WHTC University application subject guides

Chemistry

This guide has been written to help support you in your application to university. It contains the following information relevant to your subject to help you decide where to apply and put together the best application that you possibly can:

1. Links to the top courses for this subject in the UK (according to
2. Entrance requirements
3. Recommended A-levels
4. Admissions tests
5. Recommended reading
6. Interesting MOOCs
7. Useful additional resources
8. Related courses
9. Oxbridge example interview questions

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1. Course links

Below are links to the top courses for this subject in the UK (according to The Complete University Guide). Click on the links to find information about what the course is like, what you'll learn, and loads of information about things such as fees and accommodation. However, remember that there are loads of other great universities out there, so check out The Complete University Guide or just google studying your subject at university.

1. University of Oxford
2. University of Cambridge (as part of Natural Sciences programme)
3. University College London
4. University of Durham
5. University of York

6. King's College London
7. Imperial College London

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2. Entrance requirements

Here are the grades that the university suggests you need to get in to that course, and the likely offer that they will give you.

1. University of Oxford: A* A* A (Chemistry and Maths required)
2. University of Cambridge: A* A* A (At least two science/mathematics subjects required)
3. University College London: A A A (Chemistry and one of Biology, Physics or Mathematics required)
4. University of Durham: A* A A (Chemistry and Maths required)
5. University of York: A A B – A* A A (Grade A in Chemistry essential)
6. King's College London: A A B (Chemistry, and at least one of Biology, Mathematics or Physics)
7. Imperial College London: A A A (A grade in Chemistry and an A grade in Mathematics)

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3. Recommended A-levels

Different universities may differ as to what A-levels they ask you for. Some might list one subject as 'essential', while another might list the same subject as just 'helpful', so make sure to check out the course page (under Section 1 of this document, or on the university website) to be sure what your chosen university expects!

Chemistry: All courses require you to have a Chemistry A-level and some university may expect you to achieve a certain grade in Chemistry so check this carefully for different universities

Mathematics: Many universities also require you to have a Maths A-level. Some universities strongly recommend taking maths but it is not essential.

Additional science and Further mathematics are not essential however they are strongly recommended by some universities

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4. Admissions tests

What admissions tests are you typically required to sit in addition to submitting your application? This also differs from uni to uni, so if your chosen university isn't on this list, make sure you check out the course page so you know exactly what you need to apply.

1. University of Oxford (Interview)
   http://admissions.chem.ox.ac.uk/how-to-apply.aspx

2. University of Cambridge requires applicants to take a pre-interview written assessment https://www.undergraduate.study.cam.ac.uk/applying/admissions-assessments/pre-interview

3. University College London (None)

4. University of Durham (None)

5. University of York (Visit to the Department required)

https://www.york.ac.uk/chemistry/undergraduate/howtoapply/visit-days/

6. King's College London (None)

7. Imperial College London (None)

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5. Recommended reading

Reading some relevant books or articles is a really great way to demonstrate your passion for your chosen subject in your personal statement, and show how you've gone beyond the curriculum. Plus, if you really want to spend three

years or more studying this subject at university, it should be enjoyable! Try taking notes and jotting down your thoughts as you're reading so that you can share some of this in your personal statement.

Books to read:

1. **Why Chemical Reactions Happen by J Keeler** – this book provides the reader with all the tools and concepts needed to think like a chemist. The text takes a unified approach to the subject, aiming to help the reader develop a real overview of chemical processes, by avoiding the traditional divisions of physical, inorganic and organic chemistry.
2. **Joy of Chemistry: The Amazing Science of Familiar Things by Cathy Cobb** – this book introduces readers to the beauty and magic of chemistry. Starting with a bang a fantastic bottle rocket made from everyday objects found around the house the authors present the essential concepts of chemistry, from atomic structure to the vibrant universe of chemical reactions, using everyday experiences, friendly non-technical language, and hands-on demonstrations.
3. **Your Brain on Food: How Chemicals Control Your Thoughts and Feelings by Gary Wenk** – this book demonstrates how, as a result of their effects on certain neurotransmitters concerned with behaviour, everything we put into our bodies has direct consequences for how we think, feel, and act. The chapters introduce each of the main neurotransmitters involved with behaviour, discuss its role in the brain, and explain ways to influence it through what we consume.
4. **The Disappearing Spoon by Sam Kean -** a variety of stories follow carbon, neon, silicon, gold and every single element on the table as they play out their parts in human history, finance, mythology, conflict, the arts, medicine and the lives of the (frequently) mad scientists who discovered them.
5. **The Fly in the Cathedral by Brian Cathcart -** The book gives a good insight into the workings of a lab and the ups and downs that come with it, covering everything from the amazing feeling of discovering something ground breaking to the frustrations of faulty equipment or unsuccessful experiments. Practical science is really brought to life as a group of physicists have to design their own lab equipment and think up new methods to try and achieve something incredible- splitting the atom.

