WFA Progression Map - planning for knowledge/skills etc to build & accumulate sequentially over time

Key: ***Bold** writing shows development or progression from previous year. *Underline shows cross-over of key concepts with other end-points

Faculty: Science			Subject: Triple Physics			
End points	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Understanding of how all interactions in the Universe are reliant on forces being exchanged between two or more bodies, and that these force interactions are inextricable from the corresponding energy and momentum conservation within systems.		Forces as pushes or pulls arising from the interaction between 2 objects - contact and non-contact; forces changing speed or direction of objects. Using force arrow diagrams to represent forces in 1 dimension. The difference between weight and mass, and how to calculate the force due to a given mass in Earth's gravitational field.	**A qualitative approach to Newton's second law – applying a force changes the speed and/or direction of an object, whereas zero net force means that no change in speed or direction is possible** **Reversing Newton's second law to infer that if an object is changing speed and/or direction then there must be a net force acting, and vice versa.** **Weight as the force objects feel as a result of gravity, which is a field that differs on different planets and stars, and how to calculate the weight due to a given mass in any given gravitational field.** Forces as actions that can squash or stretch objects. Hooke's Law as a special case of stretching where displacement is proportional to force applied. Moments as the turning effect of a force; levers as simple force multipliers that can exert a larger force with a smaller movement.			**Forces as pushes or pulls arising from the interaction between 2 objects – this can be observed in both contact and non-contact forces.** **When stretching and squashing elastic and inelastic deformation can occur; Hooke's Law as a special case of this; force-extension graphs for different materials and using these to describe where materials are elastic or inelastic, temporarily deformed or permanently deformed, and to calculate energy transfers as a result of stretching.** Work done as the energy change of a system; how to calculate work done using energy equations for common stores such as kinetic or gravitational potential, and relating work done to energy transfers using the work done equation. Moments as the turning effect of a force; levers as simple force multipliers that can exert a larger force with a smaller movement. Weight as the force objects feel as a result of gravity,

			The difference between weight and mass, and how to calculate the force due to a given mass in Earth's gravitational field. Work done is the energy change of a system. Describing the motion of objects in the case where force is zero and therefore speed does not change; calculating average speed given distance covered and time taken values. Use of distance-time graphs to calculate speed, total distance covered and average speed. **Force exerted over an area results in pressure. Pressure occurs in all fluids due to particle collisions; atmospheric pressure decreases with height, whereas pressure in liquids increases with depth.**			which is a field that differs on different planets and stars, and how to calculate the weight due to a given mass in any given gravitational field. **Forces as vectors, with magnitude and direction; using force vector diagrams in 2 dimensions in order to represent multiple forces and calculate resultant forces; the use of free body diagrams in order to represent multiple forces and calculate resultant forces, using force vector diagrams in 2 dimensions in order to resolve single forces into their orthogonal components – all via scale drawings.** Levers and gears as force multipliers that can exert a larger force with a smaller movement or vice versa. Describing and explaining the factors that lead to changing forces acting on a body in atmospheric free fall, and how these lead to changing speed up to a maximum terminal velocity; representing free-fall and terminal velocity on a graph; describing how free-fall is altered by the deployment of a parachute. Distance and displacement, speed and velocity as scalars and vectors, and using 2- dimensional vector diagrams to perform

						calculations for resultant displacement or velocity via scale drawings. Distance-time, displacement - time, speed-time and velocity- time graphs and their uses to describe motion – interpreting these and constructing these; acceleration calculations using speed/velocity and time data or from speed/velocity-time graphs. **Describing how and explaining why velocity changes during circular motion, and why subsequently we can describe the object as accelerating.** **Articulating Newton's 1st, 2nd, 3rd laws and identifying and describing how they apply to and lead to real-world examples of motion/lack of motion. Inertial mass as the mass that resists acceleration, and therefore leads to Newton's second law.** **Momentum as the property of a moving object related to its velocity and mass, and subjectively experienced as the difficulty of stopping the object in a given time with a given force; momentum as a vector.**

