Science Year 11 – Autumn Term 2022

	What? **When?** **Why?**				
	PHYSICS **P7&8 Energy, Forces Doing Work** **P6 Radioactivity**	**BIOLOGY** **B7 Animal Coordination**	**CHEMISTRY** **C9-12 Chemical Change**	**PHYSICS** **P9 Electricity and Circuits**	**BIOLOGY** **B6 Plant structures & Functions**
Lesson 1 Learning intentions	**Work & Power** Identify the different ways that the energy of a system can be changed a) through work done by forces b) in electrical equipment c) in heating. Describe how to measure the work done by a force and understand that energy transferred (joule, J) is equal to work done (joule, J) Recall and use the equation: work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m) $E = F \times d$	**Hormones** Describe where hormones are produced and how they are transported from endocrine glands to their target organs including the pituitary gland, thyroid gland, pancreas, adrenal glands, ovaries and testes.	**Electrolysis** Recall that electrolytes are ionic compounds in the molten state or dissolved in water Describe electrolysis as a process in which electrical energy, from a direct current supply, decomposes electrolytes. Explain the movement of ions during electrolysis, in which: a) positively charged cations migrate to the negatively charged cathode b) negatively charged anions migrate to the positively charged anode. **(H) Write half equations for reactions occurring at**	**Electric circuits** Describe the structure of the atom, limited to the position, mass and charge of protons, neutrons and electrons Draw and use electric circuit diagrams representing them with the conventions of positive and negative terminals, and the symbols that represent cells, including batteries, switches, voltmeters, ammeters, resistors, variable resistors, lamps, motors, diodes, thermistors, LDRs and LEDs Describe the differences between series and parallel circuits	**Photosynthesis** Describe photosynthetic organisms as the main producers of food and therefore biomass. Describe photosynthesis in plants and algae as an endothermic reaction that uses light energy to react carbon dioxide and water to produce glucose and oxygen B6.9: Describe … the structure and function of the stomata.

	Describe and calculate the changes in energy involved when a system is changed by work done by forces. Define power as the rate at which energy is transferred and use examples to explain this definition. Recall and use the equation: power (watt, W) = work done (joule, J) ÷ time taken (second, s) $P = E/T$ Recall that one watt is equal to one joule per second, J/s Explain ways of reducing unwanted energy transfer through lubrication		**the anode and cathode in electrolysis** **(H) Explain oxidation and reduction in terms of loss or gain of electrons** **(H) Recall that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions**		
Lesson 2 Learning intentions	**<u>Objects affecting each other</u>** Describe, with examples, how objects can interact a) at a distance without contact, linking these to the gravitational, electrostatic and magnetic fields involved	**<u>Hormonal control of metabolic rate (higher tier only)</u>** **(H) Explain that adrenalin can be controlled by a negative feedback mechanism and is produced by the adrenal glands to prepare the**	**<u>Core practical</u>** Core Practical: Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes	**<u>Current & potential difference</u>** Recall that a voltmeter is connected in parallel with a component to measure the potential difference (voltage), in volts, across it Recall that an ammeter is connected in series with a	**<u>Factors affecting photosynthesis</u>** Explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis. **(H) Explain the interactions of temperature, light**

	b) by contact, including normal contact force and friction c) producing pairs of forces which can be represented as vectors Explain the difference between vector and scalar quantities using examples Explain ways of reducing unwanted energy transfer through lubrication	**body for fight or flight, including:** **a) increased heart rate** **b) increased blood pressure** **c) increased blood flow to the muscles** **d) raised blood sugar levels by stimulating the liver to change glycogen into glucose** **(H) Explain how thyroxine controls metabolic rate as an example of negative feedback, including:** **a) low levels of thyroxine stimulates production of TRH in hypothalamus** **b) this causes release of TSH from the pituitary gland** **c) TSH acts on the thyroid to produce thyroxine** **d) when thyroxine levels are normal thyroxine inhibits the release of TRH and the production of TSH**		component to measure the current, in amps, in the component Describe that when a closed circuit includes a source of potential difference there will be a current in the circuit Recall that current is conserved at a junction in a circuit	**intensity and carbon dioxide concentration in limiting the rate of photosynthesis.** **(H) Explain how the rate of photosynthesis is directly proportional to light intensity and inversely proportional to the distance from a light source, including the use of the inverse square law calculation.**
Lesson 3 Learning intentions	**<u>Vector diagrams</u>** **(H) Use vector diagrams to illustrate resolution of forces, a net force, and equilibrium situations (scale drawings only)**	**<u>The menstrual cycle</u>** Describe the stages of the menstrual cycle including the roles of the hormones oestrogen and progesterone, in the	**<u>Products of electrolysis</u>** Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including: a) copper chloride solution	**<u>Current, charge and energy</u>** Explain that potential difference (voltage) is the energy transferred per unit charge passed and hence	**<u>Core Practical</u>** Core practical: Investigate the effect of light intensity on the rate of photosynthesis

