

SUSTAINABILITY

Green shoots part 2 – Sustainability and the chemistry curriculum

The view from chemists
in academia and industry

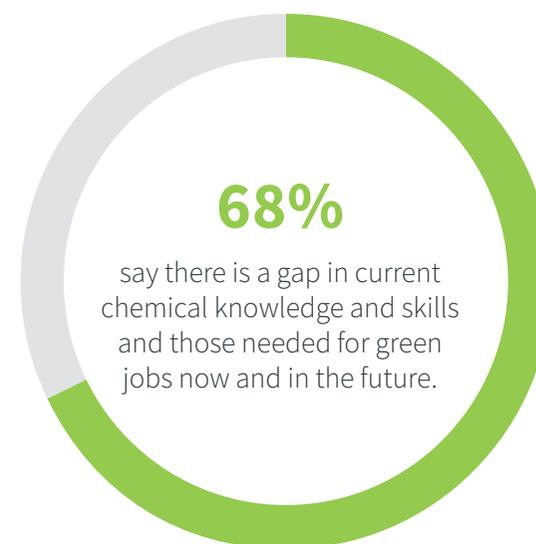
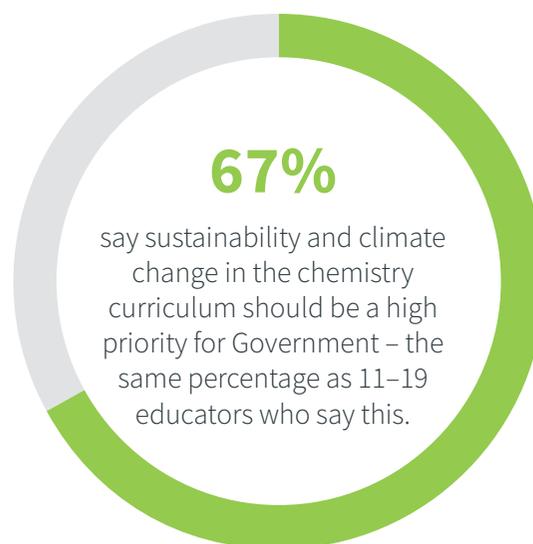
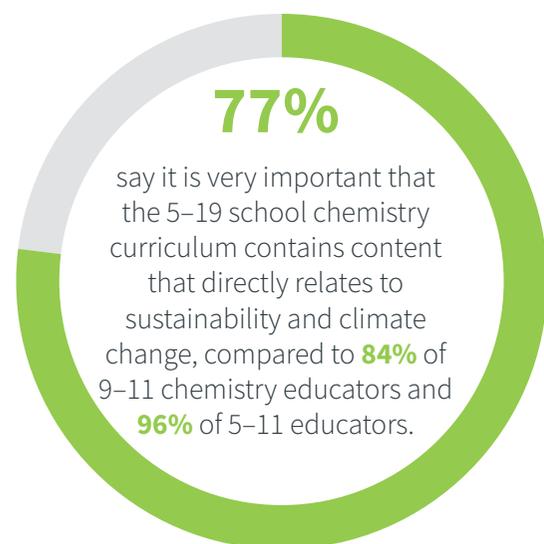


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Executive summary

In part two of our [Green Shoots](#) research we surveyed nearly 1,200 chemists in academia and industry in the UK and Ireland, building on our initial research with chemistry educators and young people.

Chemists practising in industry and academia told us that the chemistry curriculum should be updated to improve teaching on climate change and sustainability as a matter of high priority. This is essential to close the current gap in knowledge and skills needed for green jobs now and in the future.



Practising chemists in academia and industry agree with chemistry educators on the priority topics for the chemistry curriculum. They also stress the importance of all students learning about the scientific consensus on climate change.

