

the **PiXL** club
partners in excellence

Transition Pack for A Level Physics

Get ready for A-level!
**A guide to help you get ready for A-level Physics, including
everything from topic guides to online learning courses.**

Commissioned by The PiXL Club Ltd. February 2016

© Copyright The PiXL Club Ltd, 2016

**Please note: these resources are non-board specific. Please direct your
students to the specifics of where this knowledge and skills most apply.**

This resource is strictly for the use of member schools for as long as they remain members of The PiXL Club. It may not be copied, sold nor transferred to a third party or used by the school after membership ceases. Until such time it may be freely used within the member school.

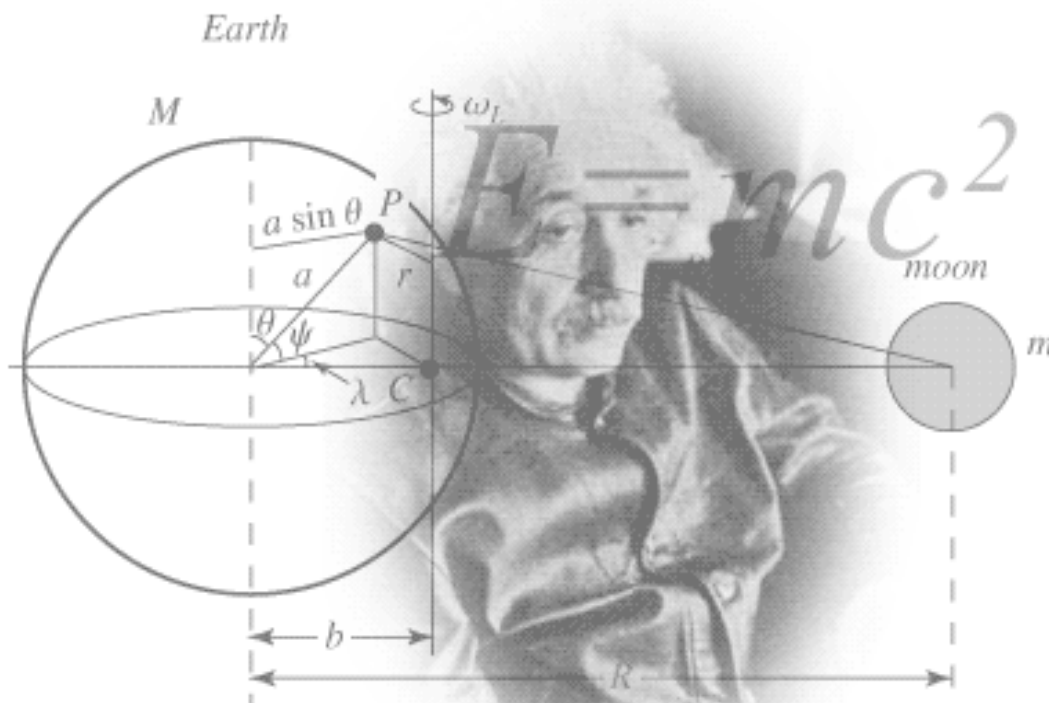
All opinions and contributions are those of the authors. The contents of this resource are not connected with nor endorsed by any other company, organisation or institution.

www.pixl.org.uk

The PiXL Club Ltd, Company number 07321607

Preparing to study

Figure



1

<http://scienceworld.wolfram.com/physics/images/main-physics.gif>

This pack contains a programme of activities and resources to prepare you to start an A level in Physics in September. It is designed for you to complete throughout the remainder of the summer term to help you prepare for your course in September.

Deadline 22nd June 2020.

So what's it like to study A level Physics at CLCC?

Your teachers: Dr Derry (Head of Physics) pderry@clcc.college

and Mrs Fox (Head of Science) kfox@clcc.college

Your course:

- Following OCR A (from 2015) exam board
- All students are expected to complete the full A level course, we do not sit AS level exams.

To find out more about the course or view the specification use this link:

<https://www.ocr.org.uk/qualifications/as-and-a-level/physics-a-h156-h556-from-2015/>

The six modules are each divided into key topics:

Module 1: Development of practical skills in physics

- Practical skills assessed in a written examination
- Practical skills assessed in the practical endorsement

Module 2: Foundations in physics

- Physical quantities and units
- Making measurements and analysing data
- Nature of quantities

Module 3: Forces and motion

- Motion
- Forces in action
- Work, energy and power
- Materials
- Newton's laws of motion and momentum

Module 4: Electrons, waves and photons

- Charge and current
- Energy, power and resistance

- Electrical circuits
- Waves
- Quantum physics

Module 5: Newtonian world and astrophysics

- Thermal physics
- Circular motion
- Oscillations
- Gravitational fields
- Astrophysics and cosmology

Module 6: Particles and medical physics

- Capacitors
- Electric fields
- Electromagnetism
- Nuclear and particle physics
- Medical imaging

How am I assessed?

