The Sutton Academy

Knowledge Rich Curriculum Plan

SCIENCE- Physics Year 10

Particle Model of Matter

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Changes of State	• Students will know that when a substance changes state, mass is conserved • Students will know that changes of state are physical changes, which differ from chemical changes because the material recovers its original properties if the change is reversed • Students will know that the energy is stored inside a system by the particles, and that this energy is called internal energy • Students will know that internal energy is the total kinetic energy and potential energy of all the particles that make up a system • Students will know that heating changes the energy stored within the system by increasing the energy of the particles that make up the system. This change will either raise the temperature of the system or produce a change of state	• *Students need to already know that:* • *melting: solid --> liquid* • *freezing: liquid --> solid* • *Evaporate: liquid --> gas* • *Condense: gas --> liquid* • *Sublimate: solid --> gas* • *Students need to already know that particle diagrams can be used to represent solids, liquids and gases* •		Tier 2 **Volume:** The amount of space that a substance or object occupies measured in mm^3, cm^3 or m^3. Tier 3 **Internal Energy:** the total kinetic energy and potential energy of all the particles in a system
Lesson: Density	• Students will know that density is defined by the equation: density = mass ÷ volume • Students will know that the units of density are kilograms per metre cubed • Students will know how to recognise/ draw particle diagrams for solids, liquids and gases • Students will know that generally solids are more dense than liquids, which are more dense than gases • Students will know how to explain the differences in density of substances using the particle model Students will know how to explain the differences in density between different states of matters in terms of the arrangement of atoms or molecules.	• *Students need to already know that density is a measure of how the amount of mass a substance has in a given volume* • *Students need to already know that the units of volume are metres cubed* • *Students need to already know that particle diagrams can be used to represent solids, liquids and gases* *Students need to already know that the units of mass are kilograms*		Tier 2 Tier 3 Density: a measurement of mass per unit volume

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Density required practical	• Students will know how to practically measure the density of a regular shape Students will know how to practically measure the density of an irregular shape	• *Students need to already know that a balance is used to measure mass* • *Students need to already know how to calculate volume of shapes* *Students need to already know how to measure volumes of liquids*	Measuring mass and volume Recording data accurately.	Tier 2 Tier 3 Density: a measurement of mass per unit volume
Lesson: Particle Motion in Gases	• Students will know that the molecules of a gas are in constant random motion • Students will know that the temperature of a gas is related to the average kinetic energy of the molecules of the gas. • Students will know that changing the temperature of a gas at constant volume will change the pressure exerted by the gas. • Students will know how to explain the motion of the molecules in a gas relating it to the temperature and the pressure Students will know how to explain qualitatively the relation between temperature and pressure (at constant volume)	*Students need to already know that the particles in a gas are able to move freely within their container.*		Tier 2 **Random**: Happening without method or conscious decision Tier 3 **Pressure:** continuous physical force exerted on or against an object by something in contact with it
Lesson: Pressure in gases (Triple only)	• Students will know that gases can be compressed or expanded by pressure changes. • Students will know that gas pressure produces a net force at right angles to the wall of the container. • Students will know how to use the particle model to explain how increasing the volume (at constant temperature) can decrease the pressure. • Students will know that for a mixed mass of gas at constant **temperature**: pressure x volume = constant p V = constant • Students will know that the unit for pressure is pascals, Pa	*Students need to already know that the particles in a gas are able to move freely within their container.*		Tier 2 Tier 3 **Pressure:** continuous physical force exerted on or against an object by something in contact with it

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know that work is the transfer of energy by a force • Students will know that doing work on a gas increases the internal energy of the gas, leading to an increase in the temperature of the gas • Students will know how to use the equation: pressure x volume = constant			

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Electrical Circuits

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Circuit Basics	• Students will know the symbols for: a switch (open and closed), cell, battery, diode, resistor, variable resistor, LED, lamp, fuse, voltmeter, ammeter, thermistor and LDR Students will know how to draw and interpret circuit diagrams	• ***Students need to already know how to represent circuits*** ***Students need to already know the importance of complete circuits***	*Making simple circuits*	*Tier 2* *Tier 3* *parallel - components connected in a circuit so that the potential difference is the same across each one. These components are connected as "branches".* *Series - components connected in a circuit in such a way that the same current passes through them. These components are connected one after each other.*
Lesson: Electrical Charge and current	• Students will know the current is the rate of flow of charge • Students will know that for current to flow through a closed circuit there must be a source of potential difference • Students will know that charge flow can be calculated using the equation: Charge flow = current x time Q = I x t Students will know that the unit of charge flow is coulombs, C	• ***Students need to already know that the unit of current is amperes, A*** ***Students need to already know that the unit of time is seconds, s***		*Tier 2* *Tier 3* **Current:** A measurement of the rate of flow of electrical charge
Lesson: Series and Parallel Circuits (2 lessons)	• Students will know that a series circuit is made of one continuous loop • Students will know that in a series circuit the current through each component is the same • Students will know that in a series circuit the total potential difference of the power supply is shared between the components • Students will know that in a series circuit the total resistance of two components is the sum of the resistance of each component • Students will know that parallel circuits are made up of more than one loop (i.e. a circuit that contains branches) • Students will know that the potential difference across each branch of a parallel circuit is the same	• ***Students need to already know how to identify series and parallel circuits***	.	*Tier 2* *Tier 3* Current – the flow of charge, measured in amps Potential Difference - a measure of the work done or energy transferred to a component by each coulomb of charge that passes through it. The unit of potential difference is the volt (V) Parallel - components connected in a circuit so that the potential difference is the same across each one. These components are connected as "branches". Series - components connected in a circuit in such a way that the same current passes through them. These components are connected one after each other

