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Sustainability has never been higher on the agenda, and rightly so. From unprecedented flooding and wildfires, to record high temperatures, around the world people are losing their homes, their livelihoods and their lives because of climate change.

We have a duty and an opportunity to prepare young people to take on these challenges, and to find fulfilling jobs in the growing green economy.

Inspiring and relevant chemistry teaching has a key role to play, because the chemical sciences are essential in enabling a transition to a more just and sustainable world.

Previous research by the Royal Society of Chemistry found that eight in ten chemical researchers are working on environmental challenges, from the measurement and analysis of air pollutants to developing sustainable packaging materials and scaling up clean energy technologies.

Unfortunately, our new survey of school students and educators in the UK and Ireland shows that we are not adequately preparing the next generation to fulfil their

Key findings

We conducted a survey of 11 to 18 year olds and a survey of educators working with children aged 5 to 19 years old across the UK and Ireland to find out what they think of the

In the 11–19 curriculum:

- Young people need to learn in more depth about the chemistry underpinning climate change, particularly related to carbon literacy, the finite nature of resources, the lifecycle of materials and pollution.
- Young people also need to learn about the role they can play in looking a□er the environment.
- The curriculum should communicate clearly the strong scientific evidence on the impact of climate change and the role of human activity in causing it.
- The curriculum should cover fundamental chemistry concepts and skills, and bring them together in the context of sustainability and climate change.
- Students must be equipped with the knowledge, understanding and skills that will motivate them to progress into careers in the chemical sciences or related disciplines.

Curricula should…

…be designed flexibly to emphasise sustainability and climate change, while not over-burdening students and educators with content. Many educators identified a lack of time as a barrier to teaching about climate change. There is an opportunity to review the curriculum and reduce the emphasis on certain topics that are becoming less relevant, such as fossil fuels, while increasing the emphasis on climate change and sustainability.

…be organised so that students build progressively on their knowledge and skills related to sustainability and climate change at each stage.
This is in line with our recommended approach to curriculum development more widely (see page 28).

…make clear the scientific basis for climate change, including the unequivocal role of human actions in causing the problem. This is particularly im15 (g s)20.212 0 0 12 74.1732 307.5165 Tm[(

Young people are acutely aware of the sustainability challenges we face.

Finding a way to live in harmony with the planet is the greatest challenge we face. The most recent IPCC [illegible] concluded unequivocally that climate change effects are widespread and intensifying, and that human activity is responsible.

We are already feeling the impacts, from devastating forest fires to unprecedented flooding. It is unsurprising then, that public concern in the UK about climate change and the environment is at a [illegible][3].

Young people especially are increasingly fearful for their futures. A recent [illegible]

An inspiring and relevant chemistry education is vital for everybody.

At the Royal Society of Chemistry, we are committed to enabling young people to fulfil their potential in the chemical sciences, so our community can continue to be a catalyst for change.

We believe everybody should have an inspiring and relevant chemistry education, whether they go on to pursue further study in this area, or play their role as a scientifically literate citizen.

Whatever choices a young person makes about their career, they will live and work in a world a□ected by climate change.

Every young person needs a strong foundation in science so they can engage fully with the issues that shape society and make informed choices about their lives.

Our research shows there is a need to improve current education on climate change and sustainability.

T, E , l A C l a , l a , about including environmental sustainability across all primary and secondary courses[8].

We wanted to understand what young people and educators across the UK and Ireland think of the way climate change and sustainability are currently taught, to inform possible curriculum reforms.

We conducted two pieces of research to find out: a survey of 11 to 18 year olds and a survey of chemistry educators and related professionals working with children aged 5 to 19 years old.

The message was clear. Both young people and educators think chemistry education should cover climate and sustainability issues and related careers. However, a number of barriers get in the way of educators being able to cover these topics as fully as they would like.

This report builds on our previous work to guide the development of chemistry curricula that are fit for the future.

This report presents the results of our research with young people and educators. It builds on our previous work with the chemistry education community to develop a flexible framework for curriculum design[9]. We have included a summary of this framework in this report (see pages 28 and 29).

