Central and Eastern Europe, 41.5% for Arab States, and 32.7% for Western Europe and North America Sub-Saharan Africa, 31.8% World: 29.3%; East Asia and the Pacific: 23.9%, South and West Asia: 18.5% Figures 2, and 3, 4 show the proportion of female researchers in the field. These numbers take into account both full-time and part-time researchers, according to headcount data.

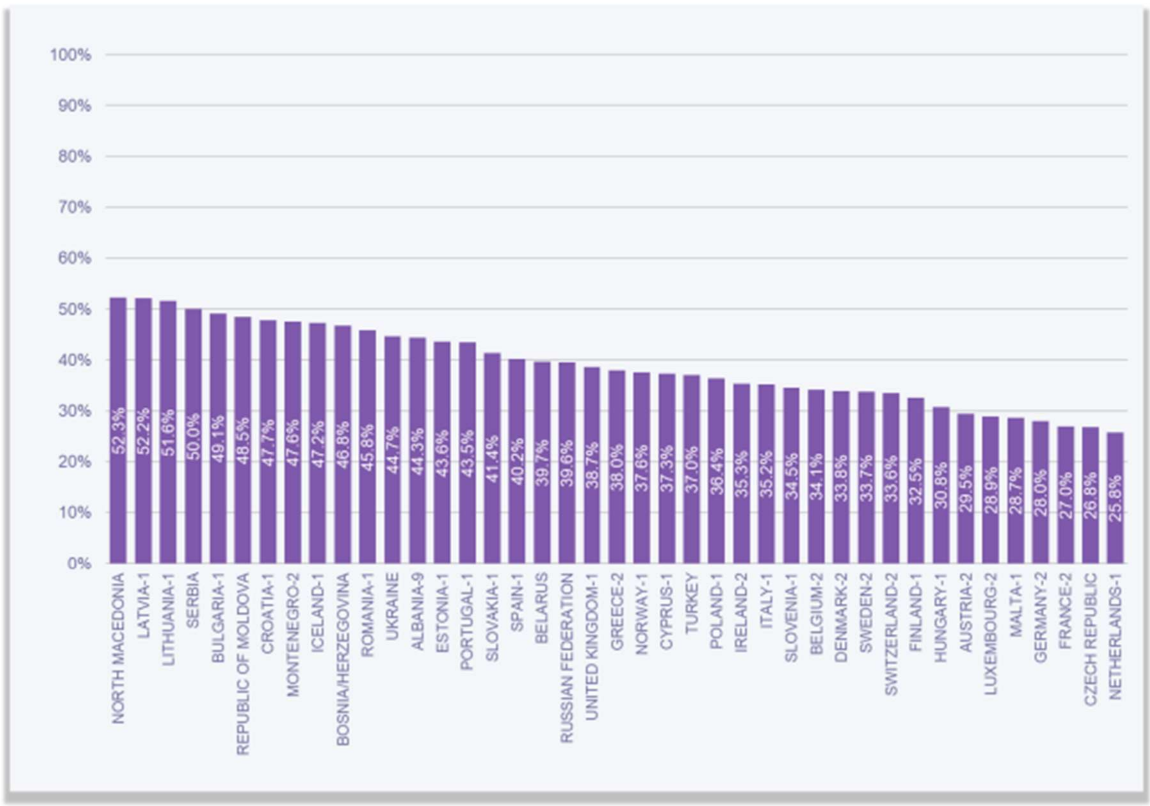
Figure 2. Participation of female researchers in the Americas
Female researchers as a percentage of total researchers (HC), 2017 or latest year available



Notes:-1=2016, -2 = 2015, -3 = 2014, -4 = 2013, -15 = 2002, -18 = 1999.
Source: UNESCO Institute for Statistics, June 2019.

