ROYAL SOCIETY OF CHEMISTRY

TALENT

Future Workforce and Educational Pathways

Foreword

In my role as President of the Royal Society of Chemistry, I see the importance of the chemical sciences every day, and the wide range of people and careers the discipline encompasses.

The RSC exists to help all these people make the world a better place through chemistry, but also to help the chemical scientists of the future. It is vital we know where the discipline is going to effectively support our members, champion the causes that will benefit them, and create improvements in wider society.

That is the purpose of this report: to understand, from the starting position of those working in the chemical sciences today, where the sector is likely to progress, how chemical scientists will be working in the future, and how the RSC can support them. That could be directly through training and career guidance or indirectly through influencing policy decisions on education, research and industrial strategy. This piece complements other RSC future-facing thought leadership work, particularly Science Horizons and Digital Futures. Taken together, all this work reinforces that health, economic and environmental progress are the key high-level drivers for R&D. Data and digital technologies are set to transform research and development, with digitisation already well underway in several areas.

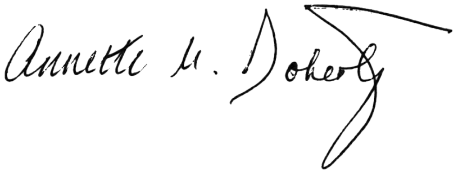
The evidence we have gathered shows the key emerging skills that will serve today's chemical scientists as they further their careers and the next generation as they begin theirs. They will work with new technologies like artificial intelligence, collaborate in new ways and tackle new challenges, from energy storage to personalised medicine.

The shift in research, industry and policy to address sustainability and the green transition is profound. It is being pursued by Governments in the UK and globally. The UK Government set out clean energy technologies, life sciences and advanced materials as areas of national strength. This project uncovers the skills needed to help chemical scientists in these and other fields succeed, innovate and drive businesses. The Scottish Government also seeks economic and jobs growth, in the context of achieving a 'just transition' – tackling inequalities and bringing society along with the changes that address climate change. By identifying crucial future skills, we can help those affected in retraining, upskilling and finding green chemistry jobs. The Welsh Government also recently put green jobs and growth at the heart of its policy prospectus, while the Northern Ireland Executive has a mission to harness a "green growth economy".

Further technology areas contributing to our economy and society also rely on chemistry. These include healthcare, food and agriculture, waste and recycling, amongst others.

We want the chemical sciences to be open to all. Understanding the education and training routes that bring people into the discipline will enable us to be more inclusive, drawing on the advantages of a diverse workforce. This research explores how to develop the interest in chemistry in more young people, help them see themselves in chemical science careers, and let them pursue those goals down the most suitable path for them. Chemistry knowledge and skills open doors to many careers across a variety of sectors, and employers value the analytical and problem-solving skills that are integral to the discipline.

I would encourage those with an interest in the skills that the UK needs to succeed, the economy needs to grow, and the chemical sciences need to progress, to work with us in furthering the recommendations of this report.



Dr Annette Doherty President, Royal Society of Chemistry

Executive summary

The chemical sciences in the UK are going through a period of change, with new technologies and techniques, such as batteries, energy storage and sustainable consumer products amongst the innovations the chemical sciences workforce drives.

The UK chemical sciences workforce totals around 314,000 people, working in a diverse range of sectors and occupations. Industries based around chemistry support a further 1.4 million jobs.

Additionally, chemistry represents an area of strong growth potential for the UK: our research shows the number of jobs in the sector in the UK could grow by 6.5% over the next decade, outstripping the wider labour market by 30%. However, these growth projections – and the innovation potential of the chemical sciences - are unlikely to be realised without the skilled individuals to fill these new jobs.

The opportunities this change and growth present make it pertinent to reassess the current chemistry skills ecosystem, from school curriculums to the options available in further and higher education, right up to continuous professional development for those in the workforce already. They allow for placing greater emphasis on skills that employers increasingly need, such as green skills, digital skills and transferable skills, as well as the technical knowledge of the chemical sciences.

If chemistry is to reach its potential as a force for positive change in the world, we must take a holistic approach today to prepare the workforce of tomorrow. With the right curriculums, the right investment in skills and the right support through employers, training providers and professional bodies, the chemical sciences workforce can continue to make the most of digital technologies and play a crucial role in achieving environmental sustainability, better health and the net zero transition.

The Royal Society of Chemistry is in a unique position within the discipline, like the hub of the wheel that is the UK chemical sciences sector, providing a central point to which all spokes – be they industry, academia, policy-makers, or education – are connected and can convene. We have drawn on expertise from each of these sectors in developing this report, are sharing its findings with them, and will continue to work with them towards the future education and skills needed for the profession.

This report brings together quantitative labour market data, on the trends impacting the UK chemistry workforce, including the significant increase in demand for green skills in chemistry jobs and what they mean for the sector over the next decade, and qualitative evidence from interviews, surveys and focus groups. It captures many discussions with Royal Society of Chemistry member groups on the labour market data analysis. These insights have helped to contextualise the data and develop our recommendations.

The evidence base from this project is enabling us to support our members and informing current programmes of work, detailed in this report, including our careers advice and our efforts to ensure inclusion and diversity in the profession. It will also inform the development of our 2026-30 Strategy. We will continue providing resources for the chemists of today and tomorrow – now informed by our picture of the key skills that will underpin the future success of chemical scientists. Ultimately, it provides important information on future skills for decision-makers, including our members and the broader chemical sciences community, and helps us to support them in their efforts to make the world a better place.

The key findings and recommendations are summarised below.

Skills development in school

- *Curriculum reform*

To elevate students' long-term performance and employability, chemistry curriculums across the UK require reform to ensure students can develop key skills as early as possible.

Giving young people access to practical, hands-on learning that is rooted in the real world is still seen as a key driver in generating positive perceptions of chemistry and a heightened level of interest, therefore these opportunities are regarded as crucial.

- *CPD support for educators*

Teachers and technicians must be encouraged to continue their own professional development if they are to be as effective as possible in conveying the variety of career opportunities in chemistry.

Supporting CPD initiatives and placing greater emphasis should be placed on providing up-to-date, subject-specific development opportunities will encourage familiarity with industry trends, which could in turn generate future economic benefits.

Skills development in further and higher education

- *Opening up technical and vocational pathways*

To meet the demands of the evolving chemical sciences sector, post-16 education must offer diverse pathways, including apprenticeships and technical qualifications, alongside academic routes.

More than 70% of workers in the sector possess at least one degree, which makes the chemical sciences have one of the UK's most well-educated workforces in the UK, but expanding vocational pathways will also ensure greater inclusivity, bringing new talent into the sector.

- *Curriculum reform at university level*

Employers and learners are keen to see sustainability given greater emphasis, with statistics showing the demand for green skills is eight times higher for chemistry roles than for the wider UK economy. Teaching must also develop digital, practical and transferable skills; both employers and universities consider those entering the workplace to lack the latter set of those skills in particular.

There is a general desire to ensure that the university experience is closer to the 'real world', with placements and work experience seen as effective ways of building professional skills – however, access to these can still be challenging.

- *Industry engagement on skills development*

Many companies are looking at ways to incorporate artificial intelligence (AI) and large language models (LLMs), so universities and course providers should look to ensure learners are digitally literate and ideally possess digital skills that can dovetail with their chemistry fundamentals.

Employers should also be encouraged to collaborate with students, education and training providers, policymakers and other institutions to ensure learning materials are as relevant as possible, feed into policy analysis and help close skills gaps.

Skills development throughout careers

- *CPD for the existing workforce*

Upskilling the current workforce is critical, given that 80% of the 2035 workforce is already employed today, so CPD in sustainability, regulatory compliance, and digital technologies will enable professionals to stay competitive and adapt to rapid changes.

Barriers such as funding and time sacrifices remain and must be addressed but employers are encouraged to take a proactive role in providing training, supported by government incentives to make CPD accessible and impactful.

- *Technicians*

The overall ageing and under-replenishment of this aspect of the workforce means concerns are growing over the loss of expertise and skills, while businesses face financial pressures when addressing this issue due to hiring and training costs.

Apprenticeships and on-the-job training can somewhat mitigate this issue. However, with CPD generally considered to be lacking and responsibilities increasing in these roles, employers offering greater development opportunities is crucial to improving technician capacity and retention.

- *Regulatory considerations and alignment*

The regulatory landscape is evolving so quickly that employers – and therefore their employees – are struggling to keep up, which places a “costly and burdensome” compliance burden on enterprise.

Regulatory training must also be integrated into education and CPD to address growing demands in compliance and safety. Greater international alignment on regulatory frameworks will reduce complexity and better prepare graduates and professionals for global opportunities.

List of recommendations

1 Introduction

1:1 About the RSC

The Royal Society of Chemistry works at the heart of the chemical sciences community to create a future that is more open, more green, and more equal. As an independent catalyst for change, we connect people and ideas through partnerships, conferences, events and networks that span the globe.

We care about protecting our natural environment, about tackling discrimination to build a truly inclusive world, and about making cutting-edge chemistry accessible wherever it's needed for the good of society. It's all built upon and lifted up by our diverse global membership, with every one of those 60,000 members bringing a unique and valuable perspective.

Our charitable purpose is to help the chemical science community make the world a better place. We strive for a world in which the chemical sciences fulfil their potential as a force for good. Many of our activities support a well-skilled STEM workforce, for example:

- Supporting our members' continuous professional development of STEM and other skills and knowledge, including through professional registration and chartership
- Connecting scientists with each other and society as a whole, so they can do their best work and make discoveries and innovation happen
- Supporting chemistry teachers to inspire future generations of scientists
- Accrediting chemistry degree courses at UK and international higher education establishments
- Publishing new research
- Developing, recognising and celebrating professional capabilities and bringing people together to spark new ideas, collaborations and partnerships
- Speaking up to influence the people making decisions that affect us all, particularly on key issues impacting our chemistry community and where their work should inform decision-making.

The RSC has a unique position within the chemical sciences community. Our membership spans the different career stages of chemical scientists, from students to retired chemists and our members work in the private, public and charitable sectors, in academia, industry, utilities, public administration, start-ups, as consultants and in many other roles.

Our members and broader community are the current chemistry workforce and many of them will form the future workforce, as educators, employers, managers, policymakers and as role models. For ease of discussion, going forwards we will refer to the "chemical sciences sector" as shorthand for these various groups.

1:2 Introduction to the Future Workforce and Educational Pathways

In this period of extensive global change, the chemical sciences are by no means immune to the influences of macro-scale trends impacting economies and the world of work.

They also face challenges more specific to the nature of chemistry and being a sector driven by research, development, innovation and manufacturing. At the same time, the chemical sciences workforce has the potential to contribute significantly to achieving sustainable economic growth and making progress towards the United Nations Sustainable Development Goals (SDGs), *right*.