6. **The New Science of Strong Materials – or Why You Don't Fall Through the Floor** - J. E. Gordon's classic introduction to the properties of materials used in engineering answers some fascinating and fundamental questions about how the structural world around us works.

5. **The Gecko's Foot: How Scientists are Taking a Leaf from Nature's Book** - Bio-inspiration is a form of engineering but not in the conventional sense. Extending beyond our established and preconceived notions, scientists, architects and engineers are looking at imitating nature by manufacturing 'wet' materials such as spider silk or the surface of the gecko's foot.

Scientific Journals to read:

RSC Chemical Science - https://www.rsc.org/journals-books-databases/about-journals/chemical-science/
Chemical Science the flagship journal from the Royal Society of Chemistry. It is open access, peer-reviewed and publishes significant findings from across the chemical sciences.

Materials Advances - https://www.rsc.org/journals-books-databases/about-journals/materials-advances/
Materials Advances is published monthly by the RSC. The journal accepts experimental or theoretical studies that report new understanding, applications, properties and synthesis of materials. Excellent reading for anyone interesting in an engineering or materials based course.

Nanoscale Advances - https://www.rsc.org/journals-books-databases/about-journals/nanoscale-advances/
Nanoscale Advances is published monthly by the RSC. The journal publishes research across the breadth of nanoscience and nanotechnology, a burgeoning area of cutting-edge research. Topics include the synthesis and properties of nanostructured and nanoscale materials, self-assembly and molecular organisation, nanotubes, molecular nanowires and nanocrystals, nanomedicine and more.

RSC Chemical Biology - https://www.rsc.org/journals-books-databases/about-journals/rsc-chemical-biology/ ***Chemical Biology*** is published monthly by the RSC and offers articles on the development of new chemical and biological techniques and tools, to studies furthering the

understanding and/or manipulation of biological processes at the molecular level. A good journal for research that bridges chemistry and chemical biology to medicine, so ideal for aspiring doctors or biomedical scientists.

Common textbooks used in first year of university:

1. Physical Chemistry, P W Atkins
2. Inorganic Chemistry, Shriver and Atkins

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6. Interesting MOOCs

Another great way of learning more about your chosen subject and demonstrating your interest is to take a MOOC, or Massive Open Online Course. These are free courses delivered by universities that you can take online. If the ones below don't take your fancy, try looking at Class Central - they have a huge list of different courses for every subject imaginable, and they're all free!

1. **Exploring everyday chemistry -** https://www.york.ac.uk/study/moocs/exploring-everyday-chemistry/

An insightful look into everyday chemistry and the chance to engage with one of the most highly rated chemistry departments in the UK. Topics include searching for new antibiotics, how to make the most delicious coffee and designing performance-enhancing sportswear.

2. **The Chemistry of Life** - https://www.edx.org/course/the-chemistry-of-life

Chemistry and biology are traditionally taught as separate subjects at the high school level, where students memorize fundamental scientific principles that are universally accepted. The goal of this course is to develop skills for generating new ideas at the interface between chemistry and biology by analyzing

pioneering studies. By bringing together knowledge from multidisciplinary fields, we are empowered with the ability to generate new ideas.

3. **Introduction to Chemistry: Reactions and Ratios -** https://www.coursera.org/learn/intro-chemistry

This is an introductory course for students with limited background in chemistry; basic concepts involved in chemical reactions, stoichiometry, the periodic table, periodic trends, nomenclature, and chemical problem solving will be emphasized with the goal of preparing students for further study in chemistry as needed for many science, health, and policy professions.

