Adapted by CLCC June 2020
Using resources from Oxford A level resources (Kerboodle)

Transition Pack for Level 3 Applied Science

Get ready for Science!
A guide to help you get ready for Level 3 Applied Science, including everything from topic guides to online learning courses.

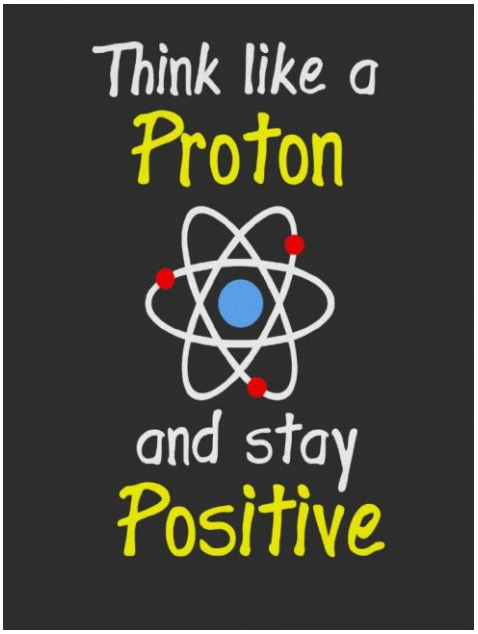
The following tasks are for you to complete over the summer holidays to help you prepare for the Level 3 Applied Science course. Please bring the completed booklets with you to your first lesson. Some tasks are general skills that check that you are confident with some ideas met at GCSE in terms of Maths skills and Practical skills in Science.

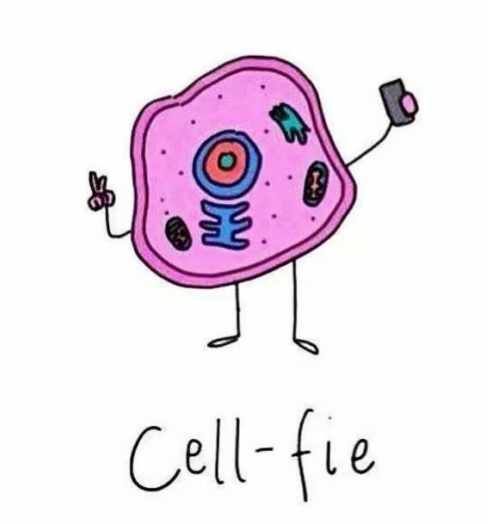
Don't worry too much if you are not sure about some of these new ideas we will cover them during the year but it will give you a head start and hopefully you will find them interesting.

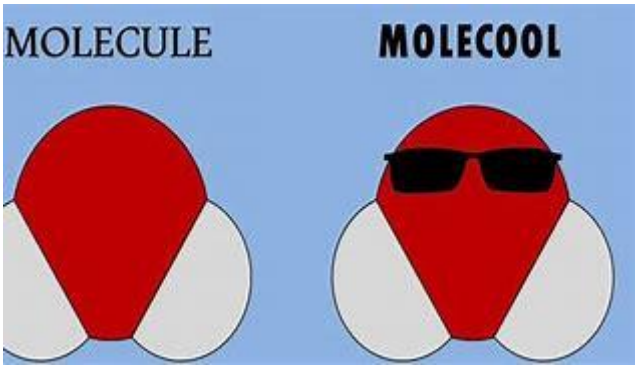
If you do have any questions about the tasks in the booklet or the course please email myself (Dr Derry) or Mrs Fox - we are always happy to help.

pderry@clcc.college **kfox@clcc.college**

Deadline 25th August 2021.







BTEC LEVEL 3 NATIONAL EXTENDED CERTIFICATE IN APPLIED SCIENCE

TEACHERS OF APPLIED SCIENCE – DR DERRY AND MRS K FOX

This course covers all three science specialisms of Biology, Chemistry and Physics, focussing on their application in the real world. Science is everywhere and developing an appreciation and understanding of science along with the skill base that this course develops is a highly desirable quality that employers and Higher Education appreciate.

Studying this course will help you develop the transferable and higher order skills which are valued by higher education providers and employers. Students will develop skills including how to plan investigations, collecting, analysing, and presenting data and communicating results which support some of the skills learners need to progress to higher education, employment, self-employment or training. Students develop into resilient learners who are able to manage their time and workload, meet deadlines and think for themselves.