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know that in a parallel circuit the current through the whole circuit Is the sum of the currents of each branch • Students will know that in a parallel circuit the total resistance is less than the resistance of the smallest individual resistor • Students will know how to use circuits to investigate series and parallel circuits • Students will know how the describe the differences between series and parallel circuits • Students will know how to determine the current, potential difference and resistance measurements at different parts of the circuit			
Lesson: Current, Resistance and Potential Difference	• Students will know that the current flowing through a component depends on the resistance of the component and the potential difference across the component • Students will know the greater the resistance across a component the smaller the current • Students will know that the equation that links potential difference, current and resistance is: Potential difference = current x resistance V = I x R • Students will know that resistance is measured in ohms • Students will know that the above equation is also referred to as "Ohm's law" • Students will know that ammeters are connected in series with the component, and voltmeters are connected in parallel with the component Students will know how to use the equation to calculate current, potential difference and resistance	***Students need to already know that resistance is a measure of how difficult it is for current to flow***		*Tier 2* *Tier 3* **Potential difference** (pd) is a measurement of the amount of **work done** or **energy transferred** to the component by each coulomb of charge that passes **The voltmeter** measures the **potential difference** (pd) across a component. The voltmeter is connected in **parallel**
Lesson: Required Practical - Resistance in a wire	1. Students will know how to set up a circuit to investigate how length of a wire affects the resistance	***Students need to know the correct circuit symbols for an ammeter, a voltmeter and a battery***	Measuring potential difference and current Identifying and controlling variables Recording results Representing results graphically	*Tier 2* *Tier 3* **Electrical resistance** of an object is a measure of its opposition to the flow of electric current

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Lesson: Resistors	• Students will know that Ohm's law says that for a component with a fixed resistance current and potential difference are directly proportional (at constant temperature) • Students will know that any component that follows Ohm's law is referred to as an ohmic conductor • Students will know that some components don't follow Ohm's law, and these are referred to as "Non-ohmic conductors" • Students will know that as the current flowing through a filament lamp increases, the temperature of the filament increases • Students will know that as the temperature of the filament increases, the resistance increases too. • Students will know that the current through a diode flows in one direction only. • Students will know that a diode has a very high resistance in the reverse direction • Students will know how to represent the IV Characteristics of different components using graphs • Students will know that the resistance of a thermistor decreases as the temperature increases • Students will know that thermistors are used in thermostats for central heating • Students will know that the resistance of an LDR decreases as the light intensity increases • Students will know that LDRs are used in automatic street lights and car headlights Students will know how to explain the design of a circuit used to measure resistance		.	*Tier 2* ***Intensity*** *– A measurable amount of a property* ***Dependent*** *– Determined by* *Tier 3* ***Ohmic Conductor –*** *A resistor that follows Ohm's law*
Lesson: Required Practical – IV Characteristics	Students will know how to practically measure the current and potential difference varies in a filament lamp, a diode and a fixed resistor	***Students need to already know how to represent circuit diagrams***	Recording results Representing results graphically	*Tier 2* *Tier 3* ***Ohmic Conductor –*** *A resistor that follows Ohm's law and an IV graph shows a directedly proportional relationship between the current and potential difference.*

