



Best practice for professional skills in an accredited degree



Introduction

In today's fast paced and competitive business environment, employers require graduates to have a broad range of work-ready skills as well as sound knowledge of their subject. Chemistry is a subject which readily allows students to develop and practise a whole range of skills, and this is one reason why chemists are so employable.

This document details the range of appropriate transferable skills - of value in chemical and non-chemical employment - that all chemistry degree programmes should support students to develop. Students should be encouraged to keep an [Undergraduate Skills Record \(USR\)](#) throughout their studies to track skills gained throughout their studies, and set targets for future development. All undergraduate degree courses accredited by the Royal Society of Chemistry must equip graduates with these skills in order to gain accreditation. Visit our [website](#) for more information about the accreditation process.

Transferable skills

A chemistry degree should enhance:

Problem-solving skills

Chemistry degree programmes should provide students with the tools to solve a range of unseen problems. Students should be able to apply the scientific method to define a problem clearly, develop testable hypotheses, design and execute experiments, analyse data, and draw appropriate conclusions. Their problem solving skills should relate to qualitative and quantitative information.

Communications skills

A chemistry degree should develop students' ability to communicate complex information effectively and concisely covering both written and oral communication by means of written documents, presentations or discussion. Students should be able to use technical language appropriately and communicate with a variety of audiences.

Numeracy and mathematical skills

Students should develop skills in handling data, algebra, functions, trigonometry, calculus, vectors and complex numbers, alongside error analysis, order-of-magnitude estimations and systematic use of scientific units.

Investigative skills

Students should develop their ability to find information, from primary and secondary information sources such as textbooks and other literature, by searching databases and the internet, and through discussions with colleagues. They should also be able to assess the quality of information accessed.



Analytical skills

Students should develop their ability to grasp complex concepts, to understand and interpret data precisely and to construct logical arguments. They should be able to break down a problem to its basic elements.

Entrepreneurial skills

Students should develop an awareness of the entrepreneurial skills that are crucial to innovation in industry and academia. This includes taking initiative to generate, develop and communicate ideas, gaining support, and delivering successful outcomes.

ICT skills

Students should develop their computing and IT skills in a variety of areas including the location, management, processing, analysis and presentation of scientific information.

Time management and organisational skills

Students should develop their ability to work independently, to use their initiative and to organise themselves to work efficiently and effectively and meet deadlines.

Interpersonal skills

Students should develop the ability to interact with other people and to engage in team work. In an integrated master's programme, this should include working in multi-disciplinary and multi-skilled teams.

Ethical behaviour

Students should gain an understanding of what constitutes unethical scientific behaviour and should demonstrate high ethical standards throughout their degree programme and subsequent career.



Case studies

Graduates aren't always aware of where and how they have developed and used transferable skills and so find it difficult to give examples when questioned. The following case studies show how professional skill development is encouraged on the accredited course of three UK universities.

"Here at the University of Leeds we have an Industry Advisory Board (IAB) that provides advice on embedding transferable skills development in our programmes. The board is composed of an independent Chair and representatives from 10 companies from multiple sectors. Module leaders are required to mark which professional skills students develop on a comprehensive mapping

document set by the University of Leeds. This forms a large matrix which gives a clear overview of exactly which professional skills are covered in each of our chemistry units. The IAB helps us identify which skills are most important for our specific target sectors and ensure our courses deliver and embed all the professional skills that students should develop during their degree.

Figure 1.
Example of the matrix used at the University of Leeds

	Analytical skills	Commercial awareness	Communication skills	Confidence	Creative problem solving	Critical thinking	Ethical awareness	Flexibility	Independent working	Initiative	Leadership	Planning & organisation	Professionalism	Research skills	Social/cultural sensitivity	Team working	Time management	Use of knowledge
CHEMXXXX	X		X			X			X									X
CHEMXXXX	X		X			X			X					X		X		X
CHEMXXXX	X		X			X			X			X						X
CHEMXXXX	X				X	X			X									X
CHEMXXXX	X		X		X	X			X									
CHEMXXXX	X				X				X						X		X	X
CHEMXXXX	X				X	X					X							X
CHEMXXXX	X				X	X			X									X

This matrix enables us to ensure that we effectively embed professional skills within the chemical curriculum and we are currently working on how best to communicate this information to our students to ensure they will have confidence that they have developed the skills that future employers require.

