



BREAKING THE BARRIERS

Women's retention
and progression in the
chemical sciences



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For further information, please email diversity@rsc.org

Foreword

Talented, hard-working people should not be made to feel that they cannot progress in their field.

There is no acceptable reason to stop someone achieving their potential. Yet it is evident from our research in the community that barriers exist when it comes to progression and retention in the chemistry profession. Our recent report, *Diversity Landscape of the Chemical Sciences*, highlighted that while this is the unfortunate truth for more than one group, it is a particular challenge for women working in academia.

Gender balance is not a target in and of itself but an outcome of an equitable system. As our survey respondents say, the academic system should be focused on retaining the best talent, 'regardless of gender or any other protected characteristic.'

I am encouraged by the strength of feeling in the community on this issue, demonstrated by the level of engagement and number of in-depth answers we received in response to this study. The reports, evidence, ideas and recommendations you shared with us capture different perspectives and a wide range of circumstances, but all have the same underlying message.

There is plenty of evidence, and not enough action.

We must acknowledge and applaud the progress made so far. But there is so much more that must be done to break the barriers down for good – and to make a genuine difference, we must all act now.

We are ready to take the lead on driving this change – and indeed, we are already putting our plans into action. But we cannot make the impact required alone. Bringing down the barriers will require everyone to work together.

We can all do something to ensure that every person in the chemical science community has the same opportunity to use their talent and make a difference for the benefit of all.

Let's make sure that chemistry really is for everyone.



Robert Parker

Chief Executive, Royal Society of Chemistry

2 Executive summary

In early 2018, our *Diversity Landscape of the Chemical Sciences* report showed a worrying lack of progress in developing and retaining women in leadership positions in the chemical sciences.

The report provided evidence that just 9% of chemistry professors in the UK are women. This means that between undergraduate study and reaching senior positions in academia, the relative proportion of female chemists drops by 35 percentage points.

Talented women interested in an academic career are leaving the sector before reaching their full potential.

Excellent female scientists who stay in academia are not progressing to senior grades in the same proportion as their male peers.

Continuing at the current rate of change, we will never reach gender parity.¹

Our new study identifies three key barriers to women's progression in the chemical sciences:

Academic funding structures: current short-term funding and contracting structures, combined with current definitions of scientific excellence and success, are creating uncertainty and unnecessary amounts of pressure.

Academic culture: inconsistencies in the quality and accountability of management, poor sponsorship and recognition opportunities for women, lack of transparency in recruitment and promotion processes, unequal allocation of workloads, overloading female chemists with academic citizenship activities, and reported cases of bullying and harassment are driving talented people elsewhere.

Balancing responsibilities: practical barriers that have impacts at different stages in chemists' careers, a lack of opportunity for part-time and flexible working, plus a lack of understanding and respect for caring responsibilities are forcing individuals to choose between a career and other demands on their time.

These challenges are not specific to one gender. However, it is clear that they disproportionately affect women.

At a national level, progress in increasing diversity in the chemical sciences remains extremely slow.

The vast majority (99%) of our survey respondents acknowledge the seriousness of the issues raised in this report, and their comments give the entire community a mandate for action.

Cultural change is needed, and the time to act is now.

As the UK's professional body for chemical scientists, we will use our position, influence and connections to:

- ▶ take the lead
- ▶ push for accountability
- ▶ develop best practice

We have a five point action plan:

- 1** To launch a bullying and harassment helpline by summer 2019
- 2** To launch grants for carers in early 2019
- 3** To launch annual recognition for chemistry departments that demonstrate significant progress in inclusion and diversity
- 4** To facilitate an exchange of best practice between peers
- 5** To launch a gender equality forum to accelerate culture change

Significant change does not happen when one group acts in isolation. It is essential that every part of our community – academic funders, academic employers, societies, and you as individuals – works together to drive momentum and promote further change.

These are complex issues, and change is going to take time. But change has to start somewhere, and the more we do now, the better.

3 Introduction

“Excluding or diminishing any section of society weakens science.”

It is clear from the evidence that a continued challenge for gender equality exists, particularly in retaining and developing women into positions of leadership within the chemical sciences. Change is happening, but nowhere near fast enough. Continuing at the current rate of change, a simple statistical analysis of the data tells us that we will never reach gender parity.¹

We designed this study to look into the reasons why the retention and progression of women is low, with three overall objectives:

- 1 To improve our understanding of the barriers to retention and progression of women in academic roles
- 2 To identify actionable solutions to enable women to meet their full potential in these roles
- 3 To begin to investigate issues of retention and progression of women outside academia

The focus on academia came about because of the data gathered as part of our report, *Diversity Landscape of the Chemical Sciences*, and because:

- ▼ the problem is particularly acute in STEM
- ▼ our issue of women's retention and progression is particularly pronounced in comparison with other scientific disciplines, and
- ▼ there is clear potential for us to have an impact at scale in this area.

Through a major survey, interviews and focus groups, we gathered data from more than 1,800 people across the community, giving us new insights into the barriers facing women in the chemical sciences.

Building a clearer picture

The research took place at the same time as other relevant reviews and activity in the sector, including:

- ▼ The 2018 Athena SWAN Review²
- ▼ Royal Society of Edinburgh's 2018 review of 'Tapping all our Talents'³
- ▼ The UK Research and Innovation (UKRI) 'strategy and action plan' on diversity, expected in spring 2019⁴ and its call for experts on diversity and inclusion to feed into this.

The benefit of addressing retention and progression of women is clear to the community itself. More diverse teams will produce better science and will deliver economic benefits through increased productivity.⁵⁻¹⁰

Increased diversity in leadership will ensure talented scientists learn with and from role models to which they can relate. This contributes to making UK Higher Education science institutions (HEIs) desirable places to learn and work, in a competitive global research environment.

Addressing systemic changes discussed in this report will have impacts beyond the chemical sciences. Improving employment practices in academia will help UK HEIs to create working environments that meet the needs and expectations of a new generation of researchers, across disciplines. Parity of parental leave will create potential for societal change, with benefits for overall productivity, wellbeing and more cohesive communities.

Chemistry should be for everyone. Acting now will help to make this a reality.



"I don't think there are any role models I know who have managed to balance an academic career and a family and a life."

Focus group

Female, PhD, UK

4 Methodology

We designed our approach to encourage open and honest conversation. The interviews and survey were open to all respondents. Focus groups comprised female chemists at different stages of their careers.



Focus groups

PhD students
Early career researchers
Senior academics
Academic leavers



Telephone interviews

Senior academic and industry contacts
Policy & diversity specialists
Representatives from funding bodies



Online survey

Open to all, including non-chemists
1,787 responses
A high level of interest

People are eager to talk

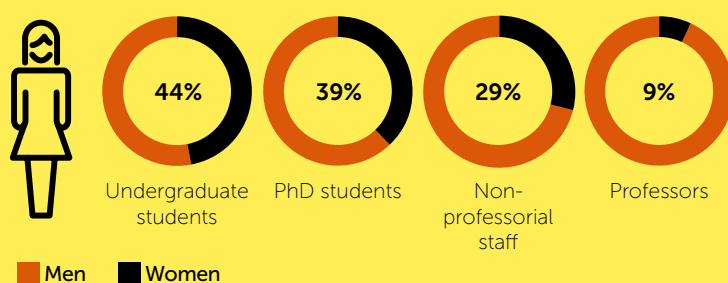
In the survey particularly, large numbers of respondents (in some instances as many as 600) provided detailed insights on individual open-ended questions.