Progress is monitored by regular 6 week tests and assessed home work plus pixl support lessons to be completed outside of the laboratory in student's personal study periods. There are 3 exams at the end of the course: Modelling physics, Exploring physics and Unified physics.

Section title:

Key ideas identified:

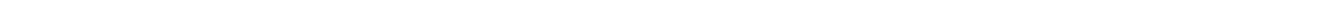
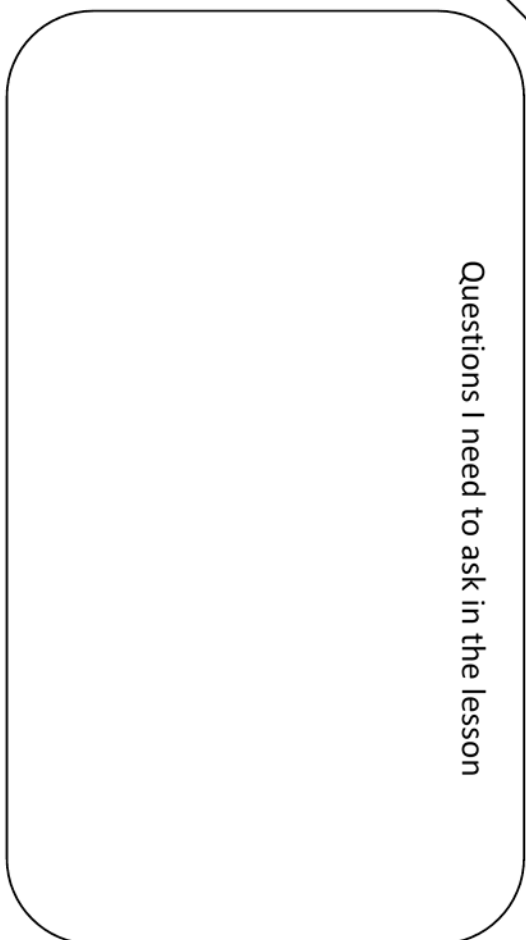
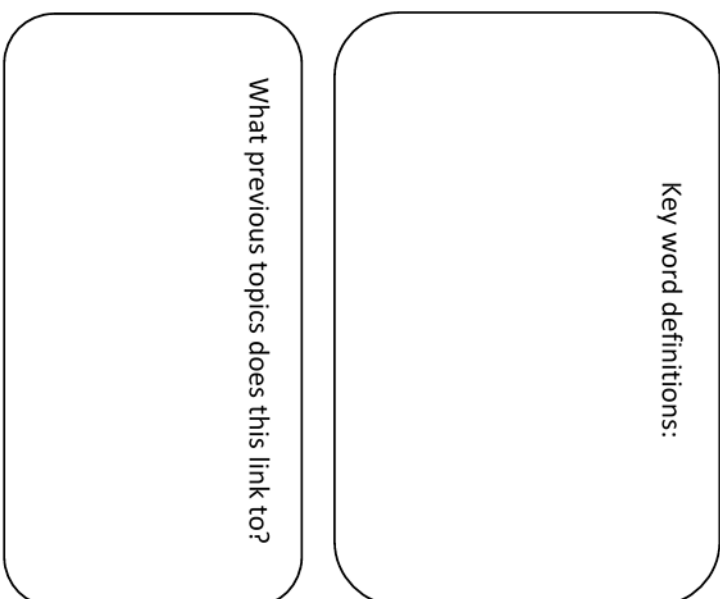
Where can this topic be found in your textbook?

Useful diagrams/tables etc..

Key word definitions:

What previous topics does this link to?

Questions I need to ask in the lesson



Research activity

To get the best grades in A Level Physics you will have to get good at completing independent research and making your own notes on difficult topics. Below are links to 5 websites that cover some interesting Physics topics. Make 1 page of notes from each site covering a topic of your choice.

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. If you do not like the layout of this sheet you can use the Cornell notes system:

<http://coe.jmu.edu/learningtoolbox/cornellnotes.html>.

