



NASA and Women's Rights

*Collaboration report with the
Women in STEM and Women Rights
Team of GHRD*



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“A bird cannot fly with one wing only. Human space flight cannot develop any further without the active participation of women.” - Valentina Tereshkova

Introduction

Since its inception, science has remained one of the most male-dominated professions as it was typically seen as masculine, rational, impersonal, and rigorous – traits often contrasted with stereotypes of female nature. Despite having now moved away from such generalisations and misconceptions about gender, the fields of science, technology, engineering and mathematics (STEM) remain unequal in the distribution of men and women, as women continue to face barriers in entering STEM fields for a variety of reasons. Impediments to women's advancement in STEM include gender disparities in caregiving responsibilities; sexist hiring practices, including tests of physical strength and/or concerns about women's strength, safety on the job, or suitability for the role; a lack of female role models; and fears of sexual and/or other forms of harassment or discrimination. If more women were encouraged to be part of STEM-related teams and faculties, not only would the quality of work improve by including more perspectives, but women would also get greater career opportunities in a well-paid industry, which can reduce the gender pay gap (Maryville, 2023). Moreover, science benefits from a diversity of perspectives, be it gender, ethnicity, age, or other factors, as it means more diversity of thought, collaboration, creativity, and innovation. We cannot underestimate the issues that could arise when half our global population does not have a seat at the table where key decisions are made and ideas are proposed.

The United Nation's data from 2021 states that women are underrepresented as researchers in STEM fields in all regions with the global average being 28.8 percent and the number of women in the aerospace industry staying around 20 percent over the last 30 years (UN, 2021). Moreover, only 11 percent of astronauts have been women and women account for only 19 percent of CEOs and leaders in aerospace and defence (UN, 2021). This highlights that much still needs to be done in the fields of STEM to advance gender equality and increase female representation. No other space agency is quite as prominent as the National Aeronautics and Space Administration (NASA) in the US in championing space exploration. As such, it is the focus of this report to analyse women's rights within the space agency. Additionally, we include statements from Mrs. Sandra Cauffman, a Costa Rican electrical engineer and Deputy Director of the Astrophysics Division at NASA. Her 35 years of work experience at NASA help contextualise and corroborate the findings of our report.

Background of NASA and Its Gendered Discrimination

NASA was founded in 1958 in the midst of the Cold War, succeeding the National Advisory Committee for Aeronautics (NACA). The rivalry between the United States and the Soviet Union at the time meant that the US government had to project strength, prosperity, and stability, thereby creating a masculine, competitive environment for the space agency's beginning – something that would come to shape the organisation with lingering effects to this day. With the 1957 launch of the artificial satellite Sputnik by the Soviet Union, space became another arena for the superpowers to compete against each other. Astronauts were seen as soldiers in this effort, and women were kept away from the conflict, thereby excluding them from representing half of humanity in space. This early exclusion of women from NASA's space programme has led to a legacy of underrepresentation for women in policy, security, and exploration, continuing to this day as women remain a minority at the space agency. While the Soviet Union launched its first female astronaut Valentina Tereshkova into space in 1963, the US did not bother to match its counterpart in gender equality until much later with Sally Ride in 1983. Women were not considered as candidates for NASA astronauts until the 1970s. During the early 1960s, when NASA was training the male astronauts of Project Mercury, thirteen American women, often dubbed the Mercury 13 or the First Lady Astronaut Trainees, were also going through astronaut training. Unfortunately, they would never get the chance to fly in space as they were never made an official part of NASA.

However, focusing solely on women as astronauts glosses over the many women who have worked in the American space effort in integral positions behind the scenes, often as 'human computers' who performed highly complex mathematical calculations. Women, including many black women, were involved in spaceflight calculations done completely by hand. Even before NASA, brilliant women, such as Mary Jackson who later became NASA's first black female engineer, were making great contributions to the space effort in NACA. Nevertheless, women were excluded from the astronaut corps and other highly visible key positions for decades. With the advances of social changes in society, notably the Civil Rights Act of 1964 and the Equal Employment Opportunity Act of 1972, which prohibits discrimination on the basis of race, colour, religion, sex, or national origin and prohibits job discrimination for reasons of race, religion, colour, national origin, and sex respectively, the doors to NASA were opened to women as great efforts were made to increase its gender and racial diversity. Charlie Blackwell-Thompson, the first female launch director, said that the ratification of the 19th Amendment not only gave many American women the right to vote, but "it enabled the path that eventually all of us were able to walk down" (Howell, 2020).