It is essential that policymakers ensure every young person leaves school with the chemical skills and knowledge they need to thrive, which includes being able to fully participate in e□orts to tackle climate change.

What a good chemistry education should achieve

At an individual level, a chemistry education should:

Inspire people with a sense of curiosity and wonder about the fundamental nature of the world around them.

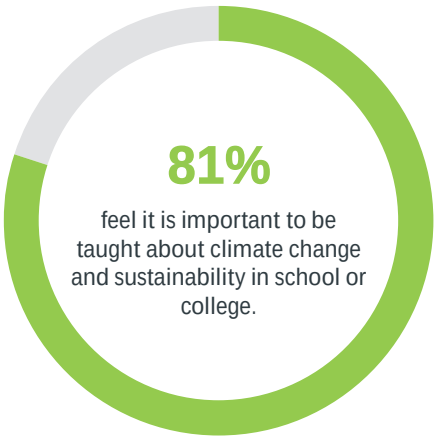
Empower them to make decisions about their own lives and critically evaluate scientific and technological developments that impact society.

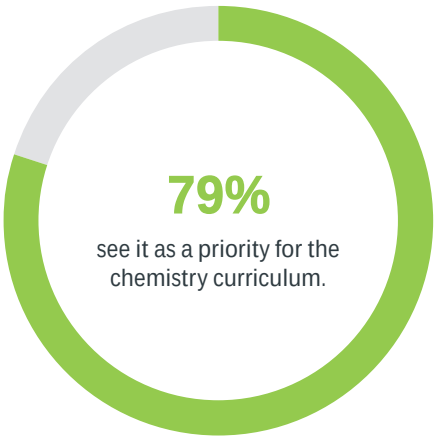
Equip them with the knowledge and skills to pursue further study and rewarding careers in the chemical sciences and a wide range of related fields.

At a national level, it should ensure we have a sustainable supply of people with the curiosity, knowledge and skills to:

Enable growth and productivity – the chemical sectors, add £87

Young people also expect to be educated about climate change and sustainability at school in chemistry lessons.

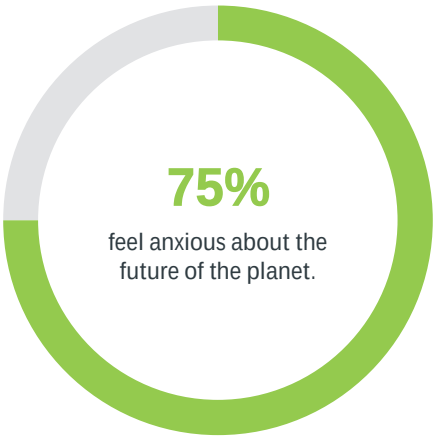




“I believe the young people have to look after the planet as they will be living on it... But I think it's the educator's job to make sure the children know what they have to do.”

YOUNG PERSON

Young people are extremely concerned about climate change and want to take action.



“This is a conversation that everyone needs to be having... If everyone did one thing, it would make a huge impact.”

YOUNG PERSON

Young people think that schools, colleges and universities have the biggest responsibility to promote and educate people about sustainability, followed by the Government and scientific societies.

Young people want the media to provide more detailed and balanced information on climate change.

In addition to our online survey, we asked 16 to 17 year olds to send short videos sharing their views. Many said they would like the media to provide a more detailed, balanced representation on the key issues. They highlighted the BBC as a trusted source of information in a world of 'fake news'.

"Nine times out of ten, the news doesn't cover anything very well to do with climate change. I feel like it's quite hushed under the carpet. It's not something that's talked about enough."

