ABEUNT STUDIA IN MORES

Wanstead High School

Education with Character

Physics
Curriculum Content 2024 - 25

Key Stage 4 - Year 10 & 11
Key Stage 5 - Year 12 & 13

Contents

GCSE Physics Year 10 and 11

Pupils receive 4 lessons of Physics each fortnight.

The importance of Physics in the curriculum is to understand the fundamental mathematical relationships that govern natural phenomena and apply those relationships to interesting problems. It helps fuel curiosity about how the world around us works.

Physics inspires pupils to develop Education with Character by knowledge and a set of incredibly useful skills, in a fun and safe way, which has the added benefit of making them attractive to a wide range of employers.

Skills developed in Physics are established through a rigorous understanding of the scientific method, and a wide variety of practicals.

What is taught	When is it taught (Terms or Half Terms)	Reading list and Literacy focus	Where the curriculum is ambitious
Topic 1: Energy	**Term 1, Year 10**	"Sustainable Energy – Without the Hot Air" by David JC MacKay "Energy: A Beginner's Guide" by Vaclav Smil	Ambition in the Energy topic can be fostered by exploring advanced thermodynamics, including concepts such as entropy and the laws of thermodynamics. Pupils can be stretched through projects that involve calculating energy efficiency in various systems or designing renewable energy solutions. Investigating the impact of energy consumption on global sustainability and engaging with current research on energy storage technologies can further deepen their understanding.
Topic 1: Energy	**Term 2, Year 10**		
Topic 2: Electricity	**Term 3, Year 10**	"The Boy Who Harnessed the Wind" by William Kamkwamba and Bryan Mealer "Electrified Sheep: Glass-Eating Scientists, Nuking the Moon, and More Bizarre Experiments" by Alex Boese	To add ambition in the Electricity topic, pupils can explore complex circuit designs and the principles of electromagnetism. Challenging tasks may involve creating and analysing multi-component circuits, understanding electrical safety in greater detail, and exploring the role of electricity in cutting-edge technologies such as electric vehicles and smart grids. Pupils can also engage in projects that involve the practical application of Ohm's and Kirchhoff's laws.
Topic 2: Electricity	**Term 4, Year 10**		
Topic 3: Particle Model of Matter	**Term 5, Year 10**	"The Particle at the End of the Universe" by Sean Carroll	Ambition in the Particle Model of Matter can be achieved by delving into kinetic theory and the behaviour of gases under different conditions. Pupils can be stretched by conducting experiments to investigate phase changes and the properties of materials at the molecular level. Exploring real-world applications, such as the development of new materials or the study of nanoscale physics, can provide additional challenge and context.
Topic 4: Atomic Structure	**Term 6, Year 10**	"The Disappearing Spoon: And Other True Tales of Madness, Love, and the	In the Atomic Structure topic, ambition can be added by exploring quantum mechanics and the behaviour of subatomic

		History of the World from the Periodic Table of the Elements" by Sam Kean	particles. Pupils can be challenged to understand and apply the principles of wave-particle duality and electron configurations in complex atoms. Engaging with the latest research in particle physics, such as the study of the Higgs boson or dark matter, can stretch their analytical and conceptual skills.
Topic 5: Forces	**Term 1, Year 11**	"Forces and Motion: From High-speed Jets to Wind-up Toys" by Christopher Cooper "Newton's Rainbow: The Revolutionary Discoveries of a Young Scientist" by Kathryn Lasky	To add ambition in the Forces topic, pupils can delve into advanced mechanics, including the study of moments, equilibrium, and fluid dynamics. Challenging tasks may involve analysing complex systems in equilibrium, exploring the principles of torque and rotational motion, and investigating real-world applications such as bridge design or aerospace engineering. Projects that require mathematical modelling of forces can further enhance their understanding.
Topic 5: Forces	**Term 2, Year 11**		
Topic 6: Waves	**Term 3, Year 11**	"How Music Works" by John Powell	Ambition in the Waves topic can be fostered by exploring wave-particle interactions, the Doppler effect, and the applications of wave theory in technology. Pupils can be challenged with experiments that investigate the properties of different types of waves, including sound, light, and electromagnetic waves. Analysing the use of waves in medical imaging, communication technologies, and astronomy can provide additional depth and context.
Topic 7: Magnetism and Electromagnetism **Topic 8: Space Physics**	**Term 4, Year 11**	"The Physics of Superheroes" by James Kakalios "Astrophysics for Young People in a Hurry" by Neil deGrasse Tyson	To add ambition in Magnetism and Electromagnetism, pupils can explore the principles of electromagnetic induction, magnetic fields, and their applications. Challenging tasks may involve designing and building electromagnets, investigating the principles behind electric motors and generators, and exploring the role of electromagnetism in modern technology such as MRI machines and maglev trains. Engaging with advanced theoretical concepts, such as Maxwell's equations, can further stretch their understanding. Ambition in Space Physics can be achieved by exploring the latest discoveries in astrophysics, cosmology, and planetary science. Pupils can be challenged to analyse data from space missions, understand the principles of orbital mechanics, and investigate the life cycle of stars and the structure of galaxies. Projects that involve simulating space travel, studying the effects of space on the human body, and exploring the search for