						1-dimensional vector addition of momentum values. Calculating stopping distances of moving vehicles by combining their thinking distance (under constant velocity) and braking distance (under constant acceleration); relating stopping distances to energy transfers through the velocity squared component of kinetic energy. **Satellites and how they remain in orbit; describing the acceleration and circular motion of satellites. (Triple)** **Force exerted over an area results in pressure. Pressure occurs in all fluids due to particle collisions; atmospheric pressure decreases with height, whereas pressure in liquids increases with depth.** Using volume and density to perform displacement calculations to find up-thrust in different fluids.
	NC/Spec coverage	NC/Spec coverage Gravity	NC/Spec coverage Contact forces Pressure	NC/Spec coverage	NC/Spec coverage	NC/Spec coverage Forces in action Motion Force and motion Force and pressure
Understanding of how all matter is made up of tiny particles, significantly		The particle model – all matter is made up from atoms, and these atoms can be arranged as molecules, compounds or in mixtures.	The Earth's orbit around the Sun and its effects – the day solar cycle, monthly lunar cycle, yearly seasonal cycles; the seasons and the		Molecules and compounds as having electrostatic forces binding them, which need to be overcome in order to break them apart.	

smaller than the cells studied in biology. The particles are always moving, have spaces between them, and adding heat to them makes them move faster. How the particles are arranged and move dictates the state and properties of the macroscopic substances we interact with every day.		Molecules and compounds as having electrostatic forces binding them, which need to be overcome in order to break them apart. States of matter and changes of state between solid, liquid and gas, and describing the changes that take place to the substances on a macro-level between these states of matter. States of matter and changes of state between solid, liquid and gas, and describing the changes that take place to the substances on a particle model- level between these states of matter, in terms of particle energy, particle movement, position, binding forces. Physical changes as changes of state; chemical changes as changes of chemical property when more than one atom is chemically bonded together. Conservation of mass in both physical and chemical changes. Compounds formed by chemical changes having different properties to the atoms that comprise them.	Earth's tilt, day length at different times of year, in different hemispheres. The Moon's orbit around the Earth and its effects – the tides. Gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different **A qualitative approach to internal energy to begin to discuss the difference between temperature and energy – temperature as how hot an object feels, but energy as the total amount of energy stored in it.** **Energy flows as heat energy from high temperature systems to low temperature systems.** **Heating and thermal equilibrium, through the processes of conduction (contact heating in solids), convection (circular flow heating in fluids) and radiation (electromagnetic heat energy given off by all objects and passing through a vacuum).** Brownian motion in fluids, with particles exhibiting random motion due to their energies. Diffusion in fluids from areas of high concentration		Density as the mass per volume of a substance; different methods of calculating density experimentally, for regular solids, irregular solid and fluids **States of matter and changes of state between solid, liquid and gas, and describing the changes that take place to the substances on a macro-level between these states of matter.** **States of matter and changes of state between solid, liquid and gas, and describing the changes that take place to the substances on a particle model- level between these states of matter, in terms of particle energy, particle movement, position, binding forces.** Physical changes as changes of state; chemical changes as changes of chemical property when more than one atom is chemically bonded together Conservation of mass in both physical and chemical changes. Compounds formed by chemical changes having different properties to the atoms that comprise them.	

			to areas of low concentration down a concentration gradient. Compounds formed by chemical changes having different properties to the atoms that comprise them.		Diffusion in fluids from areas of high concentration to areas of low concentration down a concentration gradient; osmosis as a special case. Internal energy as the sum of kinetic and potential energies of particles in a substance; the temperature of a substance related to the average kinetic energy per particle in the substance; potential energy reflecting the bound state of matter of a substance. Potential energy as a negative quantity that needs to be overcome in order to separate particles. **Heating and thermal equilibrium, through the processes of conduction (contact heating in solids), convection (circular flow heating in fluids) and radiation (electromagnetic heat energy given off by all objects and passing through a vacuum), relative to increasing or decreasing internal energy.** Heating and changing temperature and changing state – specific heat capacity as the consideration when increasing temperature and therefore increasing kinetic energy of particles both not potential energy, and	