The number of responses, and the level of detail in them, show that there is a clear desire in the community to discuss and urgently act upon the issues explored in this report.

5 Retention and progression in UK academic institutions: how things stand

The leaky pipeline

Retention of, and development of, women into senior roles in the chemical sciences remains exceptionally poor. The term leaky pipeline describes the way that the proportion of women falls as chemists advance through key academic career stages.



Those who responded to this report called this current rate of progression, and the factors that contribute to it as 'shameful' and 'offensive'.

A noticeable imbalance

The current imbalance of men and women in senior roles in chemistry is evident to chemists at all levels.

Importantly, we also found evidence of inequality of opportunity, and reports of bullying, discrimination and harassment in UK chemistry departments.



"In chemistry, no matter where you go, it seems male dominated as you go up the chain."

Focus group
Female, PhD, UK



"It is interesting that, as a black faculty member, it was not until I was in academia that I was minded that I'm female and I'm black... It is a constant fight."

Stakeholder interviewee
Female, senior academic, UK

99%

**of female chemists in UK
academia can evidence
the lack of retention and
progression of women**

Wide-reaching implications

The imbalance of men and women in leadership roles is not exclusive to academia, to the chemical sciences as a whole, or to UK chemistry. But, for those working in a sector that celebrates scientific discovery and innovation, the rate of progress is 'frustratingly' and 'inexcusably' slow.



"With me the situation is more complex because it is not just being a female, but also being an Asian female, and an Asian female who speaks English as her third language, so all of this compounds."

Focus group

Female, early career researcher, UK

A constant fight

Frustratingly slow

Little support

Exceptionally poor

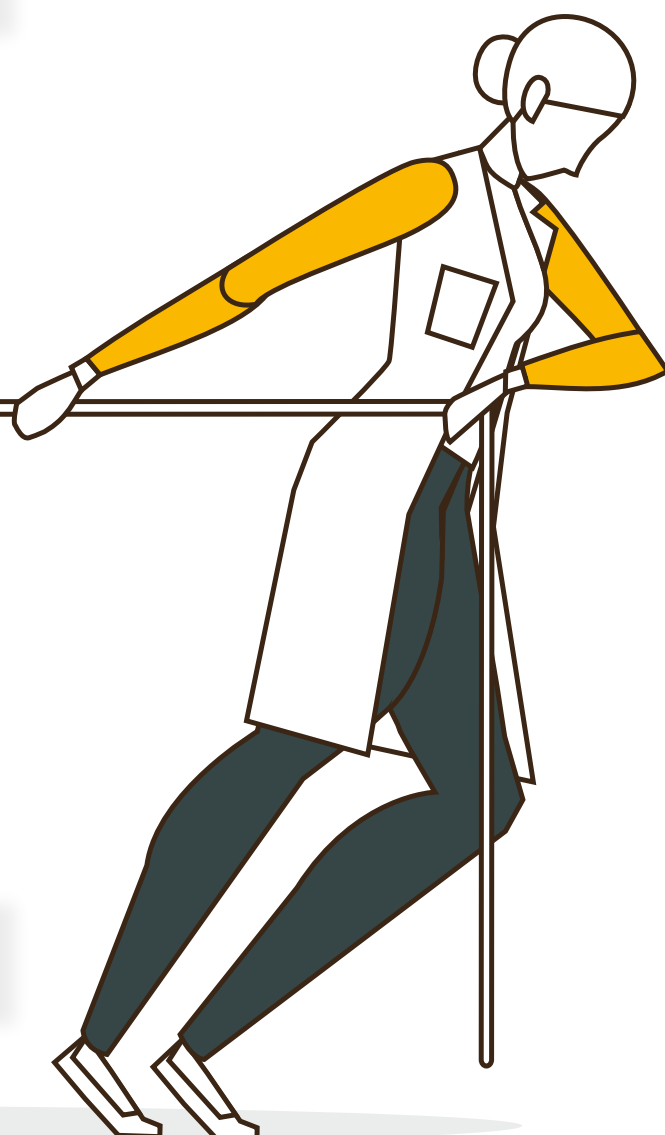
Unbearable pressure

Offensive

Not sustainable

Inexcusable

Appalling



Understanding the barriers to retention and progression

Getting to the root of why barriers exist for female chemists is complex.

When making choices, chemical scientists working in academia are influenced by a mixture of different personal and external factors. As a result, the barriers identified were extensive and varied, affecting women differently at different stages in their careers.

Many women face additional challenges. The research found that female chemists feel further disadvantaged on grounds of ethnicity, background or language skills, on top of gender challenges. In these cases, the impact of barriers to progression is even greater.

Three key themes



Academic funding structures

The dominance of short-term contracts creates unnecessary pressure and uncertainty

Funding eligibility criteria can be arbitrary and can limit opportunities instead of creating them

Definitions of success are skewed towards a 'publish or perish' mentality

"We need a culture change where the criterion for progression is more than how many papers you've published and how much money you've brought in."



The academic culture

Decisions about recruitment and promotion lack transparency and fairness

Quality of management and leadership in UK chemistry departments is inconsistent, with few relatable role models

There is a tendency for academic citizenship responsibilities to fall to women

"[Female chemists] are...too smart, in fact, to stay in chemistry, where the conditions are absolutely appalling."



Balancing work with other responsibilities

Long working hours are seen as necessary for career progression

Lack of part-time and flexible working options makes it harder to manage caring responsibilities

Provision of affordable, high-quality childcare is frequently inadequate

"The high demands of academia are incompatible with the time required to have a family. There is no work-life balance."

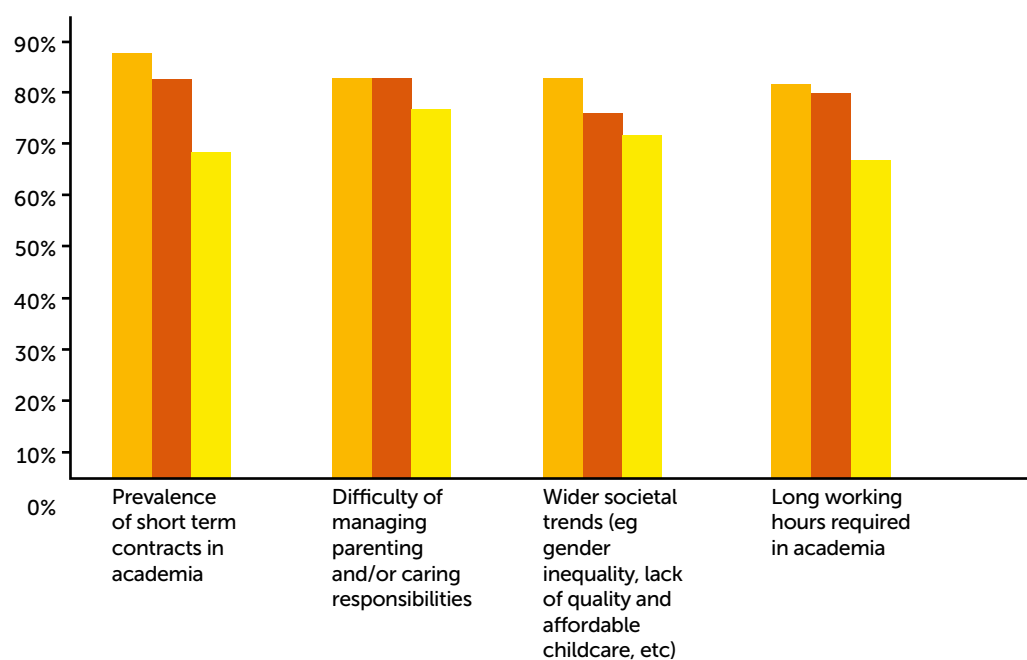
All of these factors apply to both men and women, but they disproportionately affect female academics in the chemical sciences.

