HIGH STORRS SIXTH FORM BRIDGING WORK

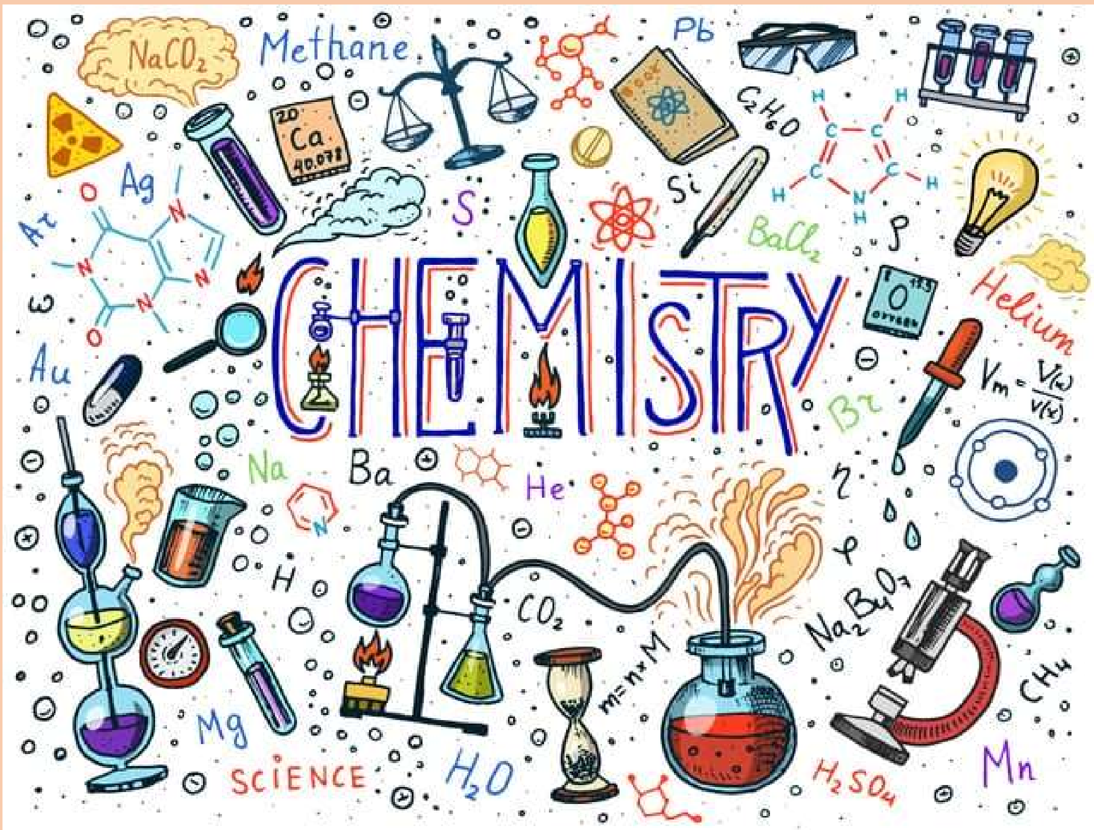
HIGH STORRS SCHOOL

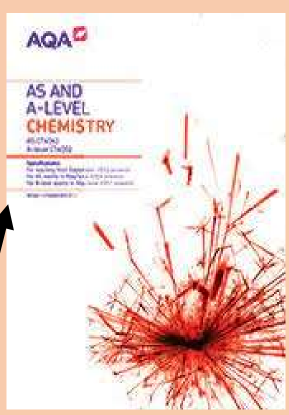
Designed for Success

2023

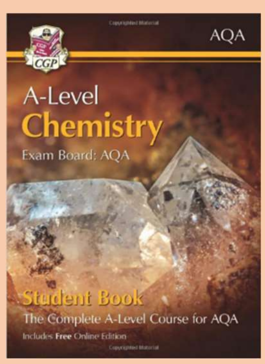
Chemistry

A-level Chemistry Transition Pack



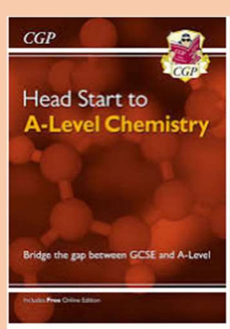


The **specification** can be downloaded from the AQA website www.aqa.org.uk



This is the **textbook** that we recommend. You could get it now, independently, or buy it through school with a discount in September.