					<u>specific latent heat as the consideration when changing state and therefore changing potential energy of particles both not kinetic energy and therefore not temperature.</u> Brownian motion in fluids, with particles exhibiting random motion due to their energies, even in a substance ostensibly at rest. Pressure occurs in all fluids due to particle collisions with the walls of a container and the subsequent momentum change and exertion of a force; atmospheric pressure decreases with height, whereas pressure in liquids increases with depth Explaining the causes of gas pressure from a particle model perspective, taking into account the positions, kinetic energy, speed and spacing of particles; linking this to work done on the substance as the internal energy of a fluid is increased and how this results in volume or pressure changes	
	NC/Spec coverage	NC/Spec coverage Links to chemistry – the particle model	NC/Spec coverage Links to: - Chemistry - the particle model - Contact forces Pressure Heating and cooling	NC/Spec coverage	NC/Spec coverage Molecules and matter Links to: Conserving and dissipating Energy transfer by heating	NC/Spec coverage
Understanding that the atoms that		*The particle model – all matter is made up from*		Models of the atom and how these have changed	<u>**Atomic structure of atoms, with positive protons and**</u>	Radioactive decay through both spontaneous and

contribute to particle theory are themselves composed of even smaller particles. The compositions and arrangements of these smaller particles dictates the chemical properties of substances, and changing these can lead to drastic and unexpected energy changes.		*atoms, and these atoms can be arranged as molecules, compounds or in mixtures. Molecules and compounds as having electrostatic forces binding them, which need to be overcome in order to break them apart.*		over time, from Dalton's billiard ball model to JJ Thomson's plum pudding model, to Rutherford's nuclear model, to Bohr's energy level model. reach given mass using half-life. The three types of ionising radiation – alpha, beta, gamma their constituent parts, their mass, their charge, their ionising properties and their penetrative properties. The uses of ionising radiation in consumer products and industry, and the links between the properties of the three types and their uses. The detection of ionising radiation using GM tubes. Contamination vs irradiation and the difference in the uses of irradiation as compared to the hazards of contamination. Hazards of radioactive emissions in industry and medicine and how to reduce risk to a safe level; background radiation sources and their significance; how to safely dispose of radioactive waste Radioactive decay through both spontaneous and induced nuclear fission –	**neutral neutrons forming a nucleus, orbited by negatively charged electrons in energy levels at different distances defining property of a given element.** Using element symbols to define the numbers of each type of particle in a neutral Atom Neutral atoms having equal numbers of protons and electrons, ions having differing numbers of electrons; using element symbols to represent ions. Neutron number of atoms may change without changing the element represented; referring to atoms with differing numbers of neutrons as isotopes.	induced nuclear fission – the breakdown of a large unstable nucleus into two new smaller, more stable nuclei with the emission of two or three neutrons and the release of energy in the form of electromagnetic radiation. Chain reactions in nuclear fissions and showing these in a flow diagram format. Using symbol equations to show the process of spontaneous or induced fission. **The uses of fission in nuclear fission power stations – their construction, how electricity in generated inside them, how they are designed with safety features to prevent chain reactions and nuclear meltdowns.** Nuclear fusion, where two smaller unstable nuclei are fused at high temperatures and pressures to form a new larger more stable nucleus, with the release of energy in the form of electromagnetic radiation and the emission of a neutron. Explaining why chain reactions cannot occur in nuclear fusion.

				the breakdown of a large unstable nucleus into two new smaller, more stable nuclei with the emission of two or three neutrons and the release of energy in the form of electromagnetic radiation. Chain reactions in nuclear fissions and showing these in a flow diagram format **Using symbol equations to show the process of spontaneous or induced fission.** The uses of fission in nuclear fission power stations – their construction, how electricity in generated inside them, how they are designed with safety features to prevent chain reactions and nuclear meltdowns. Atomic structure of atoms, with positive protons and neutral neutrons forming a nucleus, orbited by negatively charged electrons in energy levels at different distances defining property of a given element. Using element symbols to define the numbers of each type of particle in a neutral Atom Neutral atoms having equal numbers of protons and		Describing how nuclear fusion occurs in stars but cannot be reproduced at scale on Earth due to the high pressures and temperatures required. The life cycle of the solar system. (Triple) The life cycle of stars, from clouds of dust and gas to nebula / white, dwarves /neutron stars/black holes depending on their initial mass. (Triple)