- Practising chemists say the top four topics for young people pursuing further study or careers in the chemical sciences are: the lifecycle and impact of materials; carbon literacy, the finite nature of resources; and pollution. These were the same priorities identified by chemistry educators.
- Practising chemists also say students should learn about the scientific consensus on climate change by the time they leave school, with many suggesting that chemistry teachers should also help students understand the wider political and social context.
- This is significant given that, in our earlier research, **40%** of those teaching chemistry to ages 16 to 19 years said they worried about teaching about sustainability and climate change because others might see them as controversial topics.

This strengthens our call for Governments to urgently update the school chemistry curriculum so it:

- Prepares all young people to fully participate in efforts to tackle climate change and sustainability challenges.
- Equips them to progress into green jobs in the chemical sciences and contribute fully to the green economy.



Introduction

Our previous Green Shoots research found that young people and chemistry educators around the UK and Ireland think climate change and sustainability should be a key priority for the chemistry curriculum at all ages.

Young people are acutely aware of the climate change and sustainability challenges they face. Eight in ten of the students we surveyed, who were aged 11 to 19 years, told us that they think climate change is an urgent challenge to solve and a priority for the chemistry curriculum.

Chemistry educators agree, with **84%** of educators teaching ages 11–19 years and **94%** of those teaching ages 5–11 years saying it is important that chemistry and science lessons cover climate change and sustainability. However, many feel that current chemistry curricula are falling short. Two thirds of those teaching ages 11–19 years think the chemistry curriculum should have more content on climate change and sustainability, rising to nine in ten of those teaching primary school age.

Understanding the science of sustainability is not only important to enable young people to take their place as scientifically literate citizens – it is also essential to equip them for jobs in the green economy. The UK Government aims to support two million green jobs by 2030ⁱ, as part of the transition to net zero carbon emissions by 2050.ⁱⁱ

We wanted to better understand how well chemistry teaching in schools prepares young people for further study and work related to the chemistry of climate change and sustainability. We asked chemical scientists currently working in academia and industry what they think of the way the current chemistry curriculum covers these topics. 1,198 practising chemists responded to our survey.

Their message was clear: the chemistry curriculum must be updated to close the current gap in skills and knowledge needed for green jobs now and in the future.

ⁱUK Government press release, 12 November 2020. Available at: <https://www.gov.uk/government/news/uk-government-launches-taskforce-to-support-drive-for-2-million-green-jobs-by-2030>

ⁱⁱUK Government press release, published 20 April 2021. Available at: <https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035>

Core sustainability knowledge and skills

We asked practising chemists what young people studying chemistry at school most need to learn about in relation to climate change and sustainability, selecting from a range of options.

Practising chemists said the priority sustainability topics for *students going on to pursue further study or a career in the chemical sciences* are:

1. Lifecycle and impact of materials and products; role of chemistry in developing new materials.
2. Carbon literacy: the science and relative impact of how sectors and individual actions contribute to climate change.
3. The finite nature of resources, element conservation, critical raw materials.
4. Pollution (air, soil and water).

They said the priority sustainability topics for *all young people* to cover by the time they finish compulsory chemistry education are:

1. Carbon literacy: the science and relative impact of how sectors and individual actions contribute to climate change.
2. The finite nature of resources, element conservation and critical raw materials.
3. The scientific consensus in relation to climate change and how it is established.
4. Pollution (air, soil and water).

Respondents also suggested some *additional priorities for the curriculum* in free text comments. The additional topics that participants suggested were:

1. Energy and related sustainability issues, such as cost, production, storage and recycling.
2. The role of chemistry in understanding and addressing climate change and sustainability issues.
3. Personal and societal responsibilities related to climate change and sustainability.
4. The role of politics in decision making and the way information on these topics is presented and sometimes misrepresented.

Contextualising climate change and sustainability

While chemists working in industry and academia identified similar priorities for the chemistry curriculum as chemistry educators, there was a notable difference. They also stressed the **importance of all students learning about the scientific consensus** in relation to climate change by the time they finish compulsory chemistry education.

