

Online submission

17 April 2023



Australian Academy of Science submission on the *Diversity in STEM Review*

The Australian Academy of Science (the Academy) welcomes the opportunity to comment on the *Diversity in STEM Review*.

The Academy recommends that the Review:

- Implement the recommendations of the Women in STEM Decadal Plan, including research into barriers and solutions for underrepresented groups.
- Draws from myriad practical examples of actions to achieve gender diversity contained within the Women in STEM Decadal Plan and the submissions of the Decadal Plan champions.
- Explore how the concept of 'science capital' could translate to or be enacted in Australia's education context, as an influential measure for students' attraction to and aspirations for STEM subjects and careers.
- Build an appropriate and nuanced understanding of the intersection of STEM and First Nations knowledge systems.
- Embed evaluation as an essential element of all government STEM diversity and inclusion initiatives.

We need all the available STEM talent if we are to address the scientific challenges of our time. Australia needs to draw on the talents, creativity, and skills of all our people to create a diverse, flexible, and skilled workforce.

To date, our policy focus has been limited to initiatives to encourage the participation of women in STEM. There is a significant opportunity and imperative to broaden this focus to 'diversity in STEM', and to define and implement measures to enable participation of other underrepresented groups.

Barriers to women's participation in STEM and effective solutions are known. The [Women in STEM Decadal Plan](#), led by the Academy in partnership with the Australian Academy of Technology and Engineering, involved extensive national consultation and provides strategic opportunities and actions to achieve gender equity in STEM by 2030.

Many actors across the STEM ecosystem have used the Decadal Plan to guide their actions. For example, the Women in STEM Ambassador has developed evaluation guidelines and tools to enable evaluation of all gender equity measures so that we know and continue to invest in what works.

The Academy strongly recommends that the Review build on the Decadal Plan and its recommendations to take a whole-of-STEM ecosystem approach. The Decadal Plan (appendices 3 and 4) also contains practical solutions collated from national consultations and from research practice.

The Academy continues to steward the Women in STEM Decadal Plan by hosting a growing network of 44 Decadal Plan Champion organisations. The Decadal Plan Champions have publicly aligned their gender equity activities with the six opportunities outlined in the Women in STEM Decadal Plan. This emergent network of leading STEM organisations spans all parts of the ecosystem, including academia and research, industry, small to medium enterprises, institutions and the public sector. Details of the practical actions the Decadal Plan Champions have taken to address gender equity are available [here](#).

Representation of women in some fields of STEM has slowly improved, but females are still significantly [underrepresented](#) in particular fields such as mathematics and physics (Figures 1 and 2). Representation of women declines as careers progress through to higher-level positions in both the STEM research sector and STEM organisations.

To make progress, Australia needs a strong focus on addressing systemic and cultural issues which impact career progression for underrepresented groups, such as structures of recruitment, academic promotion and research funding models, toxic organisational cultures, harassment, gendered expectations of caregiving responsibilities and physical accessibility in the workplace.

Gender by two-digit Fields of Research, ordered by disciplines with more female than male researchers

Women are still significantly underrepresented in particular fields such as mathematics and physics. Representation of women declines as careers progress through to higher-level positions in both the STEM research sector and STEM organisations

