**The Nottingham Emmanuel School – PhysicsCurriculum Map (2022-2023)**

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| Intent statement | The science curriculum at Emmanuel will provide students with the new knowledge needed to navigate the modern world. This will allow our students to develop their scientific literacy which will enable them to make informed decisions. This will empower and equip our students to be good role models, who are mindful of the word around them and give them the skills to make meaningful contributions to society. We aim to remove barriers to learning through raising aspirations via an inclusive and diverse curriculum for all students. |
| Diversity across the curriculum | Our curriculum represents the diversity of our students by promoting science as accessible to all. We will use inclusive language, images and texts and promote scientific role models that represent the diversity of our school community. We will deliver the science curriculum with an awareness of the different religious beliefs of our students whilst being mindful of any unconscious bias. |
|  |  | AUT 1 | AUT 2 | SPR 1 | SPR 2 | SUM 1 | SUM 2 |
| Year 10 | Title and objectives | **Particle Model** | **Atomic Structure** | **Atomic Structure /waves** | **Waves continued** | **Revision and exams** | **Revision and exams** |
| Core knowledge | 1 Density 2 Density RPA3 Thermal conductivity RPA4 Specific heat capacity5 Specific Heat Capacity RPA6 Changes of state and internal energy7 Specific latent heat8 Pressure and temperature in gases9 Pressure and volume in gases | 1 History of the atom2 Alpha, beta and gamma radiation3. Uses and dangers of radiation4 nuclear equations and background radiation5 half life | 6 Is nuclear radiation dangerous7 uses of radiation8 nuclear fission9 nuclear fusionWaves:1 – what is a wave?2 transverse and longitudinal waves RPA3 electromagnetic spectrum4 Uses and dangers of electromagnetic waves | 5 Black Body Radiators RPA6 light - reflection7 Seeing coloured light8 light – refraction RPA9 Lenses10 sound 11 ultrasound12 earthquake P and S waves |  |  |
| Skills | * Manipulation of equations.
* Standard form and significant figures
* Use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids
* Dimensions to be measured using appropriate apparatus such as a ruler, micrometer or Vernier callipers.
* Working critically with primary and secondary evidence:
* Plan and carry out an investigation to find out which type of insulation will reduce heat loss the most.
* Obtaining and presenting primary evidence:
* Working critically with primary and secondary evidence:
* Identify possible hazards, the risks associated with these hazards, and methods of minimising the risks.
* Make measurements with appropriate precision and record data in appropriate tables.
* Evaluate data and working methods.
* Recognise random and systematic errors; identify their causes.
* Identify causes of uncertainty in final calculated values and suggest ways of reducing the inaccuracies to improve the accuracy of the calculated values.
* Obtain evidence and present data
* Inversely proportional relationships.
 | * Risk assessment and health and safety considerations
* Scientific notation in terms of representing isotopes.
* Half life calculations – interpreting written information
* Interpreting data from graphs.
* Evaluating models.
* Calculating percentages
 | * Research some radioactive sources used in medicine and the properties of these tracers (half-life, type of radiation emitted and state).
* Evaluating risks in wider societal contexts.
* Use of standard form, significant figures and prefixes
* Method writing
 | * Drawing ray diagrams
* Using a protractor
* Interpreting oscilloscope traces
* Depth calculations.
* Standard form for showing large distances and sizes
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| Covid recovery | Skills focus through spaced retrieval to catch up... | Exam question practice and metacognition strategies to help with revision and exam technique |
| Careers | “Big Question” on objective slide set in a wider world context |
| Year 11 | Title and objectives | **Forces and motion** | **Forces and their interactions** | **Space / Magnetism and electromagnetism** |  | **Revision and exams** | **Revision and exams** |
| Core knowledge | 1 Stopping distance2 Distance and displacement3 speed and velocity 4 distance time graphs5 Velocity time graphs6 velocity and acceleration7 v2=u2+2aS8 newton’s Laws9 Acceleration RPA10 terminal velocity11 Momentum12 Momentum and force | 1 Scalars and Vectors2 mass vs weight3 Resultant forces4 resolving forces5 Hook’s law RPA6 moments7 levers and gears10 pressure11 pressure in liquids12 pressure in liquids equation13 atmospheric pressure | 1 Our place in the universe2 Orbital motion3 Stellar Evolution4 red Shift5 The expanding universe1 Permanent and induced magnets2 Magnetic Fields3 Magnets and electromagnets4 The motor effect5 Uses of the motor effect6 Electromagnetic induction7 transformers8 microphones |  |  |  |
| Skills | * Translate between graphical and numeric form
* y=mx+c represents a linear relationship
* Plot two variables from data
* Determine slope and intercept of a linear graph
* Draw and use the slop of a tangent to a curve
* Decimal forms
* Standard form
* Use appropriate significant figures
* Change the subject of an equation
* Substitute numbers into equations
* Solve simple algebraic equations
* Correct units
* Use appropriate significant figures
* Hypothesis and predictions
* Variables
* Repeats
* Calculating means
* Recording results
* Present data and observations
* Describing patterns or trends
* Making conclusions
	+ Draw and use the slop of a tangent to a curve
	+ Determine slope and intercept of a linear graph
* Area between curve and x-axis in physics
 | * Rearrange and substitute in values to the equation
* Convert units as appropriate and use standard form.
* Using a newton meter to measure weight.
* Scale drawing – using a protractor, reading and setting appropriate scales
* Recognising and proving directly proportional relationships
* Data analysis – using graphs to make conclusions
 | * Decimal forms
* Standard form
* Change the subject of an equation
* Substitute numbers into equations
* Solve simple algebraic equations
* Correct units
* Ratios and fractions
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| Careers | “Big Question” on objective slide set in a wider world context. |
| Year 12 | Title and objectives | **Particle Physics and Waves** | **Quantum phenomena and Waves** | **Electricity and Mechanics** | **Electricity and Mechanics** | **Revision and Mechanics** | **Revision and Materials** |
| Core knowledge | **Particle Physics (2 teacher)*** Atomic structure and nuclear stability
* Matter, antimatter and photons
* The particle Zoo
* Conservation Rules
* Quarks and anti quarks