			extra-terrestrial life can provide additional challenge and inspire curiosity. These ambitious tasks and projects aim to stretch pupils' understanding and skills, preparing them not only for their exams but also for further studies and careers in science.
	Term 5, Year 11		Use data, collected from challenge weeks/end of topic tests and all other assessments, to provide targeted revision.
	Term 6, Year 11		Use data, collected from challenge weeks and end of topic tests and all other assessments, to provide targeted revision.

How are pupils informally and formally assessed?	Fortnightly tests Challenge week assessments End of Year assessments, including Challenge Weeks In lesson exam questions Homework Verbal questioning Work in exercise books
Developing Independent and Home Learning Skills	"Prep booklet" - a booklet containing exam questions which help pupils prepare for the fortnightly test at Key Stage 4. The use of online learning platforms such as Oak national academy and YouTube channels such as: Cognito.edu, Fuse School and free science lessons.
Useful e-Learning Resources (e.g., web links)	**https://www.physicsandmathstutor.com/** - Physics and Maths Tutor **https://www.bbc.co.uk/bitesize/examspecs/zpgcbk7** - Triple Biology **https://www.bbc.co.uk/bitesize/topics/zthssrd** - Combined Biology **https://senecalearning.com/en-GB/blog/gcse-biology-revision/** - Seneca

Equipment for lessons	Black or blue pen, green pen, pencil, eraser, ruler, highlighter, scientific calculator, glue stick.
Enrichment activities	Research tasks and after school activities.
Careers curriculum	NHS cadets after school once a week for 39 weeks.

Head of Department and email contact	Mr M Hadden m.hadden@wansteadhigh.co.uk

A Level Physics - Year 12 and 13

Pupils receive 9 or 10 lessons each fortnight.

Studying Physics at A Level is a fundamental component of our curriculum, providing pupils with a profound understanding of the principles that govern the universe. It equips pupils with the skills to analyse and interpret physical phenomena, laying a strong foundation for navigating the complexities of the natural world and technological advancements.

A Level Physics fosters the development of Education with Character by promoting resilience, critical thinking, and independent learning. Pupils are encouraged to tackle challenging problems, engage in rigorous experimentation, and develop logical reasoning skills. These experiences prepare them to approach real-world issues with confidence and creativity.

Moreover, A Level Physics cultivates essential skills such as problem-solving, analytical thinking, and quantitative analysis. Pupils learn to design and conduct experiments, interpret data, and apply their knowledge to various contexts, from understanding the fundamental forces of nature to exploring cutting-edge technologies in engineering and beyond.

Our curriculum is designed to promote a holistic understanding of science, integrating concepts across biology, chemistry, and physics. This approach helps pupils see the interconnectedness of scientific disciplines, allowing for a deeper and more nuanced understanding of each subject. By studying Physics in this integrated manner, pupils build a robust knowledge base that prepares them for further education and diverse career paths in science, engineering, technology, and more.

Overall, A Level Physics offers a rigorous and ambitious curriculum that inspires curiosity, fosters academic excellence, and equips pupils with the skills and knowledge needed to succeed in their future endeavours.

