

Why do we teach what we do in Physics?

Overarching View and Principles

Physics is a cohesive subject which when understood correctly should be presented as a single base of knowledge rather than a set of separate and unrelated topics. Wherever you choose to start therefore presents problems and no single area can be fully explored without a grasp of many other different areas.

Therefore, the physics curriculum is written in a partially spiral manner – but also condenses and compresses where sensible to do so for the sake of efficiency and to maximise teaching time. It is written in sympathy with the Maths Curriculum structures so that it should vary rarely be the case that a student needs a mathematical skill for Physics that has not been first addressed through maths. For this reason, we have taken much of the mathematical content that exists in many KS3 physics schemes and delayed it until students are in a better position to understand it. For example, KWh are commonly found in Year 7 courses but students find it difficult to properly comprehend them due to lacking skill of “rearranging equations” – which then requires the exact same lesson to be delivered higher up the school once these concepts are understood. The HGS scheme aims written up here aims to avoid as many such inefficiencies visiting most specific concepts once but most topics twice. Other areas of the KS3 National Curriculum are not delivered lower down the school as topics such as Ohm’s Law and Energy transfers being most effectively delivered by a physics specialist.

Y7 – Forces, Electricity, the Solar System, and Global Warming

The first three modules are foundational to physics and are introduced at a basic level here – all content in these topics is revisited in later years. This is essential as there is a small but significant fraction of the Y11 cohort who were not students at HGS in year 7 and as such it is not sensible to visit something here and then never again touch on it before GCSE.

The first module taught in physics Y7 is the forces topic. This topic is the one most widely taught at Primary school and is the topic that students find easiest to access and one in which they are keen to share past experiences. It is in this module whereby key skills are taught such as experimental skills, mathematical relationships and general working in a lab. This allows for easier transition between KS2 and KS3. The second topic is electricity and this topic is much more conceptual focussed but sticks to current and potential difference qualitatively rather than going into a quantitative understanding of Ohm’s Law – this is covered in Year 11 by specialist teachers. The third module is the one that interests the students the most and covers ‘The Solar System’. This topic is much more fact based.

The year wraps with a bespoke look at the issue of global warming – which is not covered in depth in any scheme of work at KS3 across the school. This module is taught after the End of Year examinations and as such is not formally assessed.

Y8 – Heat, Magnets and the Universe

Designed to fit around the Year 7 and 8 chemistry schemes and to build on the complexity of the course in Y7, the Heat and Magnets topics are taught first in Y8. These two topics are also (just as the core Y7 content) precursors to more in depth study in the GCSE years. The mathematical content in Y8 is also very low as whilst high ability student’s mathematical ability is sufficient at this point to start dealing with more complex concepts – due to the “streamed” nature of the maths setting at

HGS this is not true for all students. Therefore, it is important that the content covered at this point is appropriate for all learners and that there is not an implicit barrier put up on those who are in lower maths sets. Therefore, maths skill required is kept to those needed in experiments such as averaging.

Heat recaps the structure of Solids, Liquids and Gases from what students have learnt in Y7 Chemistry, insulation and the methods that heat moves – it is delivered in the context of exploring the Antarctic and so links in with geography and history on a number of lessons. It dovetails with the Chemistry module about matter – where related concepts about expansion of solids and separation of mixtures are explored.

Magnets is a bespoke unit written to introduce the concept of what a Magnet is – how they can be created, and some real world uses of Magnets. It exists to provide a bridge between the KS2 treatment of magnets, and the detailed and extensive knowledge required of magnets in the KS4 triple science higher tier. We specifically wrote this module so that students at that point in year 11 would not be encountering magnets for the first time in 6 years only a few months before their GCSE's. Conceptually difficult ideas about magnetism such as the generator effect and the motor effect are not covered in any detail here but introduced as small examples of uses of electromagnets.

The year wraps with a non-assessed look at the deeper cosmos in a second bespoke unit of the year. This module exists for two reasons – firstly if students do not go on to study triple science at GCSE – this will be the last and only time they would look at this topic – and so to provide a broad curriculum coverage it is an important piece of the puzzle. Secondly for those who will go on to study triple science it is vital that they have an understanding of the greater cosmos for context to much of what is to come as well as being a foundational study to much of triple module P8 “global challenges”.