Drawing out the detail

For many, these issues are manifestations of wider social problems that are damaging for individual women and their discipline.

How much do these potential factors impact on the lack of retention and progression of women in UK academic roles in the chemical sciences?

(% who selected 'very strong' or 'fairly strong' impact)



Female chemists working in UK academic roles (base: 184)

All chemists working in UK academic roles (base: 316)

All UK respondents (base: 1265)

Figure 1: The top four factors given as barriers to retention and progression by respondent type

78%

of chemists who currently work in UK academia felt that the prevalence of short-term contracts has an impact on the retention and progression of women

78%

also said that managing parenting and caring responsibilities has an impact

The impact of academic funding structures

Over-reliance on short-term funding

- ▶ Reliance on short-term funding often leads to short-term contracts, particularly for early career researchers. The prevalence of these short-term contracts creates uncertainty and a lack of security.
- ▶ Many reported this as the main reason why people leave academia at post-doctorate level – and 83% of UK female academics said this had an impact on progression and retention of women.
- ▶ This insecurity, paired with perceived 'constant competition' for funding and for jobs can result in a high level of pressure.
- ▶ Some perceived that 'arbitrary' limitations and eligibility criteria for funding increase competition and limit opportunities.
- ▶ When these issues of insecurity combine with a lack of process and transparency about how funding and personnel decisions are made, many people – and disproportionate numbers of women – choose to leave academia.
- ▶ Respondents emphasised that these patterns have a disproportionately negative impact on women.

Progress is dictated by narrow definitions of excellence

- ▶ There were concerns that current definitions of excellence in science are narrow and outdated.
- ▶ The research world is changing and there is broad recognition that the 'publish or perish' model is redundant. Yet among our respondents, it is still perceived to be the primary driver of career progression.
- ▶ Funding and promotion decisions are driven by research output. Efforts and successes in areas including teaching, pastoral responsibilities and academic citizenship activities, including Athena SWAN and REF (Research Excellence Framework) preparation do not 'count' towards promotion prospects.
- ▶ Women reported being more heavily involved with activities in these undervalued areas than their male counterparts.
- ▶ A number of respondents questioned whether women should actively avoid contributing to non-research activities; others said that science would suffer as a result.

Other major causes of attrition related to current funding models

- ▶ Inadequate funding for long-term leave, particularly for those on short-term contracts, can have a big influence. This includes:
 - ▶ entitlement to paid leave
 - ▶ funding so that research can continue in their absence (where appropriate), and
 - ▶ funding for those on short-term contracts to be able to return to their research role.
- ▶ Inadequate provision for part-time and flexible working is another major barrier. Again, this disproportionately affects women who are still more likely to be the primary carer for dependants.



"I think the big driver [of the 'leaky pipeline'] is that there is inequality in recognition of all the demands of an academic career. So there are lots of things expected of you as a woman in academia but there is no equality in terms of what is recognised that contributes to your progression."

Stakeholder interviewee

Female, academia, UK

The impact of academic culture

Recruitment, promotion and policy-making decisions lack transparency and fairness

- ▶ Many respondents described a lack of fair and robust recruitment processes in their institutions. There were strong concerns about transparency.
- ▶ Promotion criteria in many departments still focus exclusively on research outputs. This has a negative impact on women who spend a significant proportion of time on non-research citizenship activities for the benefit of their department.
- ▶ Decision-making about personnel lacks transparency and is often too informal. Opportunities for promotions, committee positions and industry partnerships are often discussed and decided in social settings or 'behind closed doors'. Often women are not present when these conversations take place.
- ▶ There were concerns that some senior male academics recruit 'in their own image'.



"The academic career path is not sustainable for men and women. Moving from postdoc to postdoc after 2 to 3 years with little pay progression, moving city or even country. I left after my first postdoc as I was no longer interested in pursuing an academic career, and this was a major deciding factor."

Survey respondent

Female, industry, UK



"Thinking about all the collaborations I've worked on... they've all started in the pub."

Focus group

Female, senior chemist, UK

Quality of management and leadership in UK chemistry departments is inconsistent

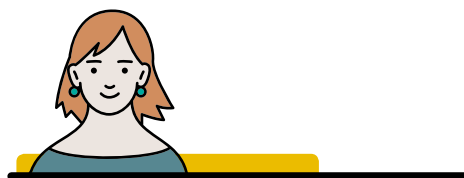
- ▶ Common criticisms include:
 - ▶ insufficient access to managers and a lack of management support
 - ▶ unequal access to managers relative to male peers
 - ▶ a lack of guidance, support and sponsorship
 - ▶ failure to communicate opportunities that could assist career progression
- ▶ It seems that lack of training, capability and experience all contribute to poor management. A number of participants reported conversations with senior colleagues who are eager to improve their management skills.
- ▶ Good managers were reported as rare. Our respondents gave examples of characteristics a good manager may exhibit:
 - ▶ being a role model
 - ▶ discussing career pathways, opportunities and requirements for promotion
 - ▶ offering guidance on mentoring/colleague sponsorship
 - ▶ sharing policies to support parenting and caring

Respondents have major concerns about employment terms that discourage retention and progression

These include:

- ▶ inadequate policies for parental leave
- ▶ limited opportunities for part-time and flexible working
- ▶ failing to deal effectively with claims of bullying and harassment

Beyond failures of process, management and communication, the research captured detailed reports of discrimination, bullying and harassment



"Having a senior male champion, mentor to say you are ready...is probably the single biggest thing [that has supported my progression]."

Focus group

Female, senior academic, UK



"If a postgrad student becomes pregnant during her studies, she is most likely forced to take a break. My university was one of the first arranging a lab technician to help a pregnant postgrad student when she couldn't work with solvents of certain chemicals anymore due to health concerns. This model really should be adopted in more universities... With more postdoctoral students the number of women in other senior academic roles would surely rise as well."

Survey respondent

Female, UK



"In my experience, few promotional opportunities are advertised on a part-time basis. Since more part-time workers tend to be female this is inherently a limitation on their progression until such time as they are able to recommence full-time hours."