On Applicants' Day you will be given a **Headstart to A level Chemistry** workbook.



Use some of your time over the summer to consolidate important bits of GCSE Chemistry and see how it connects to A levels.

You can collect it from Visitors' Reception if you didn't come to Applicants Day

An Introduction to A-level Chemistry

You're one of the lucky students who have chosen to study A level Chemistry. Chemistry students get to investigate a huge range of ideas: the big question you'll ask yourself is 'what is the world made of?' If you choose it as career, you have the potential to help solve all sorts of problems. You could work on a cure for cancer, or you might develop a new food: the possibilities are endless.

The objective of this pack is to help make this transition easier for all students. Students should work through it during the summer to help ensure you are ready to start the course in September

There are two types of task in this booklet, Essential tasks and Suggested enrichment.

Essential tasks

Pages 3- 9 cover the essential tasks that should be submitted in your first lesson. Some of the information is there to help you answer the questions.

The four questions to be submitted are shown with red boxes around them and can be found on the following pages:

- Page 3: Chemical Equations
- Page 4: Sub-atomic Particles
- Page 5: Ionic Compounds
- Page 8-9: Uncertainties

These will be marked by your teacher and fed back upon in the first few weeks of the course.

The Chemistry Tutor YouTube channel has a series of videos called Headstart to A level Chemistry.

This will help you with these questions as well as give you the chance to have really strong foundations in these topics before starting them in September.

[Headstart to A level Chemistry Playlist]

Enrichment: Extra-mile activities

We highly recommend that you spend some of your summer finding out about why chemistry is so fascinating and so important. We have made a number of suggestions, (in purple boxes) about the sort of thing you could do here, but there will be other ideas too.

These are covered on pages 10 onwards and include a large variety of options.

1) Chemical Equations

Balancing equations for chemical reactions is necessary because of the law of conservation of mass:

Matter cannot be created or destroyed.

This means that all the atoms of each element that you have at the start of a reaction should still be present at the end.

A chemical equation balancing game: http://education.jlab.org/elementbalancing

This simulation may also be helpful if you find balancing equations hard:
https://phet.colorado.edu/en/simulation/balancing-chemical-equations

Balance these equations:

$C + O_2 \rightarrow CO$

$Ba + H_2O \rightarrow Ba(OH)_2 + H_2$

$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

$HCl + Mg(OH)_2 \rightarrow MgCl_2 + H_2O$

$N_2 + H_2 \rightarrow NH_3$

$Na_2O + HNO_3 \rightarrow NaNO_3 + H_2O$

$Fe_2O_3 + CO \rightarrow Fe + CO_2$

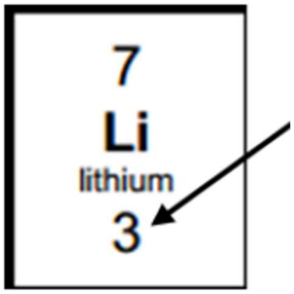
$[Cu(OH)_2(H_2O)_4] + Cl^{1-} \rightarrow [CuCl_4]^{2-} + H_2O + OH^{1-}$

$Al^{3+} + e^{1-} \rightarrow Al$

$I_2 + e^{1-} \rightarrow I^{1-}$

2) Sub-atomic particles

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the atom.



Atomic number =3, electrons = 3, Arrangement 2 in the first shell and 1 in the second or Li = 2,1

Atomic number is also called the proton number as it is equal to the number of protons in an atom.

Mass number = protons + neutrons

You will have used the rule of electrons shell filling, where: The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).

Q1. Complete the following table to show the number of sub atomic particles in each case.

Atom or Ion	Atomic Number	Mass Number	Number of Protons	Number of neutrons	Number of electrons
$^{14}_{7}N$					
Li	3	7			
Ar		40	18		
K			19	20	
Al				14	13
$^{35}_{17}Cl$					
$^{37}_{17}Cl$					
$^{16}_{8}O^{2-}$					
$^{23}_{11}Na^{1+}$					
	53			74	54
	1			0	0
		14		7	10

Q2. In the table there were two isotopes of chlorine shown. Use the example of chlorine to explain what isotopes are.

