

Transition Pack for AQA Applied General Science

So, you are considering
applied science?



This pack contains a programme of activities and resources to prepare you to start AQA Applied General Science in September. It is aimed to be used after you complete your GCSE, throughout the remainder of the Summer term and over the Summer Holidays to ensure you are ready to start your course in September. As an Applied General Science course, we will cover a range of topics, including Key concepts in science; Applied experimental techniques; Science in the Modern World; The Human Body; Investigating Science and one option unit, so an all-round interest in the subjects is essential



Before you begin, the following links will help you clear up any misconceptions found at GCSE Science

<https://app.senecalearning.com/dashboard/courses/add/enroll/f02a8398-a3e9-4a23-8b89-0c8ed30d9506>

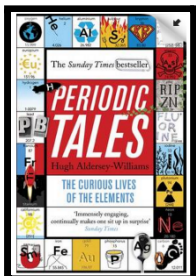
<https://app.senecalearning.com/dashboard/courses/add/enroll/3b24f592-8dea-4b4e-bd4d-855b344a819e>

<https://app.senecalearning.com/dashboard/courses/add/enroll/eda31dd6-706e-4cef-a456-467535abc1c0>

Book Recommendations

For those avid readers amongst you the following list is by no means exhaustive but may be interesting to read

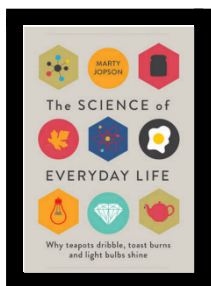
Periodic Tales: The Curious Lives of the Elements (Paperback) Hugh Aldersey-Williams



ISBN-10: 0141041455

This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.

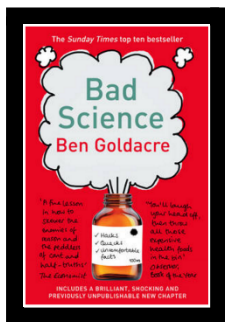
The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine (Hardback) Marty Jopson



ISBN-10: 1782434186

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

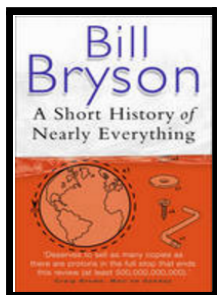
Bad Science (Paperback) Ben Goldacre



ISBN-10: 000728487X

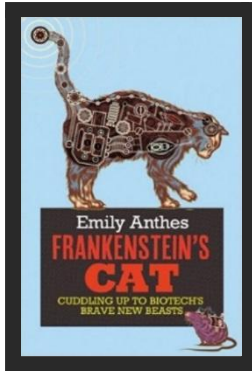
Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science – this book will make you think about everything the advertising industry tries to sell you by making it sound ‘sciency’.

A Short History of Nearly Everything



ISBN – 0552997048

A modern classic. Popular science writing at its best. A Short History of Nearly Everything Bill Bryson’s quest to find out everything that has happened from the Big Bang to the rise of civilization - how we got from there, being nothing at all, to here, being us. Hopefully by reading it you will gain an awe-inspiring feeling of how everything in the universe is connected by some fundamental laws.



Frankenstein's cat

Discover how glow in the dark fish are made and more great Biotechnology breakthroughs. Available at local bookstores and at amazon.co.uk

Movie / Video Clip Recommendations

Hopefully you'll get the opportunity to soak up some of the Sun's rays over the summer – synthesising some important Vitamin-D – but if you do get a few rainy days where you're stuck indoors and you prefer films to books here are some ideas for films to watch or clips to find online.

Science/Sci Fi Films

1. Moon (2009)
2. Gravity (2013)
3. Interstellar (2014)
4. The Imitation Game (2015)
5. Something the Lord Made (2004)
6. Gorillas in the Mist (1988)
7. Andromeda Strain (1971)

Online Clips / Series

1. **Minute Physics** – Variety of Physics questions explained simply (in felt tip) in a couple of minutes. Addictive viewing that will have you watching clip after clip – a particular favourite of mine is “Why is the Sky Dark at Night?”

<https://www.youtube.com/user/minutephysics>

2. **Wonders of the Universe / Wonders of the Solar System** – Both available on Netflix as of 17/4/16 – Brian Cox explains the Cosmos using some excellent analogies and wonderful imagery.

3. **The Fantastic Mr. Feynman** – I recommended the book earlier, I also cannot recommend this 1 hour documentary highly enough. See the life's work of the “great explainer”, a fantastic mind that created mischief in all areas of modern Physics.