What is taught	When is it taught (Terms or Half Terms)	Reading list and Literacy focus	Where the curriculum is ambitious
Matter and radiation **Waves** **Quarks and Leptons** **Optics**	**Year 12 Autumn**	Matter and Radiation "Introduction to Quantum Mechanics" by David J. Griffiths Waves "The Physics of Waves" by Howard Georgi Quarks and Leptons "Quarks and Leptons: An Introductory Course in Modern Particle Physics" by Francis Halzen and Alan D. Martin Optics "Principles of Optics" by Max Born and Emil Wolf	**Matter and Radiation:** Ambition is added by exploring particle-wave duality and applications of radiation in medical imaging. Pupils investigate cutting-edge research in particle accelerators and radiation therapy. **Waves:** Ambition is fostered by delving into interference and diffraction, with applications in telecommunications and medical imaging. Pupils analyse advanced wave properties and practical uses. **Quarks and Leptons:** Pupils explore the Standard Model, examining roles of subatomic particles and experimental evidence, stretching their understanding with research at CERN. **Optics:** Ambition is added through advanced optical phenomena and modern applications like fibre-optic communication. Pupils design experiments involving lenses, mirrors, and diffraction gratings.
Forces in Equilibrium **Electric Current** **Forces on the move**	**Year 12 Winter**	Forces in Equilibrium "Engineering Mechanics: Statics" by J.L. Meriam and L.G. Kraige	**Forces in Equilibrium:** Pupils tackle complex equilibrium problems involving multiple forces and torques, exploring real-world applications in structural engineering and biomechanics.

DC Current		Electric Current "Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew N.O. Sadiku Forces on the move "Classical Mechanics" by Herbert Goldstein DC Current "Electronic Principles" by Albert Malvino and David Bates	**Electric Current:** Pupil's design and analyse complex circuits, investigate material effects on resistance, and explore applications in renewable energy systems and electronics. **Forces on the Move**: Ambition is fostered by analysing motion in various contexts, such as projectiles and circular motion, with applications in vehicle dynamics and aerospace engineering. **DC Current:** Pupil's study advanced DC circuit principles, designing and analysing complex circuits with multiple power sources, exploring practical applications in electronics and power distribution.
Newton's Laws **Quantum Phenomena** **Force and Momentum Work, Energy and Power** **Materials**	**Year 12 Spring**	Newton's Laws "The Feynman Lectures on Physics, Vol. I" by Richard P. Feynman, Robert B. Leighton, and Matthew Sands Quantum Phenomena "Quantum Mechanics: The Theoretical Minimum" by Leonard Susskind and Art Friedman Force and Momentum Work, Energy and Power "Physics for Scientists and Engineers" by Raymond A. Serway and John W. Jewett Materials "Materials Science and Engineering" by William D. Callister Jr.	**Newton's Laws:** Ambition is added by exploring complex applications of Newton's laws in various contexts, such as planetary motion, vehicle safety design, and sports physics. Pupils engage in projects that model real-world scenarios, requiring detailed calculations and simulations to deepen their understanding of force and motion. **Quantum Phenomena:** Pupils delve into advanced quantum mechanics, exploring wave-particle duality, the photoelectric effect, and Heisenberg's uncertainty principle. Engaging with recent research and practical applications, such as quantum computing and cryptography, provides further challenge and context. **Force and Momentum Work, Energy and Power:** Ambition is fostered by analysing complex systems involving collisions and energy transformations. Pupils undertake detailed investigations of conservation laws in dynamic systems and explore practical applications in engineering, such as crash safety and energy efficiency. **Materials:** Ambition is added by examining advanced material properties, such as superconductivity, nanotechnology, and smart materials. Pupils engage in experiments to test material behaviour under different conditions, linking their findings to real-world applications in construction and manufacturing.
Motion in a circle **Radioactivity** **Nuclear Energy** **Simple Harmonic Motion** **Gases** **Thermal Physics**	**Year 13 Autumn**	**Motion in a circle** "Classical Dynamics of Particles and Systems" by Jerry B. Marion and Stephen T. Thornton **Radioactivity**	**Motion in a circle:** Pupils explore the principles of circular motion in-depth, including centripetal and centrifugal forces. They apply these concepts to real-world scenarios, such as satellite orbits, amusement park rides, and rotational dynamics in sports, challenging their problem-solving skills. **Radioactivity:**