Q3. Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) F^{1-} g) Ca^{2+}

3) Ionic Compounds

Positive ions (cations)		Negative ions (anions)	
Name	**Symbol**	**Name**	**Symbol**
Hydrogen	H^+	Hydroxide	OH^{1-}
Sodium	Na^+	Chloride	Cl^{1-}
Lithium	Li^+	Bromide	Br^{1-}
Silver	Ag^+	Oxide	O^{2-}
Magnesium	Mg^{2+}	Hydrogencarbonate	HCO_3^{1-}
Calcium	Ca^{2+}	Nitrate	NO_3^{1-}
Zinc	Zn^{2+}	Sulfate	SO_4^{2-}
Aluminium	Al^{3+}	Carbonate	CO_3^{2-}
Ammonium	NH_4^{1+}	Phosphate	PO_4^{3-}

Some elements have more than one charge. For example, iron can form ions with a charge of +2 or +3. Compounds containing these are named Iron(II) and Iron(III) respectively.

Ionic compounds must have an overall neutral charge. The ratio of cations to anions must mean that there is as many positives as negatives.
For example:

NaCl		MgO		$MgCl_2$	
Na+	Cl^{1-}	Mg^{2+}	O^{2-}	Mg^{2+}	Cl^{1-}
					Cl^{1-}
+1	-1	+2	−2	+2	−2

Work out what the formulas for the following ionic compounds should be:

1. Magnesium bromide
2. Calcium chloride
3. Aluminium hydroxide
4. Sodium oxide
5. Potassium carbonate
6. Magnesium sulphide
7. Calcium nitrate
8. Barium oxide
9. Zinc chloride
10. Ammonium chloride
11. Ammonium carbonate
12. Aluminium bromide
13. Iron(II) sulfate
14. Iron(III) sulfate

4) Uncertainties

Sources of uncertainties

Every measurement you make has some uncertainty. The true value for a measurement will lie within the range that is predicted by the uncertainty that is quoted.
A good experimental will attempt to reduce the uncertainty in the outcome of an experiment.

There are a number of issues that have to be considered when assessing uncertainty. Including:
- the judgments that are made by the experimenter
- the resolution of the instrument used
- the procedures adopted (e.g. repeated readings)
- the size of increments available (e.g. the size of drops from a pipette).

Readings and measurements

It is useful, when discussing uncertainties, to separate measurements into two forms:

Readings
the values found from a **single judgement** when using a piece of equipment

Measurements
the values taken as the **difference between two values.**

For example, when using a thermometer, a student only needs to make one judgement (the height of the liquid). This is a reading. It can be assumed that the zero value has been correctly set.

For burettes and rulers, both the starting point and the end point of the measurement must be judged, leading to two uncertainties.

When calculating a <u>change</u> in a measured quantity (e.g. mass or temperature) you must take two readings to arrive at the overall measurement (a start value and an end value). Since you make 2 judgements, the total uncertainty of a measurement is double the uncertainty for a single reading.

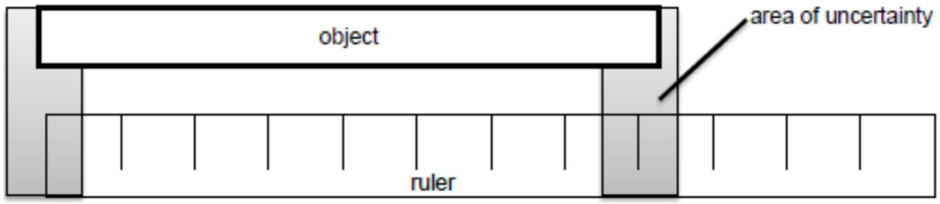
Reading One judgement only – so uncertainty is quoted value	**Measurement** Two judgements required – so uncertainty is doubled
Thermometer – to measure a single temperature	Thermometer – to measure a temperature **change**
Balance to measure a mass	Balance to measure a mass **change**
Measuring cylinder to measure volume	Burette to measure a volume of solution added
Volumetric Flask	Ruler to measure length
pH meter	

The uncertainty in a **reading** when using a particular instrument is plus or minus half of the smallest division or greater.