<https://www.youtube.com/watch?v=LyqleixXTpw>

4. **Rough science – the Open University – 34 episodes available**

Real scientists are ‘stranded’ on an island and are given scientific problems to solve using only what they can find on the island.

Great fun if you like to see how science is used in solving problems.

There are six series in total

http://www.dailymotion.com/playlist/x2igjq_Rough-Science_rough-science-full-series/1#video=xxw6p1r

or

<https://www.youtube.com/watch?v=IUoDWA259I>

5. **Growing New Organs**

Anthony Atalla's state-of-the-art lab grows human organs — from muscles to blood vessels to bladders, and more.

http://www.ted.com/talks/anthony_atala_growing_organs_engineering_tissue?language=en

6. **A New Superweapon in the Fight Against Cancer**

Cancer is a very clever, adaptable disease. To defeat it, says medical researcher and educator Paula Hammond, we need a new and powerful mode of attack

http://www.ted.com/talks/paula_hammond_a_new_superweapon_in_the_fight_against_cancer?language=en

Research activity

To get the best grades in applied science you will have to get good at completing independent research and making your own notes on difficult topics. Below are links to 4 websites that cover some interesting science topics.

Using the Cornell notes system: <http://coe.jmu.edu/learningtoolbox/cornellnotes.html> make 1 page of notes from each site covering a topic of your choice.

1. <http://home.cern/about>
CERN encompasses the Large Hadron Collider (LHC) and is the largest collaborative science experiment ever undertaken. Find out about it here and make a page of suitable notes on the accelerator.
2. http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html
The solar system is massive and its scale is hard to comprehend. Have a look at this award winning website and make a page of suitable notes.
3. <http://bigpictureeducation.com/cell>
The cell is the building block of life. Each of us starts from a single cell, a zygote, and grows into a complex organism made of trillions of cells. In this issue, we explore what we know – and what we don't yet know – about the cells that are the basis of us all and how they reproduce, grow, move, communicate and die.
4. <http://bigpictureeducation.com/exercise-energy-and-movement>
All living things move. Whether it's a plant growing towards the sun, bacteria swimming away from a toxin or you walking home, anything alive must move to survive. For humans though, movement is more than just survival – we move for fun, to compete and to be healthy. In this issue we look at the biological systems that keep us moving and consider some of the psychological, social and ethical aspects of exercise and sport.

Now try a wider research task. Use the same note taking system to research and produce a 1 page report on the following question:

5. **Why is copper sulfate blue?**

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

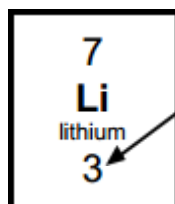
Pre-Knowledge Topics

Chemistry – Electronic structure, how electrons are arranged around the nucleus

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

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).



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

Li = 2,1

At **A level** you will learn that the electron structure is more complex than this, and can be used to explain a lot of the chemical properties of elements.

The 'shells' can be broken down into 'orbitals', which are given letters: 's' orbitals, 'p' orbitals and 'd' orbitals.

You can read about orbitals here:

<http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top>

Now that you are familiar with s, p and d orbitals try these problems, write your answer in the format:

1s², 2s², 2p⁶ etc.

Q1.1 Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V h) Ni i) Cu j) Zn k) As

Q1.2 Extension question, can you write out the electron arrangement of the following **ions**:

a) K⁺ b) O²⁻ c) Zn²⁺ d) V⁵⁺ e) Co²⁺

Chemistry – Oxidation and reduction

At GCSE you know that oxidation is adding oxygen to an atom or molecule and that reduction is removing oxygen, or that oxidation is removing hydrogen and reduction is adding hydrogen. You may have also learned that oxidation is removing electrons and reduction is adding electrons.

At A level we use the idea of **oxidation number** a lot!

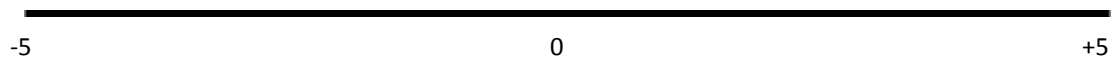
You know that the metals in group 1 react to form ions that are +1, i.e. Na⁺ and that group 7, the halogens, form -1 ions, i.e. Br⁻.

We say that sodium, when it has reacted has an oxidation number of +1 and that bromide has an oxidation number of -1.

All atoms that are involved in a reaction can be given an oxidation number.