This report builds on the RSC's *Chemistry's Contribution* report (2020), which defines the chemistry-using workforce, quantifies its economic contribution in the UK and explains its role in innovation and productivity.[1] Our Interim Data Report, conducted by Lightcast for the RSC, updates the analysis of the chemistry workforce and takes a forward look at how this is likely to change given the external influences expected in the coming decade.

This concluding report takes the evidence from Lightcast and additional engagement from across the chemical sciences sector to offer analysis and recommendations to support and boost the workforce and skills that constitute the chemical sciences sector of the UK.

These are the headline questions this report set out to answer:

- How can the RSC best support our members and wider communities in seizing the opportunities and managing the risks of economic and social change in an uncertain world?
- What are the opportunities and needs for chemistry skills and knowledge to promote a green economic recovery in the shorter term and to achieve net zero as part of a sustainable longer-term future?[2]
- Pathways in chemistry need to adapt so that prospective employees have the skills and knowledge needed by employers in the future?
- How should the RSC develop our careers support for students in schools, colleges and universities?

This report will address the UK skills system, covering the course of entering and following a career through initial education, specialist academic or vocational training, and continuing to acquire and develop skills throughout a working life.

1:3 Methodology

In this report, the term "chemistry workforce" captures all who, in the course of their day-to-day work, need to employ knowledge, skill and abilities related to chemistry – whether that is in a laboratory, plant, in the field, or at a desk, and in the private, public, or charitable sectors. Not all those people would identify as chemical scientists or even hold a chemistry degree.

Similarly, discussion of "skills" describes all the skills, knowledge and abilities required to succeed in roles in the chemical sciences, be they specialist or general, practical or knowledge based. It is not confined to specialist skills and knowledge in chemistry.

This report includes evidence from Lightcast's interim report, which detailed the conclusions of data analysis and a literature review. Data sources were both public and proprietary, while the literature review material was identified and provided by the RSC. For further methodological information on this phase of the project, please see Lightcast's interim report.[3]

Following the data analysis we continued to gather evidence by engaging with chemical scientists within and beyond existing RSC networks, to further explore our research questions and the conclusions from Lightcast's work. Some of this served to contextualise and build on the data-driven findings, centring them in the experiences of chemical scientists. This included engaging with 21 of the RSC's interest groups and committees, using guided discussion to address aspects of the findings relevant to each group's expertise. Two focus groups were held with teachers to capture their inputs.

We commissioned Nutcracker Research to run five focus groups and conduct 10 interviews, this time without using the data analysis report, so that we captured the views of the participants on our research questions without using the data to steer or prompt them.

We conducted a survey of individuals in technician roles to understand the views of this section of the workforce. Finally, we also considered data from other RSC surveys, including the annual Science Teaching Survey and our biennial Pay and Reward Survey of members.

All of these sources were compared and cross-referenced to find areas of consensus or points of differentiation that needed further exploration. Illustrative quotes from our community engagement are included throughout this report.

For a detailed breakdown of methodology and participants, see **Appendix 1**.

1:4 Policy context

Many of the recommendations in this report touch on education and skills, which are largely devolved policy matters in the UK.

The UK Government, the Scottish Government, the Welsh Government, the Northern Ireland Executive, and increasingly combined authorities in England are key decision-makers and many recommendations in this report are addressed to all those bodies. Many trends impacting the UK chemistry sector are also relevant across Europe and/or internationally.

The UK Government has set out its five key missions that will define its first term of office.[4] The chemical sciences are vital to secure progress in the areas of economic growth, developing clean energy technologies, breaking down barriers to opportunity and improving our health – detailed here are points of particularly strong chemistry relevance that the Future Workforce project addresses:

- **Kickstart economic growth**

Our evidence details the growth of sectors employing the chemical sciences, which is projected to be 30% faster than the overall UK workforce. The increasing importance of sustainable feedstocks and products, energy efficiency and products' life cycles means the chemical sciences will be of paramount importance to growing companies driving our modern economy.

- **Make Britain a clean energy superpower**

Chemistry research and skills play an important role in a range of clean energy technologies, particularly batteries, solar panels, superconducting magnets and hydrogen. The Lightcast analysis shows a strong growth in demand for nuclear engineers, based on jobs postings,[5] and for green skills across chemical science roles.

- **Break down barriers to opportunity**

The level of job growth in the chemical sciences means the sector will provide job opportunities in the coming years. Our evidence shows a need to modernise the chemistry curriculum and support teachers, so that every child receives an excellent chemistry education. It suggests a need to be more inclusive and open more opportunities to those who do not want to follow traditional academic routes. We aim to increase awareness of different routes into chemistry, for example through 'A Future in Chemistry'.[6]

- **Build an NHS fit for the future**

Many jobs in the healthcare sphere involve chemistry, from drug development to hospital lab technicians. From providing the latest affordable treatments to interpreting diagnostic tests, chemical science skills underpin the NHS.

Chemistry also sits at the crux of the multidisciplinary areas of engineering biology and advanced materials identified as priority technologies and areas of strength and opportunity for the UK in the Science and Technology Framework.[7] Artificial intelligence (AI) is also highlighted as a priority technology and will bring significant changes to research and work across chemistry sectors and fields. Further, chemistry is an integral aspect of advanced manufacturing, clean energy industries and life sciences – three of the key growth-driving sectors identified in the recent Industrial Strategy Green Paper.[8]

All these priorities will require a UK workforce that possesses the skills to develop, work with and apply swiftly developing technologies in identified priority science and tech sectors. However, the recent Skills 2030 report from Policy Connect (following an inquiry by the Skills Commission) highlights challenges in the skills system in England, particularly around investment, devolution and coordination with economic policies.[9] Skills policy is an expressed priority of the UK government, and integral to progress with the government's missions. Skills England recently identified life sciences, green jobs (for example in hydrogen) and professional scientific and technical industries as areas of growth by 2035.[10] The Industrial Strategy acknowledges a skills mismatch in the UK and highlights a lack of the technical skills that will underpin science-driven technology areas.[11] We are applying this lens of skills need to the chemical sciences sector.

Chemistry is relevant in many different policy contexts. On an international level, chemical technologies are crucial to achieving progress toward the United Nations' Sustainable Development Goals;[12] In the UK, the chemical sciences sector will contribute to priorities in the Devolved Administrations of green growth, a just energy transition and high-skilled jobs. Chemistry-based firms and spinouts are also key players in skills clusters and innovation zones centred around UK universities – as identified as local growth drivers in the Industrial Strategy Green Paper, making this analysis also relevant to local policymakers including towards the development of Local Skills Improvement Plans.

For all these reasons, governments and combined authorities across the UK need to deliver the right policy interventions for education and skills – Skills England could play a valuable role in convening and sharing best practice. Universities and vocational education providers should use this labour market information to review curriculum content and delivery approaches; sector employers to plan upskilling; employees to help them plan their careers. The RSC as a professional body is using the findings not only to help these actors, but also to shape our own professional development offer to members.

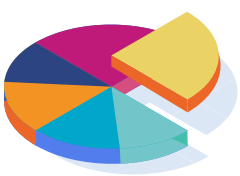
This report aims to contribute a set of recommendations to enable the UK's governments, education providers, employers and professional bodies to contribute to the world-class skills system that the UK needs to realise its potential, drive economic growth and deliver on its priorities.

1:5 Key findings on the chemical sciences workforce and skills

The data analysis done by Lightcast on national statistics and propriety data from online job adverts gives us an excellent understanding of the UK chemical sciences workforce as it is currently. The key findings that underpin the discussion in this report include:

- The chemical sciences workforce comprises around 314,000 individuals across a broad range of sectors. This figure includes core chemistry occupations, such as researchers and laboratory technicians, as well as associated occupations, such as environmental health professionals, but excludes around 39,000 general science teachers and about 23,000 higher education staff more broadly linked to science with a significant chemistry content such as biosciences, pharmacy, environmental studies, chemical engineering and materials engineering.[13]
- Industries based around chemistry support a further 1.4 million jobs.
- Projected growth of the chemical sciences workforce over the next decade is 30% higher than the UK labour force as a whole (6.5% vs 5%).
- The nature of employers in the sector is changing. We are seeing a switch from large manufacturers to smaller specialist R&D-driven firms and expert manufacturers. There is also growth in professional services and consulting.
- There is a high prominence of sustainability and green skills in chemistry jobs, with these sought eight times more often in chemical science roles than on average across all UK jobs.
- Demand for transferable skills in all roles within chemistry has been increasing – these are the skills related to professional activity that enable people to work effectively, such as communication, problem-solving and management skills, that apply regardless of the exact role. Twelve of the top 20 most common skills mentioned for chemistry roles are transferable.
- The chemistry workforce has a much higher average level of education than the wider UK workforce, with more than 70% possessing at least a degree level qualification. This is reflected in chemical sciences jobs being around twice as likely as the average to specify required qualifications for eligibility.

Other sources support the significant growth potential of the chemical sciences, with the recent Innovate UK report 'Sustainable Carbon Ambition for the UK Chemicals Industry' stating that by 2050, the UK chemicals industry will have doubled economic output.[14] However, there are also labour supply-side risks that could hamper achieving the potential these sectors represent.



1:6 Key findings on future trends affecting the sector

Our second phase of research, engaging in depth with the chemical sciences community, validated and contextualised the findings from the data analysis.

While we received a lot of information relevant to specific sectors, industries and jobs, some overarching trends were identified that are driving significant change and impacting individuals' skills and career development:

- Sustainability and the green transition are significantly affecting the chemistry sector, and skills and knowledge requirements
- Data and new digital technologies are driving changes in skills needs
- Many chemical scientists work in highly regulated sectors and work environments, where managing risks to employee, consumer and environmental safety is very important.

These topics are corroborated by many other sources. Skills England also identify technology adoption and the green transition as "megatrends" that will affect the future of the UK labour market and the RSC's 'Digital Futures' report investigated the long-term promise of and concerns about the use of data and digital technologies for scientific discovery.[15]

Developing chemicals regulations, standards and protocols that appropriately balance human health, environmental protection, business growth and innovation, as well as balancing desire for a stable regulatory environment with the need for regulation to respond to the opportunities and risks in new technologies and developments can be challenging for policymakers.

Keeping up with regulation can be challenging for practitioners - this is frequently a topic of discussion amongst RSC members. We will explore the detail of how these trends are impacting the chemical sciences to develop ways that the skills system can address their challenges and harness their opportunities.