Significant improvements have been made by NASA to promote women's rights and gender equality within its organisation, but there is still further to go. Julie Rathburn, an expert on jovian moons at the Planetary Science Institute in Claremont, California, found that women make up a mere 15 percent of planetary mission science teams, even though at least a quarter of planetary scientists are women, with the disparity being even worse for ethnic minorities (Voosen, 2017). Another survey conducted by the agency itself finds that although women make up about a third of NASA's workforce, they comprise just 28 percent of senior executive leadership positions and make up only 16 percent of senior scientific employees (NASA, 2018). As such, the remainder of this report examines NASA's engagement with women's rights and gender equality in the workplace.

Barriers Against Women in NASA

Discrimination in Education

Beneath NASA's remarkable achievements lies a narrative of resilience in the face of great barriers, woven from discrimination and biases, that have cast shadows on the potential of countless women. Women have had to overcome numerous obstacles in entering STEM fields and advancing in their careers, both academic and professional. Biases and stereotypes can shape educational experiences, influencing choices, confidence levels, and career aspirations from an early age (Stewart-Williams and Halsey, 2021). These educational challenges are compounded by those occurring in the workplace, as despite a great deal of change since 1962, women have not yet achieved full workplace equality. Traditional assumptions about women's roles in the workplace have not yet disappeared. Engineering and other technical fields are still highly male-dominated. Fewer women study and work in STEM because these fields have more male-dominated cultures that are not supportive of or attractive to women and other minorities.

Gender-based differences in occupational preferences and priorities are thought to be evident and are shaped by a complex interplay of influences (Stewart-Williams and Halsey, 2021). These differences are not formed in isolation, rather, they are significantly influenced by the surrounding environment and societal factors. Figures of authority such as adults, including parents, teachers, and others, may unintentionally influence sex differences in occupational preferences and priorities. Historically, not enough support and encouragement has been given to girls to pursue STEM fields due to the belief that girls were not as good in these subjects. Educators and parents often underestimate a girl's abilities in maths and sciences, starting as early as preschool. Young girls then internalise the negative messages in their surroundings, disregarding their abilities and unconsciously stopping themselves from reaching their full potential. These negative stereotypes about girls and women form the basis of their self-assessments, driving women away from STEM, regardless of their actual capabilities. For example, in our interview conducted with Sandra Cauffman, she told us of her desire to study and obtain a degree in electrical engineering but was turned away by the university because of her gender (GHRTV, 2023). Additionally, once in her study programme, the professor did not believe she or her other female classmates would complete the degree, who were later top of their class. Additionally, young girls are not exposed enough to STEM to inspire their technical confidence and interest in these subject matters. Thus, many girls are unaware of the opportunities available to them.

Apart from parental influences, it is also believed that children tend to steer themselves based on what they perceive as favoured by their gender peers, which can affect their interest in activities, even unfamiliar ones. Similarly, prevailing stereotypes about STEM careers being male-dominated and isolating may deter girls. Hence, bias in STEM environments, or the anticipation of bias, might diminish both interest in STEM careers and engagement in STEM subjects among girls and women. (Stewart-Williams and Halsey, 2021). This is where the importance of role models in the field of STEM is seen, as young girls need examples of women in STEM to see themselves in that space. For all ages, role models are essential to countering biases and stereotypes.

There are other potential instances of bias, both within STEM fields and the broader academic context. For instance, research by Dworkin et al. (2020) reveals that neuroscience papers authored by males as both the first and last authors tend to receive higher citation rates compared to those with authors of different sexes or with both female authors. Moreover, instances of sexism and harassment faced by women in STEM, whether at work, in field settings, or during conferences, can foster a desire to exit

both academia and STEM fields altogether, as noted in studies by Biggs et al. (2018). The concept of a 'leaking pipeline' symbolises how individuals, especially women, may gradually disengage from education and career paths due to influences such as stereotypes, biases, lack of support, isolation and cultural norms (Liu, et al 2019). This theory emphasises the importance of addressing these challenges at each stage, from early education to the workforce, to ensure a more equitable representation of underrepresented groups in fields like STEM (Liu, et al 2019). Hence, the period prior to students selecting diverse academic paths, in secondary education and beyond, is a pivotal juncture for addressing the gender disparity issue in girls' participation within these fields (González-Pérez et al., 2020).