Survey respondent

Female, charity, UK

The impact of balancing responsibilities

Managing responsibilities outside of work, including caring for relatives, and building a family, alongside a career in research, poses challenges at different stages.

Challenges when starting out

- ▶ Many respondents, male and female, spoke about how difficult it can be for researchers early in their career to settle in a fixed location and secure a home.
- ▶ This is particularly problematic for 'double career' couples, and is compounded by contractual and employment conditions.
- ▶ A significant number of respondents said they or others have been told to choose between a career and family.
- ▶ Some reported a lack of support on completing lab-based research while pregnant.
- ▶ Many described the provision for cover and pay while on long-term leave or parental leave as inadequate. They described the negative impact on the careers of those who have no funding to return to research after a career break.

Challenges for young and growing families

- ▶ Many reported struggling with managing a young family, particularly early in their academic careers when a high level of research output, travel and long hours are often expected for career progression.
- ▶ Many said that being available for speaking and networking events is more difficult with dependants.
- ▶ The challenge of career progression is compounded for returning parents, who report being 'overburdened' with teaching and administrative responsibilities to the point where their research career suffers.
- ▶ Concern about limited opportunities for flexible and part-time working deters many from pursuing academic careers.
- ▶ A significant number of women reported being directed or demoted to alternative roles (in most cases more junior or administrative) following a career break.
- ▶ Having multiple career breaks can exacerbate the factors above. Several parents reported putting a second child 'on hold'.

Maintaining a 'double career' relationship or family

- ▶ Relocation for promotion and overseas travel can be essential for career progression. In these circumstances, one partner's career often has to take precedence.
- ▶ Many reported that in a majority of cases a woman's career gives way to their partner's.
- ▶ Regular relocations become more difficult with dependants.

Extended family caring responsibilities

- ▶ The time required to support and care for family members or loved ones can demand significant time away from work. There is often little understanding or accommodation of this.

Further issues raised

Some senior academic chemists voiced strong criticism of the gender pay gap, and their personal experiences of it.

Early career researchers described being offered 'promotions' that resulted in pay cuts.

There was also a widely held view that women, are less likely than their male peers to nominate themselves for opportunities that may progress their careers. Both male and female participants saw the impact of this issue in recruitment and promotion processes.

A small group of respondents, including several senior academic women, contested some of these barriers. They attributed lack of parity in numbers of senior male and female academic chemists to individual circumstance and choices (character, suitability for academic career, skills, life choices) as opposed to systemic issues that require focus.

Many of these barriers apply to both men and women, however, they disproportionately affect women.

Many of these barriers apply to women in settings outside chemistry departments including other STEM disciplines and in commercial organisations.

Other barriers are present – discrimination, harassment and bullying exist at scale.

The 'lack of relatable role models' describes the absence of 'next-up' or senior chemists (of all genders) to which others can aspire. Participants at all career stages emphasised the importance of seeing senior colleagues lead aspirational lives.

Spotlight



"For me, the greatest lesson to be taken from industry is flexible working for everyone, not just for women. This enables all genders to take on more equal shares for caring responsibilities (whether child or elder care) meaning that one, usually a woman, isn't forced into lower paying part-time work or into leaving the sciences altogether."

Survey respondent
Female, industry UK

Improving diversity in industry

Many women who work in industry share the experiences of those in academia.

74%

of respondents who work in industry have seen evidence of the lack of progression and retention of women outside academia. Respondents described common challenges including the imbalance in the numbers of men and women, as well as structures and behaviours that do not support diversity.

Several respondents described leaving academia in search of a more diverse workforce and inclusive culture. Some felt that they did find this in industry. **Others are disappointed they did not.**

Respondents from outside academia were keen for their sectors to address these challenges. Several said that the chemical science community as a whole should work harder to share best practice on measures that work.

A small number of respondents cited examples of businesses that have achieved strong representation of women in leadership roles.

These best-practice examples include:

- ▶ effective policies for women returners
- ▶ establishing expectations that all genders can take parental leave and adopt flexible working practices
- ▶ close scrutiny of recruitment processes



“I work in a big chemical company as a research scientist. The environment is very much hierarchical and male-dominated (45 years old and above). They use many means to suppress young generations in the company, particularly women. There is a pay gap and a gender gap in roles. I see very little progression and support in this company and this frustrates me and pushes me down. I wish there are more women in leadership positions and fair treatment of all employees.”

Survey respondent Female, industry, UK

6 The case for change

How much do these potential factors impact on the lack of retention and progression of women in UK academic roles in the chemical sciences?

(% who selected 'very strong' or 'fairly strong' impact)

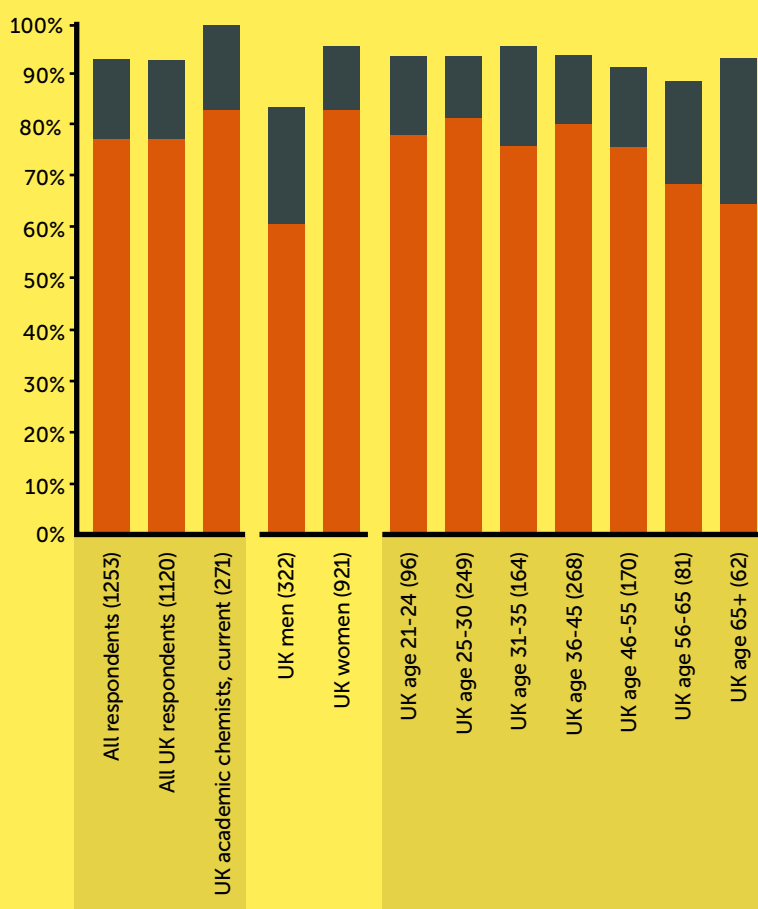


Figure 2: Responses to a call for action on women's retention and progression by age, gender and job role

■ Fairly important
■ Very Important

Building on current momentum

There is significant criticism of the perceived lack of progress on these issues to date.

Many respondents recognise and celebrate the efforts of individual university departments, organisations and networks that work to improve progression and retention of women.

