



TALENT

The elements of a successful chemistry curriculum:

The Royal Society of Chemistry's
vision for 11–19 chemistry education

Foreword	3
Introduction	4
A community and evidence-informed framework	4
Members of our Curriculum and Assessment Working Group	5
Our vision for chemistry education	6
Our aim	7
Coherent progression across 5-19 education	8
The curriculum framework	9
Our approach to developing the framework	9
A curriculum for all	9
Guiding principles	9
The importance of contexts	10
A framework for a successful chemistry curriculum	11
A complete view of chemistry	11
An overview of structure	11
Underpinning skills and attributes	13
Practical science skills	13
Global citizenship	13
The Big Questions and key ideas	16
Summative assessment of chemistry	17

Foreword

We are currently in a period of unprecedented global challenge on both environmental and societal issues such as climate change, food supply, healthcare and the economy. The chemical sciences have a vital role to play in tackling these issues and underpin several key growth sectors prioritised by government, including clean energy, life sciences, and advanced manufacturing.

Chemistry offers a world of opportunity for young people. Everyone deserves an engaging, relevant, and inspiring chemistry education. Now more than ever, the curriculum must be fit for purpose – highlighting these opportunities, equipping learners with the skills and knowledge to be scientifically informed citizens, and showing that chemistry is for people like them. Learners are eager to explore contemporary issues and want to understand the many ways chemistry can improve lives and address global challenges.

In 2014, the Royal Society of Chemistry established the Curriculum and Assessment Working Group (CAWG) to develop an evidence-based, expert-led curriculum framework that progresses coherently through secondary education. Since then, through direct engagement and our annual Science Teaching Survey, teachers have told us that chemistry curriculums have become overloaded and disconnected from real-world issues that fail to inspire learners to think ‘chemistry is for people like me’.

To address these concerns and shape our thinking on curriculum reform, we’ve developed detailed positions on key areas such as sustainability, digital skills, and representation: grounded in evidence and informed by the community. The vision for chemistry education presented here is designed to prepare young people for the future, whatever path they choose.

This 11–19 curriculum framework enables learners to encounter a broad range of modern chemistry, demonstrating both its everyday impact and its potential to solve some of the most pressing challenges of the 21st century. It also ensures students develop the skills and knowledge that employers value. With flexibility built in, curriculum learners can design courses that work for all learners, regardless of qualification pathway.

We updated this document in October 2025 to serve as a starting point for current and future curriculum reform across the UK and Ireland.



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Introduction

The chemical sciences have a critical role to play in the global challenges we face and in the technological advances being developed to help meet these challenges. We must ensure science and chemistry curriculums are equipping young people with the skills and knowledge needed for the future.

The Royal Society of Chemistry aims to inform the development of chemistry curriculums and qualifications by governments and other authorities throughout the UK and Ireland. This document presents a proposed framework to inform curriculum design at ages 11–19. While this proposal is intended to be a valuable resource to policymakers and curriculum designers, we hope it will also be of interest and use to teachers.

The ideas in this document rest on a much greater body of work, which provide further details and suggestions for implementation. Building on the curriculum framework that was originally published in 2020, this updated and expanded framework represents what we see as the core of an ideal chemistry curriculum, but by no means its totality. While our ideas about good curriculums should always be reviewed in the light of evidence and experience, we aim here to present something that is enduring and can be used flexibly in different education systems and types of qualification.

We have engaged with the chemical sciences and education communities to update and expand on this framework, so that we continue to be aligned with their needs and have broad support for our proposals. This is part of a continuing conversation; our policy positions expand on the ideas in this report, and further details on content and implementation can be found in the accompanying document "Answering the big questions: our chemistry curriculum in detail".

A community and evidence-informed framework

The curriculum framework presented here has been developed by a succession of curriculum and assessment working groups, composed of experts in curriculum design and experienced teachers and educators.

The working groups referred to evidence on good curriculum design in general and on effective learning in chemistry in particular, as well as looking at current practice. They thought about the most important knowledge and skills to teach to learners aged 11–16 years and 16–19 years, as well as the guiding principles that should underpin good curriculum design. From these discussions, our curriculum framework emerged.