"I think, across the board, (a) massive focus for the whole industry is sustainability. (It) is something that companies are talking about a lot more and (...) our customers want to know, for example, our EcoVadis rating (...). And with a lot of companies having external sustainability targets I think it's probably the biggest (trend)." **PRACTITIONER (Industry)**

2 Skills development in school

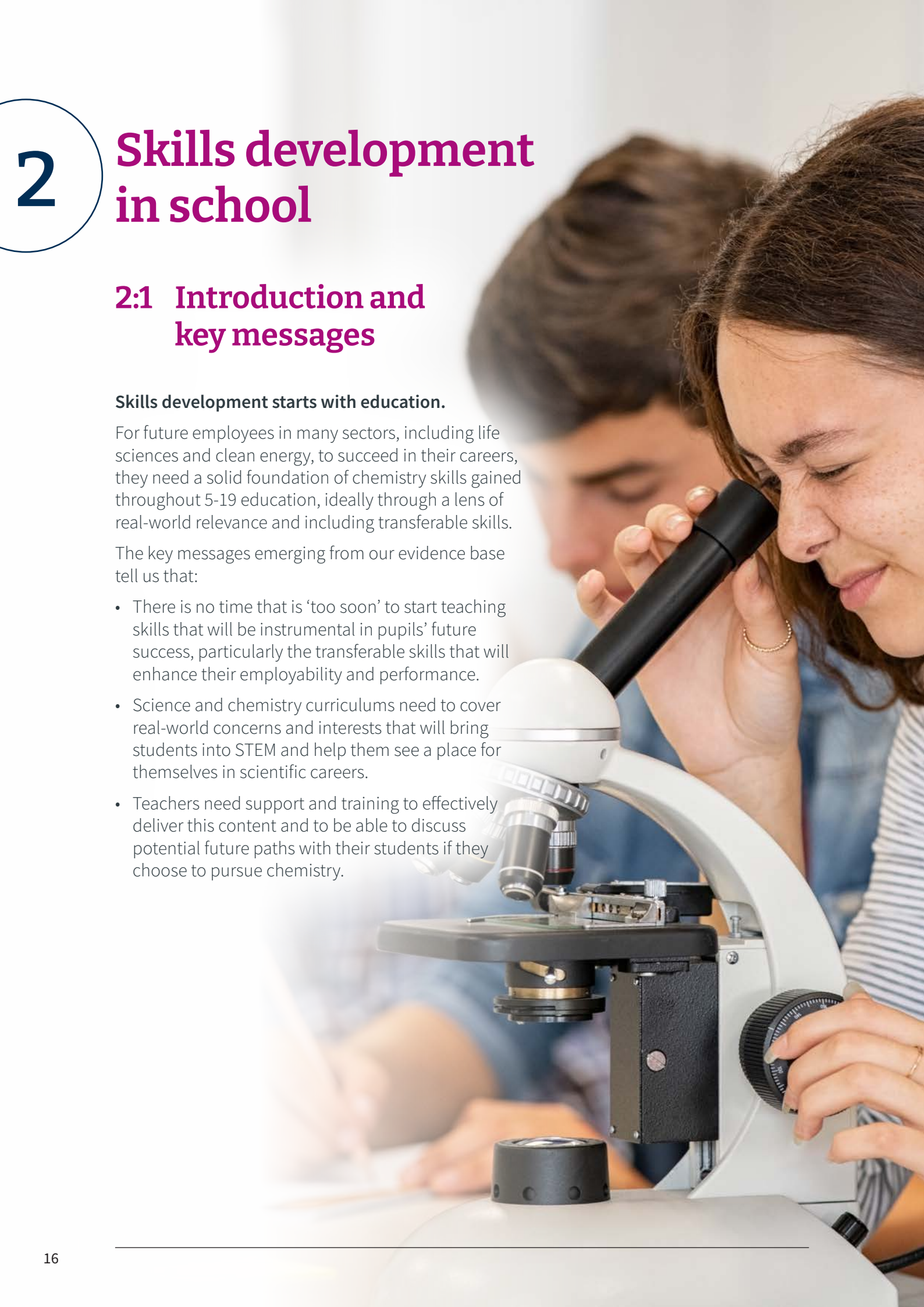
2:1 Introduction and key messages

Skills development starts with education.

For future employees in many sectors, including life sciences and clean energy, to succeed in their careers, they need a solid foundation of chemistry skills gained throughout 5-19 education, ideally through a lens of real-world relevance and including transferable skills.

The key messages emerging from our evidence base tell us that:

- There is no time that is 'too soon' to start teaching skills that will be instrumental in pupils' future success, particularly the transferable skills that will enhance their employability and performance.
- Science and chemistry curriculums need to cover real-world concerns and interests that will bring students into STEM and help them see a place for themselves in scientific careers.
- Teachers need support and training to effectively deliver this content and to be able to discuss potential future paths with their students if they choose to pursue chemistry.



2:2 Practical, digital and transferable skills for future jobs

Practical work supports the understanding of chemistry as an empirical science and provides the opportunity to learn skills that are useful not only for progression into further study and careers in the sciences, but also more widely.

However, the 2023 RSC Science Teaching Survey (run in association with the Institute of Physics and Royal Society of Biology) shows that 60% of teachers feel there is insufficient time for practical activities to be taught alongside the theory in the curriculum.[16]

At the same time, young people have told us that they are unhappy with the small amount of teaching they get on sustainability, while they are interested in future careers or study in this area.[17] The introduction of meaningful contexts and real-world relevance, such as showing links with sustainability, in science education from the primary phase could help capture pupils' interest in science.[18]

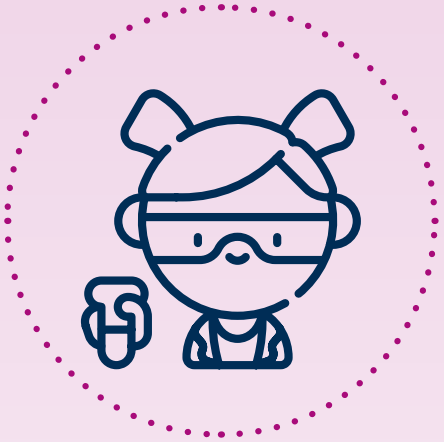
Our qualitative engagement indicates that not all young people have the skills to work in the digital environment of the workplace or university. We heard this from teaching academics and employers alike, who reported that some students and new recruits lacked the digital skills to use common workplace software.

Another key message from our research, backing up the skills data analysis done by Lightcast, has been the need for transferable skills such as communication and interpersonal skills, on top of technical skills, to enable people to work effectively in STEM jobs.

This was echoed by our engagement with teacher focus groups that indicated there is no point that is too soon to incorporate transferable skills as well as science knowledge into STEM (and thus chemistry) education. Although building pupils' transferable skills and capabilities around how they work and interact with others starts in their primary education, there is scope to widen the capabilities being developed so that some of the key skills highlighted in this report are introduced at an earlier stage.

Chemistry curriculums need to have the right balance of content to allow for the development of technical and transferable skills. They also need to provide flexibility for teachers to introduce practical work as well as applications that demonstrate the breadth of chemistry and its contribution to society. Changes to the science curriculum could introduce additional opportunities for practicing transferable and digital skills, as well as to build an early affinity and familiarity with using all these widely applicable skills in a chemistry context.

At the time of writing, there are critical opportunities open to act on the findings of this research, including the curriculum and assessment review in England and the draft science specification for the new curriculum by the awarding body in Wales.



Recommendation 1

Ensure science and chemistry curriculums for ages 5-19 are equipping young people with the skills and knowledge needed for the future, including transferable skills and digital literacy – achieved via a relevant and engaging education with a strong focus on sustainability and exploration of chemistry through hands-on practical activities.

2:3 Supported by well-equipped teachers

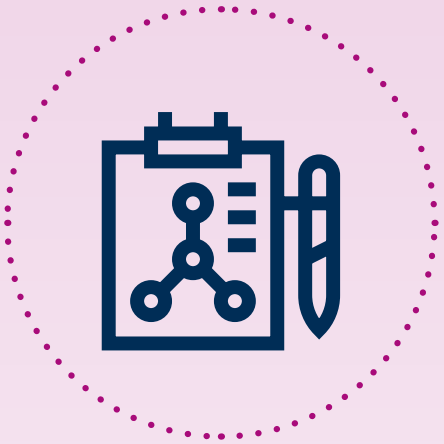
A solid foundation of chemistry skills relies on a modern and relevant curriculum, delivered by an unbroken chain of expert teachers who are able to link curriculum learning to careers.[19]

Governments have previously stated the need to have subject specialist teachers to increase the effectiveness of STEM education, and acknowledged that these are currently lacking in England (with this also being the case in the devolved nations).[20] Previous RSC evidence has highlighted the persistent under-recruitment of chemistry graduates into initial teacher training (ITT) and suggested actions to address this.[21]

Furthermore, the 2024 Science Teaching Survey[22] shows that many chemistry teachers are not receiving sufficient subject-specific professional development that could keep them up to date with contemporary developments in their subject and give them the confidence to talk to students about modern chemistry careers.[23]

The Survey also saw 20% of teachers reporting that they are unaware of the skills that employers in the chemical sciences are looking for.[24] We investigated this further through a focus group and found that those who were happy they did know these skills had investigated them independently or had a background of working in these fields before teaching. Our focus group teachers expressed a desire to understand what skills employers were looking for so they can pass on these useful skills to students and explain *why* they are developing these skills and the use they will be in future.

It is vital each of the four UK governments invests in a systematic approach to CPD for teachers in the sciences to ensure teachers have access to quality assured professional development throughout their careers. This needs to include subject-specific CPD for science and specialist chemistry teachers, keeping them up to date with the forefront of the discipline, its applications and the changing nature of STEM occupations and the skills they require.



Recommendation 2

Empower teachers to deliver a modern and relevant chemistry curriculum by improving access to funded, high-quality, subject-specific CPD.

Ensure that teachers have access to up-to-date information about the skills employers are looking for so that they can link the chemistry curriculum they teach to careers in chemistry.

What the **RSC** is doing

The findings from this work confirm the importance of sustainability, green chemistry and effective use of digital technologies, and the RSC is working to understand and share how best these topics should be included in the chemistry curriculum.

We are undertaking policy work on the place of digital skills in the chemistry curriculum at school level. Currently, chemistry specifications and curriculums in schools do not offer many opportunities for digital skills development, or application of digital skills in a chemistry context. Our work involves investigating the current landscape, teachers' views and opinions on the inclusion of digital skills applied to chemistry, and the feasibility of including these skills. With this we will be able to make informed recommendations on the implementation of digital skills into the science/chemistry curriculum at 5-19.

Following on from our *Green Shoots* sustainability work[25] and the 2023 Science Teaching Survey findings, we are also conducting a series of workshops with first-year undergraduate students to better understand their experiences of climate change at school level and sustainability education. Our aim is to identify what sustainability and climate change content at 11-19 should be delivered in the chemistry curriculum and how. These discussions will help produce a series of recommendations, intended to sit alongside our 11-19 curriculum framework[26] and our recommendations for developing a primary science curriculum.[27]

Currently the subject requirements in England at Key Stage 4 ensure students experience a broad and balanced curriculum that includes English, maths, science among others.[28] At post-16 there is currently no such requirement, with many students following an academic route only studying three subjects at A-level (in England, Wales and Northern Ireland).[29] We aim to explore this approach at post-16 and determine whether a more broad and balanced curriculum that enables students to gain a wider range of skills and knowledge would be preferable for learners. We will go on to make recommendations on the implementation of sustainability and climate change, digital literacy and digital skills into the 5-19 science/chemistry curriculum. This will build on our existing curriculum framework.