- a) <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.

- b) 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.

- c) <https://phet.colorado.edu/en/simulations/category/html>

PhET create online Physics simulations when you can complete some simple experiments online. Open up the resistance of a wire html5 simulation. Conduct a simple experiment and make a one page summary of the experiment and your findings.

- d) <http://climate.nasa.gov/>

NASA's Jet Propulsion Laboratory has lots of information on Climate Change and Engineering Solutions to combat it. Have a look and make notes on an article of your choice.

- e) <http://www.livescience.com/46558-laws-of-motion.html>

Newton's Laws of Motion are fundamental laws for the motion of all the object we can see around us. Use this website and the suggested further reading links on the webpage to make your own 1 page of notes on the topics.

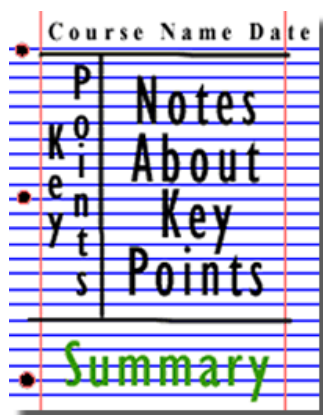


Figure 2: <http://coe.jmu.edu/learningtoolbox/images/noteb4.gif>

Pre-Knowledge Topics

Below are ten topics that are essential foundations for your study of A-Level Physics. Each topic has example questions and links where you can find our more information as you prepare for next year. 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 Physics. For each of the following topics, you need to use the resources suggested to produce one page of notes. Please use the Flipped Learning sheet – one for each topic. 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.

Symbols and Prefixes

At A 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 A level course. You need to learn these!

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	$\times 10^9$

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 54600 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.

Standard Form

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 $\dots \times 10^y$. E.g. for an answer of 1200kg we would write 1.2×10^3 kg. For more information visit: www.bbc.co.uk/education/guides/zc2hsbk/revision

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

Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. 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 | 5. $v = u + at$ to find u |
| 2. $Q = I \times t$ to find I | 6. $v = u + at$ to find a |
| 3. $E = \frac{1}{2} m v^2$ to find m | 7. $v^2 = u^2 + 2as$ to find s |
| 4. $E = \frac{1}{2} m v^2$ to find v | 8. $v^2 = u^2 + 2as$ to find u |

Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

<http://www.purplemath.com/modules/rounding2.htm>

Give the following to 3 significant figures:

- | | |
|-------------|-----------|
| 1. 3.4527 | 4. 1.0247 |
| 2. 40.691 | 5. 59.972 |
| 3. 0.838991 | |

Calculate the following to a suitable number of significant figures:

6. $63.2/78.1$
7. $39+78+120$
8. $(3.4+3.7+3.2)/3$
9. 0.0256×0.129
10. $592.3/0.1772$

Atomic Structure

You will study nuclear decay in more detail at A level covering the topics of radioactivity and particle physics. In order to explain what happens you need to have a good understanding of the model of the atom. You need to know what the atom is made up of, relative charges and masses and how sub atomic particles are arranged. The following video explains how the current model was discovered www.youtube.com/watch?v=wzALbzTdnc8

Describe the model used for the structure of an atom including details of the individual particles that make up an atom and the relative charges and masses of these particles. You may wish to include a diagram and explain how this model was discovered by Rutherford

Recording Data

Whilst carrying out a practical activity you need to write all your raw results into a table. Don't wait until the end, discard anomalies and then write it up in neat. Tables should have column heading and units in this format quantity/unit e.g. length /mm. All results in a column should have the same precision and if you have repeated the experiment you should calculate a mean to the same precision as the data.

Below are link to practical handbooks so you can familiarise yourself with expectations.

<http://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDF>

<http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf>

<http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf>

Below is a table of results from an experiment where a ball was rolled down a ramp of different lengths. A ruler and stop clock were used.

1) Identify the errors the student has made.