4. **Good Brain, Bad Brain: Drug Origins (University of Birmingham) -**

https://www.futurelearn.com/courses/good-brain-bad-brain-drugs
Explore our past, present and future understanding of drugs with this online course. Where do drugs come from? How do they work?

5. **University of Manchester** - https://www.manchester.ac.uk/study/online-blended-learning/what-you-can-study/moocs/

Offers a wide range of MOOCs including from clinical bioinformatics to water sanitation and supply

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7. **Useful additional resources**

There are loads of other great things out there that you might want to look at to develop your interest and strengthen your application, from videos to podcasts, to websites. Here are a few suggestions:

Chemistry World - https://www.chemistryworld.com/

Free to access articles

Chemistry World publishes a range of articles on stories from the world of chemical research. It provides a range of research-based, news and opinion-

based pieces on some of the most important current fields. Excellent for keeping up to date on what's happening in the chemical community.

Nature – www.nature.com

Free to access articles

Nature is a British multidisciplinary scientific journal, first published on 4 November 1869. It is one of the most recognizable scientific journals in the world, and was ranked the world's most cited scientific journal by the Science Edition of the 2018 *Journal Citation Reports* and is ascribed an impact factor of 43.070, making it one of the world's top academic journals.

New Scientist – www.newscientist.com

Free to access articles

New Scientist, first published on 22 November 1956, is a weekly English-language magazine that covers all aspects of science and technology. Based in London, it publishes editions in the UK, the United States, and Australia. Since 1996 it has been available online.

Discover – www.discovermagazine.com

Free to access articles

Discover is an American general audience science magazine launched in October 1980 by Time Inc.

Science - https://www.sciencemag.org

Free to access scientific articles

Science, also widely referred to as Science Magazine, is the peer-reviewed academic journal of the American Association for the Advancement of Science and one of the world's top academic journals.

Elsevier - https://www.elsevier.com/about/open-science/open-access/open-access-journals

Free to access scientific articles

Elsevier has a long list of open-access journals on a broad range of topics. Search by keyword to find articles on any subject you are interested in.

Ted Talks - https://www.ted.com/topics/biology

Free to watch video lecture series

TED is a nonprofit devoted to spreading ideas, usually in the form of short, powerful talks (18 minutes or less). TED began in 1984 as a conference where Technology, Entertainment and Design converged, and today covers almost all topics — from science to business to global issues — in more than 100 languages.

Sigma Aldrich - https://www.sigmaaldrich.com/chemistry/chemical-synthesis/learning-center/cheminars.html

Sigma Aldrich is one of the world's best-known suppliers of lab-grade chemicals. They offer web-based seminars describing the latest, innovative chemical synthesis technologies and products in their catalogue. Excellent for any pursuing drug design, pharmacy or industrial chemistry.

Chemistry World - https://www.chemistryworld.com/webinars

Chemistry World offers short webinars on current research – great for personal statements!

Royal Society of Chemistry - https://www.rsc.org/careers/chemcareers/

The **RSC** offers career guidance and advice to those interested in pursuing a future within the chemical sciences.

American Chemical Society Webinars -
https://www.youtube.com/user/acswebinars

A series of webinars from the ACS that explores a wide variety of topics: from the chemistry of rocks and minerals to Chemistry's role in sports.

The Royal Society of Medicine - https://www.rsm.ac.uk/resources/rsm-live

The Royal Society of Medicine is a leading provider of high-quality continuing postgraduate education and learning to the medical profession. Its mission is to advance health, through education and innovation.

8. Related courses

At university, there are loads of different combinations of subjects that you can do. Maybe you might find one of these alternatives more interesting? A few ideas are listed below with a sample link, but in most cases there are lots of universities that offer these different combinations so make sure to have a good look around!

Many universities offer joint/combined Honours programmes in which you are able to combine Chemistry with other subjects. Examples of these courses are:

- Biology and Chemistry
- Chemistry and Earth Sciences
- Chemistry and Mathematics
- Chemistry and Physics
- Chemistry and Molecular Physics

These are just some examples of possible courses – there are many other options out there for you to research!