The RSC offers a variety of professional development opportunities to teachers of chemistry:

- Sustained professional development courses run throughout the academic year, each comprising four sessions facilitated online by subject matter experts. In 2024 to date 254 teachers have accepted a place on these courses with 73% completing.
- Teacher support sessions covering current topical issues. These have had 469 attendances this year.
- A suite of online, self-paced subject knowledge courses that are accessible anywhere, any time and that are fully funded. There have been 664 subscriptions to these courses so far in 2024.

A new and improved portfolio of courses is being developed that will gradually replace the originals.

We have material available online to help teachers and students understand the potential variety of careers in chemistry and the skills needed to succeed in them, including over 100 job profiles from real individuals who have pursued a wide range of chemistry careers. These are accessible through the 'A Future in Chemistry' microsite.[30] Additionally, we ran the information campaign "Not all chemists wear white coats" to generate curiosity about chemistry careers and dispel the stereotype that all chemists work in a laboratory. Resources from this are still available online.[31]

3 Skills development in further and higher education

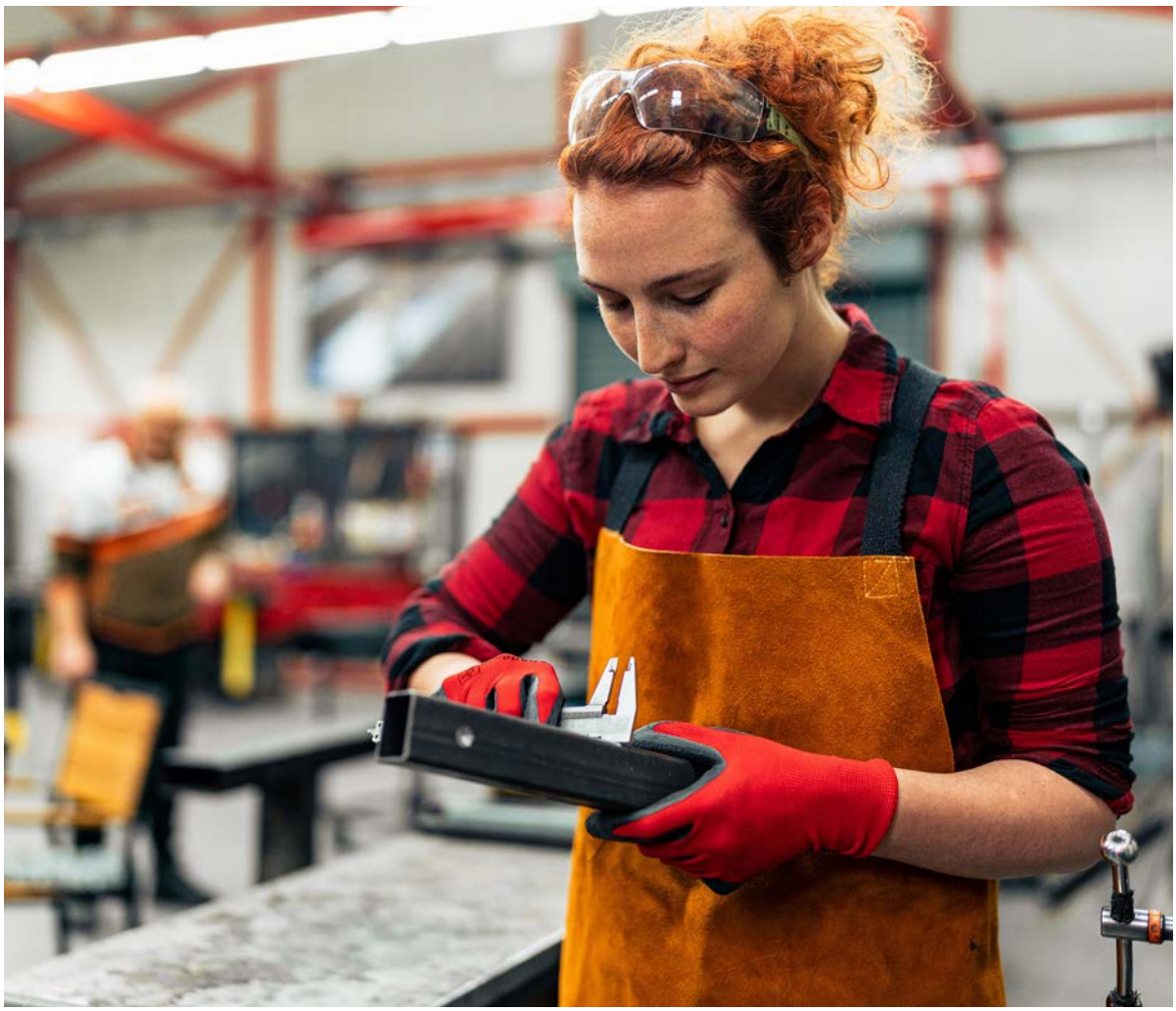
3:1 Introduction and key messages

After the age of 16, students have several different skills development pathways available to them.

In Scotland, Wales or Northern Ireland, they either enter the workforce or continue formal education on a vocational or academic path; this is a similar story in England, though some compulsory education or training remains until 18. All these routes are potential pathways into the chemical science sector. Currently, most will follow the academic path of A-Levels/Highers/Advanced Highers and university, as the Lightcast data shows – with over 70% of the workforce possessing at least an undergraduate degree.

However, we are keen that all routes into the chemical sciences are improved, broadened and encouraged to make the sector accessible to as many people as possible and bring in a range of talent. Our evidence base points to recommendations for vocational teaching in further and higher education as well as reviews of chemistry curricula in universities. Key messages include:

- Ensuring that vocational and academic routes awarding qualifications at the same level are held in parity of esteem should be a focus for Skills England and devolved equivalents. Policy decisions and public messaging could change perspectives and open up the chemical sciences sector, which has a higher-than-average demand for specified qualifications and attainment, to more people through a wider choice of routes.
- University chemistry education should focus more on preparing students for their future careers by including training in transferable skills. Specifically for chemical science careers, courses should increase content on current macro-scale trends affecting the sector, such as digital technologies and sustainability, and introduce students to the requirements of working in a highly regulated sector.
- More employers need to engage with the skills system to have a greater influence on the skills and knowledge of the next generation of employees. Collaboration on skills development should involve a breadth of stakeholders including universities, schools and other training providers as well as policymakers. Working directly with education providers to supplement specialist teaching or give access to advanced technology would further aid skills development and foster effective partnerships.



3:2 Vocational education

Vocational education – training that prepares someone to competently undertake a defined occupation – has always been a choice for those looking to enter technical and STEM jobs.

This form of training can include full-time study at various levels from school leaver through to foundation degree. Alternatively, learners can combine part-time study with work, as is the case with apprenticeships, which are available at different educational levels up to degree apprenticeships.

The awarding of recognised qualifications through vocational routes such as apprenticeships allows people to demonstrate their skills and suitability for potential roles, but they are not – and do not have to be – offered for all apprenticeships or vocational training routes.

The Lightcast research illustrated that the chemical science workforce is highly educated, with a far higher average qualification level than the UK as a whole. Chemistry jobs are bucking the national trend of no longer specifying particular qualification levels in order to be eligible – the proportion of jobs in the sector doing so is around double the national average, and 65% of those specifying a qualification required a degree.

By contrast, a below-average proportion of the jobs advertised were apprenticeships. It is possible that apprenticeship opportunities are not featuring on the job boards used to source the data, but we know the numbers taking vocational routes that are the main pathways into chemistry remain low[32] – Skills England highlights an "acute shortage of technician-level STEM skills … attributed to an undersupply of people with level 3-5 vocational qualifications over the last 20 years."[33] To illustrate this, the 2022/23 academic year saw 408 level 3-5 apprenticeships started in the Laboratory Technician and Technician Scientist pathways[34] – compared to 4,900 students accepted onto a chemistry degree course.[35] The apprenticeship figure is disappointingly low given the growth potential for chemistry sectors and the importance of staffing at the technician level.

The growth potential in chemistry jobs over the coming decade and beyond should provide opportunities for those taking vocational and technical pathways into chemistry and should act as a catalyst to invest in these pathways. An expansion of vocational routes could bring opportunities in the sector to people less likely to attend university, such as those from lower socioeconomic backgrounds.[36]

The Lightcast analysis shows that some aspects of the chemical sciences workforce do make above-average use of apprenticeships, particularly for nuclear engineers, laboratory operations and support, and manufacturing operations and support. These cases can be an example of the effectiveness of vocational routes into a chemistry career.[37]

The research also found that qualifications are specified in almost two fifths of chemistry job postings.[38] Offering qualifications as part of a science apprenticeship helps individuals show they meet requirements for the sector. It also helps them to demonstrate their skills to employers in a range of different sectors, equipping them for potential future changes and economic shifts.

Additionally, qualifications can help employers to be confident that the training they are either providing for staff, or looking for during recruitment, is of a high standard – giving current and relevant underpinning scientific knowledge, transferable skills, and allowing skill and career progression.

Recommendation 3

Apprenticeship training providers should consider embedding recognised qualifications at appropriate levels in their training programmes, so their graduates are best able to demonstrate their skills and value across different chemical sciences employers.

3:3 A more applied and professional experience in undergraduate courses

Focus groups with employers, trainers and employees all reported that graduates can struggle to apply their theoretical knowledge.

Some graduates experience difficulties when asked to solve open-ended questions or follow unspecified routes to set experimental goals. They can struggle to trouble-shoot difficulties with equipment or unexpected practical outcomes. These difficulties can stem from experience of teaching where the theory is introduced and a carefully curated practical experiment with detailed steps shows what this process looks like in a lab setting.

Employers indicated they want graduates who can apply a problem-solving mindset to better deal with these real-world situations. It is possible to train undergraduates in this skill through project work with more open-ended goals requiring multiple steps. Of course, not every situation or industry can be replicated during degree study – it is therefore essential that students understand the skills such as problem-solving that they are gaining through their practical training and how they can be applied in future.

Other transferable skills that should be incorporated into the degree experience include communication and leadership. These are some of the most important skills identified by Lightcast and by employers that are sought when making hiring decisions, as they are integral to modern science.

Researchers need to be able to communicate what they are doing and why, interact effectively and appropriately with other business functions, including those that may not share the same levels of scientific expertise, and work as part of a project team that itself sits within a wider organisation and works towards common goals. Again, this can be tackled in university through group work, presentations and other tasks that develop these skills.

Some employers told us that graduates can lack an understanding of how a commercial company operates distinctly from an academic lab. Concerns including business viability and cost effectiveness were new to them, as was working in a regulated sector requiring detailed record-keeping. Some maintained a “last-minute cramming” approach to work tasks.

