Transition from GCSE to BTEC Applied Science

at The Deepings School

This pack contains a programme of activities and resources to prepare you to start BTEC Applied 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.

This work booklet aims to give you a head start by helping you:

- to pre-learn some useful knowledge from the first chapters of your BTEC Level 3 Qualification.

- understand and practice of some of the maths skills you will need.

Part 1: Booklet activities

After completing the activities in the booklet, I should be able to:

- produce a page of concise research notes

- recall the answers to the pre-knowledge topics

- perform maths skills including:

    o Writing in standard form

    o Recalling, rearranging and using formula in calculations

    o Unit conversions

Part 2: Seneca Learning assignments

In addition to the activities in this booklet, you are required to complete assignments on Seneca Learning that cover selected topics from the externally examined unit for Applied science. These are important 'bridging' topics, a good grasp of which will help you transition to A-level work.

Make yourself a free account at www.senecalearning.com if you don't already have one, and use this class code to access the assignments: **tw68ohhohu**

Track your progress

Topic	Title	Completed (date)	Comments Do you need more practice? Are you confident with this area? What areas of weakness have you identified?
Research activities	Topic 1: The Cell		
	Topic 2: Exercise, Energy and Movement		
	Topic 3: CERN		
	Topic 4: Why is copper sulphate blue?		
	Topic 5: ITO and touch screen devices		
Chemistry	Topic 1: Isotopes and mass		
	Topic 2: Electronic structure		
	Topic 3: Mass and the mole		
Biology	Topic 1: Exchange and Transport		
	Topic 2: Cells		
Physics	Topic 1: Standard form		
	Topic 2: Symbols and Prefixes		
	Topic 3: Equations and calculations		
Science investigation skills	Key word glossary		

Research activities

Research, reading and note making are essential skills for BTEC Applied Science study. For the following task you are going to produce 'Cornell Notes' to summarise your reading.
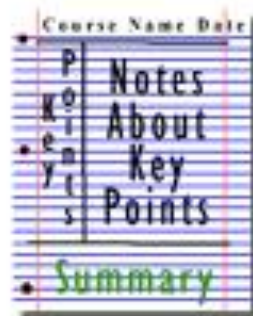
1. Divide your page into three sections like this

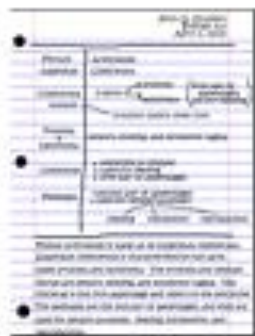2. Write the name, date and topic at the top of the page

3. Use the large box to make notes. Leave a space between separate idea. Abbreviate where possible.

4. Review and identify the key points in the left hand box

5. Write a summary of the main ideas in the bottom space

Images taken from http://coe.jmu.edu/learningtoolbox/cornellnotes.html

Research activities

For each of the following topics, you are going to use the resources to produce one page of Cornell style notes.
Use the links or scan the QR code to take you to the resources.

Topic 1: The Cell
Available at:
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.

Topic 2: Exercise, Energy and Movement
Available at:
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.

Topic 3: 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.
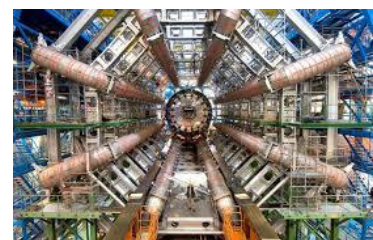
Topic 4: Why is copper sulphate blue?
http://www.docbrown.info/page04/4_75trans.htm
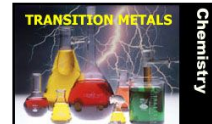Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

TRANSITION METALS

Doc Brown's Chemistry

GCSE 9-1, IGCSE, O Level Chemistry Revision Notes

Task 5: ITO and the future of touch screen devices
ITO
https://www.sciencedirect.com/topics/materials-science/indium-tin-oxide – 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?