In addition, several respondents suggested that chemistry teaching should help students understand the science of climate change and sustainability within the **wider social and political context**, as reflected in the additional priorities outlined on the previous page.

This is significant given that, in our earlier research, **40%** of those teaching chemistry to ages 16 to 19 years said they worried about teaching about sustainability and climate change because others might see them as controversial topics. The feedback from chemists in academia and industry reinforces the argument for ensuring the curriculum **empowers teachers to state the scientific consensus** directly.

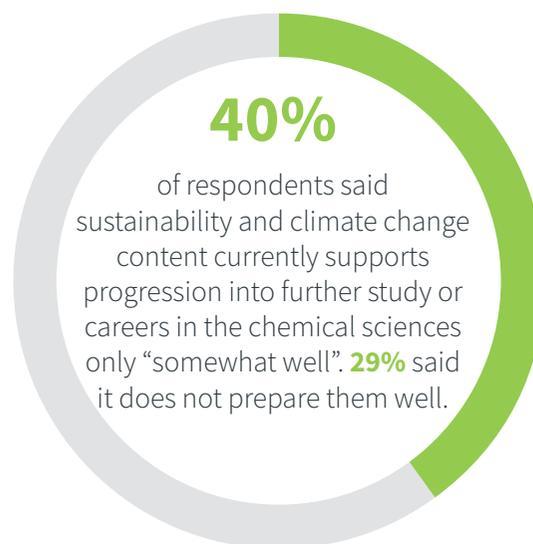
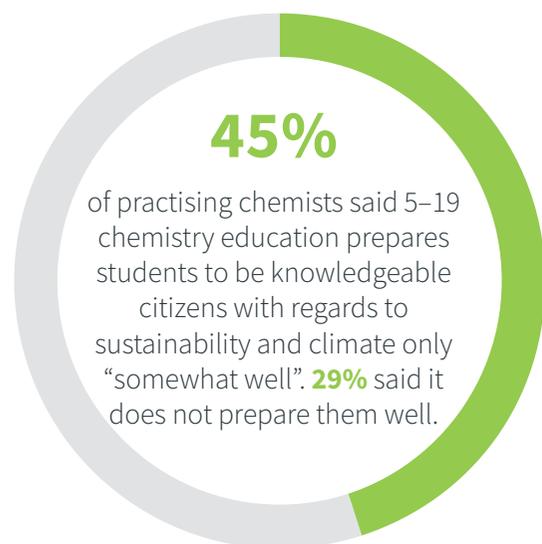
“It is really important for young scientists to have an understanding [of] how chemicals contribute to global issues including climate change, and how chemicals can be used to support sustainability measures.”

“Both personal and company/corporate responsibilities should be included [in teaching about climate change].”

“A key point for me is that... students and citizens also need to learn about the broader social, political, and economic landscape that has created these serious environmental problems. Technical knowledge is vital, but we need to look beyond merely technical solutions to these challenges.”

Preparing young people for the future

Most practising chemists think that current chemistry education in schools equips students only somewhat well to engage with climate change and sustainability, whether as knowledgeable citizens or through further study or work – and around one in three say it doesn't prepare them well.



In addition, **32%** of respondents in free text comments said that sustainability and climate change topics are lacking in the chemistry curriculum.

Many respondents also suggested that the **current curriculum content is out of date**. This is similar to feedback from chemistry educators, many of whom suggested that the curriculum could be improved by reducing some content, eg on fossil fuels, and adding more on specific sustainability topics.

“The Irish Chemistry curriculum is very academic and stale – [there is] no space/time/inclination within the curriculum or the education system to open discussions on climate change and sustainability and the relationship to the sciences both positive and negative.”