We have tested our ideas with teachers and other educators through reviews of draft documents, focus groups and other discussions. Practice was also shared with our sister professional bodies, the Institute of Physics and the Royal Society of Biology, which have conducted parallel exercises. We are grateful to everyone who has shared their insights with us.

Members of our Curriculum and Assessment Working Group

The Royal Society of Chemistry is grateful to the following members of the working group for their contributions to the work that led to the development of the first edition of this document.

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Our vision for chemistry education

The Royal Society of Chemistry's mission is to empower communities to offer a high quality chemistry education for all, enabling young people to become scientifically informed members of society, and preparing them for further study and careers in the chemical sciences.

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 and the planet.



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 £39 billion¹ in gross value added to the UK economy every year.



Address global challenges such as climate change, the unsustainable use of natural resources, water and food security, health and energy.

Our aim

Focusing on learners aged 11–19 years, the Royal Society of Chemistry has developed a chemistry curriculum framework that sets out what we value in, and about, chemistry in a way that aims to be coherent, inclusive and appropriate for all school-age learners. This framework now sits alongside a complimentary framework for a future primary science curriculum, developed by an expert panel, in partnership with the Institute of Physics, the Royal Society of Biology and the Association for Science Education.

The framework covers areas of chemistry that all learners should encounter by the end of the compulsory study of chemistry – ideally age 16. Learners should then cover all areas in more detail if they choose to study chemistry post-16. If teaching time allows, other topics could be added or a more comprehensive range of applications presented.

This framework is not intended to be a scheme of work or an exam specification, or to imply any particular teaching sequence. It is designed to guide the development of more detailed courses of study and qualifications that will suit learners and serve progression paths throughout the UK and Ireland.

Chemistry curriculums differ considerably between England, Scotland, Wales, Northern Ireland and the Republic of Ireland. Each of these curriculums have their strengths but also areas where they could be improved.

We will continue to engage with and influence reforms as they occur in the different regions of the UK and Ireland, using this framework at the heart of our messaging. Overall we are looking for curriculum design to:

- be more coherent and interconnected, moving away from disjointed topics.
- make the fundamental principles of, and about, chemistry more explicit.
- better integrate learning about the applications and impacts of chemistry, including using up-to-date examples.
- have a better progression of learning through the educational stages.

Coherent progression across 5–19 education

To ensure coherent progression in understanding it is important that the narratives remain linked, while specific aims at different education stages are accounted for. This will support age-appropriate conceptual development of the subject. While each stage has its own set of aims, they stay connected through the Big Questions.

We set out the key aims for each educational stage below. We have included ages 5–11 years to illustrate the connections and common themes between this framework and our vision for primary science.

Aims for each educational stage

5–11 years

Lay the foundations of chemistry education within a science framework, in terms of scientific knowledge, skills and enquiry. Learners start to become informed about the part that science plays in the world around them.

11–16 years

Provide a broad and balanced chemistry education for all learners, including about the role of chemistry in the world around them. Prepare learners who wish to pursue either an academic or a technical pathway.

16–19 years

Prepare learners for further study on academic or technical pathways and careers related to chemical sciences, through developing essential skills and embedding a secure knowledge base.

THE ELEMENTS OF A SUCCESSFUL CHEMISTRY CURRICULUM: THE ROYAL SOCIETY OF CHEMISTRY'S VISION FOR 11–19 CHEMISTRY EDUCATION

The curriculum framework

Our approach to developing the framework

A curriculum for all

In designing this framework, we have carefully considered the skills and knowledge learners will need at each stage of education to pursue further study and work. This includes helping them understand the variety of contexts and careers in which chemistry is used so they can make informed decisions.

We also recognise that most learners will ultimately not work in the chemical sciences, and so it is important to consider their needs as future scientifically informed global citizens who help work towards a more sustainable and equitable world.

To achieve these aims, the curriculum needs to support good understanding of conceptual knowledge, development of relevant skills, and an understanding of the importance of chemistry to society.