Pre-Knowledge topics

1 Chemistry

Chemistry topic 1 – Isotopes and mass

You will remember that an isotopes are elements that have differing numbers of neutrons.

Hydrogen has 3 isotopes; H_1^1 H_1^2 H_1^3

Isotopes occur naturally, so in a sample of an element you will have a mixture of these isotopes. We can accurately measure the amount of an isotope using a mass spectrometer. You will need to understand what a mass spectrometer is and how it works at A level. You can read about a mass spectrometer here:

http://bit.ly/pixlchem3
http://www.kore.co.uk/tutorial.htm
http://bit.ly/pixlchem4
http://filestore.aqa.org.uk/resources/chemistry/AQA-7404-7405-TN-MASS-SPECTROMETRY.PDF

Q1.1 What must happen to the atoms before they are accelerated in the mass spectrometer?

Q1.2 Explain why the different isotopes travel at different speeds in a mass spectrometer.

A mass spectrum for the element chlorine will give a spectrum like this:

75% of the sample consist of chlorine-35, and 25% of the sample is chlorine-37.

Given a sample of naturally occurring chlorine ¾ of it will be Cl-35 and ¼ of it is Cl-37. We can calculate what the mean mass of the sample will be:

Mean mass = 75 x 35 + 25 x 37 = 35.5
　　　　　　 100　　　 100

If you look at a periodic table this is why chlorine has an atomic mass of 35.5.

http://www.avogadro.co.uk/definitions/ar.htm

An A level periodic table has the masses of elements recorded much more accurately than at GCSE. Most elements have isotopes and these have been recorded using mass spectrometers.

　GCSE　　　　　　　　　　　　　　　　　A level

Given the percentage of each isotope you can calculate the mean mass which is the accurate atomic mass for that element.

Q1.3 Use the percentages of each isotope to calculate the accurate atomic mass of the following elements.

a)　　　Antimony has 2 isotopes: Sb-121 57.25% and Sb-123 42.75%

b)　　　Gallium has 2 isotopes: Ga-69 60.2% and Ga-71 39.8%

c)　　　Silver has 2 isotopes: Ag-107 51.35% and Ag-109 48.65%

d)　　　Thallium has 2 isotopes: Tl-203 29.5% and Tl-205 70.5%

e)　　　Strontium has 4 isotopes: Sr-84 0.56%, Sr-86 9.86%, Sr-87 7.02% and Sr-88 82.56%

Chemistry topic 2 – 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).

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://bit.ly/pixlchem1

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:

$1s^2, 2s^2, 2p^6$ 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) O^{2-} c) Zn^{2+} d) V^{5+} e) Co^{2+}

Chemistry topic 3 – Mass and the Mole

The Periodic table can tell you the relative atomic mass of an element. This allows us to compare the mass of elements and compounds to each other since we are unable to physically measure their mass.

To calculate mass of an element you are looking at the MASSive number, of that element, in the Periodic table, so in the case of Lithium above it is 7. There are no units of mass here because it is a relative number.

If we wanted to calculate the Relative formula mass (Mr) of LiF , it would be 7+19 = 26

https://youtu.be/-_-fNVmDwJk

https://youtu.be/Md4BQL91U6w

The mole is a new unit you need to learn about. 1 mole of any substance will contain 6.022×10^{23} particles of that substance. This is called Avogadro's number.

We can use the formula triangle to calculate the number of moles of an element or compound. You need to learn the equation: Moles = Mass / Mr

Calculate the number of moles in 10g of: (You will first need to calculate the Mr and then use the triangle)

a) Ca   b) Al   c) S   d) Cl   e) Ar   f) NaCl   g) H_2O h) MgO   i) CaO   j) $CaCO_3$ k) $Mg(OH)_2$

2 Biology

Organisms need to exchange substances selectively with their environment and this takes place at exchange surfaces. Factors such as size or metabolic rate affect the requirements of organisms and this gives rise to adaptations such as specialised exchange surfaces and mass transport systems. Substances are exchanged by passive or active transport across exchange surfaces. The structure of the plasma membrane enables control of the passage of substances into and out of cells