		Radioactivity: Introduction and History" by Michael F. L'Annunziata **Nuclear Energy** "Nuclear Physics: Principles and Applications" by John Lilley **Simple Harmonic Motion** "Vibrations and Waves" by A.P. French **Gases** "Kinetic Theory of Gases: An Anthology of Classic Papers" by Stephen G. Brush **18. Thermal Physics** "An Introduction to Thermal Physics" by Daniel V. Schroeder	Ambition is fostered by investigating the principles of radioactive decay, nuclear reactions, and their applications. Pupils analyse the effects of radiation on biological systems and explore the use of radioisotopes in medicine, industry, and energy production. **Nuclear Energy:** Ambition is added by exploring the principles of nuclear fission and fusion. Pupils investigate the design and operation of nuclear reactors, the challenges of nuclear waste management, and the potential of fusion as a future energy source, engaging with current research and debates. **Simple Harmonic Motion:** Pupils delve into the mathematical modelling of oscillatory systems, such as pendulums and springs. They explore the applications of simple harmonic motion in engineering, seismology, and acoustics, enhancing their analytical skills through practical experiments and simulations. **Gases:** Ambition is fostered by studying the behaviour of gases under various conditions, including real gas deviations from ideal behaviour. Pupils investigate applications in meteorology, aerodynamics, and respiratory systems, conducting experiments to deepen their understanding of gas laws. **Thermal Physics:** Ambition is added by exploring advanced thermodynamic principles, including entropy, enthalpy, and the Carnot cycle. Pupils engage in detailed analyses of heat engines, refrigeration cycles, and the laws of thermodynamics, linking their knowledge to real-world energy systems.
Capacitors **Magnetic Fields** **Gravitational Fields** **Electric Fields** **Electromagnetic Induction**	**Year 13 Winter**	**Capacitors** "Capacitors: Technology and Trends" by G. Prakash and R. Jain **Magnetic Fields** "Introduction to Electrodynamics" by David J. Griffiths	**Capacitors:** Pupils explore the principles and applications of capacitors in-depth, including energy storage, filtering, and signal processing. They design and conduct experiments to investigate capacitor behaviour in AC and DC circuits, enhancing their understanding of electronic components. **Magnetic Fields:** Ambition is fostered by examining the principles of electromagnetism and magnetic field interactions. Pupils investigate the applications of magnetic fields in electric motors, generators, and magnetic resonance imaging (MRI), conducting experiments to apply their theoretical knowledge.

		Gravitational Fields "Gravity from the Ground Up" by Bernard Schutz	**Gravitational Fields:** Ambition is added by exploring the principles of gravitational fields and their effects on celestial and terrestrial bodies. Pupils analyse orbital dynamics, gravitational waves, and the applications of gravitation in space exploration and geophysics, enhancing their understanding through complex problem-solving tasks.
		Electric Fields "Electricity and Magnetism" by Edward M. Purcell and David J. Morin	**Electric Fields:** Pupils delve into the principles of electric fields and their applications in various technologies. They investigate the behaviour of charged particles in electric fields, explore the design of capacitors and electric field sensors, and conduct experiments to apply their theoretical knowledge.
		Electromagnetic Induction "Electromagnetic Field Theory Fundamentals" by Bhag Singh Guru and Hüseyin R. Hiziroglu	**Electromagnetic Induction:** Ambition is fostered by exploring the principles of electromagnetic induction and its applications in power generation and transmission. Pupil's design and conduct experiments to investigate inductors, transformers, and the principles of electromagnetic waves, linking their knowledge to modern technologies.

How are pupils informally and formally assessed?	End of unit tests Assessment tasks, including Challenge Weeks End of year assessments Retrieval tasks Homework Verbal questioning Work in exercise books
Developing Independent and Home Learning Skills	All slides will be uploaded to Google Classroom before the lesson, as pre-reading is required for some topics due to complexity Flipped learning lessons Isaac physics and Seneca used for quizzes and HW.
Useful e-Learning Resources (e.g., web links)	**https://senecalearning.com/en-GB/** **https://www.physicsandmathstutor.com/** **https://isaacphysics.org/**
Equipment for lessons	Black or blue pen, green pen, pencil, eraser, ruler, highlighter, glue stick, calculator, protractor.
Enrichment activities	**TBC**
Careers curriculum	**TBC**
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