An element, Na or O₂ is always given an oxidation state of zero (0), any element that has reacted has an oxidation state of + or -.

As removing electrons is **reduction**, if, in a reaction the element becomes **more** negative it has been reduced, if it becomes more positive it has been oxidised.



You can read about the rules for assigning oxidation numbers here:

<http://www.dummies.com/how-to/content/rules-for-assigning-oxidation-numbers-to-elements.html>

Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember:

Metals have a + oxidation state when they react.

Oxygen is 'king' it always has an oxidation state of -2

Hydrogen has an oxidation state of +1 (except metal hydrides)

The charges in a molecule must cancel.

Examples: Sodium nitrate, NaNO₃

Na +1 3x O²⁻
+1 -6

To cancel: N = +5

sulfate ion, SO₄²⁻

4xO²⁻ and 2- charges 'showing'
-8 -2

S = +6

Q2.1 Work out the oxidation state of the underlined atom in the following:

- a) MgCO₃ b) SO₃ c) NaClO₃ d) MnO₂ e) Fe₂O₃ f) V₂O₅
g) KMnO₄ h) Cr₂O₇²⁻ i) Cl₂O₄

Physics - Symbols and Prefixes

Prefix	Symbol	Power of ten
Nano	n	$\times 10^{-9}$
Micro	μ	$\times 10^{-6}$
Milli	m	$\times 10^{-3}$
Centi	c	$\times 10^{-2}$
Kilo	k	$\times 10^3$
Mega	M	$\times 10^6$
Giga	G	$\times 10^9$

At level 3, unlike GCSE, you need to remember all symbols, units and prefixes. Below is a list of quantities you may have already come across and will be using during your level 3 course

Quantity	Symbol	Unit
Velocity	v	ms^{-1}
Acceleration	a	ms^{-2}
Time	t	s
Force	F	N
Resistance	R	Ω
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	kgms^{-1}
Power	P	W

Density	ρ	kgm^{-3}
Charge	Q	C

Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54 600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m. Express in standard form.
8. Convert 1002 mV into V. Express in standard form.
9. How many eV in 0.511 MeV? Express in standard form.
10. How many m in 11 km? Express in standard form.

Physics - Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at level 3. For a recap of GCSE watch the following links:

www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable

www.youtube.com/watch?v=_WWgc3ABSj4

Rearrange the following:

1. $E = m \times g \times h$ to find h
2. $Q = I \times t$ to find I
3. $E = \frac{1}{2} m v^2$ to find m
4. $E = \frac{1}{2} m v^2$ to find v
5. $v = u + at$ to find u
6. $v = u + at$ to find a
7. $v^2 = u^2 + 2as$ to find s
8. $v^2 = u^2 + 2as$ to find u

Physics - Waves

You have studied different types of waves and used the wave equation to calculate speed, frequency and wavelength. You will also have studied reflection and refraction.

Use the following links to review this topic.

<http://www.bbc.co.uk/education/clips/zb7gkqt>

<https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves>

<https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves>

1) Draw a diagram showing the refraction of a wave through a rectangular glass block. Explain why the ray of light takes this path.

2) Describe the difference between a longitudinal and transverse waves and give an example of each

3) Draw a wave and label the wavelength and amplitude

Biology - Cells

The cell is a unifying concept in biology, you will come across it many times during your two years of level 3 study. Prokaryotic and eukaryotic cells can be distinguished on the basis of their structure and ultrastructure. In complex multicellular organisms cells are organised into tissues, tissues into organs and organs into systems. During the cell cycle genetic information is copied and passed to daughter cells. Daughter cells formed during mitosis have identical copies of genes while cells formed during meiosis are not genetically identical

Read the information on these websites (you could make more Cornell notes if you wish):

<http://www.s-cool.co.uk/a-level/biology/cells-and-organelles>

<http://www.bbc.co.uk/education/guides/zvjycdm/revision>

And take a look at these videos:

<https://www.youtube.com/watch?v=gcTuQpuJyD8>

<https://www.youtube.com/watch?v=L0k-enzoeOM>

<https://www.youtube.com/watch?v=qCLmR9-YY7o>

Task:

Produce a one page revision guide to share with your class in September summarising one of the following topics: Cells and Cell Ultrastructure, Prokaryotes and Eukaryotes, or Mitosis and Meiosis.

Whichever topic you choose, your revision guide should include:

Key words and definitions

Clearly labelled diagrams

Short explanations of key ideas or processes.