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

http://www.s-cool.co.uk/a-level/biology/gas-exchange

http://www.s-cool.co.uk/a-level/biology/nutrition-and-digestion/revise-it/human-digestive-system

And take a look at these videos:

http://ed.ted.com/lessons/insights-into-cell-membranes-via-dish-detergent-ethan-perlstein

http://ed.ted.com/lessons/what-do-the-lungs-do-emma-bryce

Task:

Create a poster or display to go in your classroom in September. Your poster should either: compare exchange surfaces in mammals and fish or compare exchange surfaces in the lungs and the intestines. You could use a Venn diagram to do this. Your poster should:

Describe diffusion, osmosis and active transport

Explain why oxygen and glucose need to be absorbed and waste products removed

Compare and contrast your chosen focus.

Biology Topic 2: Cells

The cell is a unifying concept in biology, you will come across it many times during your two years of A level 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

Tasks:

1) 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.

2) Draw a fully labelled diagram of a plant cell, animal cell and bacterial cell.

The version you will learn about during the course is much more detailed than you have come across before. Include information about the function of each new component you come across. You will need to learn all of these.

3 Physics

At A level quantity will be written in standard form, and it is expected that your answers will be too.
This means answers should be written as ....x 10^y. E.g. for an answer of 1200kg we would write 1.2 x 10^3kg. For more information visit: www.bbc.co.uk/education/guides/zc2hsbk/revision

1. Write 2530 in standard form.
2. Write 280 in standard form.
3. Write 0.77 in standard form.
4. Write 0.0091 in standard form.
5. Write 1 872 000 in standard form.
6. Write 12.2 in standard form.
7. Write 2.4 x 10^2 as a normal number.
8. Write 3.505 x 10^1 as a normal number.
9. Write 8.31 x 10^6 as a normal number.
10. Write 6.002 x 10^2 as a normal number.
11. Write 1.5 x 10^{-4} as a normal number.
12. Write 4.3 x 10^3 as a normal number.

Physics Topic 2: Symbols and Prefixes

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

At BTEC level, 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 BTEC 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 Topic 3: Equations and calculations

Use the following information to help you answer the questions below.
- The units needed for wave calculations are metres, seconds, metres per second and hertz.
  1 kHz = 1000 Hz   1 MHz = 1 000 000 Hz   1 m = 100 cm = 1000 mm.
- The speed of light in a vacuum (and air) is 3×10^8 m/s.
- The speed of sound in air is 330 m/s.
- wave speed (metre/second, m/s)   =   frequency (hertz, Hz) $\times$ wavelength (metre, m)
  $$v = f \times \lambda$$
- wave speed (metre/second, m/s)   =   distance (metre, m) / time (second, s)
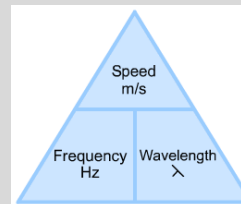
1   Two sound waves have frequencies of 250 Hz and 17 600 Hz, respectively. Calculate the wavelengths of both of these waves.

      a)

      b)

2   The wavelength of a sound wave is 2.8 cm. Calculate the frequency   of the waves in hertz.

3   Ripples on the surface of water are noticed to travel 560 cm in 54 seconds. Calculate the speed of these waves in metres per second.

4   Red light has a wavelength of 7.5×10^{-7} m in air and blue light has a wavelength of 4.0×10^{-7} m in air. Use the wave equation to find:

      a   the frequency of red light

      b   the frequency of blue light

      c   how many more blue waves are produced than red waves each   second.