COURSE OUTLINE

The course content is split into four units of work:

- Unit 1 – Principles and Applications of Science 1 (External Assessment through examination)
- Unit 2 – Practical Scientific Procedures and Techniques (Internal assessment – portfolio assignments)
- Unit 3 – Science Investigation Skills (External assessment through examination and synoptic internal assessment)
- Unit 4 – Physiology of Human Body Systems (Internal assessment – portfolio assignments)

HOW AM I ASSESSED?

There are four units, two internal and two externally assessed. Students must complete and achieve at Near Pass grade or above in all external units and achieve a Pass or above in all internal units.

Transition from GCSE to Level 3 Applied Science

Moving from GCSE Science to A Level can be a daunting leap. You'll be expected to remember a lot more facts, equations, and definitions, and you will need to learn new maths skills and develop confidence in applying what you already know to unfamiliar situations.

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

- to pre-learn some useful knowledge from the first chapters of your A Level course
- understand and practice **some of the** maths skills you'll need.

Retrieval questions

You need to be confident about the definitions of terms that describe measurements and results. Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

Practical science key terms

When is a measurement valid?	when it measures what it is supposed to be measuring
When is a result accurate?	when it is close to the true value
What are precise results?	when repeat measurements are consistent/agree closely with each other
What is repeatability?	how precise repeated measurements are when they are taken by the *same* person, using the *same* equipment, under the *same* conditions
What is reproducibility?	how precise repeated measurements are when they are taken by *different* people, using *different* equipment
What is the uncertainty of a measurement?	the interval within which the true value is expected to lie
Define measurement error	the difference between a measured value and the true value
What type of error is caused by results varying around the true value in an unpredictable way?	random error
What is a systematic error?	a consistent difference between the measured values and true values
What does zero error mean?	a measuring instrument gives a false reading when the true value should be zero
Which variable is changed or selected by the investigator?	independent variable
What is a dependent variable?	a variable that is measured every time the independent variable is changed
Define a fair test	a test in which only the independent variable is allowed to affect the dependent variable
What are control variables?	variables that should be kept constant to avoid them affecting the dependent variable

Basic components of living systems

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

What is the formula to calculate magnification?	magnification = $\frac{\text{size of image}}{\text{actual size of object}}$
Why are cells stained before being viewed with a light microscope?	staining increases contrast between different cell components, makes them visible, and allows them to be identified
What is an eyepiece graticule?	a glass disc that fits on top of the eyepiece lens that is marked with a fine scale from 1 to 100
What is a stage micrometer?	a microscope slide with a very accurate scale in micrometers (μ) engraved on it
What is a scientific drawing?	a labelled line drawing that is used to highlight particular features and does not include unnecessary detail or shading, it should always have a title and state the magnification
What is magnification?	how many times larger an image is than the actual size of the object being viewed
What is resolution?	the ability to see individual objects as separate entities
What is the function of the nucleus?	controls the metabolic activities of the cell as it contains genetic information in the form of DNA
What is the nucleolus?	area within the nucleus that is responsible for producing ribosomes
What is the function of mitochondria?	site of production of ATP in the final stages of cellular respiration
What are vesicles?	membranous sacs that are used to transport materials in the cell
What are lysosomes?	specialised forms of vesicles with hydrolytic enzymes that break down waste material in cells
What is the role of the cytoskeleton?	controls cell movement, movement of organelles within the cell, and provides mechanical strength to the cell
Name the three types of cytoskeletal filaments	microfilaments, microtubules, and intermediate fibres
Give two types of extension that protrude from some cells	flagella (whip-like protrusions) and cilia (tail-like protrusions)
What is the endoplasmic reticulum (ER)?	a network of membranes enclosing flattened sacs called cisternae
What are the functions of the two types of ER?	smooth ER – lipid and carbohydrate synthesis, and storage rough ER – synthesis and transport of proteins
What is the function of the Golgi apparatus?	plays a part in modifying proteins and packaging them into vesicles

Maths skills

1 Units and prefixes

A key criterion for success in Science is the use of correct units and the management of numbers. You have already attempted some questions on prefixes – here are a couple more to have a go at!