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
				non-Ohmic conductor if the graph of voltage versus current is not a straight line and the relationship is not directly proportional.
Lesson: Power	• Students will know that the power that is transferred in a device is related to the potential difference across it and the current through it • Students will know the equation for calculating power as: power = potential difference x current Power = current squared x resistance • Students will know that power is measured in Watts Students will know how to use the equations to calculate power, current, resistance and potential difference	*Students need to already know that the unit of potential difference is V, the unit of current is A and the unit of resistance is ohms*		*Tier 2* *Tier 3* **Electric power** is the rate, per unit time, at which energy is transferred by an electric circuit. **Watt**: The SI unit of power is the watt, one joule per second.
Lesson: Static Electricity (TRIPLE ONLY)	• Students will know that insulating materials can be electrically charged by rubbing them against other insulating materials. • Students will know that electrons are rubbed off one material and on to the other. • Students will know that a material that loses electrons will become positively charged • Students will know that a material that gains electrons will become negatively charged • Students will know that two like charges repel each other. • Students will know that two opposite charges attract each other. • Students will know that attraction and repulsion are examples of non-contact force • Students will know how to explain the production of charged objects. Students will know that sparking is caused by electrons returning to ground through a conductor	*Students need to already know that electrons are negatively charged subatomic particles*		*Tier 2* *Tier 3* **Ground:** A direct electrical connection to earth or a connection to a particular point in an electrical circuit

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Lesson: Electric Fields (TRIPLE ONLY)	• Students will know that a charged object creates an electric field around itself. • Students will know that the electric field is strongest close to the charged object. • Students will know that the further away from the charged object, the weaker the field • Students will know that if a second charged object is placed in an electric field it experiences a force. Students will know that an electric field can be represented by a diagram. Straight lines are used to represent the field, with arrows showing the direction of the field (pointing towards a negative charge, away from a positive charge)	***Students need to already know that charged objects experience repulsion or attraction***		*Tier 2* *Tier 3* **Force field:** An area where an object would feel a non-contact force **Field lines**: lines that are drawn to demonstrate a force field

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SCIENCE- Physics Year 10

Radioactivity

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Atoms	• Students will know that atoms are very small, having a radius of about 1 x 10^-10 m • Students will know that the radius of the nucleus of an atom is less than 1/10 000 of the radius of an atom. • Students will know that most of the mass of an atom is concentrated in the nucleus. • Students will know that electrons are arranged at different distances from the nucleus, called energy levels. • Students will know that an electron may move further from the nucleus of the atom (to a higher energy level) through the absorption of electromagnetic radiation • Students will know that an electron may move closer to the nucleus (to a lower energy level) by emitting electromagnetic radiation Students will know that electromagnetic radiation is a type of radiation that is a wave	• *Students need to already know that an atom is made up of protons, neutrons and electrons. They should already know that:* *- Protons are positive subatomic particles with a relative mass of 1. They are found in the nucleus of an atom.* *- Neutrons are a neutral subatomic particle. They have a relative mass of 1 and are found in the nucleus of an atom* *- Electrons are a negatively charged subatomic particle. They have a negligible relative mass and are found in electron*	Quantitative and qualitative comparisons of magnitudes of size.	Tier 2 **Radius**: a straight line from the centre to the circumference of a circle or sphere Tier 3 **Atom:** The smallest indestructible building blocks of all substances. Atomic number: The number of protons within the nucleus of an atom. **Atomic mass:** The number of protons and neutrons within the nucleus of an atom.
Lesson: Mass Number, atomic number and isotopes	• Students will know that an atom has an equal number of protons and electrons as atoms have no overall electrical charge • Students will know that all atoms of a particular element have the same number of protons. • Students will know that the number of protons in an atom of an element is called its atomic number. • Students will know that the total number of protons and neutrons in an atom is called its mass number. • Students will know that to calculate the number of neutrons in an atom you would subtract the atomic number from the mass number			Tier 2 Tier 3 **Atomic number:** This is the number of Protons found in the nucleus of an atom **Relative Atomic Mass (Ar):** This is the mass of an atom compared to all the other atoms in the period table. It is a ratio and has no unit. **Atomic mass**: The total mass of the number of protons and neutrons. The relative mass of each proton and neutron = 1. The mass of an electron is not included because it is regarded as having no mass.

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know that atoms of the same element (have the same number of protons) with different numbers of neutrons are called isotopes • Students will know that atoms become positive ions if they lose outer electron(s) Students will know how to relate differences between isotopes to differences in subatomic particles			
Lesson: History of the Atom	• Students will know that new experimental data will lead to scientific models being changed or developed • Students will know that the discovery of subatomic particles in order were: electrons --> protons --> neutrons • Students will know that before electrons were discovered, atoms were thought to be tiny spheres that couldn't be divided (John Dalton's model) • Students will know that the discovery of the electron led to the plum pudding model. (JJ Thompson) • Students will know that the plum pudding model is the idea that an atom is a ball of positive charge with negative particles (electrons) scattered in it • Students will know that in the alpha scattering experiment alpha particles were fired at gold foil. The observations made were that most of the positively charged alpha particles went straight through the gold foil, and some alpha particles were deflected, suggesting that there was a positive charge in the centre of the atom • Students will know that the results of the alpha scattering experiment led to	• *Students need to already know that all substances are made up of atoms* *Students need to already know that scientific ideas develop over a period of time*		Tier 2 Tier 3 **The Nuclear Model:** The atom is made up of a densely positively charged nucleus. The rest of the atom is mainly empty space, with electrons surrounding the nucleus **John Dalton's Atomic Theory:** Atoms are tiny hard spheres, that can't be broken down into anything smaller **The discovery of the neutron:** The neutron was discovered as being a part of the nucleus. **Plum Pudding Model:** Electrons were discovered. The atom is made up of a ball of positive charge, with negatively charged particles scattered inside randomly. **The Bohr Model:** Very similar to the nuclear model, but the electrons are in energy levels (or shells) surrounding the nucleus.