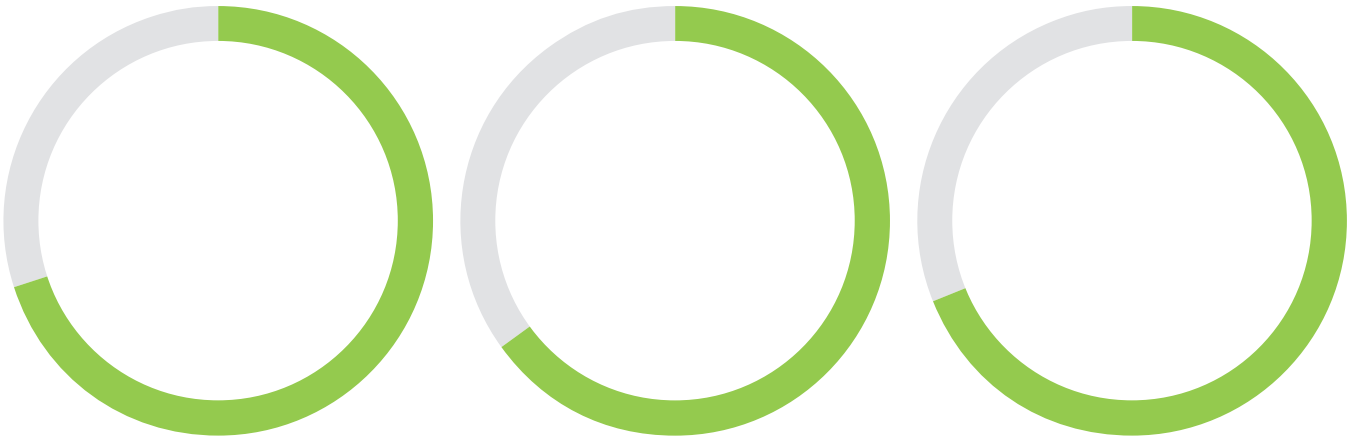
YOUNG PERSON

What do young people and educators think about current climate change and sustainability teaching in science and chemistry?

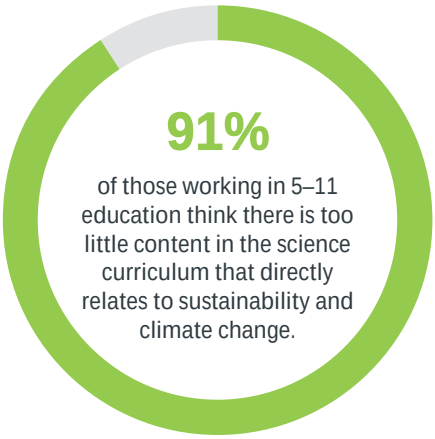
Two thirds of educators teaching ages 11–19 years think the chemistry curriculum should have more content on climate change and sustainability, rising to nine in ten for those teaching primary school age.

Opinion is fairly evenly split among young people about whether they need more or better quality science teaching on climate change and sustainability.

Educators think there is not enough content on climate change and sustainability in current curricula for ages 11 to 19 years.



Primary school educators feel even more strongly that there should be more content on sustainability and climate change in the science curriculum.



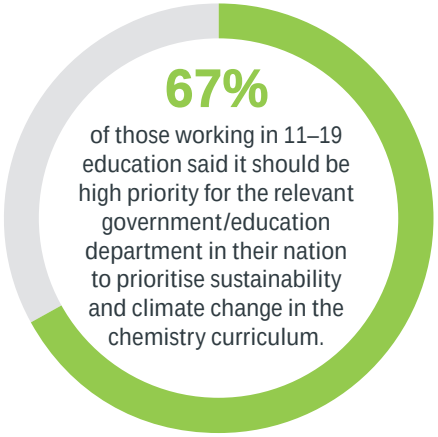
"Personally I think [sustainability] should be the bedrock of the whole science curriculum (and the other subjects as well)."

EDUCATOR (5–11 EDUCATION)

Educators want the Government to prioritise sustainability and climate change in the chemistry curriculum.

"The overall curriculum should be changed to accommodate the topics of sustainability and climate change."

EDUCATOR



"School gives a good scientific explanation of how climate change occurs and also talks about the impacts of climate change action... But I feel that there's a lack of focus on the urgency and importance of the issue."

YOUNG PERSON

At ages 5 to 11 years, the biggest barriers to teaching about climate change and sustainability are curriculum design and lack of time and resources.

57% said when teaching ages 5 to 11 years the curriculum is not well designed to support teaching on climate change and sustainability.

57% said they don't have enough time to teach content in a sustainability context.

35% said they don't have enough resources to teach these topics.

At ages to 11 to 14 years, the biggest barriers are too much duplication of content and curriculum design.