				electrons, ions having differing numbers of electrons; using element symbols to represent ions. Neutron number of atoms may change without changing the element represented; referring to atoms with differing numbers of neutrons as isotopes. **<u>Models of the atom and how these have changed over time, from Dalton's billiard ball model to JJ Thomson's plum pudding model, to Rutherford's nuclear model, to Bohr's energy level model.</u>** Reach given mass using half-life . **The three types of ioning radiation – alpha, beta, gamma their constituent parts, their mass, their charge, their ionising properties and their penetrative properties.** **The uses of ionising radiation in consumer products and industry, and the links between the properties of the three types and their uses.** **The detection of ionising radiation using GM tubes**. **Contamination vs irradiation and the difference in the uses of**		

				irradiation as compared to the hazards of contamination. **Hazards of radioactive emissions in industry and medicine and how to reduce risk to a safe level; background radiation sources and their significance; how to safely dispose of radioactive waste.** Radioactive decay through both spontaneous and induced nuclear fission – the breakdown of a large unstable nucleus into two new smaller, more stable nuclei with the emission of two or three neutrons and the release of energy in the form of electromagnetic radiation. Chain reactions in nuclear fissions and showing these in a flow diagram format Using symbol equations to show the process of spontaneous or induced fission. The uses of fission in nuclear fission power stations, their construction, how electricity in generated inside them, how they are designed with safety features to prevent chain reactions and nuclear meltdowns		

				Nuclear fusion, where two smaller unstable nuclei are fused at high temperatures and pressures to form a new larger more stable nucleus, with the release of energy in the form of electromagnetic radiation		
	NC/Spec coverage	NC/Spec coverage Links to chemistry – the particle model	NC/Spec coverage Links to chemistry – the particle model and types of reaction	NC/Spec coverage Radioactivity	NC/Spec coverage Links to chemistry	NC/Spec coverage Space
Understanding that all particles carry an abstract quantity labelled as energy that can be stored in different stores, which can be transferred between stores or between systems but is always conserved. In some forms energy cannot be observed and has the potential to do work; in others it causes movement of particles or whole systems.		Energy as a property of systems that allows them to 'do things' or to 'make things move', and that can be found in different stores within a system. Energy transfers can take place between different stores in a system, but the energy within a closed system is constant – energy is conserved. Waves transfer energy with no net transfer of matter. Some energy stores are visible and 'make things happen', and some are invisible, and have the potential to make things happen, which are called potential stores. Simple calculations can be carried out to calculate the magnitude of the energy in different stores. Energy is stored in food and fuels, and we can calculate the energy stored in different substances experimentally.	Power is the rate of transfer of energy to or from a system. Power can be calculated using the power equation. Some energy waves can pass through matter – longitudinal waves – whilst others can pass through matter or a vacuum – transverse waves. All waves are uncharged. **Different fuels come from different energy resources, and these have different energy density levels, different advantages and disadvantages to acquiring them, and different advantages and disadvantages to using them as fuels to create heat energy or electricity. The acquisition of energy resources and their use has a range of environmental, social and economic impacts.**	<u>**Energy as a property of systems that allows them to 'do things' or to 'make things move', and that can be found in different stores within a system.**</u> **Energy transfers can take place between different stores in a system, but the energy within a closed system is constant – energy is conserved.** **Some energy stores are visible and 'make things happen', and some are invisible, and have the potential to make things happen, which are called potential stores**. Energy that is not usefully transferred is dissipated into the surroundings as heat. **Kinetic energy, gravitational potential energy and elastic potential energy can be calculated, and properties or results about an object or system**	Potential energy as a negative quantity that needs to be overcome by doing work on a system. Efficiency is the percentage of energy that is put into a system that results in increasing useful or desired energy stores. <u>Energy that is not usefully transferred is dissipated into the surroundings as heat.</u> **Internal energy as the sum of kinetic and potential energies of particles in a substance; the temperature of a substance related to the average kinetic energy per particle in the substance; potential energy reflecting the bound state of matter of a substance.** Heating and thermal equilibrium, through the processes of conduction (contact heating in solids), convection (circular flow	