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	the conclusion that the mass of an atom is concentrated in the nucleus, and that the nucleus is charged (Ernest Rutherford) • Students will know that the model that developed from the alpha scattering model was referred to as the "nuclear model" • Students will know that Niels Bohr adapted the nuclear model, by suggesting that the electrons are orbiting the nucleus at set distances • Students will know that further experiments led to the discovery that the nucleus contained smaller particles, leading to the discovery of protons Students will know that experiments performed by James Chadwick led to the discovery of neutrons			
Lesson: Radioactive Decay	• Students will know that some atomic nuclei are unstable. • Students will know that when the nucleus becomes stable it releases radiation. Students will know that this is a random process known as radioactive decay • Students will know that activity is the rate at which a source of unstable nuclei decays. • Students will know that the unit of activity is becquerels (Bq) • Students will know that count rate is the number of decays recorded each second. • Students will know that a Geiger-Muller tube is a detector that is used to detect radiation • Students will know that nuclear radiation is emitted is either an alpha	***Students need to already know that protons are positively charged, neutrons are neutral and electrons are negatively charged***		Tier 2 *Unstable – likely to change* Tier 3 ***Activity*** *– Rate at which a source of unstable nuclei decays. Measured in Becquerels (Bq)* ***Count rate*** *– Number of decays recorded each second using a detector (Geiger-Muller tube).*

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	particle, a beta particle, a gamma ray or a neutron. • Students will know that an alpha particle consists of two neutrons and two protons, and is sometimes referred to as a helium nucleus. • Students will know that a beta particle is a high speed electron ejected from the nucleus as a neutron turns into a proton • Students will know that a gamma ray is electromagnetic radiation from the nucleus. • Students will know that an alpha particle has an electrical charge of +2 • Students will know that a beta particle has an electrical charge of -1. • Students will know that penetrating power is the ability for radiation to travel through a material. • Students will know that ionising power is the ability for radiation to ionise an atom. • Students will know that an alpha particle is weakly penetrating, and is stopped by paper • Students will know that a beta particle is moderately penetrating, and is stopped by aluminium foil • Students will know that a gamma ray is highly penetrating, and is stopped by thick lead • Students will know that an alpha particle is highly ionising • Students will know that a beta particle is moderately ionising • Students will know that a gamma ray is weakly ionising • Students will know that dangers associated with nuclear radiation is			

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	proportional to how ionising the radiation is Students will know how to apply knowledge of the properties of radiation to uses sources of radiation.			
Lesson: Nuclear Equations	• Students will know that nuclear equations are used to represent radioactive decay • Students will know that an alpha particle can be represented as a helium nucleus. • Students will know that a beta particle is represented by the symbol for an electron. • Students will know that alpha decay causes the mass number to decrease by 4 and the atomic number to decrease by 2 • Students will know that beta decay doesn't affect the mass number, but causes the atomic number to increase by 1. • Students will know that the emission of a gamma ray doesn't change the mass number or atomic number of an atom. Students will know how to represent alpha and beta decay through the use of a balanced equation	***Students need to already know that when representing atoms, the mass number goes superscript and the atomic number goes subscript.***	Writing equations	Tier 2 Emission: the production and discharge of something Tier 3 Transmutate: the changing of one element into another through nuclear radiation
Lesson: Half-Life	• Students will know that radioactive decay is random. • Students will know that the half-life of a radioactive isotopes is the time it takes for the number of nuclei of the isotope in a sample to halve, or the time taken for the count rate/ activity from a sample containing the isotope to fall to half its initial level.	***Students need to already know that unstable nuclei become stable through radioactive decay.***	Interpreting graphs	Tier 2 Random: happening without method or conscious decision. Tier 3 Half-life: The time taken for the radioactivity of a specified isotope to fall to half its original value