There are also many other courses that incorporate the study of chemistry. Here are a few examples:

Natural Sciences

This degree is multidisciplinary, so you'll be able to study across the subjects of all three sciences and mathematics (and possibly even more). Different universities offer slightly different degree programmes so make sure you check carefully what your chosen university offers.

Biochemistry

Biochemistry largely covers the study of biological chemistry, molecular biology, integrative cell biology and genes and genomics. This course will give you a solid foundation for further study or graduate roles where a broader knowledge of molecular biosciences is needed. The academic and key skills you'll develop mean you will also be prepared for a wide range of alternative careers.

Chemical Engineering

Turning raw materials into valuable, useful products: That’s what Chemical Engineering does at its core. Chemical Engineering is a multidisciplinary field in which you learn everything about complex industrial processes, from design to development to production. The job opportunities for Chemical Engineering graduates are extremely versatile: You can work in virtually any industry, e.g. in pharmaceuticals, food processing, pulp & paper, electronics, petrochemicals, biotechnology and many others.

Materials Science

Materials Science is an interdisciplinary subject, spanning the physics and chemistry of matter, engineering applications and industrial manufacturing processes. Modern society is heavily dependent on advanced materials, for example, lightweight composites for faster vehicles, optical fibres for telecommunications and silicon microchips for the information revolution. Materials scientists study the relationships between the structure and properties

of a material and how it is made. They also develop new materials and devise processes for manufacturing them. Materials Science is vital for developments in nanotechnology, quantum computing, batteries and nuclear fusion, as well as medical technologies such as bone replacement materials.

Environmental Chemistry

Environmental Chemistry is concerned with the behaviour of chemicals (natural or man-made) in air, water, soils and sediments. It is an interdisciplinary field at the cross roads of important scientific subjects centred around advanced analytical chemistry. It requires knowledge of fundamental principles of many subject areas, including organic chemistry, soil science, biochemistry, toxicology and ecology.

You will learn about the chemistry of organic and inorganic compounds, whether they are produced on purpose or generated as by-products of industrial processes, and about their reactivity and their interactions with living systems.

Pharmaceutical Science

Pharmaceutical chemistry plays a huge role in drug design and discovery, from treating diabetes to curing cancer. Learn how drugs are designed and optimised from lead compounds, their modes of action and pharmacology, and how they are developed through trials and into manufacture. There is a focus on synthetic organic chemistry, but will also give you a strong foundation in physical and inorganic chemistry and spectroscopy.

Pharmacy

Pharmacy is a degree that combines the study of pharmaceutical science with the practise of pharmacy. These courses often cover a wide range of subjects such as human biology and origins of disease, pharmaceutical chemistry, and

physical sciences. This degree enables you to develop your scientific, technical and communication skills.

Biomedical Science

Biomedical science focuses on how cells, organs and systems function in the human body; an exciting and dynamic area that is highly relevant to the understanding and treatment of human diseases.

Chemical Physics

Chemical physics offers a good foundation in chemistry, physics and mathematics with particular focus on atomic and molecular science and its interdisciplinary applications.You will also focus on areas at the interface between chemistry and physics, such as physical and non-synthetic inorganic chemistry with an emphasis on materials science and nanoscience.

9. Oxbridge example interview questions

As you will know, applicants to Oxford and Cambridge have to take an interview in order to get a place. It is normal to get open-ended questions, as well as being given charts or pieces of writing to analyse. Here is a sample of the kind of questions you might get asked. Remember, you're supposed to not know the answer! They often deliberately choose topics that they think no one will have studied in order to make the questions fair. What they're looking for is to see how you think under pressure, and how you can present your ideas and your logic.