For example, a temperature measured with a thermometer is likely to have an uncertainty of ±0.5°C if the graduations are 1°C apart.

Readings are often written with the uncertainty. An example of this would be to write a voltage as (2.40 ± 0.01) V. It is usual for the uncertainty quoted to be the same number of decimal places as the value. In written exams, students can assume the uncertainty to be ±1 in the last significant digit. For example, if a boiling point is quoted as being 78 °C, the uncertainty could be assumed to be ±1 °C.

Measurement example: length
When measuring length, **two** uncertainties must be included: the uncertainty of the placement of the zero of the ruler and the uncertainty of the point the measurement is taken from.
As both ends of the ruler have a ±0.5 scale division uncertainty, the measurement will have an uncertainty of ±1 division.



- The uncertainty of a reading (one judgement) is at least ±0.5 of the smallest scale reading.
- The uncertainty of a measurement (two judgements) is at least ±1 of the smallest scale reading.

Repeated measurements

If measurements are repeated, the uncertainty can be calculated by finding **half the range** of the measured values.

Percentage Uncertainties

The percentage uncertainty in a measurement can be calculated using:

$$\text{Percentage uncertainty} = \frac{\text{uncertainty}}{\text{measured value}} \times 100$$

The percentage uncertainty in a repeated measurement can also be calculated using:

$$\text{Percentage uncertainty} = \frac{\text{uncertainty x number of judgements}}{\text{mean or calculated value}} \times 100$$

Titrations

Titration is a special case where a number of factors are involved in the uncertainties in the measurement.

Titrations are usually done until there are at least two titres that are concordant, i.e. within a certain allowable range, often 0.10 cm^3. These values are then averaged.

The total error in a titre is caused by three factors:

Error	Uncertainty
Reading the burette at the start of the titration	Half a division = ±0.05 cm^3
Reading the burette at the end of the titration	Half a division = ±0.05 cm^3
Judging the end point to within one drop	Volume of a drop = ± 0.05 cm^3
Total	± 0.15 cm^3

Errors and uncertainties questions

1) Calculate the **percentage apparatus uncertainty** for each of the following.

a) measuring a solution in a pipette with a **reading** of 25.0 cm^3 (uncertainty ± 0.1 cm^3)

b) measuring a solution in a measuring cylinder with a **reading** of 25 cm^3 (uncertainty ± 1 cm^3)

c) measuring a solution in a pipette with a **reading** of 10.0 cm^3 (uncertainty ± 0.1 cm^3)

d) measuring 24.25 cm^3 of solution in a titration from a burette (**total uncertainty** ± 0.15 cm^3)

e) measuring a mass <u>**change**</u> of 2.41 g (uncertainty of each mass reading ± 0.01 g)

f) measuring a temperature <u>**change**</u> of 13.9^{o}C (uncertainty of each temperature reading ± 0.1^{o}C)

g) measuring 8.0 cm^3 of water into a boiling tube from a burette (uncertainty **of <u>each</u> volume** is ± 0.05 cm^3)

To work out a **percentage experimental error** (% difference between a true value and an experimental value:

a) work out the difference between the experiment and true value
b) calculate % difference = (difference ÷ true value) x 100

An experiment is accurate if the % difference from true value is smaller than total apparatus % uncertainty.

2) The Mr of a substance was found to be 106.2 by experiment, which compared to the true value of 104.3. The total apparatus uncertainty in this experiment was 2.6%.

a) Calculate the percentage experimental error (the % difference from true value).

b) State and explain whether the experiment was accurate.

3) The enthalpy change for a reaction was found to be –55.4 kJ mol^{-1} by experiment which compared to the true value of –58.1 kJ mol^{-1}. The total apparatus uncertainty in this experiment was 3.2%.

a) Calculate the percentage experimental error (% difference from true value).

b) State and explain whether the experiment was accurate.