There has also been progress on changing funding structures to have an impact on diversity. Some funders in the UK are leading current best practice.¹¹

However, at a national level, this progress is still only incremental. Efforts to increase the balance of men and women in senior roles show only small improvements.



"This issue should be of the highest priority for all bodies connected to chemistry, because the current situation is so dire. If one cares at all about chemistry as a discipline, it's impossible not to care about this."

Survey respondent
Female, media, UK

93%

**of survey respondents
believe that it is up to
the chemical science
community to tackle the
issues of attrition and
progression**

95%

**of respondents working in
chemical sciences academia
at UK institutions believe
this too**

Picking out the key themes

Participants cited moral, personal, institutional and systemic reasons for addressing the current imbalance of men and women in senior roles in chemistry.

For many respondents, the rationale for change is 'because it is the right thing to do' and 'because it's a basic principle of equality.' They indicated that 'the numbers speak for themselves'.

A small group of survey respondents questioned the importance of focusing efforts on addressing the gender imbalance; they felt that opportunities do exist for young women and are there for women to take.



"I'm a woman in the chemical sciences and I want an academic career. Currently in my department 2 out of 50 members of academic staff are women. Do the maths."

Survey respondent

Postgraduate student, UK



"...Women choose to have families, which is a very significant responsibility and not compatible with a competitive career as a professional chemist. Women face zero discrimination. Quite the opposite. Women chemists are encouraged at every opportunity."

Survey respondent

Male, industry, UK

Respondents also highlighted the range of personal, institutional, economic and societal benefits that stem from establishing equality in the chemical sciences:

Theme	Who does this affect?			What our survey respondents say
	Individuals	Teams / institutions	Society	
 Loss of talent				"Unlock half the talent! A no-brainer."
 Diversity is vital for research				"The widest pool of scientists results in the best science. Excluding or diminishing any section of society weakens science."
 Diversity creates a more positive working environment				"Gender balance is key to a functioning academic department." "I don't want to work in an environment with just a bunch of other men."
 The issues that need fixing solve wider challenges				"There should just be a good look at working conditions in academia. Fixing that doesn't need to be specifically targeted at women, though resolving those issues may well result in retaining proportionally more women."
 A pipeline of diverse role models is essential to inspire the next generation of diverse chemists				"We are losing excellent scientists... not only is this desperately unfair but will have ramifications on research both past, present and future."
 Reputational risk to the discipline				"There is now a societal drive towards a more equal gender split in all workplaces and so chemical sciences needs to address this and work towards it."
 Reputational risk to HEIs in a globally competitive market				"Current and future students will come from diverse backgrounds. The idea that universities will be able to compete in the future with an almost entirely English, white male professoriate is laughable."
 Economic costs				"UK plc is missing out by not making the most of its talent pool." "It is just such a waste – why train these people and then throw away their talent?" "We lose so many amazing minds to other sectors because of the employment terms in academia."

Addressing an ongoing challenge

Our survey includes strong anecdotal evidence of harassment and bullying. Some respondents even described these behaviours as characteristic of academic departments.

We have reports from academia and industry that described instances of men and women, mostly senior colleagues, demonstrating bullying and harassing behaviours. Some reported incidents involving young male peers.

A number of respondents referred to the 'unchecked power' of managers in some teams and institutions.

There is clear concern about a culture of secrecy and lack of accountability around harassment.

These negative behaviours affect women and men in academia; however, once again, they disproportionately affect women.



"I have personally experienced an academic environment of exclusion and derogatory shaming in front of colleagues. This has occurred from senior colleagues, with particularly difficult circumstances with one. When I have reported this to management, there has been little done. I have been told that I need to handle such issues..."

Survey respondent

Female, lecturer, UK



"There must be a clear guideline as to what to do when you are harassed. It should be possible for women (or men) that are harassed to go to a third party to seek help, without having to fear that her/his career could be affected."

Survey respondent

Female, post-graduate student, UK

Spotlight



"We are not getting the return on investment in education [of women in chemistry]. [Not paying] attention to the women you have invested in and nurtured... is like trying to be the best with one hand tied behind your back... We need to put a sharp focus on this."

Stakeholder interview

Female, academic, UK

Economic impact of the loss of women from UK academic teams

Several interviewees highlighted the economic impact of the current gender imbalance, and discussed the benefits that improvements would deliver. These included:

1 Increasing individual and family finances

2 Boosting GDP through increasing participation, productivity and earnings

- ▶ Raising labour force participation
- ▶ Improving the return on investment from the education budget
- ▶ Closing the gender pay gap
- ▶ Increasing innovation and productivity as a result of more diverse teams

3 Supporting and securing science's future contribution to the UK economy

- ▶ Securing the future of UK HEIs and the HE sector, ensuring these retain a competitive edge
- ▶ Securing the UK's future talent pipeline in a competitive and global market
- ▶ Contributing to future economic development of the wider chemical sciences sector (an important growth sector itself)
- ▶ Positive impact on other sectors that have demand for SET (science, engineering and technology) skills
- ▶ Encouraging the development of new ideas, entrepreneurial opportunities and diversification

A small number referenced the NHS costs arising from the mental health 'burden' of academic staff. They indicated that these costs will decrease if working practices in HEIs are consciously improved.

Others suggested that the sector would benefit from greater analysis of the economic impact of attrition, believing that evidence of financial costs to the sector will motivate change. Only a small number of interviewees spontaneously mentioned the wider economic impact of the loss of women from academia.

For many, the moral reasons for 'fixing' this loss take precedence. A number of survey respondents urged the community to move on from analysis to action with tangible outcomes.

The challenges of assessing the economic contribution of women in science are well documented.¹² The Women's Business Council estimated the economic cost of the loss of women in science to the UK economy to be £2bn annually.¹³ However this figure, based on calculating the loss of graduate earnings across STEM, does not explore the economic impact of senior women in particular, or the potential economic impact of reputational decline for institutions and UK HE overall.

Other studies have demonstrated the economic benefits of more diverse teams. A recent report from McKinsey provided evidence of the economic benefit of diversity in business. It concluded that:

"Following a meticulous analysis of 300 companies around the world, we found a difference in return on equity of 47% between the companies with the most women on their executive committees and those with none, and a 55% difference in operating results."¹⁴

An accurate assessment of the cost of attrition of female academic staff in chemistry would require faculties to collate and share data on: destination of leavers, salaries, changes in team performance and productivity. The lack of data on these points does not detract from the economic imperative to improve gender imbalance.



Spotlight Perspectives on Athena SWAN

This research captured conflicting perspectives on the effectiveness and impact of the Athena SWAN programme. Many in the community eagerly await the results of Advance HE's 2018 Athena SWAN review.¹⁵

Raising awareness...

A significant number of participants in this review acknowledged the success of Athena SWAN in raising the profile of gender equality agenda across the sector.

The initiative is strongly praised for its principle of holding universities to account on progress. Many described seeing some positive impact of the Charter in their teams, ranging from more open discussion and awareness of the diversity issues, to changes in policy and practice.

A small number of respondents said it has made a positive contribution to the appointment of women to senior roles in their departments.

...or creating more challenges?