A good chemistry education also effectively portrays the practice of science, including the people that carry it out. This practice is based on historic contributions to scientific discovery across different cultures and geographical locations. Chemistry education should reflect how science is a global endeavour.

Learners should be able to relate to, and identify with, people and contexts within this modern representation of science. If learners feel that their identity aligns with a subject, that it is for people like them, they are more likely to pursue that subject further.

Guiding principles

The Curriculum and Assessment Working Group considered the existing curriculum documents for the nations of the UK and Ireland, as well as views from experts in curriculum design to arrive at a set of guiding principles that underpinned the development of the curriculum framework. These guiding principles are as follows:

- **A clear framework or narrative** that gives a coherent 'big picture' of chemistry as a subject, explains why it matters, and shows how different areas of content are connected.
- **Clear progression**, in which deepening understanding is built on a secure foundation in each aspect of the framework.
- **Encourage understanding of fundamental principles** (as opposed to surface learning of facts). This promotes deeper conceptual understanding and the ability to apply learning to novel situations.
- **Incorporate the procedural knowledge and skills**, (including practical skills), that are core to the discipline of chemistry.
- **Be informed by the available evidence²**, including findings from research, best practice, and views from informed stakeholders.

²A list of the references used can be found here: <https://rsc.li/chemistry-curriculum-framework>

In using this framework, it is also important to ensure that fully developed curriculums offer:

- **appropriate alignment** with the wider curriculum in related subjects.
- **a defined learning entitlement** that sets out clearly the level of understanding and skill that learners are expected to achieve at each stage.
- **a level of demand** that is aspirational but also allows an educational experience that is inclusive of all learners.
- **a considered amount of prescribed content**, to allow time within the curriculum to develop understanding and the flexibility for teachers to introduce meaningful contexts and applications that demonstrate the breadth of chemistry and its contribution to society.

The importance of contexts

The central and enduring ideas of chemistry, which further the learner's understanding of chemistry as a discipline, form the backbone of the framework. We have also left space to include up-to-date and relevant contexts. Teaching chemistry with stories, contexts and examples enriches learning and fosters a connection to a subject that is conceptually rich and can therefore sometimes seem abstract. Context helps learners to understand the relevance of the ideas studied and how the discipline is evolving, to develop scientific literacy, and to appreciate what chemistry brings to our society.

But learners should also see what society brings to chemistry – the diversity of the people that carry it out and who introduce new viewpoints, fresh ideas and different ways of thinking. Representation and inclusivity in chemistry education are critical to the learning experience and will help to ensure that pathways in the chemical sciences are open and attractive to all.

We recommend that contexts are chosen for national, regional and local relevance to enrich the curriculum and support maximum engagement.

A framework for a successful chemistry curriculum

A complete view of chemistry

Developing an understanding of what chemistry is, and how we can use it, is central to a successful chemistry curriculum. So we have thought deeply about what matters in, and about, chemistry and how our discipline³ is evolving.

At the heart of the framework sits our model for the discipline, shown in the diagram overleaf. The approaches to reasoning and enquiry that are important in chemistry are covered in 'Chemistry as a science', whilst the fundamental understandings of the material world that we have developed so far are covered in 'Chemical concepts'. 'Chemistry and the world' focuses on how we use these practices and concepts and how they impact society and the world. Whilst each of these aspects of chemistry is important in its own right, and should be made explicit as so, chemistry as a discipline can only be understood through the relationship between them.

An overview of structure

The following pages lay out more detail on the hierarchy of the framework. Stepping down from the three aspects that make up chemistry as a discipline, the next level of structure is a set of "Big Questions". This approach ensures there is a narrative that learning can be connected to, whilst also reflecting the enquiring nature of chemistry.