4) A student dissolved a mass of 2.62 g (balance uncertainty ± 0.01 g for each measurement) in 25 cm^3 of water (measuring cylinder uncertainty ± 1 cm^3) and found the temperature changed by 4.7ºC (thermometer uncertainty ± 0.1ºC). She found the enthalpy change to be +30.6 kJ mol^{-1} compared to a true value of +34.8 kJ mol^{-1}. measuring

a) Calculate the percentage experimental error.

b) Calculate the apparatus uncertainty for the **reading** on the measuring cylinder.

c) Calculate the apparatus uncertainty for the balance **measurement**.

d) Calculate the apparatus % uncertainty for the **temperature change**.

e) Add up each % uncertainty to get a total apparatus % error. Was the experiment accurate?

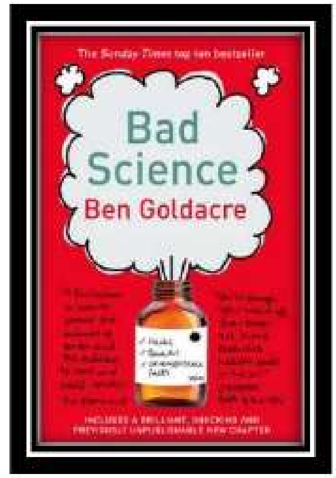
Enrichment: Extra-mile activities

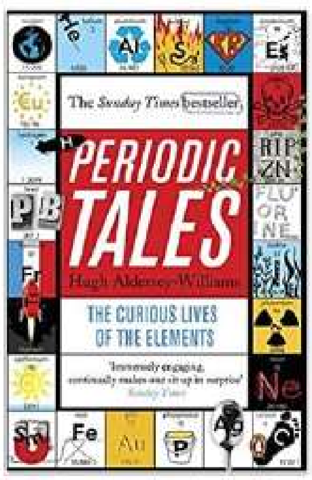
Books

Bad Science (Paperback) Ben Goldacre

Since 2003 Dr Ben Goldacre has been exposing dodgy medical data in his popular *Guardian* column. In this eye-opening book he takes on the MMR hoax and misleading cosmetics ads, acupuncture and homeopathy, vitamins and mankind's vexed relationship with all manner of 'toxins'. Along the way, the self-confessed 'Johnny Ball cum Witchfinder General' performs a successful detox on a Barbie doll, sees his dead cat become a certified nutritionist and probes the supposed medical qualifications of 'Dr' Gillian McKeith.

Full spleen and satire, Ben Goldacre takes us on a hilarious, invigorating and ultimately alarming journey through the bad science we are fed daily by hacks and quacks.





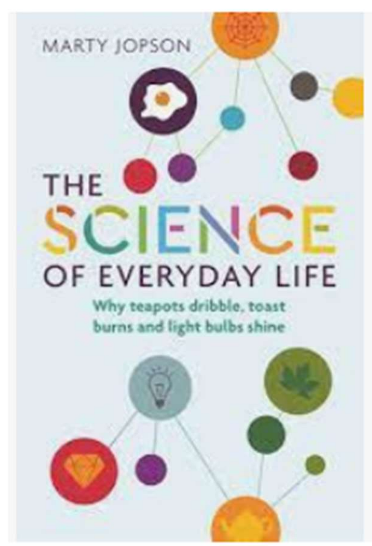
Periodic Tales: The Curious Lives of the Elements
(Paperback) Hugh Aldersey-Williams

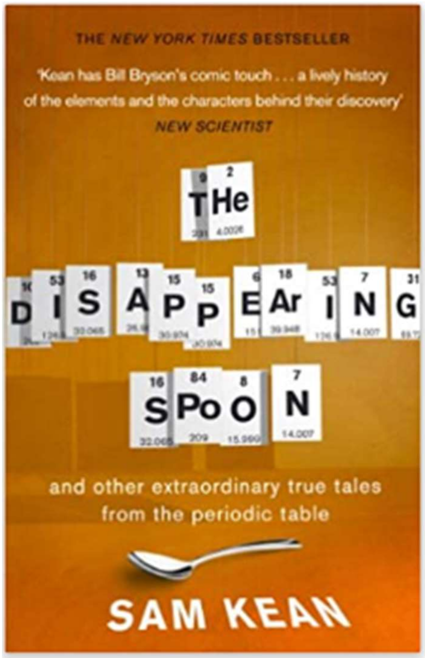
The phenomenal *Sunday Times* bestseller *Periodic Tales* by Hugh Andersey-Williams, packed with fascinating stories and unexpected information about the building blocks of our universe.