Clearly, no degree course could cover all the regulations that impact the chemical sciences sector, particularly as they change to introduce more stringent sustainability and environmental protection targets. Nevertheless, an introduction to working protocols in a highly regulated research environment could be useful to set graduates up with the right mindset.

Assessment methods can also be reviewed to better prepare students for their careers. Feedback after exams and finished coursework is not representative of the professional experience and is often not read by students.[39] Authentic assessment – assessment using problem-solving – more accurately reflects real-world situations than solely taking exams. It would also help to give students ongoing feedback that can be acted upon through iterative improvement of ongoing work, for example, projects that help them become accustomed to taking responses to their work on board.

Recommendation 4

Undergraduate chemistry courses should further highlight the value of transferable skills.

This could include more real-world experience preparing students for future professional roles as well as increased emphasis on problem-solving, awareness of regulations, and useful, iterative feedback.

"We do have graduate programs where we have internships so that students can actually come spend time with the business and get an understanding of it. Hands-on experience during these internships is invaluable."

EMPLOYER (Pharmaceuticals, Corporate)

In common with generating experience through a university environment closer to the 'real world' of a professional role, we also found that exposure to working environments through work experience, placements and job shadowing while still going through education makes students into desirable candidates both for graduate jobs and further postgraduate study. Educators and employers agreed that placements make excellent opportunities to access advanced technologies that universities are unlikely to possess (or make available to students) and give them the benefit of seeing how industrial-scale processes are carried out. Evidence supports the effectiveness of placements and work experience in building professional skills. Open University research on "values and skills mismatch", for example, suggests that some individuals starting their careers are not meeting employer expectations due to lack of work experience opportunities during the COVID pandemic.[40]

Accessing placements can be challenging, especially where they require students to move for a period, leaving their accommodation and potentially part-time work. Different lengths and formats of placements could allow more inclusive access, while paid internships help significantly to mitigate these challenges altogether and are likely to be more inclusive of students from a range of backgrounds, though they incur costs for the hosting company. We heard from chemists involved in teaching in higher education that placement years in university courses are particularly valuable for students as they can see a long-term project through and build a relationship with the host company that can potentially lead to future employment.

Where placement provision is not available, an alternative is for universities to work with companies on setting problems and challenges in relation to an industrial topic. These can be accompanied by visits to facilities and teaching by company staff; we have heard of this format being used successfully at some UK universities from RSC academic groups.

While the most effective students working in placements will be for those in higher education, there are also advantages to offering work experience at earlier stages. This may be considered more as outreach to interest younger students – including from minoritised backgrounds – in STEM careers and demystifying laboratories and STEM industries, while still providing valuable exposure to the transferable skills used in the work environment.

Recommendation 5

Companies should provide opportunities for outreach and work experience across all educational levels from GCSE/ National 5 to degree placements, so students benefit from diverse insights into a real chemical sciences workplace and associated career options.

3:4 Emphasis on interdisciplinary experience

Another area where undergraduate study can differ from the professional experience is in relatively rigid disciplinary boundaries. Employers report that students are not always sufficiently exposed to interdisciplinary ways of working that can more accurately reflect the reality of a commercial project.

For example, the UK Government has identified "engineering biology" as a key area of national strength. This field requires a range of disciplinary expertise and knowledge to apply chemical engineering techniques in biological systems, including chemistry skills. Such technologies require interdisciplinary teams with the skills to work with experts who have different subject area knowledge (this was also highlighted in the RSC's Digital Futures report, in the context of using digital technologies in chemistry).[41]

However, other RSC evidence indicates that specialised chemistry knowledge is required to be able to usefully engage in interdisciplinary work, collaborating with others who have diverse core disciplinary experience.[42] In this project as well, the importance of carefully balancing in-depth chemistry and interdisciplinary skills was highlighted.

Universities may be able to contribute to striking the right balance by incorporating interdisciplinary experiences as an aspect of project work or through case studies relevant to existing courses, whilst also ensuring that students acquire the chemistry knowledge employers require.

Rather than being expected to have detailed knowledge of multiple disciplines, the aim could be to get students accustomed to working on projects requiring different specialisms, and to thinking of potential solutions that lie outside of their immediate area of expertise. Employers find this valuable as it better reflects the experience of developing a technology from benchtop to application.

Recommendation 6

Further and higher chemistry education should emphasise the role and importance of interdisciplinary science and give experience working on interdisciplinary projects akin to the challenges faced in the professional application of chemistry.

3:5 Digital technologies and the changing nature of chemistry

Sustainability and digital technologies are the two principal areas of change within the chemical sciences. Skills in these areas are growing in demand in the chemical sciences faster than in the UK economy generally, as Lightcast's analysis has shown.

This finding was reinforced throughout our engagement with the RSC community and beyond. The RSC already recommends the incorporation of a greater emphasis on these areas within undergraduate chemistry courses through our updated degree accreditation requirements. Our engagement in this research has shown us that students agree on wanting to cover these topics in their chemistry education.

First tackling digital skills, an important question of definitions arises. This term covers a spectrum starting from what we would consider basic digital skills used in the workplace such as Excel spreadsheets, email communication and folder-based file storage. At the other end of the spectrum lie advanced digital skills such as coding, high-level data analysis and the emerging field of machine learning and artificial intelligence (AI).

In the past, basic digital skills have been assumed of students leaving secondary education. However, we are increasingly hearing that some students entering university lack professional digital skills, likely because the technology they interact with on a daily basis functions through apps on portable devices, messenger-style communication and cloud-based storage, whilst most organisations use Microsoft software for day-to-day work (Microsoft Office being the top digital skill required in Lightcast's analysis).[43]

University teachers have told us of a reluctance to include these skills in undergraduate curriculums as they take time that could be devoted to subject-specific learning, and while not universal, a lot of new undergraduates do already possess strong knowledge of these basic professional digital skills.

We have recommended above that curriculum reform is necessary in education pre-university to give a grounding in the necessary transferable skills that will allow students to perform well in university and in work. It is also becoming the case that this earlier stage of education should cover the digital skills used in a professional environment. However, until these are covered comprehensively at earlier stages, universities should be cognisant of the need to bring all their students to a basic level of competence in these skills.

Turning to advanced digital skills, the picture is varied and evolving. Coding and advanced data analysis are becoming critical skills for chemistry companies, but are often acquired through in-work training. We have heard from employers that they would rather employ a candidate with strong chemistry skills and train them in coding/data skills, rather than the other way round.

The variety of applications for these technologies also means that an undergraduate course is unlikely to cover the specifics of the application necessary in a professional context. Furthermore, software packages used by companies are often expensive, making it unlikely that universities can afford to make these available to all their students. Some universities have explored teaching coding as part of their undergraduate course but experienced pushback from their students due to the difficulty of the skills and perceived distance from their expectations of a chemistry course.

Companies are working out how they could potentially incorporate AI, including, LLMs, into their business practices. Some are already using AI for drug discovery, and we heard from some members that they were using large language models (LLMs) to accelerate certain tasks, for example producing first drafts. As it develops further, AI and LLMs are likely to find other applications in the chemical sciences sector.

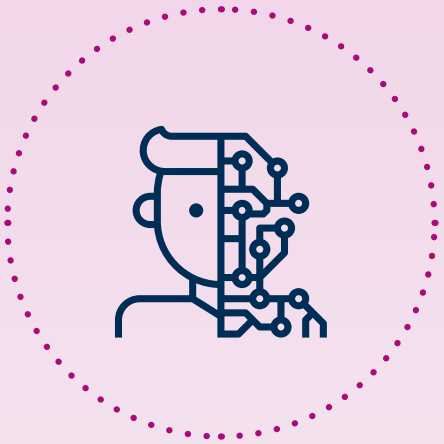
"I believe that technology is advancing very, very quickly. Software are changing very, very quickly. AI is coming into play as well. We know that we are in an era that, you know, a lot of things now can be automated if you have the knowledge and the support."

EMPLOYER (Pharmaceuticals, Corporate)

Part of our engagement on this topic covered the feasibility of teaching cutting-edge AI. Given how fast the field is evolving, university teaching staff may themselves not have the expertise to cover it effectively. Students would benefit from being exposed to the capabilities of AI and understanding how to work with it, but also need to understand its limitations.

Some employers we spoke to found that it was important employees understood how and when to use digital tools and could critique their outputs. We also heard about mistakes made by AI systems in this context. This emphasises the need for users to have a strong understanding of chemistry fundamentals to be able to interrogate the output of AI and other automated systems and watch for these mistakes rather than trusting the outputs without questioning.

This reflects findings of the RSC Digital Futures report, written before LLMs became widely available.[44] We also heard the view that, rather than presenting AI and digital tools as enabling the bleeding edge of research, their key advantage lies in automating or simplifying routine tasks, leaving more time for human-led creative and innovative work.



Recommendation 7

Chemistry courses in further and higher education should help students develop appropriate digital literacy and equip them with digital skills, including coding skills and exposure to the potential uses and risks of AI/Machine Learning.

3:6 A lens of green chemistry and sustainability

Sustainability is a multifaceted topic with relevance across the chemical sciences.

Chemistry underpins many of the technologies that are part of the global net zero transition including power generation and storage, synthetic and alternative fuels, lightweight and robust novel materials, sustainable construction, sustainable agriculture and food, among many others.[45] Relating study materials to these critical areas can help engage students with the real-world relevance of their course and point them to potential areas in which they could work.

> **"Green chemistry (is important)... trying to deal with global issues (...) (With the) clean up as well as the 'greening' of chemistry."**
>
> **CHARTERED CHEMIST**

There are also increasing efforts to improve sustainability and environmental impact in chemistry itself. This involves actions such as reduction of single-use plastics, reduction of toxic solvents and reducing energy consumption.

> **"We've changed so quickly on sustainability that, for example, a carbon footprint of a chemical is so important at the moment to make a decision. If you have your your external carbon goals and net zero strategy, your chemists really need to understand what's the carbon footprint of your chemical, how is it derived, and (to) really understand the science behind the numbers. And we didn't have that at school. None of my chemists. None of them know anything about it. (...) But carbon footprint is just a one step. (...) We started on carbon but other companies are already on biodiversity. What's the impact of that chemical on biodiversity?"**
>
> **EMPLOYER (Chemical Manufacturing, Corporate)**

Training in these areas is a pain point for companies as it can require considerable financial and resource allocation and employers tell us they would like to see an effective grounding in these topics given within chemistry degrees.

Recommendation 8

Frame chemical sciences in further and higher education with a lens of green chemistry and sustainability where appropriate, so students understand the centrality of chemistry to net zero and sustainability efforts.

3:7 Industry engagement on skills development

The best way for companies to influence the skills system, to train the people they need, and produce the graduates they are looking for, is to interact with it directly.

Some chemistry departments have Industry Advisory Boards to accommodate such direct interaction, but they report varying levels of engagement and ease of filling positions. Some universities (tending to be larger and older institutions) have longstanding relationships with large chemistry employers, consulting them on course content and even bringing in industry figures to teach relevant modules. Other universities reported advisory groups made up of alumni who have remained local.