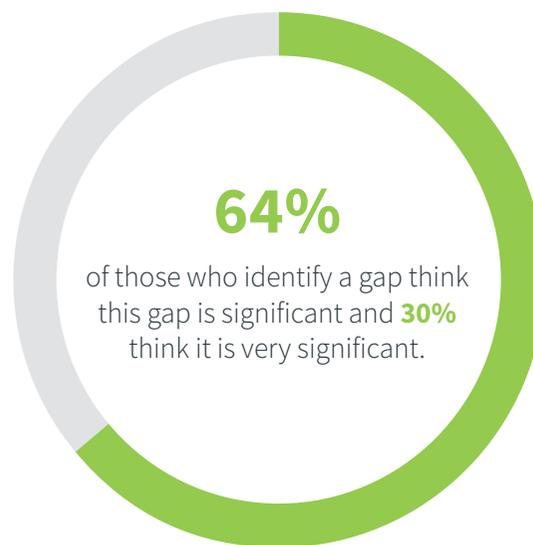
“We could open up a whole world of potential to all these young bright minds to explore and discover how chemistry could help solve some of the climate and sustainability challenges, but we do not have any inclination to “tap” that wonderful resource.”

“[My] daughter just finished [her] GCSEs. All aspects of climate change, sustainability, carbon cycle, energy use and water use [were] very poorly understood or taught.”

The skills gap

We asked chemists practising in industry and academia whether there is a gap between the skills and knowledge that chemical scientists currently have and those needed for green jobs now and in the future.

Nearly seven in ten said that there is a gap and less than one in ten said there isn't a gap, with the remainder of respondents being unsure. Of those who identified a knowledge and skills gap on sustainability topics, more than nine in ten (**94%**) said it is at least moderately significant.



Practising chemists identified a range of **specific limitations in current knowledge and skills**, including those related to: green chemistry, carbon capture and the impact of chemistry on the environment.

“I work in assessing human impacts of chemicals in water, air, soil and consumer products. This is not covered well [in the curriculum], and this is really important as all students are citizens.”

“There must be a skills gap because the company can’t find enough candidates with the right technical background for the rapidly increasing job demand to work in fuel cells or related areas.”

“I believe there is a skills gap – there is a perception that you need a sustainability qualification to have a green job. This is not the case – all STEM and wider subject areas need to be aware of what low carbon means. Carbon literacy is key and will impact new learners, those trying to upskill and those moving between sectors (reskilling away from high carbon generators).”

What we can do to help

We asked practising chemists what the Royal Society of Chemistry can do to ensure the school chemistry education equips students with the right knowledge and skills related to sustainability and climate change.

The top three priorities were:



PROVIDE education resources related to climate change and sustainability.



CALL for improvements in the chemistry curriculum.



PROMOTE the value of chemistry with regards to sustainability, to inspire change.

When asked if there is anything else they would like to add, practising chemists stressed that the school chemistry curriculum should:



EXCITE and engage students about sustainability and climate change.



PROMOTE the value of chemistry to inspire students to help address these issues.

As a scientific organisation, we will continue to:

- Communicate clearly the scientific basis for climate change and the unequivocal role of human activity.
- Work with policymakers to ensure the chemistry curriculum prepares future generations for a changing world.
- Continue to provide resources and professional development opportunities for chemistry educators to enable them to teach effectively about climate change and sustainability.
- Continue to enable young people to explore their career options in sustainability and climate change by developing and promoting our diverse career resources, showcasing a diverse range of people, roles and paths.

“Show how a career in chemistry can solve real life problems, to work toward a better place for people and wildlife. De-bunk the white lab coat persona – make chemistry cool, valued and seen as important to fixing sustainability issues and resolving other life challenges.”

“[The RSC should] continue to break down stereotypes and champion diversity. Many children are still put off chemistry because they feel it doesn’t relate to them... Demonstrate the huge array of careers in this area and champion role models.”

“Encourage the discussion! The classroom should be a safe space for the younger generation to explore their knowledge and skills, and apply them to real-life issues such as climate change and sustainability.”

“[The RSC] should lobby the exam boards and government to ensure that the 21st century science/chemistry curriculum is fit for purpose with learning about sustainability at its heart.”



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