5   The frequency of radio waves from a local radio station is 92.6 MHz. What is the wavelength of these waves?

Scientific and Investigative Skills

As part of your A level you will complete a practical assessment. This will require you to carry out a series of practical activities as well as planning how to do them, analysing the results and evaluating the methods. This will require you to: use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH), use appropriate instrumentation to record quantitative measurements, such as a colorimeter or photometer, use laboratory glassware apparatus for a variety of experimental techniques to include serial dilutions, use of light microscope at high power and low power, including use of a graticule, produce scientific drawing from observation with annotations, use qualitative reagents to identify biological molecules, separate biological compounds using thin layer/paper chromatography or electrophoresis, safely and ethically use organisms, use microbiological aseptic techniques, including the use of agar plates and broth, safely use instruments for dissection of an animal organ, or plant organ, use sampling techniques in fieldwork.
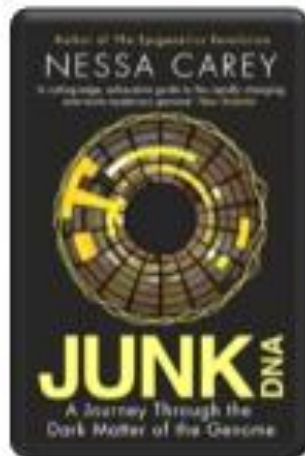
Task:

Produce a glossary for the following key words:

accuracy, anomaly, calibration, causal link, chance, confounding variable, control experiment, control group, control variable, correlation, dependent variable, errors, evidence, fair test, hypothesis, independent, null hypothesis, precision, probability, protocol, random distribution, random error, raw data, reliability, systematic error, true value, validity, zero error,

Book Recommendations

Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Biology

Surely You're Joking Mr Feynman: Adventures of a Curious Character

ISBN - 009917331X - Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle physics.

(Also available on Audio book).

Junk DNA

Our DNA is so much more complex than you probably realize, this book will really deepen your understanding of all the work you will do on Genetics. Available at amazon.co.uk
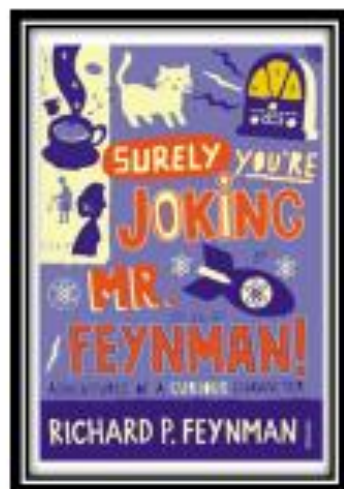
## A Short History of Nearly Everything – WE RECOMMEND!

A whistle-stop tour through many aspects of history from the Big Bang to now. This is a really accessible read that will re-familiarise you with common concepts and introduce you to some of the more colourful characters from the history of science! Available at amazon.co.uk
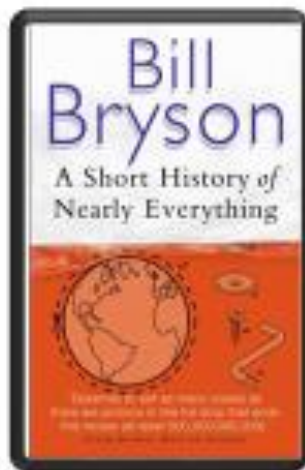
Periodic Tales: The Curious Lives of the Elements

(Paperback) Hugh Aldersey-Williams
ISBN-10: 0141041455

http://bit.ly/pixlchembook1

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.
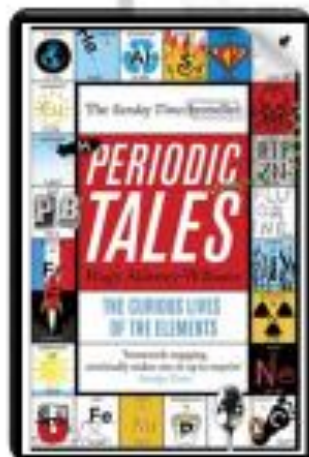
Bad Science (Paperback) Ben Goldacre

ISBN-10: 000728487X
http://bit.ly/pixlchembook3
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'.

Science websites

These websites all offer an amazing collection of resources that you should use again and again through out your course.