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know how to represent the half life of a substance by drawing a graph. • Students will know how to determine the half-life of a radioactive sample from given information TRIPLE HT ONLY: Students will know how to calculate the net decline in a radioactive emission after a given number of half-lives			Half-life: The time taken for half of a sample of isotopes to decay.
Lesson: Radioactive Contamination	• Students will know that contamination is the unwanted presence of materials containing radioactive atoms on other materials. • Students will know that hazards associated with contamination are due to the decay of the contaminating atoms. • Students will know that irradiation is the process of exposing an object to nuclear radiation. • Students will know that any object that has been irradiated doesn't become radioactive itself. • Students will know how to compare hazards associated with contamination and irradiation • Students will know that suitable precautions are taken to protect against any hazard that a radioactive source used in the process of irradiation may present. Students will know how to explain the importance of peer review when looking at hazards associated with radiation.	***Students need to already know that the hazards associated with radioactive decay are linked with the ionising power of the radiation.***		Tier 2 Sterilisation: removal or killing of microorganisms from a material Tier 3 Contamination: where radioactive material is deposited on or in an object or person Irradiation: where a material is exposed to radiation without itself becoming radioactive
Lesson: TRIPLE ONLY: Background Radiation	• Students will know that background radiation is around us all of the time • Students will know that sources of background radiation include natural sources (rocks, cosmic rays from space) and man-made sources (fallout			Tier 2 Cosmic: relating to the universe. Tier 3 Sievert: unit of radiation dose

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	from nuclear weapons testing and nuclear accidents) • Students will know that level of background radiation is affected by occupation and location Students will know that radiation dose is measured in sieverts (Sv), and that 1000 mSv = 1 Sc			
Lesson: TRIPLE ONLY: Half lives of isotopes and uses of nuclear radiation	• Students will know that radioactive isotopes have a very wide range of half-life values • Students will know how to explain the variation of hazards associated with radioactive material differs according to the half-life involved • Students will know that nuclear radiations are used in medicine to explore internal organs and to control/ destruct unwanted tissue • Students will know that radioactive tracers are used to explore internal organs • Students will know that isotopes with small half-lives are used as radioactive tracers • Students will know that the exposure to radiation is minimised as much as possible when used to destruct unwanted tissue Students will know how to evaluate the perceived risks of using nuclear radiations in relation to given data and consequences	• *Students need to already know that radiation is ionising* *Students need to already know that half-life is the time taken for half a sample of radioactive isotopes to decay*	Evaluating skills	Tier 2 Tier 3
Lesson: TRIPLE ONLY: Nuclear Fission and Fusion (2 lessons)	• Students will know that nuclear fission is the splitting of a large and unstable nucleus • Students will know that for fission to occur the unstable nucleus must absorb a neutron. • Students will know that when a nucleus undergoes fission it splits into two smaller nuclei that are roughly			Tier 2 Tier 3 Fission: the splitting of large nuclei into smaller nuclei Fusion: the fusion of smaller nuclei into larger nuclei

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	equal in size, whilst also emitting two or three neutrons and gamma rays. • Students will know that energy is released during fission reactions • Students will know that the products of fission reactions have kinetic energy • Students will know that the neutrons released during fission may go on to start a chain reaction • Students will know that the chain reaction caused by the release of neutrons is controlled in a nuclear reactor • Students will know that the chain reaction caused by the release of neutrons is not controlled in a nuclear weapon, which causes the explosion to happen. • Students will know how to draw and interpret diagrams that represent nuclear fission and chain reactions • Students will know that nuclear fusion is the joining of two light nuclei to form a heavier nucleus. Students will know that in a nuclear fusion reaction some of the mass may by converted into radiation.			

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Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Scalar and Vector Quantities	• Students will know that scalar quantities have magnitude only • Students will know that vector quantities have magnitude and direction • Students will know how to represent vectors using diagrams • Students will know how to determine whether a quantity is a scalar or vector quantity	• ***Students need to already know that quantities can be represented using arrows***		Tier 2 Magnitude: size Tier 3 Scalar: Quantity with magnitude only Vector: Quantity with size and direction
Lesson: Gravity and Weight	• Students will know that weight is the force acting on an object due to gravity. • Students will know that the force of gravity close to Earth is due to the gravitational field around Earth • Students will know that the weight of an object depends on the gravitational field strength and the object's mass • Students will know that the equation used to calculate weight is: Weight = mass x gravitational field strength W = m g • Students will know that the unit of weight is Newtons • Students will know that the unit of gravitational field strength is N/ kg • Students will know that the weight of an object may be considered to act at a single point referred to as the object's centre of mass • Students will know that the weight of an object can be measured using a calibrated spring-balance • Students will know how to perform calculations using the weight equation	***Students need to already know that the unit of mass is kg***	Measuring weight using Newtonmeters	Tier 2 Calibrate: adjust to take into account all factors Tier 3 Centre of mass: a single point on an object where the weight acts at.