Stereotypes about women's perceived capabilities in technical and scientific fields persist, contributing to a hostile work environment and limiting career progression. An effective method of breaking down stereotype barriers involves the presence of female role models. These role models play a pivotal role in enhancing a sense of inclusion within STEM and emphasising the importance of diligent effort above gender as the key to achievement in STEM fields. Observing successful women in STEM inspires self-belief and passion, as role models offer guidance, motivation and a relatable path through the male-dominated STEM field (González-Pérez et al., 2020).

Social factors including family, school, peers, and media also shape girls' perceptions of success, self-concept, and subject preferences. Influential encouragement from these sources impacts adolescents' decisions to pursue STEM fields, particularly in mathematics and technology. As families provide early guidance, schools offer structured environments, peers contribute to social norms, and media shapes cultural narratives, these cumulative forces intertwine to shape girls' attitudes and preferences. By harnessing these social dynamics to foster a supportive and empowering atmosphere, we can elevate the prospects for girls to embrace STEM pathways and contribute to a more balanced and innovative society (González-Pérez et al., 2020). To achieve this, institutional support and initiatives that promote the visibility of women in STEM as role models are essential. By celebrating and sharing their stories, we can create a more inclusive and empowering environment for current and future generations of women pursuing careers in science, technology, engineering, and mathematics.

Since the 1980s, there has been a focus on promoting gender equality and diversity within NASA and other organisations. During this period, NASA recognised the importance of encouraging and supporting women in pursuing careers in technical and supervisory roles. Training and educational programs were introduced, aiming at assisting women in transitioning from traditional roles to higher-ranking positions.

The Equal Employment Opportunity (EEO) laws required NASA, like other federal agencies, to ensure equal opportunities for all employees, regardless of gender or other protected characteristics. Additionally, NASA implemented Affirmative Action plans to actively recruit and promote underrepresented groups, including women, to create a more diverse and inclusive team. These initiatives facilitated transitions from traditional roles to technical positions, fostering skill development, professional growth, and empowerment. By embracing diversity, NASA not only tackled gender disparities but also enriched its space exploration efforts through innovation and excellence (Smith, 2022).

Ultimately, culture lies behind all the reasons for the lack of women in education. Women still face subtle discrimination in STEM education, which impacts the number of female graduates in STEM. Slowly, this is changing, as evident in NASA's increase in female hires. However, there is still further to go. More space and visibility must be created for women in STEM so that women see the opportunities available to them.

Lack of Opportunities and Corporate Discrimination

Gender-based discrimination in the workplace takes on multiple insidious forms, with overt and indirect discrimination being prominent examples. Overt discrimination is openly discriminatory practices by employers, explicitly denying women opportunities for training, hiring, or promotions based on the perception that they may not be as committed or capable as men in the long term. This form of discrimination reinforces gender stereotypes and bars women from advancing professionally, perpetuating inequality (Kessler-Harris, 2001). Indirect discrimination, on the other hand, operates more subtly through the consequences of societal norms and systemic biases. It encompasses phenomena like educational discrimination, where women have historically been discouraged or dissuaded from pursuing certain fields or positions, often as a result of deeply ingrained gender roles and expectations. Such discouragement reinforces a gender-skewed distribution of roles, limiting women's access to certain types of work and perpetuating a cycle of gender-based disparities (Kessler-Harris, 2001). According to Novakovic and Gnika (2015), some avoid certain careers out of fear of not being able to overcome barriers that may exist.