Figure 3. Participation of female researchers in Europe

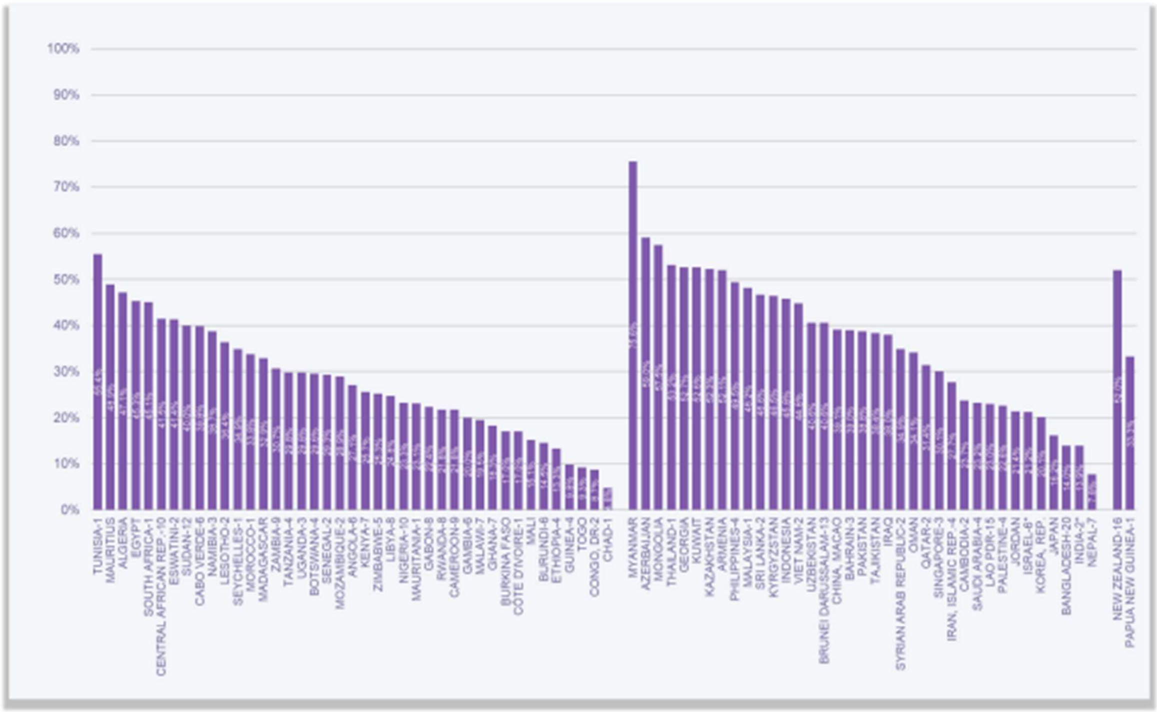
Female researchers as a percentage of total researchers (HC), 2017 or latest year available



Notes:-1 =2016, -2 = 2015, -9 = 2008.

Source: UNESCO Institute for Statistics, June 2019.

Figure 4. Participation of female researchers in Africa, Asia and the Pacific
Female researchers as a percentage of total researchers (HC), 2017 or latest year available



Notes:-1 = 2016, -2 = 2015, -3 = 2014, -4 = 2015, -5 = 2016, -6 = 2011, -7 = 2010, -8 = 2009, -9 = 2008, -12 = 2005, -13 = 2014, -14= 2003, -15= 2002, -16 = 2001, -20 = 1997.

* based on FTE data.
Source: UNESCO Institute for Statistics, June 2019.

Conclusion

No one factor contributes to the leaky pipeline of girls and women entering science research, hence there is no single panacea to the issue. Different social-psychological elements at different life stages may cause or amplify the leaky pipeline. All developmental phases share two themes. First, widespread cultural prejudices continuously depict men as ideal scientists, engineers, and technological inventors. Barriers to girls and women's participation in scientific research are created at every stage of life due to the mismatch between male science assumptions and expectations for feminine gender roles. Feelings of intellectual community belonging are a second motif that runs through all phases of life. Compared to surroundings that feel more restricted and homogeneous, learning environments and professional contexts that create belonging are much more likely to be effective in attracting, keeping, and promoting girls and women in science. Evidence-based initiatives, methods, and policies help keep girls and women interested in scientific research at every stage of their lives. Numerous initiatives aimed at all three stages of development promise to remove barriers based on gender and raise female participation, motivation, and aspirations in science fields.

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