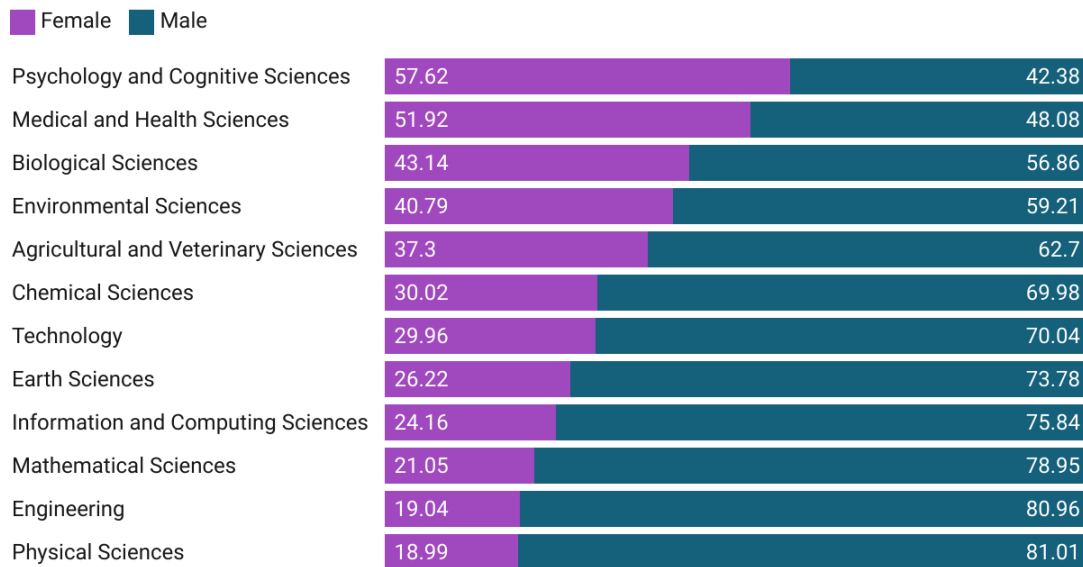


Figure 1. Source: Gender and the Research Workforce. Excellence in Research for Australia (ERA) 2018, <https://www.arc.gov.au/excellence-research-australia/era-reports>

Percentage of female researchers by STEM two-digit FoR codes in ERA 2015 and ERA 2018

ARC ERA data shows that for most fields of research in STEM, the percentage of female active researchers increased, oft times slowly, between 2015 and 2018.

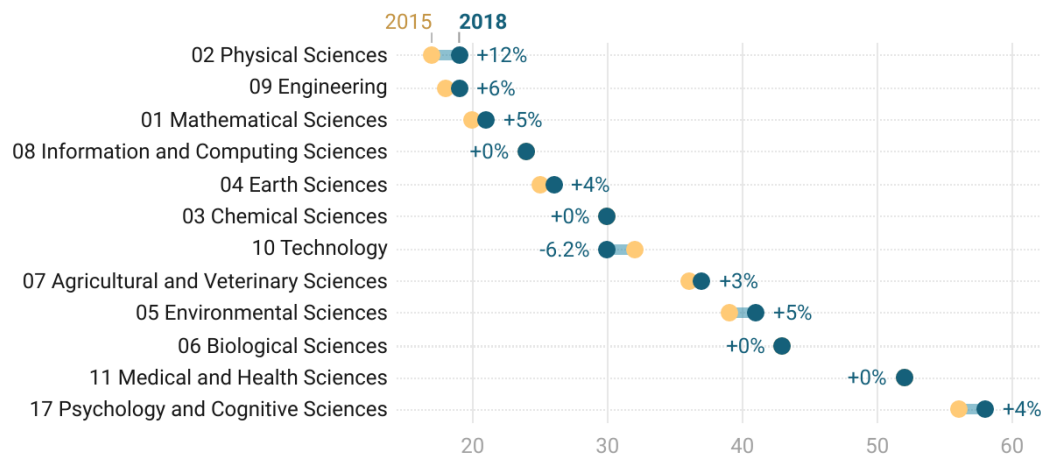


Chart: Australian Academy of Science • Source: Australian Research Council • Created with Datawrapper

Figure 2. Source: Gender and the Research Workforce. Excellence in Research for Australia (ERA) 2018, <https://www.arc.gov.au/excellence-research-australia/era-reports>

A program that is helping higher education and research organisations to achieve sustained, data-informed cultural change is [Science in Australia Gender Equity](#) (SAGE). To achieve recognition as organisations genuinely committed to gender diversity, SAGE subscribers must demonstrate real achievement in the education and research sector on key metrics for gender equity, such as the proportion of women in key leadership positions and policies and actions taken on gender equality.

The barriers faced by other underrepresented groups in STEM are less well understood. Stereotypes, discrimination and lack of diversity and representation in senior leadership are some of the barriers faced by underrepresented groups, such as culturally and linguistically diverse (CALD), Indigenous, and LGBTQIA+ women, transgender and gender diverse people.

Intersectionality

A comprehensive approach to diversity in STEM should recognise intersectionality as a foundation.

Intersectionality recognises that a person may face multiple, intersecting barriers to inclusion. Exclusion or disadvantage may come about because an individual, for example, may face not only gender barriers but that of ethnicity, disability, sexuality or mental health or other diversity dimensions. It recognises that the barriers to inclusion are interconnected, sometimes not visible and may affect a person in different ways. Awareness of intersectionality in women's participation and progression in STEM is growing but nascent.

There is an opportunity for intersectionality to be used as a way to understand and articulate the multiple barriers to a more diverse STEM workforce. Doing so will enhance our ability to recognise and address complex, intersectional barriers to diversity at an individual, organisational and systemic level. There is an opportunity to stimulate the limited research in this area to better understand the barriers faced by underrepresented groups other than women, potential solutions, and how intersectionality impacts participation in STEM. The Academy strongly recommends that the existing evidence regarding intersectionality in STEM is analysed and research gaps are identified and filled. This knowledge is essential to support informed actions to improve inclusion and diversity in STEM in Australia.