			Different fuels come from different energy resources, and these have different energy density levels, different advantages and disadvantages to acquiring them, and different advantages and disadvantages to	**can be found by combining these calculations with the principle of conservation of energy.** Power is the rate of transfer of energy to or from a system. Power can be calculated using the power equation P=W/t Work done as the energy change of a system; how to calculate work done using energy equations for common stores such as kinetic or gravitational potential, and relating energy transfers to force and time using the work done equation W = F*d Potential energy as a negative quantity that needs to be overcome by doing work on a system. **Efficiency is the percentage of energy that is put into a system that results in increasing useful or desired energy stores.** **Energy that is not usefully transferred is dissipated into the surroundings as heat.** Internal energy as the sum of kinetic and potential energies of particles in a substance; the temperature of a substance related to the average kinetic energy	heating in fluids) and radiation (electromagnetic heat energy given off by all objects and passing through a vacuum), relative to increasing or decreasing internal energy. Heating and changing temperature and changing state – specific heat capacity as the consideration when increasing temperature and therefore increasing kinetic energy of particles both not potential energy, and specific latent heat as the consideration when changing state and therefore changing potential energy of particles both not kinetic energy and therefore not temperature.	

				per particle in the substance; potential energy reflecting the bound state of matter of a substance. Heating and thermal equilibrium, through the processes of conduction (contact heating in solids), convection (circular flow heating in fluids) and radiation (electromagnetic heat energy given off by all objects and passing through a vacuum), relative to increasing or decreasing internal energy. **Heating and changing temperature and changing state – specific heat capacity as the consideration when increasing temperature and therefore increasing kinetic energy of particles both not potential energy, and specific latent heat as the consideration when changing state and therefore changing potential energy of particles both not kinetic energy and therefore not temperature.** <u>**Using them as fuels to create heat energy or electricity. The acquisition of energy resources and their use has a range of environmental, social and economic impacts.**</u> Describing the processes of generating electricity via		

				hydroelectric, wave, tidal, geothermal, solar, wind, fossil fuel and nuclear power stations, giving the advantages and disadvantages of each form of electricity generation.		
	NC/Spec coverage	NC/Spec coverage Food and fuels Energy resources Energy and power Energy adds up Energy dissipation	NC/Spec coverage Links to chemistry Heating and cooling Aspects of pressure	NC/Spec coverage Conserving and dissipating Energy transfer by heating Energy resources	NC/Spec coverage Links to Particles	NC/Spec coverage
Understanding that energy can be transferred through media in the form of waves, with no net transfer of matter. Waves can interact with matter and with one another in a multitude of ways with predictable, if unintuitive, outcomes.	Recognise that light appears to travel in straight lines Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.	Waves transfer energy with no net transfer of matter. Transverse oscillate perpendicular to the direction of energy transfer whilst longitudinal waves oscillate parallel to the direction of energy transfer. Examples of transverse waves include light, radio waves and seismic S-waves. Examples of transverse waves include sound and seismic P-waves. Use of the wave equation to find the wave speed, frequency, time period of wavelength of a wave. Like all waves, sound waves can undergo reflection, transmission or absorption. Reflected sound waves are called echoes. Waves can be detected in a variety of ways – we can	**Some energy waves can pass through matter – longitudinal waves – whilst others can pass through matter or a vacuum – transverse waves. All waves are uncharged.** **Like all waves, light waves can undergo reflection, transmission or absorption.** Reflection of light waves can be specular (regular) or diffuse (irregular), depending on whether reflection occurs from a plane surface or a bumpy one. Refraction and diffraction are both effects that can be observed when waves are transmitted. Refraction occurs when light changes direction due to a change in speed when passing through a transparent material with a differing optical density, and diffraction occurs when waves pass through a small		Reflection of light waves can be specular (regular) or diffuse (irregular), depending on whether reflection occurs from a plane surface or a bumpy one. **Refraction and diffraction are both effects that can be observed when waves are transmitted. Refraction occurs when light changes direction due to a change in speed when passing through a transparent material with a differing optical density, and diffraction occurs when waves pass through a small gap, comparable to or smaller than the wavelength of the wave, and as a result spreads out.** Waves can be detected in a variety of ways – we can use microphones or our ears to detect sound waves, and both:	**All objects at any temperature above 0 K emit infrared radiation.** **An object that absorbs all radiation falling on it, at all wavelengths, is called a black body. When a black body is at a uniform temperature, its emission has a characteristic frequency distribution that depends on the temperature. Its emission is called black-body radiation**. Red shift and Cosmic Microwave Background Radiation as evidence for the Big Bang. (Triple) Red shift is the shift in expected wavelength of light from distant celestial objects towards to the lower energy part of the electromagnetic spectrum, indicating that their sources are retreating from the observer. Since this is observed in all directions