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Resultant Force	• Students will know that a number of forces acting on an object can be replaced by a single force that has the same effect as all of the original forces acting together, and this is known as the resultant force • Students will know that a resultant force can cause an object to accelerate, decelerate, change shape or change direction • Students will know that if an object has a resultant force of 0N acting on it whilst in motion it will continue to move at constant motion • Students will know that if if an object has a resultant force of 0N acting on it whilst stationary it will remain stationary • Students will know how to determine the resultant force of 2 forces acting in a straight line	***Students need to already know that the unit for force is Newtons.***		Tier 2 Tier 3 Resultant force: a single force that has the same effect as all the forces that are acting on an object.
Lesson: Resultant Force (HT)	• Students will know that not all forces act on an object in a straight line. • Students will know how to resolve a resultant force into two components • Students will know how to use vector diagrams to illustrate the resolution of forces. • Students will know how to use vector diagrams to determine the resultant of two forces, including magnitude and direction		Interpreting diagrams Drawing scale diagrams Measuring angles	Tier 2 Component: part of a larger whole Tier 3 Vector diagrams: diagrams that represent the magnitude and direction of a quantity

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Newton's first law	• Students will know that an object in motion will remain at constant motion unless an external force is applied to it • Students will know that if a resultant force acts on an object it will cause the velocity (speed and/ or direction) to change • HT only - Students will know that the tendency of objects to continue in their state of rest or of uniform motion is called inertia • Students will know how to apply Newton's first law to explain the motion of objects	• *Students need to already know that if the resultant force acting on a stationary object is 0N the object will remain stationary* *Students need to already know that if the resultant force on a moving object is 0N then the object will continue to move at constant velocity.*		Tier 2 Tier 3 Inertia: Property of matter that causes it to remain in state of rest/ constant motion, unless an external force is applied
Work Done	• Students will know that when a force causes an object to move through a distance work is done on the object • Students will know that work done is calculated using the equation: work done = force x distance (W = F s) • Students will know that work done has the unit Joule (J) • Students will know that one joule of work is done when a force of one newton causes a displacement of one metre • Students will know how to describe energy transfers when work is done • Students will know that 1 joule = 1 newton-metre • Students will know that work done against frictional forces causes a rise in temperature of the object	*Students need to already know that joule is the unit of energy* *Students need to already know that metre is the unit of distance* *Students need to already know that newton is the unit of force* *Students need to already know that the energy stores are kinetic; gravitational potential, chemical, elastic potential, magnetic, electrostatic and thermal*		Tier 3: Work done: transfer of energy

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Speed and Velocity	• Students will know that speed is a scalar quantity as it doesn't involve direction • Students will know that the speed of moving objects is rarely constant • Students will know that typical walking speed is 1.5 m/s • Students will know that typical running speed is 3 m/s • Students will know that typical cycling speed is 6 m/s • Students will know that typical value for speed of sound in air is 330 m/s • Students will know how to make measurements of distance and time and calculate speed of objects • Students will know how to use the speed equation to calculate speed, distance and time • Students will know that velocity of an object is its speed in a given direction • Students will know how to explain why velocity is a vector quantity • Students will know that an object travelling in circular motion at constant speed has changing velocity as its direction is changing	***Students need to already know that scalar quantities are quantities with magnitude only*** Students need to already know that vector quantities are quantities with magnitude and direction	Estimations Taking measurements of distance and time	Tier 2 Uniform: Remaining the same at all times Tier 3
Lesson: Distance-time graphs	• Students will know that distance-time graphs can be used to represent the motion of an object in a straight line. • Students will know that the speed of an object can be calculated from the gradient of the distance time graph • Students will know that an accelerating object will have a curved line, and the speed at a particular point can be calculated by drawing a tangent and measuring the gradient • Students will know how to draw distance time graphs from measurements • Students will know how to interpret distance time graphs	• ***Students need to already know that speed is a measure of how fast an object is moving***	Interpreting graphs Determining gradients from graphs	Tier 2 Gradient: a measure of how steep a slope is Tier 3