Multiplication factor	Prefix	Symbol
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	n

Practice questions

1 A burger contains 4500000J of energy. Write this in: **a** kilojoules **b** megajoules.

2 HIV is a virus with a diameter of between 9.0×10^{-8} m and 1.20×10^{-7} m. Write this range in nanometres.

3 **a** 300 µm to m **b** 5 MJ to mJ **c** 10 GW to kW

2 Decimals, standard form, and significant figures

2.1 Decimal numbers

A decimal number has a decimal point. In science, you must write your answer to a sensible number of decimal places.

Practice questions

1 New antibiotics are being tested. A student calculates the area of clear zones in Petri dishes in which the antibiotics have been used. List these in order from smallest to largest.

0.0214 cm^2 0.03 cm^2 0.0218 cm^2 0.034 cm^2

2 A student measures the heights of a number of different plants. List these in order from smallest to largest.

22.003 cm 22.25 cm 12.901 cm 12.03 cm 22 cm

2.2 Significant figures

When you use a calculator to work out a numerical answer, you know that this often results in a large number of decimal places and, in most cases, the final few digits are 'not significant'. It is important to record your data and your answers to calculations to a reasonable number of significant figures. Too many and your answer is claiming an accuracy that it does not have, too few and you are not showing the precision and care required in scientific analysis.

Numbers to 3 significant figures (3 s.f.): 7.88 25.4 741 0.000 147 9.42×10^{-5} 1.56×10^{8}

0.0147 0.245 39 400 96 200 000

Notice that the zeros before the figures and after the figures are *not* significant – they just show you how large the number is by the position of the decimal point. Any zeros between the other significant figures *are* significant; numbers to 3 significant figures where the zeros *are* significant: 207 4050 1.01

If the value you wanted to write to 3.s.f. was 590, then to show the zero was significant you would have to write: 590 (to 3.s.f.) or 5.90×10^{2}

Practice questions

6 Write the following numbers to **i** 2 s.f. and **ii** 3 s.f.

a 7644 g

b 27.54 m

c 4.3333 g

d 5.995×10^{2} cm^{3}

7 The average mass of oxygen produced by an oak tree is 11800 g per year. Give this to 2 significant figures.

3 Magnification

To look at small biological specimens you use a microscope to magnify the image that is observed. The microscope was developed in the 17th century. Anton van Leeuwenhoek used a single lens and Robert Hooke used two lenses. The lenses focus light from the specimen onto your retina to produce a magnified virtual image. The magnification at which observations are made depends on the lenses used.

A cheek cell has a 0.06 mm diameter. Under a microscope it has a diameter 12 mm.
What is the magnification?

magnification = image size (mm) ÷ object size (mm) or $M = \frac{I}{O}$

Substitute the values and calculate the answer:

M = 12 mm/0.06 mm = 12/0.06 = 200 (magnification has no units)

Practice questions

Calculate the magnification of a hair that has a width of 6.6 mm on a photograph. The hair is 165 µm wide.

Remember: Use the same units. A common error is to mix units when performing these calculations. Begin each time by converting measurements to the same units for both the real specimen and the image.

3.1 Calculating the magnifying power of lenses

Lenses each have a magnifying power, defined as the number of times the image is larger than the real object. The magnifying power is written on the lens.

To find the magnification of the virtual image that you are observing, multiply the magnification powers of each lens used. For example, if the eyepiece lens is ×10 and the objective lens is ×40 the total magnification of the virtual image is 10 × 40 = 400.

Practice questions

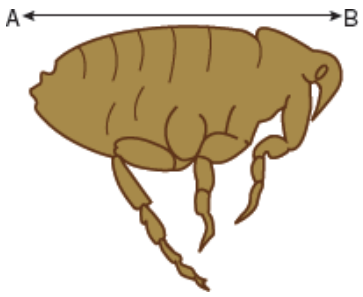
1 Calculate the magnification of the virtual image produced by the following combinations of lenses:

a objective ×10 and eyepiece ×12 **b** objective ×40 and eyepiece ×15

3.2 Calculating the magnification of images

Drawings and photographs of biological specimens should always have a magnification factor stated. This indicates how much larger or smaller the image is compared with the real specimen. The magnification is calculated by comparing the sizes of the image and the real specimen. Look at this worked example.