		use microphones or our ears to detect sound waves, and both of these cases convert the energy vibrations into an electrical signal. Some energy waves can pass through matter – longitudinal waves – whilst others can pass through matter or a vacuum – transverse waves. All waves are uncharged. Like all waves, light waves can undergo reflection, transmission or absorption. Reflection of light waves can be specular (regular) or diffuse (irregular), depending on whether reflection occurs from a plane surface or a bumpy one. Refraction and diffraction are both effects that can be observed when waves are transmitted. Refraction occurs when light changes direction due to a change in speed when passing through a transparent material with a differing optical density, and diffraction occurs when waves pass through a small gap, comparable to or smaller than the wavelength of the wave, and as a result spreads out. Ray diagrams can be used to chart the progress of	gap, comparable to or smaller than the wavelength of the wave, and as a result spreads out. Ray diagrams can be used to chart the progress of waveswhen they are reflected, refracted or diffracted. **Coloured light interacts in a way that is unintuitive – white light is composed of a spectrum of all of the colours of the rainbow, and prisms can be used to separate out these colours from white light through refraction. There are differential colour effects in absorption and diffuse reflection.**		• convert the energy vibrations into an electrical signal. • can be displayed in transverse form on an oscilloscope – whether they are transverse or longitudinal – and by interpreting the settings of the device properties such as the wavelength, amplitude, frequency and time period can be calculated. Electromagnetic radiation is a form of uncharged transverse wave that travels at the speed of light in a vacuum, regardless of frequency, and that exhibits a range of different properties depending on the frequency or wavelength of the waves. **<u>As with any wave, the shorter the wavelength of EM radiation the higher the frequency, and this causes the waves to carry a greater amount of energy.</u>** The wavelength of EM waves can vary from 10-12m to 104m, and due to their varying properties this range is split up into categories, from radio waves to micro waves to infrared waves to visible light to ultraviolet light to x-rays to gamma rays. X-rays and gamma rays (and high frequency UV radiation) are ionising forms of radiation,	from Earth this suggests that the fabric of the Universe itself is expanding. (Triple) **The further an object is, the greater the shift and thus the great the rate of recession (Triple)**

		waves when they are reflected, refracted or diffracted. Coloured light interacts in a way that is unintuitive – white light is composed of a spectrum of all of the colours of the rainbow, and prisms can be used to separate out these colours from white light through refraction. There are differential colour effects in absorption and diffuse reflection.			jointly referred to as gamma radiation. **Different EM waves can be generated in different ways, they have differing uses, and some have dangers associated with their use.** **Coloured light interacts in a way that is unintuitive – white light is composed of a spectrum of all of the colours of the rainbow, and prisms can be used to separate out these colours from white light through refraction. There are differential colour effects in absorption and diffuse reflection.** **Ray diagrams can be used to chart the progress of waves when they are reflected, refracted or diffracted.** When light passes through convex or concave lenses it can be used to form real or virtual images, and constructing scale diagrams of this can be used to calculate the magnification of a lens for a given object in a given position. (Triple)	
	NC/Spec coverage	NC/Spec coverage Light Sound Energy transfer	NC/Spec coverage Wave effects Wave properties	NC/Spec coverage	NC/Spec coverage Wave properties EM waves Light	NC/Spec coverage Space
Understanding that the two fields of electricity and	Associate the brightness of a lamp or the volume of a buzzer with the number and	Electric current as the flow of electric charge from positive to negative around	Static electricity as the build- up of net positive or negative charges when	**Series and parallel circuits – describing and calculating the difference between**	A permanent magnet is often made from a	