Our Industry Advisory Board also provides additional opportunities for students, e.g. networking opportunities and bespoke advice on CV/job application preparation that complements opportunities/information disseminated through the School's LinkedIn group."

Professor Steve Marsden,
Head of the School of Chemistry,
University of Leeds

"At the University of Reading we have a stream of modules running vertically through our courses to fully embed professional skills for chemists. Through problem based learning, our chemistry students develop professional skills that are fundamental to any career and can then use their experiences as anecdotal evidence in interviews and applications.

Our first and second year Chemical Concepts modules encourage students to think about the skills they need and how to develop them, and we use the Royal Society of Chemistry Undergraduate Skills Record for recording these skills.

In year 1, students carry out a number of group problem based learning activities. They give presentations, write reports and design a poster to explain how they have completed the task and obtained the solutions. The first activity requires students to identify and research elements suitable for a variety of industrial applications which links nicely to an introductory module in inorganic chemistry on the periodic table and solid state structures. In the following term students carry out an IT and numeracy skills based challenge, which uses team work and communication skill. Besides these group tasks there are individual activities, such as summarising an article from Education in Chemistry.

The 2nd year module focusses on the chemical industry and career management. The challenge is based on the Titan project. Teams of students act as the management group for a company producing TiO_2 in the UK. The teams have to prepare a pitch to justify the continuation of production at the UK site and are required to produce videos explaining their 5 year plans. Additionally, students develop entrepreneurial skills as they have to produce reasoned and financially sound plans for TiO_2 production. The teams then have to defend their plans in an "Apprentice-style" board room interview held with the heads of the parent company, Titan Industries. The activity runs in parallel to sessions delivered by our Careers Advisor on CV preparation and career planning and so students can clearly see the relevance of the professional skills developed to placement applications.

The development of professional skills culminates in the final years. Students carry out research projects and draw on their experiences of independent investigative and analytical skills, problem solving, ICT and communication as they write project reports, deliver presentations and attend vivas."

Professor Elizabeth Page,
Deputy Head of Department and School Director of Outreach and Internationalisation, the University of Reading

"At York, we focus on developing the skills a chemist requires in the context of chemical knowledge taught in the core of our course.

All first year students participate in a team-building industrial-style day event in which they meet their peers, engage in small group activities, and solve real-world chemical problems in teams. They also give a short oral presentation, getting guidance on presentation skills, and carry out a public understanding of science exercise in which they either write a popular science article or create a [YouTube video](#). Students develop skills in maths, biology and physics, take workshops in scientific ethics and methodology, one whole course is taught in an independent-learning style, and a team practical on 'the chemistry of a night out' encourages them to develop experiment design and time-management skills. In year 2, we have a highly innovative assessed six-lecture course teaching Chemical Health and Safety. Students do a wide range of contextualised assessed activities in their option modules from industrial

field trips to geology practicals, and in end of year 'Group Exercises', students work as mock industrial companies to solve real-world chemistry problems. They have to organise meetings, keep minutes and consider financial implications, as well as watching-back a recorded oral presentation. Third year students develop scientific writing and literature comprehension skills in a Scientific Literacy module, while MChem Group Research Mini-Projects prepare students for their major final year research projects, introducing extended report writing, preparation of a poster and planning of open-ended research. All of these professional skills come together in the students' final year extended research projects where they must show independence and self-reliance to effectively plan, develop and manage their own project."

Professor David K. Smith,
Department of Chemistry, University of York