**Waves (3 teacher)*** progressive waves and wave speed
* transverse and longitudinal waves
* Superposition and interference
* Stationary waves
* Resonance
 | **Quantum Phenomena (2 teacher)*** The photo electric effect
* Energy levels in atoms
* Wave particle duality

**Waves (3 teacher)*** Diffraction
* Young’s slits experiment and two source interference
* Diffraction gratings
* Refractive index

Critical angle and TIR | **Electricity (2 teacher)*** Circuit diagrams
* Current and potential difference
* IV graphs
* Resistivity
* Determining the resistivity of a wire

**Mechanics (3 Teacher)*** Scalars and vectors
* Resultant forces
* Resolving forces
* Forces in equilibrium
 | **Electricity (3 teacher)*** EMF and internal resistance
* The potential divider
* Power and electrical energy
* Conservations of energy and charge in circuits

**Mechanics (3 teacher)*** Moments
* Uniform acceleration
* Displacement time graphs
* Velocity time graphs
* Acceleration time graphs
* SUVAT equations
 | **Electricity ( 2 teacher)**Revision and practice**Mechanics (3 teacher)*** Acceleration due to gravity and terminal velocity
* Projectile Motion – horizontally and at an angle
* Newton’s Laws
* Conservation of momentum
* Force, momentum and Impulse
* Work and power
* Conservation of energy
 | **Materials ( 3 teacher)*** Density
* Hook’s law
* Stress and strain
* The Young’s modulus
* Stress- strain and force extension graphs
 |
| Skills | **Mathematical Skills:*** Recognise and make use of appropriate units in calculations
* Recognise and use expressions in decimal and standard form
* Use ratios, fractions and percentages
* Estimate results
* Use calculators to find and use power
* Use calculators to handle sin x, cos x, tan x when x is expressed in degrees or radians
* Use an appropriate number of significant figures
* Find arithmetic means
* Understand simple probability
* Make order of magnitude calculations
* Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined by addition, subtraction, multiplication, division and raising to powers
* Understand and use the symbols: =, <, <<, >>, >, 𝖺, ≈, ∆
* Change the subject of an equation, including non-linear equations
* Substitute numerical values into algebraic equations using appropriate units for physical quantities
* Solve algebraic equations, including quadratic equations
* Translate information between graphical, numerical and algebraic forms
* Plot two variables from experimental or other data
* Understand that y = mx + c represents a linear relationship
* Determine the slope and intercept of a linear graph
* Calculate rate of change from a graph showing a linear relationship
* Draw and use the slope of a tangent to a curve as a measure of rate of change
* Distinguish between instantaneous rate of change and average rate of change
* Understand the possible physical significance of the area between a curve and the x axis and be able to calculate it or estimate it by graphical methods as appropriate
* Apply the concepts underlying calculus (but without requiring the explicit use of derivatives or integrals) by solving equations involving rates of change, eg Δx = – 𝜆x using a graphical method
* Use angles in regular 2D and 3D structures
* Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects
* Calculate areas of triangles, circumferences and areas of circles, surface areas and volumes of rectangular blocks, cylinders and spheres
* Use Pythagoras’ theorem, and the angle sum of a triangle
* Use sin, cos and tan in physical problems
* Understand the relationship between degrees and radians and translate from one to the other