34% said when teaching ages 11 to 14 years there is too much duplication of content.

32% said the curriculum is not well designed to support teaching about sustainability and climate change.

"I would argue it is not necessarily what you include in the curriculum [about climate change and sustainability], but how it is organised, contextualised and how topics are linked."

YOUNG PERSON

At ages 14 to 16 years, the biggest barriers to teaching about climate change and sustainability are duplication of content and a lack of time and resources.

48% said when teaching ages 14 to 16 years there is too much duplication of content.

40% said there isn't enough time to teach content in a sustainability context.

38% said there aren't enough resources.

"There is duplication [of sustainability content] between GCSE chemistry and GCSE biology and students will study both, so perhaps the emphasis could change to be more chemically based to make it more relevant."

SECONDARY EDUCATOR

At ages 16 to 19 years, the biggest barriers to teaching about climate change and sustainability are lack of subject knowledge and fear of others seeing these as controversial topics.

50% said when teaching ages 16 to 19 years they didn't have the subject knowledge to teach about climate change and sustainability.

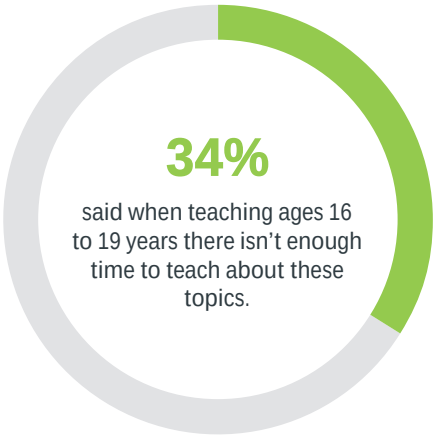
40% said they worried about teaching about sustainability and climate change because others might see it as a controversial topic.

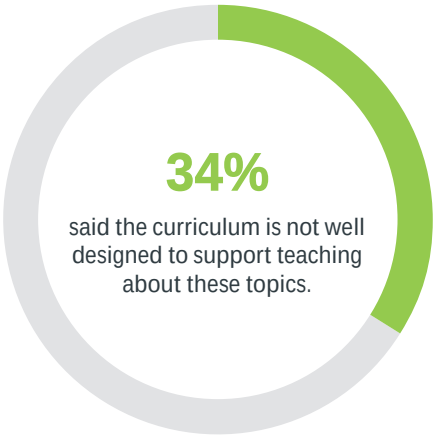
"I am not sure of the exact latest science and data and don't want to get it wrong and not be able to give evidence."

SECONDARY EDUCATOR

"Climate change isn't an opinion, and fossil fuels

Curriculum design and lack of time are also major barriers when teaching ages 16 to 19 years.



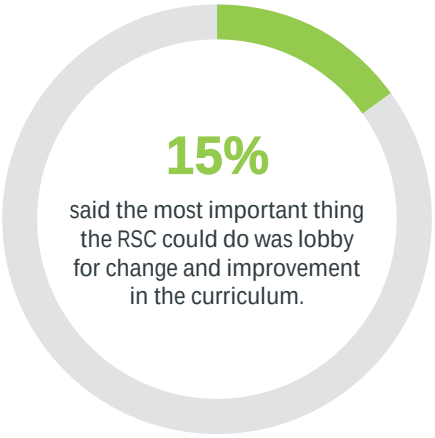


"At A Level [there is] just no time to cover anything that is not on spec and no interest if it does not contribute to [the] exam grade!"

EDUCATOR

Educators think the Royal Society of Chemistry has an important role to play in providing resources and advocating for improvements in the curriculum.

When asked in an open question to name anything they thought the RSC could do to improve teaching on sustainability:



"The existing RSC materials (The Chemistry of Climate Change) are excellent."

SECONDARY EDUCATOR

"[The RSC should] argue for changes in curriculum nationally that promote sustainability and climate change [understanding]."

SECONDARY EDUCATOR

4 What sustainability related knowledge and skills should be included in the chemistry curriculum?

Chemistry educators identified a range of sustainability topics that everybody should learn about, with carbon literacy, the lifecycle and impact of materials, the finite nature of resources and pollution being the most important.