There are a range of existing models that could offer suitable interaction routes for both large and small companies, as they often face quite different challenges. Universities are often hubs of science and research clusters in their area and there will be a chemistry department at least relatively local to many companies around the UK. We encourage firms employing chemical scientists not involved yet in the models described above to develop relationships with universities to feed in their views and needs when it comes to skills training and developing the future workforce.

In addition to working with education and training providers, companies can work with policymakers at local and national scale to influence skills supply. Local Skills Improvement Plans (LSIPs) cover the country, dividing it into 38 areas, each of which has an employer representative body feeding into the plan for the skills agenda in that region.[46] Each area produced a progress report in summer 2024 – these may give an opportunity to engage in skills policy locally. The new government has also set up Skills England, which is tasked with "bring[ing] together key partners to meet the skills needs of the next decade." Their work will involve contact with stakeholders to understand sectoral skills gaps then work with regional and national policy bodies to shape the skills system to address these needs. Chemical science employers with particular interest in the skills system are encouraged to engage with these initiatives.

Recommendation 9

Employers should shape future skills in the chemical sciences workforce by engaging with education and training providers, and policymakers locally and nationally, on their skills needs.

This could involve participating in Industrial Advisory Boards at university chemistry departments, giving students access to their technology and resources, and/or feeding in to policy analysis of local skills gaps and UK industry skills requirements.

What the **RSC** is doing

The RSC has longstanding engagement with vocational and academic education and training.

We work closely with university chemistry departments, including as an accrediting body for undergraduate degrees. Our specification for degree content is regularly reviewed and updated to keep pace with the standards required of chemistry graduates and to include contemporary developments on teaching, learning and assessment in the chemical sciences – this has recently seen updated content on transferable skills, interdisciplinary experience and tackling sustainability in course content.[47] Other materials on sustainability suitable for use in universities and in industry are available on our Chemistry and Climate Change page.[48] We have also produced resources under the "Sustainable Labs" label to help the discipline in reducing its environmental footprint.[49]

We recognise the value of placements and work experience opportunities within degree-level study and at other stages and there are already Undergraduate Research Bursaries available to support summer research placements.[50] We will investigate routes to further support and facilitate work and research placements, as well as other ways of increasing communication and collaboration between universities and industry.

We also work with vocational training providers to accredit degree apprenticeships, and have worked to set apprenticeship specifications with the Institute for Apprenticeships and Technical Education (IfATE). We hold regular webinars and host resources to help employers understand the vocational training landscape.

The RSC also has a significant body of work on inclusion and diversity issues within the chemical sciences,[51] and is currently working to improve our understanding of disability inclusion[52] and socioeconomic inclusion to increase the diversity of people choosing and fulfilling their potential in the chemical sciences. One proposed recommendation to attract and retain diverse talent is to embed principles of universal design to create inclusive study and work environments enabling everyone to reach their full potential.[53]

RSC's work in this area also includes providing opportunities for outreach and work experience to students from minoritised and marginalised ethnic backgrounds. Together with the Windsor Fellowship, we deliver Destination STEMM, a national mentoring programme for Black, Asian and Minority Ethnic students in year 12.[54]

Through our *Broadening Horizons in the Chemical Sciences* programme, we further support students and graduates from minoritised racial and ethnic backgrounds to gain industry experience and pursue careers in the chemical sciences.[55] We also support outreach activities aimed at the wider public either directly run by the RSC or through access to the Outreach Fund, helping members of our community run chemistry-based engagement activities.[56]

4 Skills development throughout a career

4:1 Introduction and key messages

As we have seen, 'megatrends' are changing the nature of work in the chemical sciences sector and the makeup of the industries employing chemical scientists.

It is important that these are acknowledged and appropriate changes made to education and training for the next generation of workers.

However, concentrating solely on this aspect of the skills system would overlook the millions of people who are already working but will need their skills to keep pace with the progress of the sector – Skills England identified that 71% of the 2035 workforce have begun their careers.[57] All stakeholders in this system can work to improve the skills development in the workforce; key messages in this area emerging from our research include:

- The variety of careers in the chemical sciences is not well known, nor is the range of important skills required to enter them. Companies should participate more in outreach on the careers they can offer chemical scientists. They should contribute to efforts around better defining workforce skills and identifying skills gaps, using the results to improve the clarity of job adverts.
- Continuous professional development (CPD) is essential for the existing workforce. There needs to be a reversal of the decline in investment in staff training, and public bodies have levers to pull that can incentivise and promote this. Employees themselves should be vocal and proactive on their need for training to develop their skills and further their careers.
- Demand for skills in the regulatory landscape is growing among companies and in the public sector – this is an area to consider in degree courses, apprenticeships and CPD, including for regulators themselves.

4:2 Skills taxonomy for career outreach and job specifications

One of the findings from our focus group work was that the students involved reported a default picture of chemistry careers as laboratory-based opportunities, often in a pharmaceutical or petrochemical company.

Data generated by Lightcast, however, shows a wide variety of roles and industries within the sector, while the RSC's 'A Future in Chemistry' further illustrates the array of opportunities available.[58]

Alongside teachers and careers advisers, an important source of information on the rich variety of jobs that employ chemical scientists is the employers themselves. Conducting outreach activities, aimed at students of all ages or the public in general, opens people's eyes to the lesser-known directions their interest in chemistry could take them, and can boost companies' public profiles as well.

Recommendation 10

Employers should be more involved in public outreach around the variety of chemistry careers and the skills required to succeed in them, for example through schools outreach, work experience and other placements.

4:3 Professional development for the existing workforce

The identification by Skills England of extant skills gaps, as well as key sectors whose growth will require appropriate skills supply (including Life Sciences and the green workforce, as we have already identified as areas of chemistry strength),[59] means that an immediate response to skills needs is necessary as well as addressing the long-term pipeline through education.

It is crucial, therefore, that upskilling and retraining are options for the existing workforce so that skills provision can keep pace with technical developments and industry changes. Effective companies will facilitate this, but employees should be active in pursuing their own development and understanding the labour market signals on how to progress their careers.

While training and professional development have clear advantages including boosting the skills base of the existing workforce, and the engagement and productivity of existing workers, there is a trade-off in cost and time required to provide the training and realise the benefits of incorporating new skills into work processes.

> **"We do crosstrain. We make sure our chemists are working on different projects that stretch their normal...what they would normally go for... (...) We try and get them on to other adhesive chemistries. So they're learning other parts as well. So yeah, if we do have skill gaps (...) it's informally covered by that, by managing it through different projects."**
>
> **EMPLOYER (Chemical Manufacturing, SME)**

Training can take various forms, which will vary in suitability depending on the needs and circumstances of the employer and employee(s). Our research found that larger firms tended to use in-house training (including circulating employees through job roles and even work sites), while SMEs sought training from external providers or used shadowing of existing coworkers. We heard that planning for skills provision is not possible over a longer period of time, as developments in technology and techniques, as well as external market factors, are too unpredictable beyond around two years. SMEs in particular accessed training in an ad hoc fashion depending on the needs of their current project.

More formal training will offer recognised qualifications, as discussed above in considering vocational education routes. There is no reason that individuals already in the labour force should not be seeking these qualifications as they are designed to impart useful skills and will be recognised in future on individuals' CVs.

There is, of course, also a place for training that does not lead to awards or qualifications. Companies providing in-house training courses, or those looking to quickly upskill employees to fill a skills gap, need the flexibility to act quickly and meet their individual needs, rather than following an accredited course. Trainers need the flexibility to choose what segment of the market they are aiming at and which types of courses and qualifications they want to offer.

Our evidence gathering for this project included a survey of people working in technician roles. Over half of respondents said CPD was "very important" in their industry, and over 90% at least "somewhat important". Less than half, though, were even "somewhat satisfied" with the level of CPD they were able to access. Barriers reported were funding and time.

Our participants in focus groups of employers and researchers also recognised the importance of training for employees. Barriers were in finding the time to complete training, and planning for when it would be needed. Discussion of our findings with RSC interest groups raised the risk that, in difficult economic circumstances, some companies will see cutting training costs as a way of saving money.

This is backed up by research that has shown a decline in private investment in training – as Skills England report, "Training expenditure is at its lowest since the introduction of the Employer Skills Survey (ESS) in 2011, with investment per employee down by 19% in real terms."[60]

There is an important role for government to incentivise training and development, especially in periods of economic strain. There may also be an aspect of de-risking investment in training where Government is providing support or investing in new technologies. Governments and Combined Authorities could also explore other levers, such as procurement policies. This also fits with the goals of the R&D People and Culture Strategy that skills gaps are filled through anticipating future needs.[61] Other independent research has also identified the need to boost skills for the future labour market, identifying (as our Lightcast research did) that transferable skills will be the most in demand across all jobs on top of the specific technical skills required.[62]

Recommendation 11

Policymakers should realise the growth potential of current chemical science industries by building skills in the current workforce, incentivising companies to support workers' development.

Employers must ensure access to CPD, particularly in the key evolving skills areas of sustainability, data/ digital technologies and effective communication.

4:4 Technician roles and the talent pipeline

The technician workforce in particular is experiencing a skills gap. People in technician roles are vital for enabling work in industry and academia, but there are concerns that turnover of staff is leading to the loss of a store of expertise and skills. Those who have made a career in technical roles are in some cases approaching retirement age; this is, on average, an ageing workforce.[63]

Losing these individuals from the workforce can result in skills and experience being lost from institutional memory. Many new entrants may be overqualified for these technical roles (as not all technical jobs require a degree and some can be competently carried out by those with training at level 3, such as the lab tech apprenticeship). This may mean excessive hiring and training costs, which could be reduced through offering more apprenticeships, potentially reducing staff turnover and improving organisational memory through on-the-job training.

As economic circumstances become more difficult, technicians often find their workload increasing. Our survey of technicians also showed a majority were unsatisfied with the availability of CPD in their role. Some have told us they have taken on additional responsibilities such as teaching, adding to their workload. While this can help develop the skills of the individual, it has the side effect of exacerbating the overall skills shortage.

If employers are to retain and develop their technician workforces, two areas of change are required. Firstly, making technical roles attractive in the long-term with clear career progression routes at the technical level and clear options for professional development, particularly in relation to skills in the areas of sustainability and digital technologies. Secondly, ensuring the roles are accessible to those with a range of different backgrounds, including those who are not graduates (against the current situation where over 60% of laboratory operations and support roles require a bachelor's degree or higher).[64]

Recommendation 12

Employers should secure the talent pipeline entering technical careers by planning ahead in relation to workforce needs and ensuring recruitment criteria reflect the needs of the role and are accessible to a range of qualification levels.

They should also improve retention of technical professionals by offering accessible and meaningful professional development, career progression opportunities and better recognition.