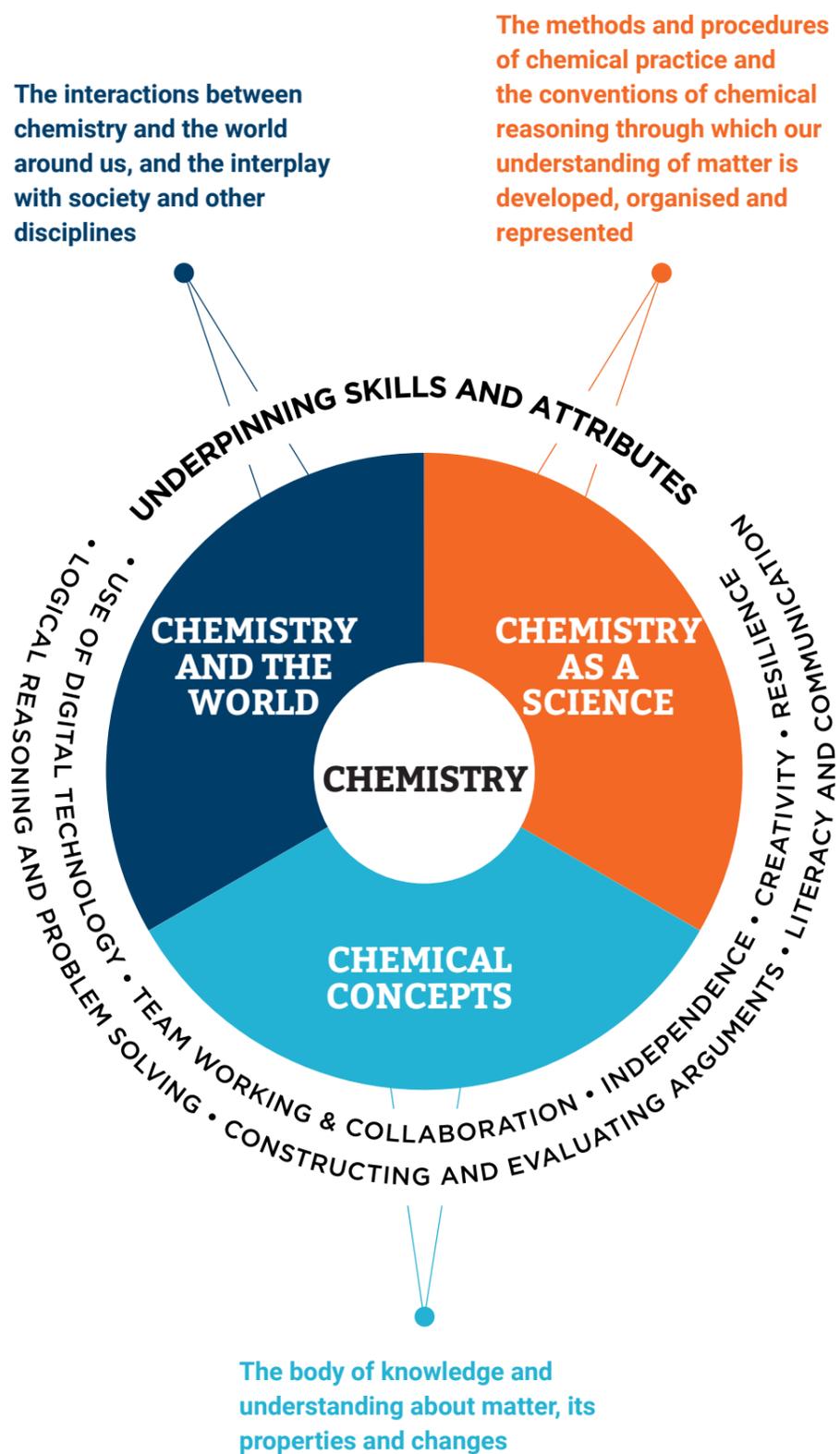
Within each Big Question we have identified the key ideas that we envisage that all learners should encounter by age 16, and in more depth in post-16 qualifications. These key ideas should not be viewed as teaching topics or suggestions. Rather they are an indication of the core ideas that need to be understood to answer each Big Question. The Big Questions and key ideas are considered further in the following pages.

We have also undertaken more detailed thinking on exactly what content could, and should, be included at each educational stage, for each Big Question. This level of detail can be found in the accompanying technical document 'Answering the Big Questions: our chemistry curriculum in detail'.

The structure of this framework is intended to be flexible enough that it can be applied to technical and academic pathways and be appropriate for any educational system in the UK and Ireland.