Research indicates that women are often underrepresented in key roles at NASA. A study conducted by the Government Accountability Office (GAO) in 2019 found that although the percentage of women in NASA has increased over the years, they are still underrepresented in leadership positions and technical roles. Women accounted for just 28 percent of senior executive positions and 33 percent of scientists and engineers, revealing a significant gap in representation at the highest levels of the organisation (GAO Report, 2019). Women can enter the STEM fields but are more likely to be in entry-level positions (Zhao, 2018). There are still glass ceilings and barriers to non-engineers in place that prevent some women from achieving career advancement. The lack of opportunities for women can be attributed to various factors, including biases in hiring and promotion practices, limited mentorship and sponsorship programs for women, and a lack of flexibility in work arrangements that disproportionately affect women with caregiving responsibilities. Addressing these barriers is essential to ensure women have equal access to opportunities for career growth and development within NASA.

Instances of gender-based discrimination can manifest in various forms, such as pay inequity, biased performance evaluations, exclusion from decision-making processes, and a hostile work environment. Studies have shown that women in NASA, like in many other fields, often encounter subtle and overt forms of discrimination that hinder their professional advancement (National Women's Law Center, 2020). NASA has taken steps to address these issues by implementing diversity and inclusion initiatives, but more needs to be done to create a truly equitable environment for women. Establishing clear reporting mechanisms for discrimination, providing training to raise awareness about unconscious bias, and promoting a culture of inclusion are crucial steps to combat corporate discrimination within NASA.

Gender stereotypes and bias persist in NASA and STEM fields, hindering women's progress. A study conducted by Moss-Racusin et al. (2012) found that both male and female faculty members in STEM disciplines rated male applicants as more competent and hireable than equally qualified female applicants, highlighting the presence of bias in hiring practices. These biases can limit the opportunities available to women and hinder their career advancement in NASA and other STEM-related industries.

The work environment and culture within NASA and STEM fields can also contribute to gender disparities. A study conducted by Valian (1999) suggests that women face subtle barriers, such as isolation, exclusion, and limited access to networks, which can impede their progress in male-dominated

environments. Often, women have to endure harassment or the degradation of being confused for secretarial staff, as was also the case for Sandra Cauffman (GHRTV, 2023). These barriers create an unwelcoming atmosphere and hinder the retention and advancement of women in these fields.

The absence of strong mentorship and adequate representation of women in leadership roles further exacerbates the challenges faced by women in NASA and STEM. A study by Stout et al. (2011) indicates that women who have access to mentors and role models are more likely to persist in STEM fields. Without proper guidance and support, women may struggle to navigate the obstacles and advance their careers within NASA and STEM industries. Sandra Cauffman also recognises the importance of increasing the pipeline for women and mentorship by showing young girls that there is a path and career for them in these fields (GHRTV, 2023). She believes that older generations can plant the seeds of a more positive and equal future by making the younger generations aware of the opportunities and possibilities ahead of them.

Efforts have been made to address the lack of opportunities and corporate discrimination against women in NASA and STEM. For instance, NASA has implemented programs like the NASA Women in STEM High School (WISH) project and the NASA GIRLS (Giving Initiative and Relevance to Learning Science) programme to engage and inspire young women to pursue STEM careers (NASA, n.d. b). Additionally, various organisations, including Women in Aerospace (WIA) and the Society of Women Engineers (SWE), work towards creating a more inclusive environment for women in these fields.

While progress has been made in addressing the lack of opportunities and corporate discrimination against women in NASA and STEM, substantial challenges persist. Gender disparities, stereotypes, biases, work environment issues, and the absence of mentorship and role models contribute to the underrepresentation of women. It is essential to continue supporting initiatives aimed at creating a more inclusive environment, fostering mentorship opportunities, and challenging biases to ensure equal opportunities and advancement for women in NASA and STEM.

Right to Equal Opportunity Still Debated

A key component of equality is the right to equal opportunity, meaning that everyone is treated equally and given the same opportunities regardless of their age, sex, race, disability, sexual orientation, disability, culture or any other personal characteristic that might be discriminated against. Needless to say, equal opportunity in a male-dominated environment such as NASA remains difficult for women who are often overlooked and passed over for advancement based on lingering outdated notions of gender. The Mercury 13 proved that women could pass the same rigorous training and tests as male astronaut candidates, at times even surpassing male performances. However, the perception of an astronaut as characteristically male has been deeply embedded in society to the point that even with significantly more data and research in the modern day proving the inaccuracy of gender stereotypes, women's ability as astronauts are still debated and contested. There remains differential treatment based on sex in spaceflight duration and how it affects the two sexes, as spaceflight is deemed more dangerous for women. This, of course, has implications for women's right to equal opportunity.