Length/cm	Time			
	Trial 1	Trial 2	Trial 3	Mean
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

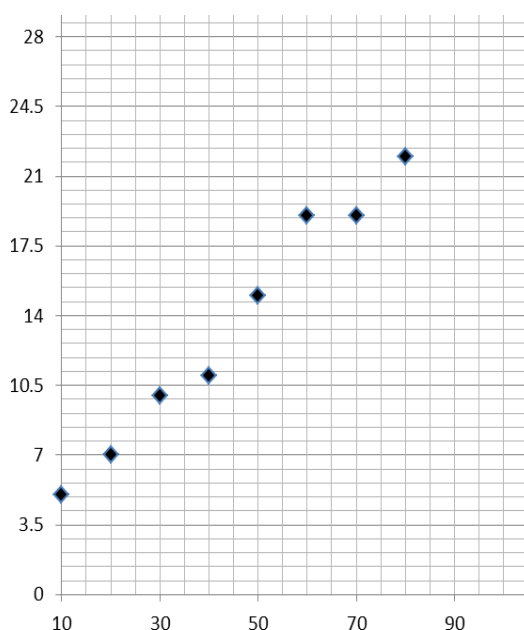
Graphs

After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

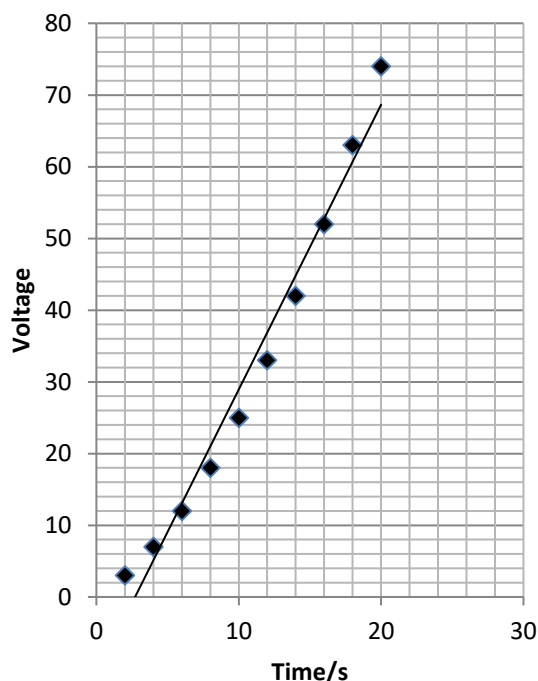
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Identify how the following graphs could be improved

Graph 1



Graph 2



Forces and Motion

At GCSE you studied forces and motion and at A level you will explore this topic in more detail so it is essential you have a good understanding of the content covered at GCSE. You will be expected to describe, explain and carry calculations concerning the motion of objects. The websites below cover Newton's laws of motion and have links to these in action.

<http://www.physicsclassroom.com/Physics-Tutorial/Newton-s-Laws>

<http://www.sciencechannel.com/games-and-interactives/newtons-laws-of-motion-interactive/>

Sketch a velocity-time graph showing the journey of a skydiver after leaving the plane to reaching the ground. Mark on terminal velocity.

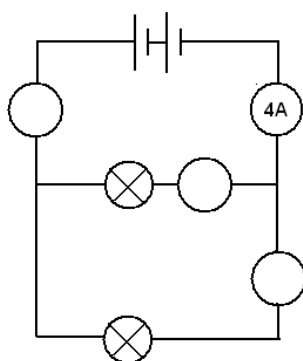
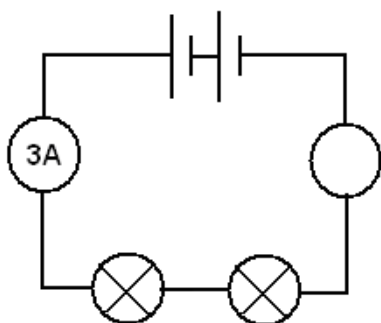
Electricity

At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

<http://www.allaboutcircuits.com/textbook/direct-current/chpt-1/electric-circuits/>

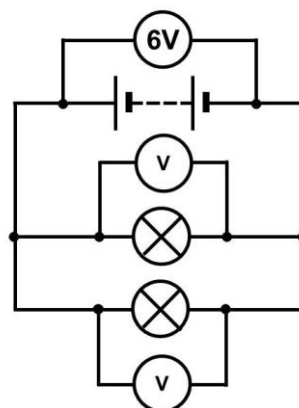
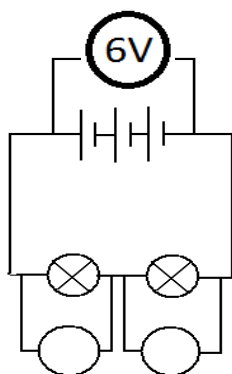
<http://www.physicsclassroom.com/class/circuits>

1a) Add the missing ammeter readings on the circuits below.



b) Explain why the second circuit has more current flowing than the first.