The image shows a flea which is 1.3 mm long. To calculate the magnification of the image, measure the image (or the scale bar if given) on the paper (in this example, the body length as indicated by the line A–B).



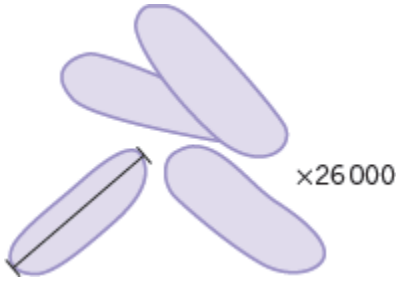
For this image, the length of the image is 42 mm and the length of the real specimen is 1.3 mm.

magnification = length of image / length of real specimen = 42/1.3 = 32.31

The magnification factor should therefore be written as ×32.31

Practice questions

2 Use the magnification factor to determine the actual size of a bacterial cell.



Seneca Learning (spend about 2 hours on this)

Your next task is to complete the Seneca GCSE **refresher sections** for Physics and Biology (you don't need to do the taster sections). As you do the GCSE refresher pages complete for us a revision aid of your choice – I suggest a mind map but if you prefer you can do a fact sheet, flash cards or even a power point.

Physics is at https://app.senecalearning.com/classroom/course/eb1a286f-2cf3-486d-a591-5494d8b256c7/section/6254010a-c9e2-477d-a457-2605b09d8af6/session

Biology is at https://app.senecalearning.com/classroom/course/76917ca0-ac10-43c9-8742-e49b861417b2/section/85450ad6-7203-4528-8be0-8a1eac5eff33/session

Section title:

Key ideas identified:

Key word definitions:

What previous topics does this link to?

Where can this topic be found in your textbook?

Useful diagrams/tables etc..

Questions I need to ask in the lesson

Pre-Knowledge Topics- All must be completed

You have come across most of these concepts to some degree at GCSE but it is really important you understand them as they are fundamental ideas in Applied Science. For each of the following topics, you need to use the resources suggested to produce one page of notes. If you find topics you are still unsure about, please use other websites to aid your understanding. Some of the research questions are followed with questions to check your knowledge. You could always email me (Dr Derry) if you get really stuck. To complete this task, use the flipped learning sheet on the previous page to help you lay out your notes; we use it for pre-reading tasks at A-level so you can get some practise at using it as you work through the tasks. If you can't print it out at home, you can just copy out the format onto your paper.

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. This explores 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: The Immune System

Available at: http://bigpictureeducation.com/immune

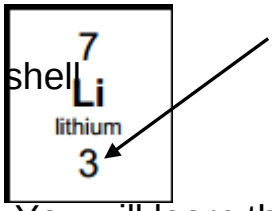
The immune system is what keeps us healthy in spite of the many organisms and substances that can do us harm. Explore how our bodies are designed to prevent potentially harmful objects from getting inside, and what happens when bacteria, viruses, fungi or other foreign organisms or substances breach these barriers.

Topic 3: Electronic structure in atoms

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).



shell

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

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

Make sure you make some notes.

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.

Q 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

Topic 4 - Chemical equations

Balancing chemical equations is the stepping stone to calculate masses in chemistry. There are loads of websites that give ways of balancing equations and lots of exercises in balancing.

http://bit.ly/pixlchem7

http://www.chemteam.info/Equations/Balance-Equation.html

http://bit.ly/pixlchem8

https://phet.colorado.edu/en/simulation/balancing-chemical-equations

Q1 Balance the following equations

a. $H_2 + 0_2 \rightarrow H_20$

b. $S_8 + 0_2 \rightarrow S0_3$

c. $HgO \rightarrow Hg + 0_2$

d. $Zn + HCl \rightarrow ZnCl_2 + H_2$

e. $Na + H_20 \rightarrow NaOH + H_2$

f. $C_{10}H_{16} + Cl_2 \rightarrow C + HCl$

g. $Fe + 0_2 \rightarrow Fe_20_3$

h. $C_6H_{12}0_6 + 0_2 \rightarrow C0_2 + H_20$

i. $Fe_20_3 + H_2 \rightarrow Fe + H_20$

j. $Al + FeO \rightarrow Al_2O_3 + Fe$

Topic 5 - Symbols and Prefixes

In Science we use a few symbols and prefixes to save us time writing lots of 0000. Some of these you will already be familiar with. Try and memorise the ones you do not know.