4:5 The impact of regulation

A recurring topic in our qualitative engagement with employers was issues they were experiencing around the fast-moving regulatory landscape. This means they are struggling to keep an up-to-date awareness of what they should be following and are equally finding it difficult to plan for the future (impacting their development of projects and products as well as their workforce).

This goes down to the level of individual employees who are uncertain about adhering to regulations in their activities, but also up to the level of supply chains and the overall design of products and manufacturing processes. We also heard that graduates start work without experience of the nature of work in such a regulated field, apart from safety protocols in university labs.

The Lightcast research found that safety and regulatory awareness is increasing as an important skill required for chemistry jobs. 'Legal, regulatory and policy' jobs are one of the fastest-growing categories of occupations within the chemical sciences. Skills in understanding regulation and ensuring compliance are in high demand and attract remuneration accordingly in these roles.

Innovate UK have also identified regulatory pressures as a threat to the UK chemicals industry,[65] citing "costly and burdensome" compliance. Regulatory change (in general, and also in divergence from international regulations in the wake of Brexit) further adds complication, particularly when introduced quickly or when multiple changes come in quick succession.

"In my area of work, radiation protection regulations [are important]. From the side of nuclear industry, there was lots of growth because of the net zero policies and pushing towards green energy. And (...) both the medical sector and the nuclear sector were affected by changes in regulations or, more precisely, the enforcement of the regulations. (...) That led to a boom in the need for people with special knowledge of radiation protection. So the sector needs to double the workforce (...) because of that change in regulations."

PRACTITIONER: Industry

Employers report that update and refresher training on regulation is commonly necessary. This can be particularly acute when new graduates do not have experience of working in such a regulated environment. However, this is also the case within government and the agencies tasked with making and interpreting regulation as well as monitoring compliance. Resource and skills constraints within government mean there is a lack of responsiveness to the latest developments in chemicals testing and risk management, creating additional unnecessary complications and costs for both regulators and businesses.

Some illustrative examples of regulations and requirements highlighted in the research as causing difficulty for firms include:

- Hazardous chemical regulations, causing changes of formulations and raw material suppliers
- Phasing out chromium and nickel from catalyst products
- Standardisation of lab management systems
- Good Manufacturing Practice regulations
- Various regulatory deadlines (compliance, or in certain cases a lack of a deadline leading to suppliers not moving towards compliance)

Regulatory landscapes are a complex issue with multiple goals and often trade-offs for all stakeholders involved, such as between regulatory stability and adapting to new technologies. Where possible, this complexity can be reduced through alignment between international regulatory regimes. Skills gaps could be easier to address if this alignment is pursued, such as through EU chemical and product regulations.

One of our active policy priorities is the establishment of a Chemicals Agency for the UK. Our proposal for a chemicals agency highlights the need for science/chemistry to be a core component of chemicals management, and the need for a skilled workforce to support regulators and industry. We have suggested a cross-governmental training programme to help upskill civil servants in the short term, and more investment in regulatory skills in educational pathways to support the longer-term development of a workforce to support regulatory development and compliance in government and industry. We also envision a future chemicals strategy that streamlines the regulatory environment and promotes beneficial international regulatory alignment.[66]

Recommendation 13

Policymakers and employers should recognise regulation as an important aspect of the skills base in industry and government; they should ensure training and CPD is available to all who develop and apply regulations and other standards.

What the **RSC** is doing

The RSC promotes professional development for members and more widely within the chemical sciences community and offers chartership and professional registration to those committed to maintaining high professional standards, across professionals including researchers, technicians and teachers.[67]

As well as this, members can receive individual support on career and skills matters through advice or mentorship.

The RSC, among a range of professional bodies, awards Professional Registration and Chartership (Chartered Chemist/Scientist/Environmentalist and Registered Scientist/Science Technician) that give formal recognition of an individual's commitment to maintaining high professional standards and continued learning.

These competence-based awards are designed to mirror the skills needed in industry at the relevant level and, working with a mentor, candidates can see where they have gaps in their skill set and look to remedy this. The awards recognise more than chemical science knowledge – they also require applicants to recognise vital transferable skills.

The RSC also accredits company training programmes that meet the requirements for these awards. This accreditation gives companies the confidence that their training and progression routes are of a recognised high standard, helping individuals to grow within the business.

The RSC is a long-term supporter of the Technician Commitment, which sets out principles for employers of technicians to ensure their work is recognised and rewarded, and that they can build sustainable careers.[68] We can work with business on how to provide these aspects for their technicians.

Resources are available from the RSC to advise individuals on skills development and direct them to training provision. Our skills and career advice service considers technical and transferable skills that could benefit an individual, and is delivered via personalised one-to-one advice, in-person talks, interactive online career development tools and online information. Our presence at larger chemical science conferences has increased to offer one-to-one advice and general skills advice at these events.

We recently introduced our new Pathfinder platform, that not only allows members to track their skills and reflect on the impact of their activities, but also signposts to tailored guidance to address gaps in their skillset and allows greater discoverability of opportunities within the RSC offer.[69] We aim to expand the capabilities of this platform and release it to a wider userbase in coming months.

continued >

Many of the professionals we spoke to over the course of this project felt mentorship from a more senior figure was a beneficial and productive way of understanding their career trajectory, their skills and any gaps, and point them towards sources of help and support for development. Particular advantages of mentorship could be realised by people from minoritised backgrounds who may not have the social contacts or professional network to replicate the function, and by those finding themselves at particularly difficult and competitive career stages such as early-career academic researchers.

The RSC offers an award-winning mentorship programme to members.[70] Launched 10 years ago, this facilitates professional members to receive and give mentoring. There are several specialist schemes which include a leadership skills programme and one dedicated to those from Black and minoritised ethnicities.

The existing member mentoring offered by the RSC is highly valued by those members that use it, and we have gained external funding to sustainably grow this project through implementation of technology solutions. This will include increasing our offer to help address the underrepresentation of minoritised communities in chemistry.

We will enhance our existing mentoring activity by targeting specific groups, working with interest groups and introducing some new software that will help automate manual elements of our mentoring process. We will focus on increasing our mentoring support for Black and minoritised ethnicities, women/girls/non-binary and chemical scientists from low socioeconomic backgrounds – groups identified by Lightcast analysis of demographics as being underrepresented in the workforce.

Member satisfaction with our career support resources is good with members rating the advice they receive as excellent in 2024,[71] and we have seen an increase in use over the last three years of 36%. Feedback is consistently good – an illustrative example from a mid-career industry member reads: “After the consultation I really feel confident that I will succeed in my future career steps and I also have a clear action plan for achieving my goals”. We are going through a process of developing new tools and improved services to increase capacity and remain a go-to body to support chemists.

The RSC maintains Subject Communities, Interest Groups, Regional Sections and other ways for chemists to network and strengthen their and their peers’ knowledge and skills of their areas of specialism.[72] We can work with and tap into these expert groups as necessary to keep the RSC at the forefront of the chemical sciences.

A critical use of this expertise is to set standards for chemistry degree courses and share best practice in pedagogy. We also interact with government on curriculum content and have materials to aid chemistry teaching in schools. Increasing awareness of this work and these resources will mean more students have the opportunity of high-quality chemistry teaching.

5 Conclusions and next steps

5:1 Conclusions

This project highlights both the range of careers in the chemical sciences in the UK and the potential for the sector to grow faster than the UK workforce in general.

Building on Science Horizons, Digital Futures and Chemistry's Contribution, it shows the role chemistry knowledge and skills are playing in economic growth and creating a healthier, more sustainable society, developing technologies like new batteries, novel drugs and advanced materials. Realising this potential will require policy and other actions to ensure the chemical sciences workforce has the green, digital and other skills to succeed – this includes individuals who have already begun their careers and will carry on contributing for decades to come.

The evidence from data analysis and sectoral engagement throughout this project led us to some clear conclusions. Success in a chemical sciences career requires a breadth of skills, knowledge and abilities both technical and transferable, so effective teaching of these must start as early as possible. The school-age curriculum can be a vehicle for practical and transferable skills, including introducing the problem-solving skills needed in the digital age. It can be crafted to confer an ongoing interest in chemistry through real-world relevance and addressing contemporary concerns including sustainability and net zero. These findings need to be acted on when reviewing chemistry and science curriculums.

Post-secondary school, the main ways into the chemical sciences workforce are through university degrees or vocational routes, for example apprenticeships. Again, our research shows the importance of including sustainability and digital skills in these pathways, alongside skills and understanding to work in interdisciplinary scientific environments. Whilst our employer conversations show many already offer apprenticeships in the sector, the growth potential of the chemical sciences, combined with an ageing technician workforce, shows both an opportunity and a need to increase the number of apprenticeship openings. It is also important that careers advisers, teachers, employers and policymakers help to ensure parity of esteem between degree and vocational routes into a chemical science career.

Additionally, exposure to the workplace and training through real-world experience is important even in academic routes, letting students develop the transferable skills that will help them apply, communicate and contextualise their expertise.

The chemical sciences sector is experiencing macro-scale trends that are changing the nature of work, requiring individuals to undertake continuous professional development to keep up to date with the latest technologies and best practice. New digital technologies are increasing the capability of data- and AI-driven development, requiring individuals to understand these systems and how to apply and interrogate their outputs. This points to the importance of employers investing in training and the advantages for individuals of seeking continuous professional development, for example through professional bodies.

Pushes to increase the sustainability of chemistry, in both the products it creates, and the processes used in research and manufacturing, require new green skills. The increasing complexity of industry, product and environmental regulation also calls for skilled individuals to help companies and regulators navigate this landscape. With the right curriculums, the right investment in skills and the right support through employers, training providers and professional bodies, the chemical sciences workforce can continue to make the most of digital technologies and play a crucial role in achieving environmental sustainability, better health and the net zero transition.

5:2 Our next steps

The RSC will continue to work to support policymakers and the sector in achieving progress in the areas highlighted within this report.

Our staff and our members contribute expertise in policy, education, research, industry, and inclusion and diversity – they will use the insights from this report to inform policy conversations and initiatives for change. We will continue to work with a range of actors across the chemical science sector, including policymakers, teachers and chemical sciences employers, to enable progress towards the recommendations in this report.

Our research provides further evidence of the benefits of collaborations between chemistry research and education in universities and companies in the chemical sciences sector. The RSC, with its central position for chemistry, will continue to convene in these spaces. We encourage members interested in these opportunities to make the most of member communities that bring together academia and industry and to share experiences of these collaborations.

The evidence base from this project is enabling us to support our members and informing current programmes of work, detailed in this report, including our careers advice and our efforts to ensure inclusion and diversity in the profession. It will also inform the development of our 2026-30 Strategy. We will continue providing resources for the chemists of today and tomorrow – now informed by our picture of the key skills that will underpin the future success of chemical scientists. Ultimately, it provides important information on future skills for decision-makers, including our members and the broader chemical sciences community, and helps us to support them in their efforts to make the world a better place.