STEM education and scientific identity

Student's participation in STEM is affected by years of lived experiences and influences across schooling, community and family. Performance metrics, such as PISA scores, do not adequately capture how interested or engaged people are in science or how likely they are to participate in a STEM career.

The Academy proposes that we aspire towards building, instead, **science capital**. '*Science capital*' is a holistic measure of a person's attitudes towards science, identification with science, understanding, behaviours and social contacts, which shapes the extent to which someone perceives science as being 'for them'. Science capital is a measure of [scientific identity](#), a key factor shaping engagement and participation in science, particularly when working towards more equitable science cultures and practices.

Science capital influences students' sustained engagement in STEM, science aspirations and progression. Science capital has been researched in the UK through projects such as [Enterprising Science](#), but is underexplored in Australia. There is an opportunity to consider how the concept of science capital could translate to or be enacted in Australia's education context as an influential measure for students' attraction to and aspirations for STEM subjects and careers.

Teachers play a significant role in determining students' attitudes, beliefs and confidence in STEM. The Academy has previously [commented](#) that STEM teachers should be qualified in STEM, both in terms of content knowledge and pedagogical skills, and should have access to fit-for-purpose professional learning and development across the course of their careers. Improving access for students who need additional support in STEM education is also important to enhance diversity and inclusion in STEM education.

The COVID-19 pandemic had a serious impact on access and equity in education, with students from low socioeconomic backgrounds, those with English as a second language, special learning needs or in rural and remote areas particularly at risk of poorer learning outcomes. The ongoing impacts on participation in STEM should be considered and addressed.

Evaluation

The Academy welcomes the independent evaluation of the Government's women in STEM programs as part of this Review. Evaluation is critical to continue to build our understanding of effective initiatives and best practice to improve diversity in STEM and enable efficient allocation of resources.

The Academy urges that every government diversity initiative have rigorous evaluation built-in as part of the program design. The evaluation guide developed by Australia's Women in STEM Ambassador and the Department of Industry, Science and Resources STEM Equity Monitor are valuable tools to support evaluation of gender equity programs and monitoring of diversity in STEM.

First Nations peoples in science

The Academy is committed to **deepening the intersections between contemporary science and research methods and traditional knowledges.**

The participation of First Nations peoples in STEM and recognising Traditional knowledge systems is important. However, the term 'Indigenous science' is often used loosely. The Review has an opportunity to lead by demonstrating an understanding of the complexity of these issues, which, though often bundled together, are distinct.

In this context, the broad phrase 'Indigenous science' can refer to:

- a) Building the capability of Indigenous peoples – either to enter science as individuals, to work with scientists on country, or to preserve Traditional Knowledge, or
- b) Science and research done with the participation of and co-design with Indigenous peoples or addressing Indigenous people's needs, or
- c) Science and research that benefits from the insights from Traditional Knowledges (such as science on the environment, biodiversity and sustainability).

Aboriginal and Torres Strait Islander peoples are under-represented in STEM, particularly at the university level, where 0.5% of the Aboriginal and Torres Strait Islander population had a STEM qualification, compared to 5% of the non-Indigenous population. This level of underrepresentation is common in all broad fields of study.

Indigenous participation in STEM should not be siloed into an individual priority or initiative but should be an integral part of diversity efforts.

The Diversity in STEM Review can build on the work done by [IP Australia](#); the example of the methodology adopted to produce the [2021 State of the Environment Report](#); and work should adhere to the [UNESCO Indigenous Declaration](#), [UN Declaration on the Rights of Indigenous Peoples](#) and the [AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research](#).

To discuss or clarify any aspect of this submission, please contact Mr Chris Anderson, Director Science Policy at Chris.Anderson@science.org.au.

Other Academy diversity in STEM initiatives

STEM Women

The [STEM Women](#) platform was developed to make women across STEM more visible and to facilitate career-enabling opportunities. It was a direct response to the findings in the Decadal Plan for Women in STEM. Since its inception, 3,669 women in STEM across 1,263 organisations and 4,133 disciplines in Australia have created profiles on *STEM Women* and many have since been engaged in various opportunities to progress their careers such as award nominations, conference invitations, speaking opportunities, committee and board appointments, media opportunities, and school visits.

In 2021 *STEM Women* was expanded to [STEM Women Asia](#) and in 2022 to [STEM Women Global](#), both hosted by the Academy. Any person who identifies as a woman anywhere in the world can register to connect to career enhancing opportunities.