However, there was substantial criticism from across the community, including some who said it has delivered some benefits in their teams. Concerns included:

- ▶ The fact that the administrative burden falls disproportionately to women chemists, taking time away from their research.
- ▶ In too many cases, applying for an Athena SWAN award is seen as a tick-box exercise.
- ▶ Inequalities persisting in some departments that have received awards.
- ▶ Institutes not aiming high enough. Receipt of a Bronze award can be perceived as 'job done'.
- ▶ The programme is resulting in only 'pockets' of progress.
- ▶ 'Positive action' can create new challenges for women. A small number say that, as a result of its demonstrable progress in recruiting a more balanced leadership team, they encounter views that women have been appointed on the basis of gender over merit. This deters other women from seeking promotion, under the impression that they need to exceed expectations for new roles and positions in order to counter views they have been appointed 'to tick a box.'

Only a small number of examples show that male staff are leading their departments' Athena SWAN work. One interviewee emphasised that having a senior male Athena SWAN lead for their faculty has helped embed the importance of increasing diversity across their team.



"It is easy to gloss over the data and present a good picture of your institution. Ask anyone who has participated in Athena SWAN!"

Survey respondent
Female, reader/senior lecturer, UK



"Having to have women on every interview panel has been a negative outcome of Athena SWAN"

Focus group
Female, senior academic, UK



"It would be good to externally influence these departments using external factors. Athena SWAN goes some of the way, but unfortunately in many places it becomes just another "little job for the ladies". Processes that change the mindset of the entire workforce, would be useful."

Survey respondent
Reader/senior lecturer, UK

7 The way forward – 'chemistry for everyone'

Making the systemic change we so clearly need in order to make chemistry for everyone is no easy task. The community does not underestimate the complexity of the challenge, but is more than ready to take it on:



"Big change is needed. It cannot and will not come from within the departments who want to keep the status quo. Don't just put a sticking plaster on this. Everything I have seen so far amounts to optics. Departments wanting change, it is about what they are "seen to be doing" rather than actually addressing the root causes. That needs to change – people are just getting sick of it, and it is also causing resentment."

Survey respondent

Male, research fellow, UK



"Nobody wants to be given something because they are a member of a protected group. Saying that, unless you have focused work in this area, people assume that you have policies that in theory are neutral but the outcomes for minority groups are not. Then we end up perpetuating inequality. So if you want to see a positive shift in a timeline less than one or two hundred years you need to be consciously pushing this forward."

Stakeholder interviewee

Male, academic, UK



"Where the Royal Society of Chemistry can make a difference is doing the communications, the case studies, saying this is important... There is a lot of consensus that we (funders, learned societies, academic institutions) need to get our houses in order, but fundamentally it requires a massive shift in academic culture and that is more challenging."

Stakeholder interviewee

Male, research funding agency, UK



"The Royal Society of Chemistry should be empowered as a professional body not only to seek change within the chemistry community, but to put pressure on Government for policy change and to inform wider society and promote cultural change."

Survey respondent

Female, lecturer, Europe (non-UK)

Reacting to our key themes

Academic funding structures:

Review and improve current funding structures

- ▶ Address reliance on short-term contracts
- ▶ Ensure academic contracts can accommodate part-time and flexible working practices
- ▶ Improve support for returners to academic roles following a career break

The academic culture:

Review and improve management and accountability in HE teams

- ▶ Increase accountability of supervisors and managers
- ▶ Ensure equal allocation of tasks and resources between men and women in university teams
- ▶ Promote and facilitate effective mentorship and sponsorship
- ▶ Increase women's participation across all academic activities
- ▶ Recognise and promote the value of different styles of leadership

Apply HR policies and practice within academic institutions

- ▶ Ensure transparency in recruitment and promotion
- ▶ Ensure promotion criteria reflect candidates' success in all areas of their role
- ▶ Enforce a zero tolerance approach to bullying and harassment

Balancing work with other responsibilities:

Address Societal inequality to support 'chemistry for everyone'

- ▶ Advocate for shared parental leave

Other important themes

In addition to these 'top-tier' themes, respondents had a range of suggestions that would improve retention and progression of women. These include:

- ▶ Further work to attract children and young people to chemistry
- ▶ Improve the provision of high-quality, affordable childcare
- ▶ Encourage and support women to self-nominate and 'push' for promotion

These themes need addressing, but impact in these areas will be limited without addressing wider systematic change.

Thoughts on our priority areas

It is clear that addressing the challenges highlighted in this report will need all of us to work together.

As the professional body for chemists in the UK and a trusted voice in the community, the Royal Society of Chemistry can take the lead on many of these issues, calling on our networks, influence and position to help effect change.

Many call for us to demonstrate, with urgency, bold and inclusive leadership, and our members are in full agreement.



"I went to a [university diversity] committee and I was the only man there, and a senior man. This demonstrated that chemistry [the chemistry department] was making a commitment [to diversity]. Several commented on it when I walked into the room. That was a sea change. It is important not to say 'women, this is your problem.'"

Stakeholder interviewee

Male, senior academic, UK

89%

of our surveyed members agree that improving the retention and progression of women in UK academic chemical science teams should be a priority for us

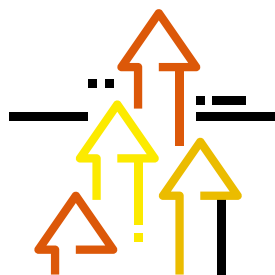
Supporting an empowered community

Respondents provided excellent and almost unanimous suggestions for the steps we, and the community as a whole, should take next to improve the retention and progression of women in chemical sciences.



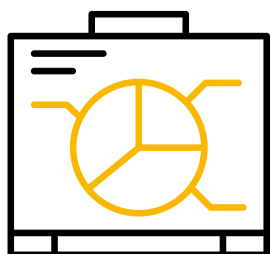
1 Communication

- ▶ Share data on lack of diversity
- ▶ Acknowledge and communicate features of the current academic structures and practices that limit diversity in academia
- ▶ Share evidence of where departments are achieving significant improvements, showcasing best practices
- ▶ Conduct further research into improving diversity in other sectors in the chemical sciences
- ▶ Further work to promote women in STEM to younger audiences



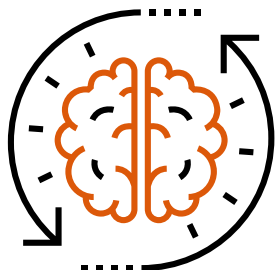
2 Advocacy and influence

- ▶ Convene a coalition for systematic change. Involve policy makers, funding councils, diversity advocates of all genders from our membership and other disciplines, NGOs, communications and diversity specialists
- ▶ Identify the change this coalition seeks (ie on science funding, contracts, management and HR to improve diversity in senior STEM roles)
- ▶ Work with the community to improve Athena SWAN
- ▶ Launch a gender equality forum



3 Funding changes

- ▶ Lobby Government for parity in parental leave entitlement and uptake
- ▶ Advocate for science funders to:
 - ▶ review career pathways. Explore options for new models / roles (including senior roles with a teaching focus)
 - ▶ provide more longer-term contracts for early career researchers
 - ▶ make flexible and part-time working possible, at scale
 - ▶ make funding contingent on progress on diversity
 - ▶ improve funding for maternity, parental leave and returners
 - ▶ review current definitions of 'excellence' in science research
 - ▶ value evidence of success in non-research roles
 - ▶ increase accountability of funded managers