Many also feel the 11–19 chemistry curriculum could be improved by reducing some content, for example related to fossil fuels, and adding more material on sustainability topics, such as pollution, green chemistry and recycling.

At primary level, educators said the focus should be on understanding our impact on the world around us and the importance of climate change, as well as science's role in tackling it.

Carbon literacy, the lifecycle and impact of materials, and the finite nature of resources are the most important sustainability topics for school leavers going on to pursue further study or a career in the chemical sciences.

42% of educators said this group should have knowledge or skills related to "Carbon literacy; the science and relative impact of how sectors and individual actions contribute to climate change."

39% of educators said this group should have knowledge or skills related to "Lifecycle and impact of materials and products; and the role of chemistry in developing new materials."

29% of educators said this group should have knowledge or skills related to "Finite nature of resources, element conservation, critical raw materials."

"Lots of my pupils are very anxious about [climate change] because of the way it is portrayed in the media. However they can be reassured and highly motivated when shown that science can provide solutions."

EDUCATOR (11–19 EDUCATION)

Carbon literacy, the finite nature of resources, pollution, and the lifecycle and impact of materials and products, are the most important sustainability topics for everybody to understand by the time they finish education, in order to be knowledgeable citizens.

47% said everybody should have knowledge or skills related to "Carbon literacy; the science and relative impact of how sectors and individual actions contribute to climate change."

36% said everybody should have knowledge or skills related to the "Finite nature of resources, element conservation, critical raw materials."

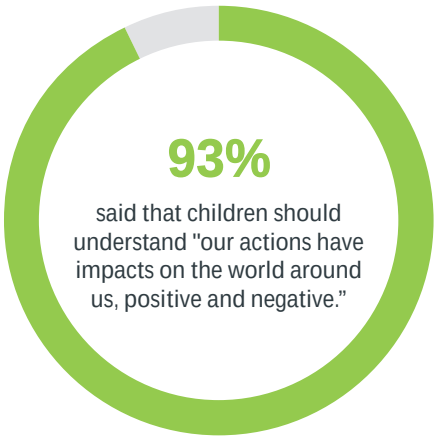
31% said everybody should have knowledge or skills related to "Pollution – air, soil and water".

30% said everybody should have knowledge or skills related to "Lifecycle and impact of materials and products; and the role of chemistry in developing new materials."

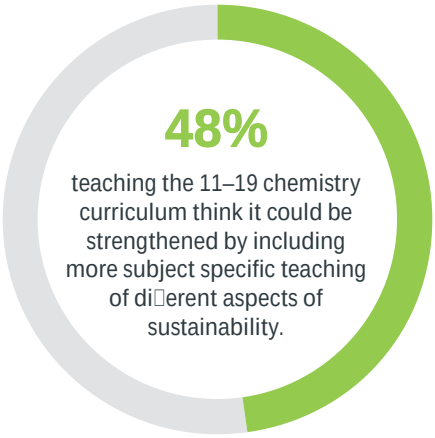
"The curriculum is so similar to the content I was taught 25 years ago and the world has changed so much."

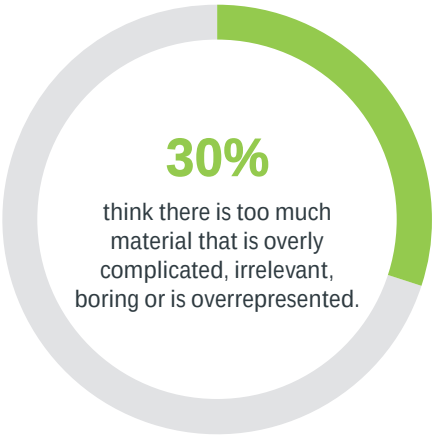
EDUCATOR (11–19 EDUCATION)

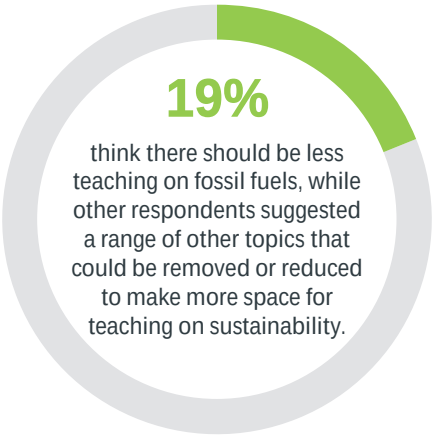
By the time children leave primary school, they should understand that our actions have an impact on the world around us, climate change is a global challenge and science can help find solutions.