Probably the best website on Biology….
Learn Genetics from Utah University has so much that is pitched at an appropriate level for you and has lots of interactive resources to explore, everything from why some people can taste bitter berries to how we clone mice or make glow in the dark jelly fish.
http://learn.genetics.utah.edu/

In the summer you will most likely start to learn about Biodiversity and Evolution. Many Zoos have great websites, especially London Zoo. Read about some of the case studies on conservation, such as the Giant Pangolin, the only mammal with scales.
https://www.zsl.org/conservation

At GCSE you learnt how genetic diseases are inherited. In this virtual fly lab you get to breed fruit flies to investigate how different features are passed on.
http://sciencecourseware.org/vcise/drosophila/

DNA from the beginning is full of interactive animations that tell the story of DNA from its discovery through to advanced year 13 concepts. One to book mark!
http://www.dnaftb.org/

Ok, so not a website, but a video you definitely want to watch. One of the first topics you will learn about is the amazing structure of the cell. This BBC film shows the fascinating workings of a cell… a touch more detailed than the "fried egg" model you might have seen.
http://www.dailymotion.com/video/xzh0kb_the-hidden-life-of-the-cell_shortfilms
If this link expires – google "BBC hidden life of the cell"

Movie Recommendations

Everyone loves a good story and everyone loves some great science. Here are some of the picks of the best films and TV based on real life scientists and discoveries. You wont find Jurassic Park on this list, but they are all great watching for a rainy day; so perfect for the British summer then.
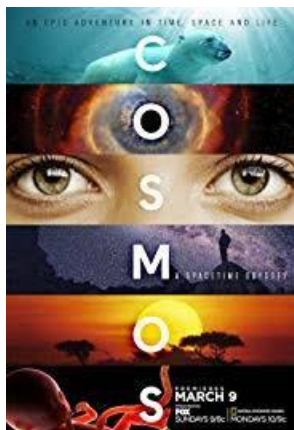
Cosmos: A Spacetime Odyssey (Series TV)
An excellent Science documentary which tries to cover a huge chunk of our Scientific discoveries throughout history. It's presented by Neil deGrasse Tyson, produced by Seth MacFarlane (Yes, from Family Guy fame) and it's on Netflix; Watch this now!
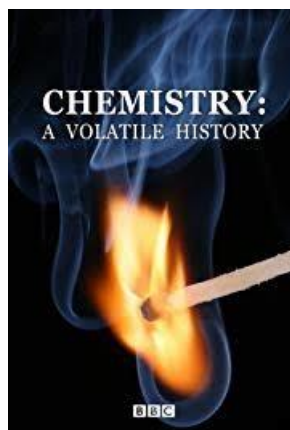
Chemistry: A volatile History (Series 2010)
a fascinating three-part series by theoretical physicist Jim Al-Khalili, exploring everything from the history of the elements to the rivalries and controversies that bedevilled scientific progress to the latest bleeding-edge attempts to split matter.

Crash course Chemistry/Biology/Physics
https://www.youtube.com/user/crashcourse
Excellent YouTube channel with playlists covering Chemistry, Biology and Physics A-level content.
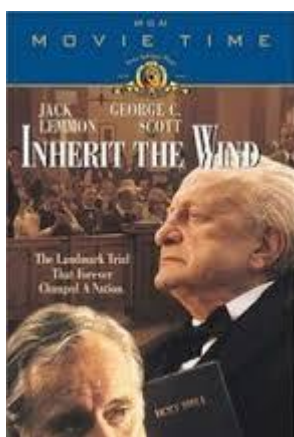Check out Chemistry Episode 1
https://www.youtube.com/watch?v=FSyAehMdpyI&list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr&index=2
and if you like, subscribe.

The Martian (2015)
Great to watch or read; it depicts an astronaut's lone struggle to survive on Mars after being left behind, and efforts to rescue him, and bring him home to Earth

Inherit The Wind (1960)
Great if you can find it. Based on a real life trial of a teacher accused of the crime of teaching Darwinian evolution in school in America. Does the debate rumble on today?

Gorillas in the Mist (1988)
An absolute classic that retells the true story of the life and work of Dian Fossey and her work studying and protecting mountain gorillas from poachers and habitat loss.
A tear jerker.