4 Culture change

- ▶ Define good management and make managers accountable for implementation
- ▶ Create and apply effective review processes (see the following Spotlight section)
- ▶ Review recruitment and promotion processes to ensure they are transparent and inclusive. This includes the way HR consultants are briefed and language in job descriptions (she/he, explicitly welcoming applications from women in their 20s and 30s)
- ▶ Make experience of non-research responsibilities a prerequisite for all research promotions
- ▶ Issue best-practice guidelines on supporting returners
- ▶ Contested: set targets for recruitment, representation on panels – ensuring these are realistic (50% gender balance is not)



5 Policy review

- ▶ Ensure diversity in our committees, divisions and boards
- ▶ Make current communications tools work harder for diversity
- ▶ Promote developments from across the science community that work towards increased diversity (eg policy changes, new programmes, funding changes)



6 Tools and support

- ▶ Guidance on career pathways and requirements at each stage
- ▶ Increase accessible networking opportunities including online events
- ▶ Promote case studies of 'next-up' men and women who balance academia and family/caring responsibilities
- ▶ Support and promote effective mentoring programmes
- ▶ Support for writing funding applications
- ▶ Increase opportunities for women to attend leadership programmes

Supporting an empowered community

There was strong but not universal support for many of the ideas put forward. Ideas suggested by individual or small groups of respondents are included in appendix 2.

Work is underway on many of these measures, delivered by individual funding bodies, chemistry departments or research groups. But the community needs more. Participants' feedback implies a need for systemic adoption of measures to achieve impact across all UK academic chemical science institutes and teams.

Overall, respondents prioritised themes 3 and 4.

Until strong leadership inspires action on the systemic measures addressed in those themes, 'softer' approaches (including tools and support for individual chemists) will continue to deliver limited improvements.



"The importance of sponsorship, mentoring and role models cannot be overestimated... I decided to go into industry as I could see a clear career path for myself, and already had examples of women I admired who had been successful. I'm still fairly early in my career... but have been supported, challenged, and have progressed well, while staying technical. I doubt I'd have had the same experience had I chosen to complete a PhD and go into postdoc research."

Survey respondent

Early career researcher, industry, UK

Spotlight



"Seeing a clear path would have made a difference to me, I could only see the struggle, the pressure, the difficulties trying to get funding. I couldn't see how I could establish myself. I couldn't see the structure or the mentor or the support. It was like a black hole."

Focus group

Female, academic 'leaver', UK

Expectations of effective and accountable management

Guidelines suggested by participants for improving management within UK HEIs include:

- ▶ Make leadership and management training statutory for all in relevant positions
- ▶ Ensure all departments have an effective review process including 360 degree feedback, and exit interviews
- ▶ Set clear guidelines on the requirements of an effective manager and monitor these through review processes including:
 - i) Support the careers of their team members
 - ▶ provide clear guidance on career pathways and requirements
 - ▶ raise awareness of funding, conferences, mentoring and other opportunities
 - ▶ provide support to enable team members to access these opportunities
 - ▶ be an effective sponsor for all talented individuals and promote a culture of sponsorship
 - ii) Ensure an equal approach to managing all genders in teams in terms of access to managers, allocation of funding for training, and non-research responsibilities
 - iii) Promote unconscious bias training / events / tools

8 Conclusion and recommendations

Every talented chemist working in UK academia should be able to meet their full potential.

Our evidence shows that this is not the case.

It is time to do something about it.

Breaking the barriers

Factors driving the current lack of diversity in the chemical sciences are systemic, complex and cumulative. The main barriers are:

- ▶ an over-reliance on **funding structures** that create uncertainty and unnecessary pressure
- ▶ an inflexible and unsupportive **academic culture** that can drive talented chemists elsewhere
- ▶ balancing responsibilities, and the perception that **caring and family responsibilities** are the primary responsibility of women

Each of these is significant, deeply ingrained, and made up of many other factors, each of which also need to be addressed to create change. There are no easy fixes, nor are there any that will please everyone in the community. But that does not give any one of us licence to stand by and do little while these challenges persist.

These barriers affect everyone, so by addressing the situation for women, we have a chance to improve working life for all people working in the chemical sciences and beyond.

What academic funders and employers must do

Funders: balance short- and long-term funding structures

Currently, short-term funding puts pressure on researchers at a time when people are often balancing life with developing their career.

Academic institutions: lay the foundations for a fair and healthy working culture

From working practices to management training, leadership teams at academic institutions – and this includes senior university staff, department heads and human resources teams – can make a real impact through even seemingly minor changes.

Ensure that policies you already have in place work in practice, introduce measures of excellence that go beyond number of papers published, and take steps to accommodate flexible working patterns.

Chemical science industry: share data and best practice

Data on women's progression and retention in academia are readily available. Related data can be harder to obtain for industry.

To build an accurate picture of the culture in every area of the chemical sciences, report your diversity data and share best practice.

Everyone: enforce a zero-tolerance approach to bullying and harassment

Currently, there is inconsistency in the consequences for proven instances of bullying and harassment, and we will not see rapid positive change without that consistency. Of the concerns raised by our respondents, this is the most urgent.

It's up to funders to take steps such as denying funding, or building in clauses to ensure that institutions and individuals have funding removed immediately when evidence of bullying or harassment is shown. It's up to employers to make sure that those consequences are consistently enforced and enhanced through their own actions.

What we will do

We are in a position of influence, and we have a duty to the chemical science community to use that position to drive cultural change.

We will build on the action we have taken over the past few years with a five point plan:

- 1** To launch a bullying and harassment helpline by summer 2019
- 2** To launch grants for carers in early 2019
- 3** To launch annual recognition for chemistry departments that demonstrate significant progress in inclusion and diversity
- 4** To facilitate an exchange of best practice between peers
- 5** To launch a gender equality forum to accelerate culture change

What you can do

Join us: we have our greatest impact when the chemical science community is united in its actions. We can lobby for change, demonstrate best practice and influence other organisations, but we need you as individuals to put this change into practice.

Act as a sponsor: sponsorship matters to women at all career stages and has a major contribution to progression and success. Support and sponsor women to succeed.

Nominate women scientists: prizes and awards have a positive impact on individuals' careers and role models in the community. Nominations of women and by women are still too low.

Act as a role model: demand and expect flexibility. Be proud of your achievements, at work and at home. Request sponsorship and mentoring.

Gender parity is just one outcome of a healthy, equitable and well-run system that works for everyone in the chemical sciences.

We can build this system together if we act now.

#ChemEquality

Appendices

Appendix 1: Research methodology

Overview

We used a mixed-methods approach to allow exploration of prompted and unprompted perspectives, at scale.

