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Physics Curriculum

Intent

Curriculum Vision

Physics is the study of the magnitude of the universe, from the depths of the cosmos to the miniscule quarks that comprise subatomic particles. From cancer treatment to climate change, gaming to artificial intelligence, physics and physicists are on the front line, helping to shape the future.

Physics is fundamental to our everyday lives, from energy and motion to materials and waves. Students gain an insight into the centrality of physics in understanding the world around them, and are challenged with new concepts such as relativity and string theory.

Knowledge is expanded as students are challenged to "Think Bigger" through tasks that take their understanding of a core concept, apply it to the real world, and make links to other topics in the course and possible career opportunities. Students learn to link their new knowledge across multiple disciplines including chemistry, oceanography, seismology, astronomy, engineering, as well as apply it to biology or medical science.

Students will develop:

- Essential knowledge and understanding of different areas of Physics and how they relate to each other
- A deep appreciation of the skills, knowledge and understanding of scientific methods
- Competence and confidence in a variety of practical, mathematical and problem-solving skills
- Interest in and enthusiasm for Physics, including developing an interest in further study and careers associated with the subject
- An understanding of how society makes decisions about scientific issues and how Physics contributes to the success of the economy and society
- Skills that they can utilise to excel in any chosen career

Concepts and Skills

The overarching concepts for Physics are:

- **Mechanics**
  - o Motion
  - o Energy

o Momentum
- **Electric Circuits**
o Electrical quantities
o Complete electrical circuits
- **Materials**
o Fluids
o Solid material properties
- **Waves and Particle Nature of Light**
o Basic waves
o The behaviour of waves
o Optics
o Quantum physics
- **Further Mechanics**
o Further momentum
o Circular motion
- **Electric and Magnetic Fields**
o Electric fields
o Capacitors
o Electromagnetic effects
- **Nuclear and Particle Physics**
o Probing matter
o Particle accelerators and detectors
o The particle zoo
- **Thermodynamics**
- **Space**
- **Nuclear Radiation**
- **Gravitational Fields**
- **Oscillations**

The overarching skills we aim to develop in Physics are:
- **Working as a Physicist**
o Using units and prefixes
o Calculating errors, uncertainty and estimations
- **Practical Skills in Physics**
o Experimental design
o Identifying types of variable
o Writing a plan
o Planning and investigation
o Implementing an investigation
o Recording data and observations
o Manipulating data
o Evaluating results and drawing conclusions
o Precision and accuracy
o Following written procedures
o Applying investigative approaches and methods when using instruments and equipment
o Safely using a range of practical equipment and materials
o Researching, referencing and reporting

Disciplinary Literacy

Disciplinary approach

In Physics we support the development of disciplinary vocabulary and the students' ability to read, write and communicate at an academic level so that they master the nuances of the curriculum. We do this by carefully selecting tasks that encourage students to consider aspects of scientific literacy, such as bias, audience, rhetoric and vocabulary. Students have the opportunity to present information

in a variety of ways, whether this be through written reports, spoken presentations or other means of communicating science.

Interdisciplinary approach

In order to support the mastery of key concepts in Physics, our interdisciplinary approach unites elements of:

- Mathematics, in terms of analysing and interpreting data, carrying out calculations of variables, and representing data graphically.
- English, in terms of understanding how to identify bias and explore audience of scientific literature. Students have the opportunity to present information in a variety of ways, whether this be through written reports, spoken presentations, or other means of communicating science.
- Music, in terms of waves and how they influence sound.
- Computer Science, in terms of mathematical processes that are used within computing and creating simulations.
- Chemistry and Biology, in terms of an understanding of the behaviour of matter, waves and energy.
- Applied Science, in terms of application of scientific procedures and techniques.

Intellectual autonomy

In order to develop intellectual autonomy and confidence, we foster the willingness and ability of students in Physics to comprehend challenging texts, assimilate key concepts and synthesise them with prior learning. Students are equipped to think critically and apply strategies independently so that they can form their own cohesive conclusions and be able to express that in writing. This is facilitated by our "Thinking Bigger" lessons, where students explore aspects of scientific literature, science in the media, and concepts broader than the specification to assimilate and draw connections with prior learning.

In addition, students have access to the following Key Stage 5 resources held centrally in our library:

- *Physics Education* journal
- *Education in Chemistry* journal
- *Nuffield Book of Data*
- Palgrave Macmillan Foundations Series books
- A range of print copies of popular science magazines

Application of Mathematics

The curriculum recognises the need for students to be able to apply mathematics effectively. In Physics students use and develop their knowledge of data interpretation and analysis to reach conclusions from collected data on scientific phenomena. This requires students to be able to rearrange formulae, substitute values and interpret the data both numerically and graphically.

Independent Study

In Physics students undertake both directed and self-directed independent learning activities that support the strengthening of long-term memory and retrieval. Independent study helps our students achieve mastery in Physics and prepares them to work at an undergraduate level.

Directed independent learning tasks set in Physics can include background reading to build knowledge and deeper connections to the existing frame of learning, or responding to interlocking questions on a given topic across more than one text source. Self-directed independent study in Physics involves retrieval practice which is a crucial component of mastery. As students encounter challenges and learn to wrestle with demanding concepts and texts, they develop not only their knowledge and understanding but also resilience through perseverance.

Instead of revision being perceived as something that is crammed into a few weeks, independent study supports spaced practice throughout the curriculum. By repeatedly returning to content covered, students' knowledge has time to 'rest and be refreshed.'

We recognise that not all students process material at the same rate. Students who need extra support to achieve mastery are supported by targeted intervention in Physics where a staged or 'scaffolded' process is used to enable students to move from being dependent learners to autonomous ones.

All students have access to our Academy library where a wide range of academic texts, journals and other resources are available.

Implementation

Overview Statement

The curriculum in Physics is sequenced coherently so that knowledge, concepts and skills are rigorously developed over time. This supports all students, including the most disadvantaged, and those with high levels of need, especially SEND. Planning is informed by Rosenshine's Principles of Instruction and Cognitive Theory which support students in building secure schemas both within Physics, as well as in connection with other subjects.

Vocabulary is developed in Physics using the principles outlined in the Frayer Model and students are equipped to be able to read, write and speak like a skilled physicist. This is done by the careful modelling of the use of physical and scientific language and symbolic conventions, and the high expectations for the correct use of these by students in their written work.

Through the use of independent study resources in Physics, students learn at greater depth so that they can become masters of the skills required to be intellectually autonomous.

Regular retrieval-based activities, including key skills checks completed in most lessons, strengthen long-term memory and aid fluency, as do our cumulative unit tests and end-of-year assessments.

Technology is employed through the use of an online platform to help support the systematic completion of independent study of all the key skills studied in Physics and feedback to students on this work.

Learning character is developed through a culture of reference to our six learning applications: awareness, collaboration, creativity, empathy, independence and resilience.

Impact

The Key Stage 5 curriculum builds upon students' initial understanding, extending their knowledge in the areas of substantive knowledge and disciplinary knowledge.

Through developing their knowledge of substantive content, students are able to engage with application in disciplinary Physics.

Students also develop an understanding of the interdisciplinary nature of their studies, and this is supported though explicit cross-curricular links in Physics, Mathematics, Chemistry, Applied Science, Psychology and Geography.

Students use their knowledge of cognitive theory to recognise and use the most impactful methods of revision and retrieval practice. There is a high expectation for students to engage with practice of routine key skills through which they can develop independence.

Academic progress in Physics is recognised through the A-level Physics qualification, which acts as a measure of mastery; this provides students with the national currency needed for access to higher education and apprenticeship courses, and prepares them for a career in any workplace.