The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine

Marty Jopson

The title says it all really, lots of interesting stuff about the things around you home!





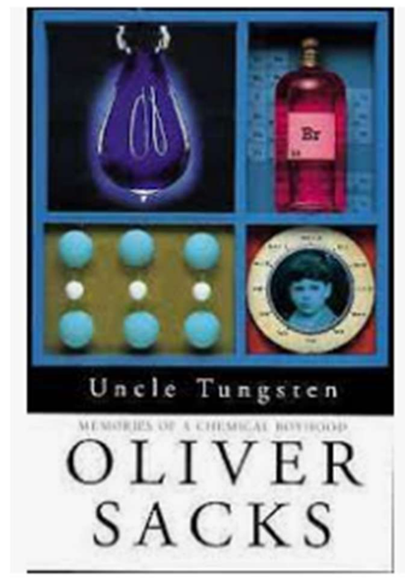
One of our crowning scientific achievements is also a treasure trove of passion, adventure, betrayal and obsession.

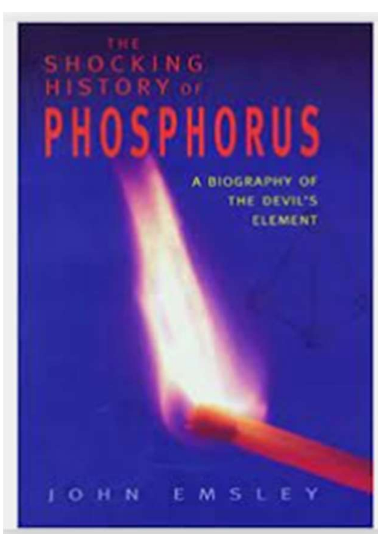
The Disappearing Spoon (Sam Kean) follows the elements, their parts in human history, finance, mythology, conflict, the arts, medicine and the lives of the (frequently) mad scientists who discovered them.

Uncle Tungsten

Oliver Sacks

A memoir of growing up in World-War-II England as part of an extraordinary scientific family, as Sacks invokes his early fascination with light, matter and energy.





The Shocking History of Phosphorus:

A Biography of the Devil's Element

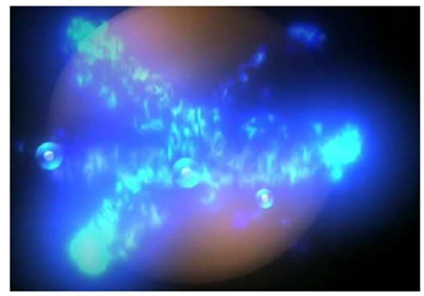
John Emsley

Born of the age of alchemy and harbouring the kind of mysterious influence that alchemists sought, phosphorus brought wealth to a few but misery to many. For over 300 years, phosphorus maimed, killed, polluted and burned - sometimes on a terrifying scale. Yet, such were its perceived benefits that doctors prescribed it, every home contained it and whole industries were dedicated to its manufacture

Videos relating to Chemistry

Play with Smart Materials
Catarina Mota:
Ink that conducts electricity; a window that turns from clear to opaque at the flip of a switch; a jelly that makes music. All this stuff exists, it's time to play with it. A tour of surprising and cool new materials.
Available at: www.ted.com/talks/catarina_mota_play_with_smart_materials

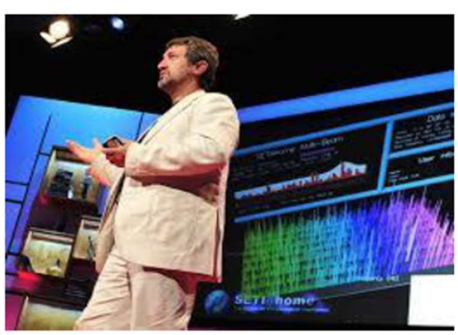
Just how small is an atom?
Just how small are atoms? Really, really, really small. This fast-paced animation from TED-Ed uses metaphors (imagine a blueberry the size of a football stadium!) to give a visceral sense



Available at : www.ted.com/talks/just_how_small_is_an_atom

Battling Bad Science
Every day there are news reports of new health advice, but how can you know if they're right? Doctor and epidemiologist Ben Goldacre shows us, at high speed, the ways evidence can be distorted, from the blindingly obvious nutrition claims to the very subtle tricks of the pharmaceutical industry.