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	$\times 10^{9}$

Q1 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.
8. How many m in 11 km?

Topic 6 - Waves

At GCSE 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 **and make notes.**

http://www.bbc.co.uk/education/clips/zb7gkqt
https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves

Topic 7 – Refraction

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

Movie Recommendations

For the following films please watch one of the selected titles and write a review on this.

These are great presentations (and free!) from world leading scientists and researchers on a variety of topics. They provide some interesting answers and ask some thought-provoking questions. Use the link or scan the QR code to view:

A New Superweapon in the Fight Against Cancer
Available at :
http://www.ted.com/talks/paula_hammond_a_new_superweapon_in_the_fight_against_cancer?language=en
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.

Why Bees are Disappearing
Available at :
http://www.ted.com/talks/marla_spivak_why_bees_are_disappearing?language=en
Honeybees have thrived for 50 million years, each colony 40 to 50,000 individuals coordinated in amazing harmony. So why, seven years ago, did colonies start dying en-masse?

Why Doctors Don't Know About the Drugs They Prescribe
Available at :
http://www.ted.com/talks/ben_goldacre_what_doctors_don_t_know_about_the_drugs_they_prescribe?language=en
When a new drug gets tested, the results of the trials should be published for the rest of the medical world — except much of the time, negative or inconclusive findings go unreported, leaving doctors and researchers in the dark.

Growing New Organs
Available at :
http://www.ted.com/talks/anthony_atala_growing_organs_engineering_tissue?language=en
Anthony Atalla's state-of-the-art lab grows human organs — from muscles to blood vessels to bladders, and more.

Movie / Video Clip Recommendations (optional)

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 here are some ideas for films to watch or clips to find online.

Dantes Peak 1997: Volcano disaster movie.
Use the link to look at the Science of acids and how this links to the movie. http://www.open.edu/openlearn/science-maths-technology/science/chemistry/dantes-peak
http://www.flickclip.com/flicks/dantespeak1.html
http://www.flickclip.com/flicks/dantespeak5.html

Fantastic 4 2005 &2015: Superhero movie

Michio Kaku explains the "real" science behind fantastic four http://nerdist.com/michio-kaku-explains-the-real-science-behind-fantastic-four/

http://www.flickclip.com/flicks/fantastic4.html

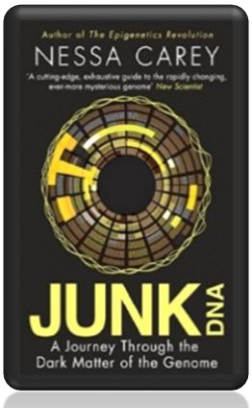
Online Clips / Series
NASA TV – Online coverage of launches, missions, testing and the ISS. Plenty of clips and links to explore to find out more about applications of Physics in Space technology.
http://www.nasa.gov/multimedia/nasatv/

Science Fictions Films

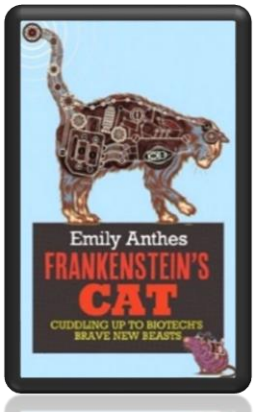
1. **Moon (2009)**
2. **Gravity (2013)**
3. **Interstellar (2014)**
4. **The Imitation Game (2015)**
5. **The Prestige (2006)**

Book Recommendations (optional)

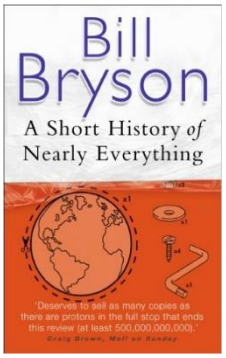
Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Science. You can choose your own book if you prefer!



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.



An easy read..
Frankenstein's cat
Discover how glow in the dark fish are made and more great Biotechnology breakthroughs.



A Short History of Nearly Everything
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!