magnetism are fundamentally and invariably linked, and as a result, the flow of electrically charged objects results in the existence of corresponding magnetic fields.	voltage of cells used in the circuit Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches Use recognised symbols when representing a simple circuit in a diagram.	a circuit, measured in amperes. The difference between current flow in series and parallel circuits - currents add where branches meet and split where branches split, whereas current is the same at all points in a series circuit. A complete circuit is required for current to flow. Potential difference, measured in volts, via battery and bulb ratings, as the energy transferred per unit charge. Potential difference is still present even if a circuit is broken. Resistance, measured in ohms, as the extent to which a component resists the flow of charge; differences in resistance between conducting and insulating components. All components in a circuit as having resistance; able to identify and describe the function of a range of electrical components and draw their circuit symbols. Magnetism as a non-contact force – north and south magnetic poles attract, whereas like poles repel. An appreciation of magnetic fields by plotting with a plotting compass,	certain objects are rubbed together. **Electric fields are present wherever there is a build-up of charge or separation of positive or negative charges, resulting in forces between charged objects or on charged objects introduced to an electric field.** The idea of electric field carrying electrostatic force as a non-contact force; forces acting across the space between objects not in contact. **Principles of electromagnetism - the magnetic effect of a flowing current (potential different alone is insufficient), electromagnets as temporary magnets that can be switched on and off, and that can have their strength altered.** DC motors in principle of operation only – with a current carrying coil of wire generating its own magnetic field which interacts with an external permanent magnetic field and experiences a force.	**current flow and potential difference dropped in different branches and different components in series and parallel circuits.** Power is the rate of transfer of energy to or from a component. Power can be calculated using the power equation P = I*V Alternating potential difference is supplied by the mains electricity supply, with the neutral wire kept at 0V and the live wire alternating between 325V and -325 V. An alternating potential difference power supply when connected in a complete circuit results in an alternating current flow, with an ‘average’ p.d. delivery of 230V (RMS p.d.). **Electromagnetism as the magnetic effect of current flow and the factors that affect the strength of the induced magnetic field – number of wires/length of wires, size of current, use of an iron core.** Determining the shape and direction of the magnetic field around a current carrying wire circular and clockwise using the right hand grip rule.	magnetic material such as steel. A permanent magnet always causes a force on other magnets, or on magnetic materials. An induced magnet only becomes a magnet when it is placed in a magnetic field. The induced magnetism is quickly lost when the magnet is removed from the magnetic field. They are only attracted, never repelled. Electromagnetism as the magnetic effect of current flow, and the factors that affect the strength of the induced magnetic field – number of wires/length of wires, size of current, use of an iron core. **Determining the shape and direction of the magnetic field around a current carrying wire – circular and clockwise using the right hand grip rule.** **The interaction of a current carrying wire’s induced magnetic field with the magnetic field of an external permanent magnet leads to an equal and opposite force on the magnet and the wire – this is called the Motor Effect.** Using a coil of wire with a split ring commutator and a	

		representation of field lines and their direction. Earth's magnetism, with the iron core of the Earth introducing a planet-wide magnetic field, with compasses used to exploit this for navigation.		The interaction of a current carrying wire's induced magnetic field with the magnetic field of an external permanent magnet leads to an equal and opposite force on the magnet and the wire – this is called the Motor Effect. Using a coil of wire with a split ring commutator and a U-shaped permanent magnet a uniform circular motion can be achieved using this effect.	U-shaped permanent magnet a uniform circular motion can be achieved using this effect.	
	NC/Spec coverage	NC/Spec coverage Potential difference and resistance Links to chemistry - Universe	NC/Spec coverage Magnetism Electromagnets	NC/Spec coverage Electric currents Electricity in the home	NC/Spec coverage Electromagnetism	NC/Spec coverage
Understanding that physics uses models to approximate theories, (given assumptions), and that these are those that best fit the evidence known at a given time, with an appreciation that theories must be testable.		Correct and safe use of apparatus. Identify hazards, risks and precautions. Making and recording observations and measurements. Variables – independent variables, dependent variables and control variables. Explain what repeatable results are. Calculate the mean of a set of results. Make predictions and conclusions from data.	Explain what reproducible results are. Explain why a method is well designed for its purpose. Selecting suitable apparatus. Compare and contrast precision and accuracy. Relating data to hypotheses. Evaluate a method. Suggest and describe appropriate sampling techniques. Variables – independent variables, dependent variables and control variables.	Use and analysis of models and required practical	Use and analysis of models and required practical	Use and analysis of models and required practical