Available at: www.ted.com/talks/ben_goldacre_battling_bad_science#t-44279



How Spectroscopy Could Reveal Alien Life
GarikIsraelianis a spectroscopist, studying the spectrum emitted by a star to figure out what it's made of and how it might behave. It's a rare and accessible look at this discipline, which may be coming close to finding a planet friendly to life.
Available at: www.ted.com/talks/garik_israelian_what_s_inside_a_star

Careers you could research

Studying Chemistry at A-level or degree opens up plenty of career opportunities, such as:


Biochemist


Forensic scientist


Chemical engineer


Biomedical scientist


Toxicologist


Perfumer


Pharmacist


Urologist


Vet


Environmental engineer

Science on Social Media

Follow on Twitter:

- Salters' Institute -Our activities include Festivals of Chemistry; Chemistry Camps; Curricula; Awards for Technicians, Graduates, A Level Students; and Seminars @salters_inst
- Daily A Level Chemistry Facts –Daily Chemistry Facts (Based on the A-Level AQA spec but most facts work with all) @chemAlevels
- Chemistry News –The latest chemistry news from only the best sources @chemistrynews
- Compound Interest–Graphics exploring everyday #chemistry. Winner of @absw2018 science blog award @compoundchem
- Chemistry World –Chemistry magazine bringing you the latest chemistry news and research every day. Published by the Royal Society of Chemistry. @ChemistryWorld
- Royal Society of Chemistry -Promote, support and celebrate chemistry. Follow for updates on latest activities @RoySocChem
- Periodic Videos–Chemistry video series by @BradyHaran& profs at the Uniof Nottingham -also see @sixtysymbols& @numberphile @periodicvideos

Find on Facebook:

- Science Now -Science Now is a dedicated community that helps spread science news in all fields, from physics to biology, medicine to nanotechnology, space and beyond!
- National Science Foundation –As an independent federal agency, NSF fund a significant proportion of basic research. For official source information about NSF, visit www.nsf.gov
- Science News Magazine -Science covers important and emerging research in all fields of science
- BBC Science News -The latest BBC Science and Environment News: breaking news, analysis and debate on science and nature around the world
- Scientific American -Scientific American is the authority on science and technology for a general audience, with coverage that explains how research changes our understanding of the world and shapes our lives.

Things to Research!

Use your online searching abilities to see if you can find out as much about the topic as you can. Remember you are a prospective A level student of chemistry so go 'one step beyond' your understanding.

Try using making a 1-page summary for each one you research. Or a short presentation.

Task 1: The chemistry of fireworks

What are the component parts of fireworks? What chemical compounds cause fireworks to explode? What chemical compounds are responsible for the colour of fireworks?

Task 2 – Why some plastic, like polyacetylene can conduct electricity

Organic materials are always insulators, aren’t they? Have you thought why?

Task 3: Why is copper sulphate blue?

Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

Task 4: Aspirin

What was the history of the discovery of aspirin, how do we manufacture aspirin in a modern chemical process?

Task 5: The hole in the ozone layer

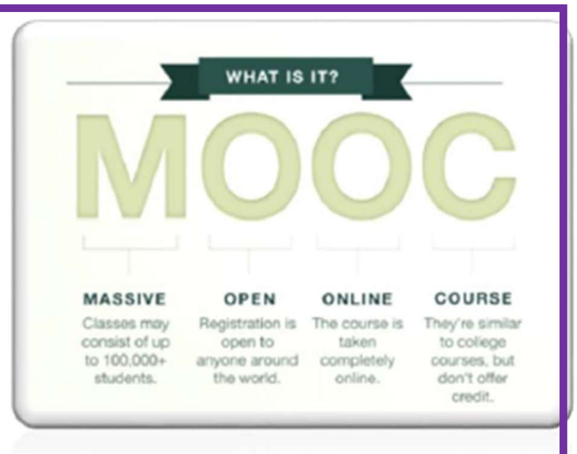
Why did we get a hole in the ozone layer? What chemicals were responsible for it? Why were we producing so many of these chemicals? What is the chemistry behind the ozone destruction?