Some educators suggested ways in which coverage of sustainability and climate change in the curriculum could be improved. For example...







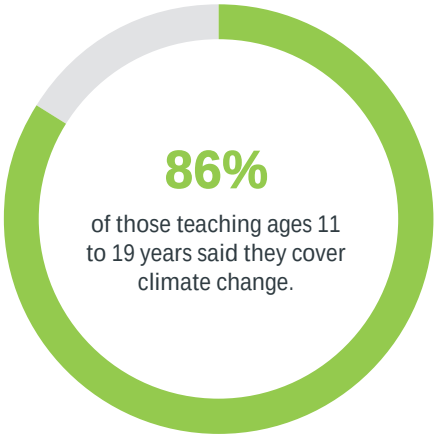
“There's a massive focus on crude oil, fractional distillation and cracking which, although it is based on important chemistry concepts, promotes an image of chemistry as not being a subject and industry that cares or wants to work on sustainability and climate change.”

SECONDARY EDUCATOR

5 How should sustainability and climate change be taught?

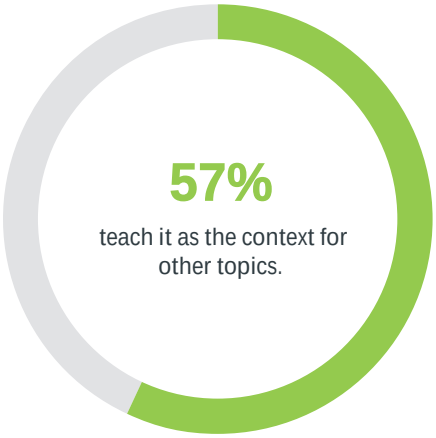
Most of those teaching chemistry for ages 11 to 19 years cover climate change and sustainability, with the majority including this as context for other topics. Very few educators think that they should be taught as a stand-alone subject.

At ages 11–19 years, most chemistry educators cover climate change, with the majority covering it as the context for other topics.



86%

of those teaching ages 11 to 19 years said they cover climate change.



57%

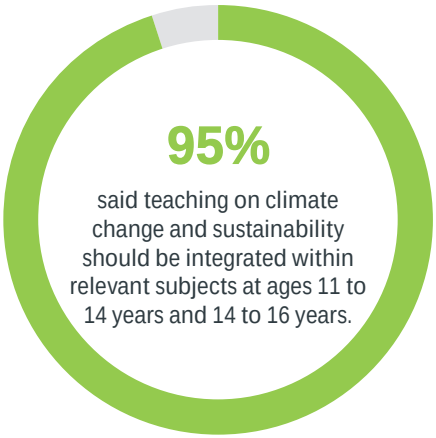
teach it as the context for other topics.

29%

teach it as a discrete topic.

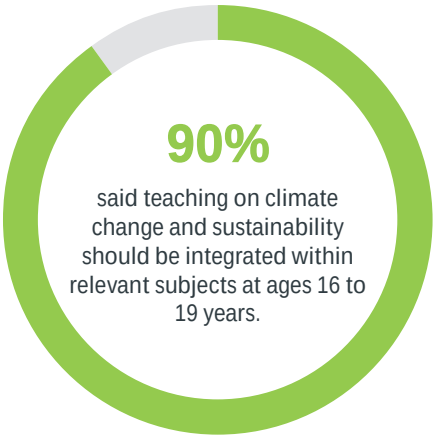
> **“We have such an enormous amount to fit in there is li le space for anything else. But, for example, energy resources type topics could be redesigned to focus on sustainability.”**
>
> SECONDARY EDUCATOR

The vast majority of chemistry educators think climate change and sustainability teaching should be integrated into relevant subjects, like science or geography.