- Why are explosions a risk in flour mills? What stops bags of flour exploding in the kitchen?
- Why do we blow on soup to cool it down?
- How many molecules are there in a glass of water?
- How does a glow-stick work?
- Why don't fish freeze?
- What issues might there be if you wanted to create a metallic oxide that has good conductive properties but is also transparent?
- What is the concentration of water?
- Why does iron rust and how can rusting be stopped?
- How does blood maintain its pH?
- Discuss the bonding in benzene.
- Why is there salt in the sea?
  What is the concentration of water?
  Why is life X enantiomer-based rather than Y?
  Why does the boiling point of water rise as salt is dissolved in it?
  How many atoms are there in a brussel sprout?
  What makes some chemicals explosive?
  How would you measure pH if I told you how many hydrogen ions there were?
  How does a glow-stick work?
  Tell me about these eggs?
  Tell me about your life, from the beginning to what made you sit in that chair
  Derive a Henderson equation.
  What is 'turning you on' in chemistry at the moment?
  How many molecules there were in the glass of water on the table?
  How would you measure pH of a solution if I told you how many hydrogen ions there were in it?
  Why do you think chemistry will change your life and the life of those around you?
  An alkane has 750 carbon atoms. Given the length of a carbon.'carbon bond and a carbon"hydrogen bond calculate the total length of the molecule.
  Calculate the number of hydrogen atoms that are in the water in a glass.
  Can you draw an alkane where every carbon atom is in a different NMR environment?
  Can you think of any ways that playing in your school football team would make you better at Chemistry?

Can you change an endothermic reaction into an exothermic one?
Compare and contrast electronegativity and ionisation energy.
Compare and contrast hydrochloric acid to phosphoric acid.
Draw the shape of the molecule B2H6 .
Estimate the mass of oxygen in this building.
Explain the bonding in benzene.
How do glow sticks work?
How do the double bonds in a hydrocarbon affect its solubility?
How do you make aspirin?
How many isomers of XXX can you draw?
How many moles of water are there in this bottle of water?
How would you measure pH of a solution if I told you how many hydrogen ions there were in it?
The nucleus and electrons are oppositely charged. Why do electrons not crash into the nucleus?
What is the density of air in this room? What about outside? What about in Beijing?
What determines whether an acid is strong or weak?
What does pH stand for?
What is entropy?
What is the cause of Le Chatelier's principle?
What is the difference between diamond and graphite? The similarities?
What is the difference between entropy and enthalpy?
What is the significance of bonding in benzene?
What is wrong with the periodic table?
What is your favourite element? Why?
What makes drugs physiologically active?
Where does Chemistry end and Physics begin?
Why are diamonds so expensive?
Why are the transition metals good catalysts?
Why are the transition metals so colourful?
Why are there so many steps in the cascade of reactions?
Why do we use water to dilute solutions?
Why does food taste better when it~s hot?
Why does the boiling point of water rise as salt is dissolved in it?
Why is glass transparent but the sand that it's made from not?

Why is life carbon based and not silicon based?
Why is Vanadium so special?
You have 30 seconds to name as many functional groups as possible.
Why does the boiling point of water rise as salt is dissolved in it?
Explain the bonding in benzene.
Write down an organic reaction you have studied at school and explain its mechanism.
Why don't fish freeze?
A container with liquid nitrogen is left in a laboratory, and its temperature is being recorded over a long period. The recorded temperature shows variations. Why?
How many grains of sand are there in the world?

How many different molecules can be made from six carbon atoms and twelve hydrogen atoms?

This question gives candidates an opportunity to demonstrate a wide understanding of chemistry and there is no simple, immediate answer.

Most candidates would start by drawing some molecules to construct some that satisfy the requirement of six carbons and twelve hydrogens. If the candidate gets stuck, the interviewer may ask them to explain how many bonds they'd expect each carbon and each hydrogen to form. This part of the interview tests candidates' familiarity with different kinds of molecules, their ability to visualise molecules in three dimensions and then draw them, and their ability to decide if two differently-drawn molecules are actually equivalent. During this process, the interviewer would also be looking at how well the candidate responds to prompting.
After a few minutes, the interviewer may use the question to move the discussion toward concepts such as chirality, cis-trans isomerism, ring strain, and isotope effects. Candidates may not have heard of these before, which is fine and to be expected; the interviewer wants to see how quickly the candidate picks up new concepts and whether they can offer plausible explanations for them. The interviewer might finish the discussion with a rather more difficult question, such as 'is a molecule only stable if all the carbons form four bonds?', thus challenging what is taught at school and getting the candidate to think critically about the nature of a chemical bond.