³ By discipline we mean an area of learning that has a particular object of research, but also specific range of practices used to further understanding in that field.

This diagram shows our model for the discipline of chemistry, showing the relationship between the three aspects. Note the underpinning skills and attributes, shown around the outside of the diagram.



Underpinning skills and attributes

Beyond the subject-specific content, the curriculum should enable learners to develop a broader range of skills necessary for a future in science as well as a wide range of study and career options. Whilst not a curriculum component specifically, learners should have the opportunity to develop the skills and attributes 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.

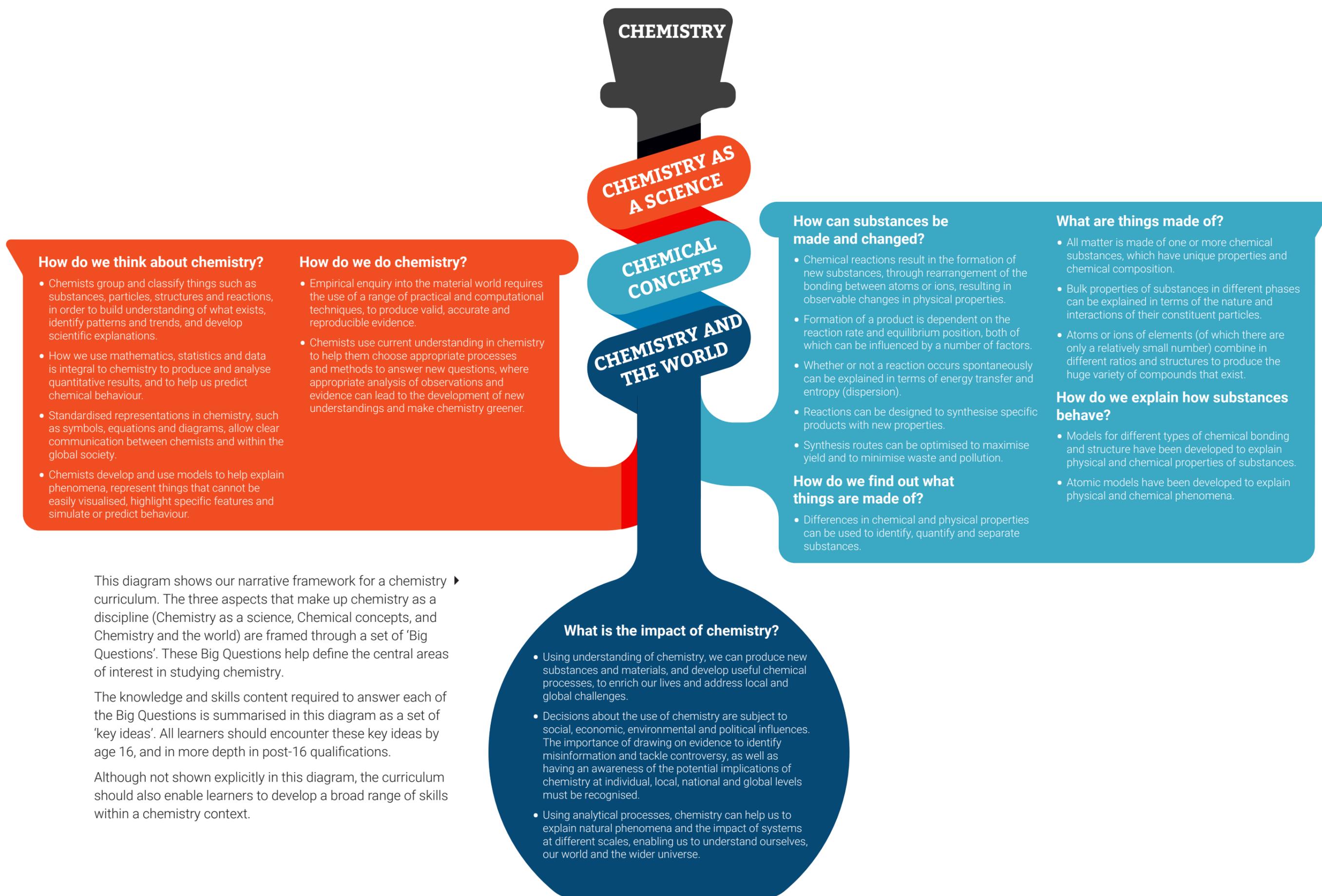
Practical science skills

Development of competency in practical skills should remain a core aim of a chemistry curriculum. Practical work supports 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. Examples of wider relevance include the ability to take accurate measurements, an understanding of hazard and risk, and an appreciation of application and innovation in the sciences.