2) Add the missing potential differences to the following circuits



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. **Make a revision page on 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.

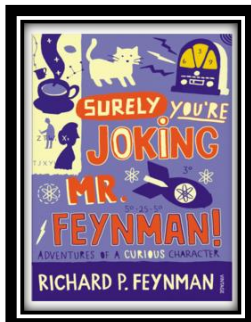
- 2) Describe the difference between a longitudinal and transverse waves and give an example of each

- 3) Draw a wave and label the wavelength and amplitude

Book Recommendations (optional)

Below is a selection of books that should appeal to a physicist – someone with an enquiring mind who wants to understand the universe around us. None of the selections are textbooks full of equation work (there will be plenty of time for that!) instead each provides insight to either an application of physics or a new area of study that you will be meeting at A Level for the first time.

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

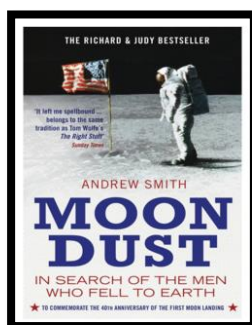


ISBN - 009917331X - Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle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

(Also available on Audio book).

<https://www.waterstones.com/books/search/term/surely+youre+joking+mr+feynman++adventures+of+a+curious+character>

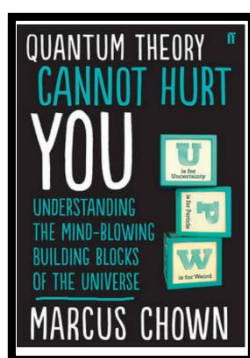
2. Moondust: In Search of the Men Who Fell to Earth



ISBN – 1408802384 - One of the greatest scientific achievements of all time was putting mankind on the surface of the moon. Only 12 men made the trip to the surface, at the time of writing the book only 9 are still with us. The book does an excellent job of using the personal accounts of the 9 remaining astronauts and many others involved in the space program at looking at the whole space-race era, with hopefully a new era of space flight about to begin as we push on to put mankind on Mars in the next couple of decades.

<https://www.waterstones.com/books/search/term/moondust++in+search+of+the+men+who+fell+to+earth>

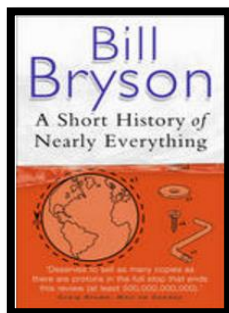
3. Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe



ISBN - 057131502X - Any Physics book by Marcus Chown is an excellent insight into some of the more exotic areas of Physics that require no prior knowledge. In your first year of A-Level study you will meet the quantum world for the first time. This book will fill you with interesting facts and handy analogies to whip out to impress your peers!

<https://www.waterstones.com/book/quantum-theory-cannot-hurt-you/marcus-chown/9780571315024>

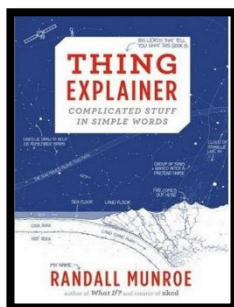
4. A Short History of Nearly Everything



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.

<https://www.waterstones.com/books/search/term/a+short+history+of+nearly+everything>

5. Thing Explainer: Complicated Stuff in Simple Words



ISBN – 1408802384 - This final recommendation is a bit of a wild-card – a book of illustrated cartoon diagrams that should appeal to the scientific side of everyone. Written by the creator of online comic XTCd (a great source of science humour) is a book of blueprints from everyday objects such as a biro to the Saturn V rocket and an atom bomb, each one meticulously explained BUT only with the most common 1000 words in the English Language. This would be an excellent coffee table book in the home of every scientist.

<https://www.waterstones.com/book/thing-explainer/randall-munroe/9781473620919>

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.

Science Fictions Films

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

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 of Netflix as of 17/4/16 – Brian Cox explains the Cosmos using some excellent analogies and wonderful imagery.

3. **Shock and Awe, The Story of Electricity** – A 3 part BBC documentary that is essential viewing if you want to see how our lives have been transformed by the ideas of a few great scientists a little over 100 years ago. The link below takes you to a stream of all three parts joined together but it is best watched in hourly instalments. Don't forget to boo when you see Edison. (alternatively watch any Horizon documentary – loads of choice on Netflix and the I-Player)

<https://www.youtube.com/watch?v=Gtp51eZkwol>

4. **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/>

5. **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=LyqleIXTpw>