		Explain the importance of controlling variables to ensure validity. Understand that whenever a measurement is made there is always some uncertainty and use the range of a set of measurements about the mean as a measure of uncertainty. Use a model to develop scientific understanding. Draw scientific diagrams. Describe a method for a practical procedure. Identify and define anomalous results	Explain what repeatable results are. Make predictions and conclusions from data. Explain the importance of controlling variables to ensure validity. Understand that whenever a measurement is made there is always some uncertainty and use the range of a set of measurements about the mean as a measure of uncertainty. Use a model to develop scientific understanding. Draw scientific diagrams. Describe a method for a practical procedure.			
	NC/Spec coverage	NC/Spec coverage Links to chemistry - the universe	NC/Spec coverage Addressed throughout the spec. E.g. through required practicals	NC/Spec coverage Addressed throughout the spec. E.g. through required practicals	NC/Spec coverage Addressed throughout the spec. E.g. through required practicals	NC/Spec coverage Addressed throughout the spec. E.g. through required practicals
The ability to use a range of mathematical tools to calculate, manipulate, predict and represent physical systems and processes.		Interpreting and drawing bar graphs to represent categoric data. Describing trends from a bar graph. Accurately using decimals, estimation, means, symbols including α sign, volumes of cubes, substituting numbers in equations in mathematical calculations.	Drawing and interpreting line graphs for 2 sets of data. Drawing and interpreting scatter graphs and inferring and describing correlation or the lack of correlation. Use of simple prefixes e.g. kilo, centi, mili in mathematical calculations; interconversion between these units.	The representation of half life on a graph and subsequent calculations Kinetic energy, gravitational potential energy and elastic potential energy can be calculated, and properties or results about an object or system can be found by combining these calculations with the principle of conservation of energy.	Density as the mass per volume of a substance; different methods of calculating density experimentally, for regular solids, irregular solid and fluids Ray diagrams can be used to chart the progress of waves when they are reflected, refracted or diffracted.	Using volume and density to perform displacement calculations to find up-thrust in different fluids. Weight as the force objects feel as a result of gravity, which is a field that differs on different planets and stars, and how to calculate the weight due to a given mass in any given gravitational field.

		Interpreting and drawing line graphs to represent continuous data. Describing trends from a line graph. Using and manipulating fractions, percentages, frequency diagrams, finding unknowns in equations, plotting variables, angles.	Drawing and interpreting pie charts to represent percentage data. Representing shapes in 3D, histograms, median and mode, areas of triangles and rectangles, significant figures, ratios.	Power is the rate of transfer of energy to or from a system. Power can be calculated using the power equation P=W/t Work done as the energy change of a system; how to calculate work done using energy equations for common stores such as kinetic or gravitational potential, and relating energy transfers to force and time using the work done equation W = F*d	When light passes through convex or concave lenses it can be used to form real or virtual images, and constructing scale diagrams of this can be used to calculate the magnification of a lens for a given object in a given position. (Triple) Heating and changing temperature and changing state – specific heat capacity as the consideration when increasing temperature and therefore increasing kinetic energy of particles both not potential energy, and specific latent heat as the consideration when changing state and therefore changing potential energy of particles both not kinetic energy and therefore not temperature.	**Forces as vectors, with magnitude and direction; using force vector diagrams in 2 dimensions in order to represent multiple forces and calculate resultant forces; the use of free body diagrams in order to represent multiple forces and calculate resultant forces, using force vector diagrams in 2 dimensions in order to resolve single forces into their orthogonal components – all via scale drawings.** Levers and gears as force multipliers that can exert a larger force with a smaller movement or vice versa. **Describing and explaining the factors that lead to changing forces acting on a body in atmospheric free fall, and how these lead to changing speed up to a maximum terminal velocity; representing free-fall and terminal velocity on a graph; describing how free-fall is altered by the deployment of a parachute.** **Distance and displacement, speed and velocity as scalars and vectors, and using 2- dimensional vector diagrams to perform calculations for resultant displacement or velocity via scale drawings.**

						Distance-time, displacement - time, speed-time and velocity- time graphs and their uses to describe motion – interpreting these and constructing these; acceleration calculations using speed/velocity and time data or from speed/velocity-time graphs.
	NC/Spec coverage	NC/Spec coverage Addressed throughout the course	NC/Spec coverage Addressed throughout the course	NC/Spec coverage Addressed throughout the course	NC/Spec coverage Addressed throughout the course	NC/Spec coverage Addressed throughout the course