While not explicitly expressed in the framework diagram, practical work should be understood as a core part of answering the question 'How do we do chemistry?' Learners should encounter a range of techniques appropriate to their stage of education and linked to other areas of the curriculum and understand the place of experimentation and observation in the wider processes of investigation.

Global citizenship

Learning about global challenges such as sustainability and climate change issues, development of vaccines and crop protection to ensure adequate food supply for a growing population and the solutions chemistry can offer, helps learners understand how chemistry contributes to solving environmental and societal problems. It provides young people with the agency to be responsible global citizens who strive to make the world a more equitable and sustainable place.



The Big Questions and key ideas

Our approach to developing a clear narrative has been informed by expert thinking on curriculum design, in particular the Big Ideas of Science Education⁴, which explains how the links between ideas and experience is better preserved in a narrative form than in a list of disconnected points.

A narrative is important in ensuring a curriculum is coherent and aids planning for progression in learning. We have adopted a “Big Questions” approach, which reflects the enquiring nature of the discipline. The Big Questions help to define the central areas of interest in studying chemistry.

Using Big Questions as a narrative framework supports development of a coherent curriculum, as content – both knowledge and skills – can be selected to answer each question. All content earns its place, which means both teachers and learners can see the relevance of what is being taught.

The Big Questions can be answered at different levels of sophistication, and therefore can be applied to development of a continuous progression of learning.

The working groups have considered in detail the knowledge and skills that are relevant to include in answer to the Big Questions at ages 11–16 years and 16–19 years. In the framework diagram, this content is summarised as the key ideas that provide answers to the Big Questions.

All learners should have the entitlement to study these ideas during their study of chemistry at secondary level, and in more depth if they choose to take the subject further. Curriculum developers would need to adapt the key ideas to the appropriate level for different educational stages and qualifications. Links can be made between different areas of the framework. Some Big Questions link to most or all areas of the framework, for example 'What is the impact of chemistry?' and we envisage that any curriculum would reflect these links.

Summative assessment of chemistry

Assessment is an indispensable tool in ensuring that learners are making progress against expectations, and in planning next steps for teaching and learning. It is also a powerful force in shaping how chemistry is taught and experienced in schools. Therefore, any programme of assessment should include all three components outlined in this curriculum framework, including practical work and contextual awareness.

Assessments should be tailored to the setting in which the curriculum is delivered and likely progression routes, whether academic or technical. Every effort should also be made to avoid bias, including on the basis of gender, socio-economic background, ethnicity or disability.

At present we suggest the following key principles for designing assessments:

- Chemistry assessment needs to include a **broader range of methods** to better reflect real-world chemistry practice and provide learners with more varied opportunities to demonstrate their skills.
- Assessment structure should consider both **learners wellbeing and measuring attainment**. There is a need to strike a balance between maintaining standards and enabling all learners to show their potential.
- **Practical work** needs to be valued and assessed directly.
- Tiering in assessment should support **progression and equity**. When designed inclusively, tiering should offer flexibility and appropriate challenge.
- Assessments should be **designed to enable every pupil to demonstrate their ability**. Fair and rigorous assessment should be inclusive by design, enabling all learners - regardless of background, ability, or disability - to demonstrate their skills.
- Generative AI (GenAI) presents **opportunities for alternative assessment models** and reducing teacher burden, but it should be used with caution. Any use must be trialled and developed iteratively and carefully to maintain standards and fairness.
- **Digital assessment** offers new opportunities to assess skills like experimental design, data analysis, and conceptual reasoning through simulations and interactive tasks. However, it should complement – not replace – traditional methods.

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