Table 1: Women in the chemical sciences – research overview

Research activity	Participants	Details	Timing
20 telephone interviews	Senior academics and other key stakeholders in the chemical science community including representatives from academia, funding and industry	In-depth conversations that followed a semi-structured discussion guide	February – July 2018
Online survey	1,787 individuals responded to the survey, 1,296 of these are UK-based	Short online survey comprising a series of closed and open-ended questions We shared the survey via email invitation to members, through our social media accounts and <i>Voice</i> magazine	March – April 2018
6 x focus groups	47 women contributed to the research through the groups held with female chemists at different stages in their careers (PhD students, early career researchers, senior academics and one academic leaver)	These were in-depth discussion sessions that followed a semi-structured discussion guide. The conversations took place in Bath, Leeds, London and York	April – May 2018

The research was designed by Firetail in partnership with the Royal Society of Chemistry's Inclusion and Diversity Committee and the Inclusion and Diversity team.

Survey

1,787 people responded to the survey. 63% of respondents completed the survey in full.

Table 2: Overview of survey respondents

Sample sizes for individual questions vary as all questions were optional.

		All respondents (overall 1,787)	UK respondents (overall 1,296)
Royal Society of Chemistry membership	Members	60%	71%
Gender	Men	26%	27%
	Women	73%	73%
	Other, prefer to self-describe	1%	1%
Field	Chemistry	87%	88%
	Physics	3%	3%
	Biology	4%	4%
	Other	5%	5%
Employment sector of those currently in employment	Academia	45%	41%
	Industry	31%	33%
	Education	9%	10%
	Civil society / charity	4%	5%
	Media	1%	1%
	Funding	1%	1%
	Government/ policy	3%	3%
	Other NB: responses for 'other' include recruitment, legal, publishing	6%	7%
Current role / stage for current academics	Respondents with PhD	56%	55%

Percentages may not sum to 100% due to rounding

		All respondents (overall: 1,787)	UK respondents (overall: 1,296)
Age	18–20	2%	2%
	21–24	9%	9%
	25–30	23%	22%
	31–35	15%	15%
	36–45	23%	23%
	46–55	15%	15%
	56–65	7%	7%
	Over 65	5%	6%
Current employment status	Student	22%	20%
	In part-time employment	7%	8%
	In full-time employment	62%	63%
	Self employed	2%	2%
	Not working due to parenting and/or caring responsibilities	1%	1%
	Career break	1%	
	Unemployed	2%	1%
	Retired	5%	6%

Percentages may not sum to 100% due to rounding

Focus groups

The focus group sessions took place at different locations and lasted 75–120 minutes.

The focus groups had between 6 and 10 respondents, representing a good range of:

- ▶ chemistry specialisms
- ▶ roles and institutions (both in terms of current and previous employers)
- ▶ demographics (ages, ethnicities and nationalities, family situations)

Table 3: Focus group details

Number of groups	Profile	Details
2	PhD students	Year 2 and 3 PhD students, working in chemistry departments
1	Academic 'leavers'	Chemists who previously worked in academia but are now in different destinations / situations
2	Early career researchers	Postdoctoral researchers and research fellows
1	Senior chemical science academics	Including lecturers, senior lecturers, readers, associate professors

Stakeholder interviews

We conducted 20 stakeholder interviews, each lasting 30–60 minutes with a range of interviewees.

Table 4: Details of stakeholder interviews

It is important to note that many of these individuals have multiple roles across a number of organisation types.

Group	Number of interviews
Senior academics (including professors, Heads of Chemistry) from chemistry and other disciplines This included 2 diversity specialists	11
Academic 'leavers' (those working in industry or education, or taking a career break)	7
Representatives from funding bodies	2 (NB: one of these also has a role in academia so is counted twice)
Learned societies	1

Appendix 2: Further suggestions

Suggestions from individual or small groups of respondents.

These themes align to those set out in the main report (see section 7).

1. Communicate: i) the scale of the challenge; ii) that systemic change is required for impact; iii) examples of good practice

- ▶ Introduction of an award to celebrate men in the chemical sciences who make outstanding contributions to improving diversity
- ▶ Link academic departments with businesses who have strong diversity models and share best practice
- ▶ Invite contributors from Nordic countries to share best practice on increasing diversity, and to deliver presentations at events

2. Convene and lead the community in support of the systemic changes

- ▶ Work with diversity and inclusion specialists to help shape next steps

3. Advocate for systemic change with UK science funders & Government

- ▶ New, small funding opportunities for early career researchers to give experience in applying for grants, to build confidence and autonomy
- ▶ Promote support for double career couples – consider 'spousal hire'
- ▶ Increase funds for travel to and childcare at conferences
- ▶ Team/collaborative funding streams and awards to recognise and encourage team success

4. Work with university departments and human resources teams

- ▶ Encourage male staff to apply for flexible working
- ▶ Introduce a funding scheme to financially 'recompense' staff for time spent on non-research activities through additional funding to support their research
- ▶ Build in more time for development in postdoctoral contracts
- ▶ Ensure that whenever a candidate is put forward for a committee post that departments have to propose at least one woman
- ▶ Educate undergraduates on diversity issues and challenges, unconscious bias
- ▶ Introduce confidential reporting committees
- ▶ Encourage departments to publish workload-allocation data
- ▶ Compulsory attendance at diversity events for all senior staff

5. Make sure policies, practice and tools work hard for diversity

- ▶ Raise awareness of current services (especially mentoring)
- ▶ Refine mentoring programme to allow women to select characteristics of the mentors they would like support from (ie career level, location, discipline, experience)
- ▶ Ensure images in publications, events and buildings convey 'next-up' chemists for all

6. Tools and support for individual chemists

- ▶ Use online conferences and networks (regional, national, European, international) to promote 'relatable role models'
- ▶ Promote the excellent opportunities available outside 'top-tier' research universities
- ▶ Teach people effective ways to negotiate with managers
- ▶ Encourage women to ask for change (eg on maternity contracts)
- ▶ Encourage chemists to have conversations with their departments about family plans early, so managers can build these into departmental planning
- ▶ Issue tools to raise awareness of unconscious bias
- ▶ Women's editions of science publications

Appendix 3: Additional analysis

The grid below shows the themes that survey respondents felt were a priority. Different populations of respondents reached a consensus on these.

	1	2	3
Respondents working in UK chemical sciences academia	Tackle reliance on short-term contracts	Acknowledgement that long working hours can have a negative impact on achieving gender-balanced research teams	Increase women's participation across all academic activities
Female respondents working in UK chemical sciences academia	Tackle reliance on short-term contracts	Increase women's participation across all academic activities	Acknowledgement that long working hours can have a negative impact on achieving gender-balanced research teams
All respondents	Ensure academic contracts can accommodate flexible working practices	Increase women's participation across all academic activities	Tackle reliance on short-term contracts
All UK Respondents	Ensure academic contracts can accommodate flexible working practices	Increase women's participation across all academic activities	Tackle the pay gap

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Thomas Graham House
Science Park, Milton Road
Cambridge, CB4 0WF, UK

T +44 (0) 1223 420066

Burlington House
Piccadilly, London
W1J 0BA, UK

T +44 (0) 20 7437 8656

International offices

Beijing, China
Shanghai, China
Berlin, Germany
Bangalore, India

Tokyo, Japan
Philadelphia, USA
Washington, USA