Appendix 1 – Details of methodology & participants

Details of the data analysis methodology is available in each chapter of Lightcast's Interim Report for this project, which can be found on the RSC website.[73]

Engagement on these results and the project research questions was carried out by the RSC and by Nutcracker Research.

Focus groups and interviews commissioned from Nutcracker, carried out between April and May 2024, included the following participants (sourced independently of the RSC, with anonymised results provided to us):

Target audience	Methodology
Employers	Seven, one-to-one online interviews with individuals involved in decision-making on chemical science skills needed in their company; mix of sectors (chemical manufacturing, pharmaceuticals and batteries)
Training providers	Three, one-to-one online interviews with individuals involved in decision-making on the chemical science training programmes/curricula in place at their institution
Practitioners in Industry	One online group with six chemists who have worked in industry for up to 10 years
Practitioners in Academia	Two online groups (three participants each): one with chemists who have been working in academia for less than five years and one with chemists employed in academia for between six and 11 years.
Chartered Chemists	One online group with six chartered chemists, each with at least 25 years' working experience spanning both industry and academia
Students	One, online group with six final-year undergraduate and masters chemistry students

The RSC's own engagement involved discussion with community and interest groups of the project and the results from Lightcast's data analysis. Those consulted were (alphabetical order):

- Analytical Chemistry Community
- Applied Materials Group
- Chemical Information and Computer Applications Group
- Committee for Accreditation and Validation
- Directors of Undergraduate Teaching
- Education Community Council
- Environment, Sustainability and Energy Community
- Faraday (physical chemistry) Community
- Food Group
- Heads of Chemistry UK
- Inclusion and Diversity Committee
- Management Interest Group
- Member Communities Board
- Member Networks Committee
- Organic Chemistry Community
- Process Chemistry and Technology Group
- Professional Standards Board
- RSC Board of Trustees
- RSC Scheme Coordinators
- Science and Innovation Leadership Forum
- Toxicology Group

As a large and diverse cohort, a survey was conducted of professionals in technician roles. 67 responses were received.

RSC interest groups that were not consulted in person were given the opportunity to submit their views and feedback on the data analysis to the project team in writing.

Heads of Chemistry UK also had the opportunity to submit detailed feedback on the data report in writing – two responses were received.

We also included information from other RSC surveys not run specifically for the purpose of this project. These were:

- **Science Teaching Survey 2023 (2,932 responses) and 2024 (1,846 responses)**
- **RSC Pay and Reward Survey 2023 (4,833 responses)**

References

1 https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/chemistrys-contribution-workforce-trends-and-economic-impact/

2 Note that the formulation of this question reflects a time when recovery from the Covid-19 pandemic was a key driver and before the mass roll-out of large language models (LLMs). This report therefore considers both green and digital, as key trends.

3 Lightcast for RSC (2023) 'The Future Workforce and educational pathways' chemistry-future-workforce-and-education-pathways-data-report.pdf – henceforth "Lightcast" https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/future-workforce-and-educational-pathways?

4 https://labour.org.uk/change/mission-driven-government/

5 Lightcast, p.35

6 https://edu.rsc.org/future-in-chemistry/

7 https://www.gov.uk/government/publications/uk-science-and-technology-framework

8 https://assets.publishing.service.gov.uk/media/670cde8692bb81fcdbe7b745/industrial-strategy-green-paper-final.pdf

9 https://www.policyconnect.org.uk/research/skills-2030-building-world-class-skills-system

10 https://www.gov.uk/government/publications/skills-england-report-driving-growth-and-widening-opportunities – henceforth "Skills England"

11 Industrial Strategy Green Paper, *ibid*, p29

12 https://sdgs.un.org/goals

13 Lightcast (2023) pp.16-17

14 Innovate UK, Sustainable Carbon Ambition for the UK Chemicals Industry, p8; https://iuk-business-connect.org.uk/wp-content/uploads/2024/08/IUK-Sustainable-Carbon-Report.pdf

15 https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/digital-futures/

16 https://www.rsc.org/policy-evidence-campaigns/chemistry-education/education-reports-surveys-campaigns/the-science-teaching-survey/2023/negative-impact-of-underfunding/#barriers-to-practical-work-table

17 https://www.rsc.org/policy-evidence-campaigns/environmental-sustainability/sustainability-reports-surveys-and-campaigns/a-sustainable-chemistry-curriculum/

18 Both our 'recommendations for a primary science curriculum' (https://www.rsc.org/globalassets/07-news-events/rsc-news/news-articles/2024/08-august/stem-primary-curriculum-recommendations.pdf) and our chemistry curriculum framework (https://www.rsc.org/globalassets/22-new-perspectives/talent/chemistry-curriculum-framework/chemistry-curriculum-brochure.pdf) for 11 to 19, emphasize the importance of contexts as well as sustainability issues

19 Gatsby Benchmarks, https://www.goodcareerguidance.org.uk/case-study/linking-curriculum-learning-to-careers

20 Education Committee "Teacher recruitment, training and retention" report (2024) - https://publications.parliament.uk/pa/cm5804/cmselect/cmeduc/119/report.html#heading-4 (para 142)]

21 https://committees.parliament.uk/writtenevidence/120420/html/

22 This is run annually by the Royal Society of Chemistry, Royal Society of Biology and Institute of Physics

23 https://www.rsc.org/policy-evidence-campaigns/chemistry-education/education-reports-surveys-campaigns/the-science-teaching-survey/2024/concerning-trends-in-working-conditions-and-staffing-levels/#:~:text=Continuing%20professional%20development

24 https://www.rsc.org/policy-evidence-campaigns/chemistry-education/education-reports-surveys-campaigns/the-science-teaching-survey/2024/1-in-5-teachers-lack-awareness-of-essential-skills-for-chemical-science-careers/

25 https://www.rsc.org/policy-evidence-campaigns/environmental-sustainability/sustainability-reports-surveys-and-campaigns/a-sustainable-chemistry-curriculum/

26 https://www.rsc.org/policy-evidence-campaigns/chemistry-education/education-reports-surveys-campaigns/chemistry-curriculum-framework/

27 https://www.rsc.org/globalassets/07-news-events/rsc-news/news-articles/2024/08-august/stem-primary-curriculum-recommendations.pdf

28 https://www.gov.uk/national-curriculum/key-stage-3-and-4 - Note that at the time of writing, academy schools are not required to follow the national curriculum, but is expected they will be in future.

29 In Scotland students generally follow a broader curriculum at post-16, usually studying 4 or 5 Higher/Advanced Higher courses.

30 https://edu.rsc.org/future-in-chemistry

31 https://edu.rsc.org/resources/not-all-chemists-wear-white-coats/1654.article

32 The apprenticeship standards most relevant to chemistry sectors include laboratory technician (level 3), technician scientist (level 5) and laboratory scientist (level 6). These are pathways to a range of scientific roles.

33 Skills England: Driving growth and widening opportunities, p34

34 https://explore-education-statistics.service.gov.uk/find-statistics/apprenticeships

35 UCAS. (2024). UCAS Undergraduate end of cycle data resources 2023. https://www.ucas.com/data-and-analysis/undergraduate-statistics-and-reports/ucas-undergraduate-end-cycle-data-resources-2023

36 Equality of access and outcomes in higher education in England, House of Commons Library, July 2024; https://researchbriefings.files.parliament.uk/documents/CBP-9195/CBP-9195.pdf

37 Lightcast p62

38 Lightcast p59

39 Pitt, E. and Norton, L. (2016) '"Now that's the feedback I want!' Students" reactions to feedback on graded work and what they do with it', Assessment and Evaluation in Higher Education. Taylor & Francis (Routledge), pp. 499-516. doi: 10.1080/02602938.2016.1142500.

40 https://www5.open.ac.uk/business/knowledge-hub/latest-news-and-trends/employers-report-skills-mismatch-younger-workers

41 https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/digital-futures/

42 https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/science-horizons/

References

43 Lightcast p56

44 https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/digital-futures/

45 https://www.rsc.org/policy-evidence-campaigns/environmental-sustainability/chemistry-and-climate-change/

46 https://www.gov.uk/government/publications/identifying-and-meeting-local-skills-needs-to-support-growth/local-skills-improvement-plans-lsips-and-strategic-development-funding-sdf

47 https://www.rsc.org/globalassets/03-membership-community/degree-accreditation/accreditation-of-degree-programmes.pdf

48 https://www.rsc.org/policy-evidence-campaigns/environmental-sustainability/chemistry-and-climate-change/

49 https://www.rsc.org/policy-evidence-campaigns/environmental-sustainability/sustainability-reports-surveys-and-campaigns/sustainable-laboratories/

50 https://www.rsc.org/prizes-funding/funding/find-funding/undergraduate-research-bursaries/

51 https://www.rsc.org/policy-evidence-campaigns/inclusion-diversity/

52 https://www.rsc.org/policy-evidence-campaigns/inclusion-diversity/surveys-reports-campaigns/disability-in-the-chemical-sciences/actions-for-employers-and-institutions/

53 https://www.rsc.org/policy-evidence-campaigns/inclusion-diversity/surveys-reports-campaigns/neurodiversity-in-chemical-sciences/resources-and-guidance-on-neurodiversity/#design-principles

54 https://www.windsor-fellowship.org/programmes/stemm-chemical-sciences/

55 Broadening Horizons in the Chemical Sciences programme

56 https://www.rsc.org/prizes-funding/funding/find-funding/outreach-fund/

57 Skills England p40

58 https://edu.rsc.org/future-in-chemistry/

59 Skills England p49

60 Skills England p35

61 R&D People and Culture Strategy, p16 https://www.gov.uk/government/publications/research-and-development-rd-people-and-culture-strategy

62 https://www.techniciancommitment.org.uk/assets/pdfs/technician-commitment-one-year-in-57482.pdf p5

63 NFER Skills Imperative 2035

64 Lightcast p61

65 Innovate UK, Sustainable Carbon Ambition for the UK Chemicals Industry, p72; https://iuk.ktn-uk.org/wp-content/uploads/2024/08/IUK-Sustainable-Carbon-Report.pdf

66 https://www.rsc.org/policy-evidence-campaigns/chemical-waste-and-pollution/uk-chemicals-agency/

67 RSC Professional Awards: https://www.rsc.org/careers/cpd/practising-scientists/

68 https://www.rsc.org/membership-and-community/supporting-organisations/technician-commitment/

69 Get started on your professional development with RSC Pathfinder (youtube.com)

70 https://www.rsc.org/careers/cpd/mentoring/

71 NPS of 70. Net Promoter Score® is a customer loyalty and satisfaction measurement taken from asking customers how likely they are to recommend your product or service to others on a scale of 0-10.

72 https://www.rsc.org/membership-and-community/connect-with-others/join-scientific-networks/

73 https://www.rsc.org/policy-evidence-campaigns/discovery-research-and-innovation/discovery-research-innovation-reports-surveys-campaigns/future-workforce-and-educational-pathways

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