Task 6: ITO and the future of touch screen devices

ITO – indium tin oxide is the main component of touch screen in phones and tablets. The element indium is a rare element and we are rapidly running out of it. Chemists are desperately trying to find a more readily available replacement for it. What advances have chemists made in finding a replacement for it?

MOOC

Want to stand above the rest when it comes to UCAS? Now is the time to act.



MOOCs are online courses run by nearly all universities. They are short FREE courses that you take part in. They are usually quite specialist, but aimed at the public, not the genius!

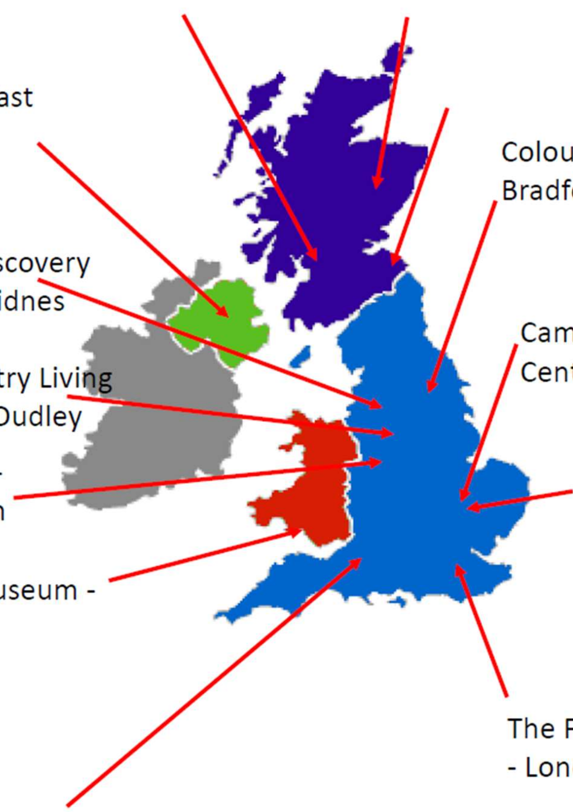
There are lots of websites that help you find a course, such as edX and Future learn.

You can take part in any course, but there are usually start and finish dates. They mostly involve taking part in web chats, watching videos and interactives.

Completing a MOOC will look great on your Personal statement and they are dead easy to take part in!

Other ideas:

- Ideas for a trip:



- Websites
    - Michio Kaku explains the "real" science behind fantastic four www.nerdist.com/michio-kaku-explains-the-real-science-behind-fantastic-four
        - www.flickclip.com/flicks/fantastic4.html
    - Periodic Table of Videos by Martyn Poliakoff www.youtube.com
    - Institution of Chemical Engineers www.icheme.org
    - Royal Society of Chemistry www.rsc.org.uk
    - Chemistry World. Chemistry in an everyday context www.chemistryworld.com

- Magazines can help you put the chemistry you're learning in context.
    - Focus,
    - New Scientist
    - Scientific American
    - The Mole
    - Catalyst magazine has a series of articles that you could look at:
        - Topic 1: Using Plastics in the Body
        - Topic 2: Catching a Cheat
        - Topic 3: Diamond: More than just a gemstone
        - Topic 4: The Bizarre World of High Pressure Chemistry
        - Topic 5: Microplastics and the Oceans

- YouTube

1. Simon Clark Tackling science's big questions.
2. Danielle Thé Big data, machines and AI.
3. Brady Haran Maths and stats channel Numberphile and chemical elements series Periodic Videos.
4. Simone Giertz A self-confessed "non-engineer", who likes to build robots.
5. Vsauce Series looking at the brain and consciousness.
6. Crash Course Various subjects, e.g. aerospace engineering, biomedicine and energy.
7. AsapSCIENCE Explaining scientific conundrums, such as "What if you stopped brushing your teeth forever?"
8. The Brain Scoop "Chief curiosity correspondent"
9. Veritasium https://www.youtube.com/user/1veritasium
10. Kurzgesagt https://www.youtube.com/user/Kurzgesagt

- Films
    - The Human Experiment. A documentary that explores chemicals found in everyday household products.
    - The Insider. A research chemist comes under personal and professional attack when he decides to appear in a "60 Minutes" expose on Big Tobacco.