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Acceleration	• Students will know that acceleration is a measure of the rate of change of velocity • Students will know that the unit of acceleration is m/s^2 • Students will know that an object slowing down is decelerating, and that this is negative acceleration • Students will know that acceleration is calculated using acceleration = change in velocity / time taken • Students will know how to calculate acceleration using both the acceleration equation and the uniform acceleration equation found in the data sheet.	• ***Students need to already know velocity is a vector quantity***		Tier 2 Tier 3 Acceleration: the rate of change in velocity
Lesson: Velocity-time graphs	• Students will know that velocity time graphs can be used to represent the motion of an object • Students will know that the acceleration of an object can be calculated from the gradient of a velocity-time graph • Students will know that the distance travelled by an object can be calculated from the area under a velocity-time graph • Students will know how to draw velocity-time graphs • Students will know how to interpret velocity-time graphs •	***Students need to already know that acceleration is the rate of change in velocity*** Students need to already know that velocity is a vector quantity	Drawing Graphs Interpreting Graphs Calculating gradients	Tier 2 Tier 3
Lesson: Stopping Distance	• Students will know that the stopping distance of a vehicle is the sum of the thinking distance and the braking distance • Students will know that the thinking distance is the distance the vehicle travels during the driver's reaction time • Students will know that the braking distance is the distance the vehicle travels under the braking force	***Students need to already know that kinetic energy is a store of energy in a moving object***		Tier 2 Tier 3 Stopping Distance: the total distance a car travels when coming to a stop Thinking distance: the distance a car travels when the driver responds to a stimulus and applies their foot to the brake

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know that the greater the speed of the vehicle, the greater the stopping distance • Students will know that reaction times vary from person to person, with typical values ranging from 0.2 to 0.9 s • Students will know that a driver's reaction time can be affected by tiredness, drugs, alcohol and distractions • Students will know that when brakes are applied on a vehicle, work is done by the friction force between the brakes and wheels to reduce the kinetic energy of the vehicle, causing the temperature of the brakes to increase • Students will know that the greater the speed of a vehicle the greater the braking force needed to stop the vehicle. • Students will know that large decelerations can lead to brakes overheating and/ or loss of control. • Students will know how to evaluate the effect of various factors on braking distance • Students will know that the braking distance of a vehicle can be affected by adverse road and weather conditions (such as wet or icy conditions) and poor condition of the vehicle (such as brakes or tyres) • Students will know how to measure human reaction times. • Students will know how to evaluate measurements from simple methods to measure the different reaction times			Braking distance: the distance a car travels when the brake has been applied

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know how to evaluate the effect of various factors on thinking distance. • TRIPLE ONLY: Students will know how to estimate the distance for a vehicle to make an emergency stop varies over a range of speeds typical for that vehicle • TRIPLE ONLY: Students will know how to interpret graphs relating speed to stopping distance for a range of vehicles			
Lesson: Forces and Elasticity	• Students will know that at least two forces are required to stretch, compress or twist an object • Students will know that elastic deformation means that an object is able to return to its original shape once the forces have been removed • Students will know that inelastic deformation means that an object is unable to return to its original shape after the forces have been removed • Students will know that the extension of an object is directly proportional to the force applied, up until the limit of proportionality. • Students will know that the equation that links force, spring constant and extension is: force = spring constant x extension F = k e • Students will know that, when looking at compressed elastic objects, the extension is the compression of the object • Students will know how to calculate work done in stretching a spring using the equation:	• ***Students will already know that the unit for force is N*** • ***Students will already know that the unit of extension is m*** ***Students will already know that the unit of spring constant is N/m***	Interpreting graphs Interpreting data	Tier 2 Compress: squash Tier 3 Elastic deformation: object returns to its original shape when forces are removed Inelastic deformation: object doesn't return to its original shape when forces are removed

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• elastic potential energy = 0.5 x spring constant x extension squared • Students will know how to use the force equation to calculate force, spring constant and extension • Students will know how to describe the difference between linear and non-linear relationships between force and extension • Students will know how to interpret data from an investigation of the relationship between force and extension			
Lesson: Hooke's Law Required Practical	• Students will know the method used to investigate the effect of increasing the force applied to an elastic object on the extension of the elastic object • Students will know that the independent variable is the force • Students will know that the dependent variable is extension • Students will know that the control variables include the object the force is being applied to	• *Students will already know how to convert cm to m* • *Students will already know that the force of weight is changed when mass is changed*	Interpreting graphs Identifying and controlling variables	
Lesson: Moments (triple only) (2 lessons)	• Students will know that a force or a system of forces may cause an object to rotate • Students will know how to describe examples in which forces cause rotation • Students will know that the turning effect of a force is called the moment of the force • Students will know that the size of the moment of a force can be calculated using: Moment of a force = force x distance M = F d	• *Students will already know that the unit for force is N*		Tier 2 Tier 3 Moment: the turning effect of a force

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know that the unit of moments is Nm • Students will know that the distance is the perpendicular distance from the pivot to the line of action of the force, in metres • Students will know that if an object is balanced, the total clockwise moment about a pivot equals the total anticlockwise moment about the pivot • Student will know how to calculate the size of the force or the distance from a pivot acting on an object that is balanced • Students will know that a simple lever and gear system can be used to transmit the rotational effects of a force • Students will know how to explain how levers and gears transmit the rotational effects of forces			