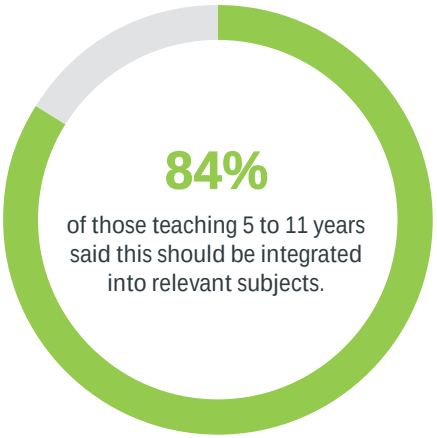
95%

said teaching on climate change and sustainability should be integrated within relevant subjects at ages 11 to 14 years and 14 to 16 years.



90%

said teaching on climate change and sustainability should be integrated within relevant subjects at ages 16 to 19 years.



84%

of those teaching 5 to 11 years said this should be integrated into relevant subjects.

Making young people aware of careers in sustainability and climate change

Sustainability and climate change o□er a range of rewarding careers and the number of related jobs will increase as we transition to a green economy. Young people are interested in careers in these areas, but there is room to improve awareness of the options in the chemical sciences.

Studying chemistry can lead to a huge range of careers including in sustainability.

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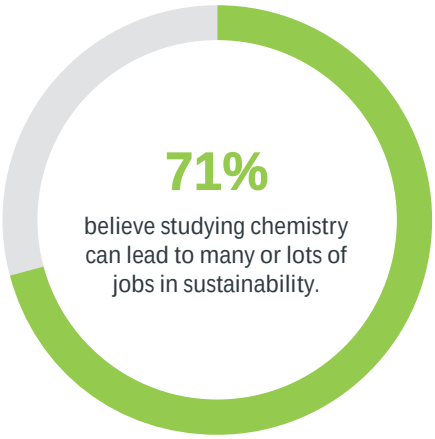
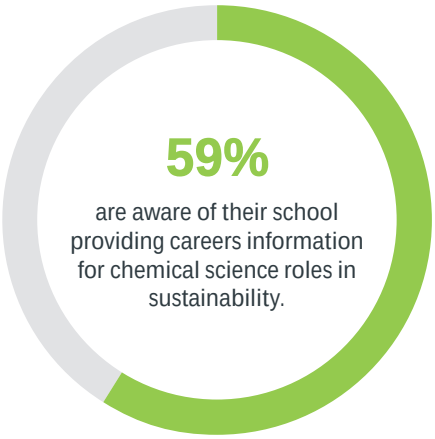
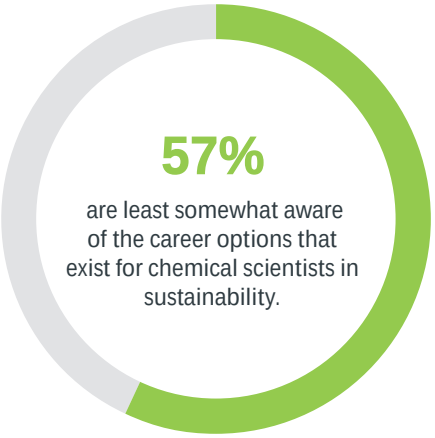
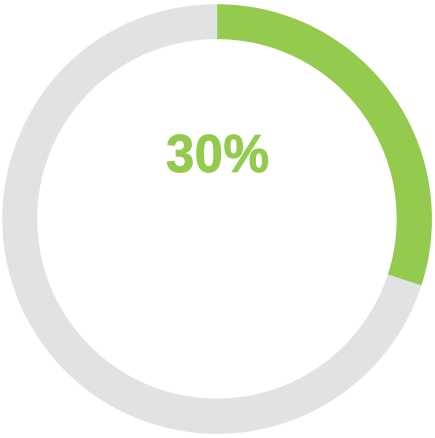
The majority of young people are aware of sustainability careers in the chemical science.





The majority of educators are aware of career options for chemical scientists in sustainability, but a sizeable minority are not.





A complete view of chemistry

Developing an understanding of what chemistry is, and how we can use it, is

9 The elements of a successful chemistry curriculum: The Royal Society of Chemistry's