In the past, NASA has employed protectionist measures regarding the likelihood that female astronauts could develop radiation-based cancers due to long-term spaceflight, restricting the amount of time female astronauts spend in space (Healey 2018). Patriarchal and protectionist ideas still deem women as weak and less capable than men – masked as well intending. With the prospect of sending an astronaut to Mars, the debate of female participation in spaceflight is once again being brought up due to the long flight time and its impact on the female body. Without a doubt, the concerns over female health are valid and necessary in dangerous space missions; however, the decision must remain with the women who choose to dedicate their lives to becoming astronauts and representing humanity. The opportunity should not and cannot be taken away from them. This would risk limiting women's participation, not only in their jobs at NASA, but also in a more diverse exploration of space and our universe, failing to include non-male perspectives – an enduring problem at NASA since its inception.

Gendered Language in NASA

Much of the issues faced by women, not just those working at NASA, stem from outdated stereotypes and ideas of gender, often depicting women as inferior. Language remains a factor contributing to gender discrimination and polarisation. By now it is evident that an astronaut has typically been framed as a male profession. In its early years, NASA was complicit in gender binary polarisation as a propaganda tool in the Cold War, making a show of the American astronaut heroes and their doting housewives and by extension their perfect households and American values. Entire magazine and newspaper spreads depicted the courageous male astronaut and their beautiful, loving wives. Since then, much has fortunately changed. NASA's style guide was updated to include a section urging that "all references to the space program should be non-gender specific" (NASA, n.d. a). This would mean the use of words and phrases such as human, piloted, unpiloted or robotic instead of manned or unmanned. Moreover, by expanding the definition of 'astronaut' to include all crew members on the space shuttle and not just the pilot, NASA eliminated the jet testpilot requirement that had kept women out of space a decade earlier, thereby creating more space for women in the agency.

Within the field of gender organisation theory, American sociologist Joan Acker (1990) coined gendered organisations as the "advantage and disadvantage, exploitation and control, action and emotion, meaning and identity of men and women" within organisational spaces (p. 146). We can then interpret certain organisations as sites that (re)produce gender dynamics and the gender order. By not improving the situation of women and their equality, NASA, like many other organisations, can be considered a

gendered institution. Until women stand on equal footing with their male peers, be it as senior-level staff or astronauts with the same capabilities, the ideas and perceptions of women as lesser persist, reinforcing outdated norms regarding women and gender. Now, in the 21st century, it is time we move on from such gendered institutions and make space for all genders at all levels of all industries.

Recommendations and Conclusion

Early education plays a crucial role in shaping children's perceptions and interests. Efforts should be made to address gender biases in learning materials, ensuring that educational resources promote gender equality and encourage girls' participation in STEM subjects. Highlighting the accomplishments and contributions of women scientists, engineers, and astronauts can inspire young girls and challenge gender stereotypes. Including more women role models in curricula, textbooks, and media is also crucial in breaking down barriers and encouraging girls to pursue STEM fields.

Achieving gender equality also requires addressing the gender pay gap. Organisations, including NASA, should ensure that women receive equal pay for equal work. Transparent salary structures, policies promoting pay equity, and regular pay audits can help identify and rectify any gender pay disparities. Additionally, the 'Matilda Effect' refers to the systematic undervaluation and underrepresentation of women's contributions to scientific research. Recognising and acknowledging the achievements of women researchers is crucial. Institutions, funding agencies, and scientific journals should actively work to prevent bias and ensure equitable recognition and visibility for women in STEM. In the digital age, it is important to consider the gendered impacts of technology and design policies that promote inclusivity. This includes addressing online harassment and creating safe and inclusive digital spaces that encourage women's participation in STEM fields.

To conclude, in spite of the remarkable advancements of women in NASA, female employees have still not achieved equality and as always, there is further progress to be made. Beckwith et al. (2016) argued that gender inequality stems from the fact that organisations were created by men, for men. Now it is time to make sure that our organisations are made for all people.

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