The Sutton Academy

Knowledge Rich Curriculum Plan

SCIENCE- Physics Year 10

Energy Transfers

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
Lesson: Energy Changes	• Students will know that materials can be good or poor conductors • *Students will be able to compare the thermal conductivities of different materials* • *Students will know that conductivity is a measure of how well a material conducts energy when heated* • *Students will know how to describe the changes to the particles when a material is conducting heat*			*Tier 3: Conductivity: A measure of how well a material conducts heat*
Lesson: Specific Heat Capacity	• Students will know that the amount of energy stored in/ released from a system as its temperature changes can be calculated using the equation: change in thermal energy = mass x specific heat capacity x temperature change • Students will know that the unit of thermal energy is Joules • Students will know that the unit of specific heat capacity is J/kg °C • Students will know that the specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of a substance by one degree Celsius • Students will know how to use the equation to calculate change in thermal energy, mass, specific heat capacity and temperature change Students will know how to practically determine the specific heat capacity of a substance	***Students will already know that the unit of mass is kg***		*Tier 2* *Tier 3* ***Specific heat capacity:*** *The energy required to change the temperature of 1kg of a substance by 1°C*
Lesson: Specific Heat Capacity required practical	• Students will know how to practically measure the specific heat capacity	• ***Students need to already know that a balance is used to measure mass*** • ***Students need to already know that a thermometer is used to measure temperature***	Measuring mass and temperature Recording data accurately.	
Lesson: Changes of state and specific latent heat	• Students will know that the energy needed for a substance to change state without increasing the temperature is called the "latent heat" • Students will know that the specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance without changing the temperature • Students will know that the symbol for specific latent heat is L	• ***Students need to already know that energy is measured in joules, J*** • ***Students need to already know that mass is measured in kilograms, kg***		Tier 2 Compressed: squashed Tier 3 **Internal Energy:** The energy stored within a system by the particles. Internal energy = kinetic energy + potential energy **System:** a portion of the Universe that is being studied for the changes that take place within it.

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	• Students will know that the unit for specific latent heat is joules per kilogram, J/kg • Students will know that specific latent heat of fusion refers to the change of state from solid to liquid • Students will know that the specific latent heat of vaporisation refers to the change of state from liquid to vapour. • Students will know how to use the equation: Energy for a change of state = mass x specific latent heat E = m L • Students will know how to interpret heating and cooling graphs that include changes of state • Students will know how to distinguish between specific heat capacity and specific latent heat			
Lesson: Power	• Students will know that power is the rate at which energy is transferred or the rate at which work is done • Students will know that to calculate power they would use the equation: Power - energy transferred / time Power = work done / time • Students will know that the unit for power is Watts (W) • Students will know that the unit of work done is Joules • Students will know that the equivalent units of Watts is Joules per second (J/s) Students will know how to use the equations to calculate power, energy, time and work done	• ***Students need to already know that the unit of energy is Joules*** • ***Students need to already know that the unit of time is seconds.*** ***Students need to already know how to convert time into seconds***		*Tier 2* *Efficient: achieving maximum productivity with minimum waste* *Tier 3* *Power: a measure of how much energy is transferred each second* *Work Done: Transfer of energy from one store to another*
Lesson: Conservation of energy	• Students will know that energy can't be created or destroyed • Students will know that energy that has dissipated has been transferred into a non-useful energy store, normally thermal energy of the surroundings • Students will know that energy can be transferred usefully • Students will know that when energy is transferred in a closed system, there is no net change in the total energy	***Students need to already know the different stores of energy***		*Tier 2* *Tier 3* ***Mechanical Energy****: Energy stored by an object depending on its position and motion* ***Closed system:*** *A system where no matter can transfer in or out of* ***Lubricant:*** *A substance used to reduce friction*

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Working Scientifically	Tiered Vocabulary and Reading Activity
	Students will know that there are methods for reducing unwanted energy transfers, such as through the use of lubrication			
Lesson: Reducing energy loss in a building	• Students will know that thermal energy can be transferred through conduction, convection and radiation • Students will know that the higher the thermal conductivity, the higher the rate of energy transfer • Students will know that the rate of cooling of a building is affected by the thickness and the thermal conductivity of its walls • Students will know that insulation can be used to slow down the rate of cooling, as insulation is a poor thermal conductor Students will know that methods used to reduce energy loss in a home include using double glazing, installing cavity-wall insulation, installing insulation in the roof and through draught proofing	***Students will already know that some materials are better at conducting heat than others***	*Interpreting data*	*Tier 2* *Insulation: Material used to insulate something* *Cavity: a hole or empty space between two materials* *Tier 3* *Convection: the transfer of heat by the circulation or movement of the heated parts of a liquid or gas*
Lesson: Insulation Practical (Triple only)	*Students will practically investigate insulating materials*			