**Practical Skills*** use appropriate analogue apparatus to record a range of measurements (to include length/distance, temperature, pressure, force, angles, volume) and to interpolate between scale markings
* use appropriate digital instruments, including electrical multimeters, to obtain a range of measurements (to include time, current, voltage, resistance, mass)
* use methods to increase accuracy of measurements, such as timing over multiple oscillations, or use of fiducial marker, set square or plumb line
* use stopwatch or light gates for timing
* use calipers and micrometers for small distances, using digital or vernier scales
* correctly construct circuits from circuit diagrams using DC power supplies, cells, and a range of circuit components, including those where polarity is important
* design, construct and check circuits using DC power supplies, cells, and a range of circuit components
* generate and measure waves, using microphone and loudspeaker, or ripple tank, or vibration transducer, or microwave / radio wave source
* use laser or light source to investigate characteristics of light, including interference and diffraction
* use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data
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| Year 13 | Title and objectives | **Astrophysics** | **Further Mechanics and Fields** | **Thermal Physics and Fields** | **Nuclear Physics and Fields** | **Exams and Revision** | **Exams and Revision** |
| Core knowledge | **Astrophysics ( 2 teacher)**• Units and quantities used in astrophysics• Stellar Magnitudes• Stars as black body radiators• Stellar spectral classes• The Hertzsprung Russell Diagram and stellar evolution• Supernovae, neutron stars and black holes**Astrophysics (3 teacher)**  • Lenses• Optical telescopes• Non optical telescopes• Comparing telescopes• The Doppler effect and red shift• The Big Bang Theory• Detection of Binary stars, quasars and exoplanets | **Further Mechanics ( 2 teacher)*** Circular Motion
* Centripetal force and acceleration
* Simple Harmonic Motion
* SHM in a mass – spring system
* SHM in a simple pendulum
* Free and forces vibrations and resonance

**Gravitational Fields ( 3 teacher)*** Newton’s Law of Gravitation
* Gravitational field strength
* Gravitational potential
* Orbits of planets and satellites
 | **Thermal Physics (2 teacher)*** Thermal energy transfer
* Gas Laws
* Ideal Gas Equation
* Kinetic Theory of Gases

**Electric Fields (3 teacher) teacher)*** Coulomb’s Law
* Electric field strength
* Electric potential

**Capacitors*** Capacitance
* Energy stored in a capacitor
* Dielectrics
* Charging and discharging capacitors
 | **Nuclear Physics ( 2 teacher)*** Rutherford Scattering
* Measuring nuclear radii
* Alpha, beta and gamma radiation
* Radioactive decay
* Nuclear instability
* Mass defect and binding energy
* Energy in nuclear fission and nuclear fusion reactions
* Thermal Nuclear Reactors

**Magnetic Fields ( 3 teacher)*** Magnetic flux density
* Moving charges in a magnetic field

**Electromagnetic Induction*** Electromagnetic induction
* Magnetic flux and flux linkage
* Faraday’s law and Lenz’s law Alternating current
* Transformers
 |  |  |
| Skills | **Mathematical Skills*** Recognise and make use of appropriate units in calculations
* Recognise and use expressions in decimal and standard form.
* Use ratios, fractions and percentages
* Estimate results
* Use calculators to find and use power, exponential and logarithmic functions
* Use calculators to handle sin x, cos x, tan x when x is expressed in degrees or radians
* Use an appropriate number of significant figures
* Find arithmetic means
* Understand simple probability
* Make order of magnitude calculations
* Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined by addition, subtraction, multiplication, division and raising to powers
* Understand and use the symbols: =, <, <<, >>, >, 𝖺, ≈, ∆
* Change the subject of an equation, including non-linear equations
* Substitute numerical values into algebraic equations using appropriate units for physical quantities
* Solve algebraic equations, including quadratic equations
* Use logarithms in relation to quantities that range over several orders of magnitude
* Translate information between graphical, numerical and algebraic forms
* Plot two variables from experimental or other data
* Understand that y = mx + c represents a linear relationship
* Determine the slope and intercept of a linear graph
* Calculate rate of change from a graph showing a linear relationship
* Draw and use the slope of a tangent to a curve as a measure of rate of change
* Distinguish between instantaneous rate of change and average rate of change
* Understand the possible physical significance of the area between a curve and the x axis and be able to calculate it or estimate it by graphical methods as appropriate
* Apply the concepts underlying calculus (but without requiring the explicit use of derivatives or integrals) by solving equations involving rates of change, eg Δx = – 𝜆x using a graphical method
* Interpret logarithmic plots
* Use logarithmic plots to test exponential and power law variations
* Sketch relationships which are
* modelled by y = k / x, y = kx2 , y = k / x2, y = kx, y = sin x, y = cos x, y = e±x, and y = sin2x, y = cos2x as applied to physical relationships
* Use angles in regular 2D and 3D structures
* Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects
* Calculate areas of triangles, circumferences and areas of circles, surface areas and volumes of rectangular blocks, cylinders and spheres
* Use Pythagoras’ theorem, and the angle sum of a triangle
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* use methods to increase accuracy of measurements, such as timing over multiple oscillations, or use of fiducial marker, set square or plumb line
* use stopwatch or light gates for timing
* use calipers and micrometers for small distances, using digital or vernier scales
* correctly construct circuits from circuit diagrams using DC power supplies, cells, and a range of circuit components, including those where polarity is important
* design, construct and check circuits using DC power supplies, cells, and a range of circuit components
* use signal generator and oscilloscope, including volts/division and time-base
* generate and measure waves, using microphone and loudspeaker, or ripple tank, or vibration transducer, or microwave / radio wave source
* use laser or light source to investigate characteristics of light, including interference and diffraction
* use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data
* use ionising radiation, including detectors
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