Y9 – Sound Waves, Light Waves and Wave Interactions

The topics covered in this year are those that have been covered extensively in KS2 by all students and is the part that the majority of students enjoy as well as having some clear understanding from prior learning and experiences. Y9 marks the bridge between KS3 and KS4 with students choosing GCSE options and the maths content in physics starting to ramp up. This year also features a number of lessons that are cross-curricula and gives students the chance to see how physics fits into the wider world. Such examples as birdsong, earthquakes and tsunamis, how to make music, and UV ensure that students start to learn that physics is there to answer how the world works.

The modules are true KS3 topics – but the content and foundations in each unit form building blocks for study of the Waves unit in the double and triple GCSE in Year 11.

The sound topic looks at the ear, pitch of notes, ultrasound and related issues and is delivered first as it is conceptually easy and students have had previous exposure to.

Immediately following Sound, we then move into a topic about 'Light' and the different electromagnetic waves that are all around us. This topic takes an in depth look at each part of the electromagnetic spectrum in turn and is more conceptually difficult for the students to understand. However, with their previous learning on Sound, the conceptual difficulty is reduced. Some parts of this topic are on the KS4 curriculum but this topic is much more in depth than what is required at GCSE.

The final compulsory module of the year (Wave Interactions) takes everything that has been learnt prior about waves and shows how waves interact by reflection, refraction and diffraction and how this science shows up all around us. Such as the eye, virtual reality, and tsunamis. This is the topic that features heavily from KS4 topic and is at the end of the year so that it can help bridge the gap between what students have learnt at KS3 with what they learn at KS4.

After end of year assessments, some time is given to introduce KS4 radioactivity – specifically to allow students to meet the concept of an alpha particle and radiation which are vital to understand the content at the start of Y10.

Y10 – Matter, Forces and Energy

(Triple modules P1: Matter, P2: Forces and P7: Energy – Double modules P1: Matter, P2: Forces and P5: Energy)

Delivery starts with P1 – Matter picking up where chemistry leaves off in Y9 with the structure of the atom and its historical development. Work quickly moves into the concepts of Density (a revisit from Y7) and the new concept of specific heat capacity. This is the first point of true mathematical complexity – however given we have delayed it to this point almost all students are able to confidently approach the mathematics in science and we successfully avoid the association that many students who struggle with maths in lower years would often project into physics. P2 is the most detailed mathematical module of the entire GCSE course and this is interwoven deliberately with the Energy module in the second half of the year. These two modules are naturally taught together and so I remain unsure as to the exam boards decision to separate them. These modules build on the forces module in year 7 – again reinforcing our spiral curriculum.

Y11 – Electricity, Magnetism, Radioactivity, Waves and Global Challenges

Triple modules P3: Electricity, P4: Magnetism, P6: radioactivity, P8: Global Challenges, P5: Waves – Double modules P3: Electricity and Magnetism, P4: Waves and Radioactivity, P6: Global Challenges.

Triple physics is (deliberately) back loaded on time – with 33% more teaching time in Y11 compared to Y10 – this allows the time to cover the remaining 50% of the course at maximum efficiency as all needed mathematical concepts have been long since taught within the mathematics department. Electricity (spiral from yr7) is followed by Magnetism (spiral from yr8) is followed by the new content of radioactivity, which being taught late means that the nuclear model and concepts such as isotopes have been long since covered in chemistry. We then deliver the Waves unit – which builds on much of their learning in Yr9. The triple content then wraps up with the wholistic “global challenges” topic which has a significant extra terrestrial element that links back to Y8. Both double and triple physics have time to recap, review and recap content all relevant topics.

In this way ALL the GCSE topics have their roots in Y7, Y8 and Y9. This way no topic in the time constrained GCSE units is totally new – and all students therefore have some prior knowledge on which to base their GCSE studies.

Version 1 - Andrew Jackson – Dec 2019

Version 2 – Alex Goldring – June 2021

Version 3 – Andrew Derrett – August 2022