	(H) Draw and use free body force diagrams **(H) Explain examples of the forces acting on an isolated solid object or a system where several forces lead to a resultant force on an object and the special case of balanced forces when the resultant force is zero**	control of the menstrual cycle. Explain how hormonal contraception influences the menstrual cycle and prevents pregnancy. Evaluate hormonal and barrier methods of contraception.	b) sodium chloride solution c) sodium sulfate solution d) water acidified with sulfuric acid e) molten lead bromide (demonstration) Predict the products of electrolysis of other binary, ionic compounds in the molten state. Explain formation of the products in the electrolysis of copper sulfate solution, using copper electrodes, and how this electrolysis can be used to purify copper	that the volt is a joule per coulomb Recall and use the equation: energy transferred (joule, J) = charge moved (coulomb, C) × potential difference (volt, V) $E = Q \times V$ Explain that an electric current as the rate of flow of charge and the current in metals is a flow of electrons Recall and use the equation: charge (coulomb, C) = current (ampere, A) × time (second, s) $Q = I \times t$	
Lesson 4 Learning intentions	**<u>Atomic models</u>** Describe an atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus. Recall the typical size (order of magnitude) of atoms and small molecules. Describe how and why the atomic model has changed	**<u>Hormonal control of the menstrual cycle (higher tier only)</u>** **(H) Explain the interactions of oestrogen, progesterone, FSH and LH in the control of the menstrual cycle, including the repair and maintenance of the uterus wall, ovulation and menstruation.** **(H) Explain the use of hormones in Assisted**	**<u>Reactivity</u>** Deduce the relative reactivity of some metals, by their reactions with water, acids and salt solutions. **(H) Explain displacement reactions as redox reactions, in terms of gain or loss of electrons.** Explain the reactivity series of metals (potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc,	**<u>Resistance</u>** Explain how changing the resistance in a circuit changes the current and how this can be achieved using a variable resistor Recall and use the equation: potential difference (volt, V) = current (ampere, A) × resistance (ohm, Ω) $V = I \times R$ Explain why, if two resistors are in series, the net resistance is increased, whereas with two in parallel	**<u>Absorbing eater & mineral ions</u>** Explain how substances are transported into and out of cells, including by diffusion, osmosis and active transport. Explain how the structure of the root hair cells is adapted to absorb water and mineral ions

	over time including reference to the plum pudding model and Rutherford alpha particle scattering leading to the Bohr model	**Reproductive Technology (ART) including IVF and clomifene therapy.**	iron, (hydrogen), copper, silver, gold) in terms of the reactivity of the metals with water and dilute acids and that these reactions show the relative tendency of metal atoms to form cations	the net resistance is decreased Calculate the currents, potential differences and resistances in series circuits Explain the design and construction of series circuits for testing and measuring	
Lesson 5 Learning intentions	**<u>Inside atoms</u>** Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass (nucleon) number and using symbols in the format $^{13}_{6}C$ Recall that the nucleus of each element has a characteristic positive charge, but that elements differ in mass by having different numbers of neutrons. Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons Recall that in an atom the number of protons equals	**<u>Control of blood glucose</u>** Explain the importance of maintaining a constant internal environment in response to internal and external change. Explain how the hormone insulin controls blood glucose concentration. **(H) Explain how blood glucose concentration is regulated by glucagon.** Explain the cause of type 1 diabetes and how it is controlled.	**<u>Ores</u>** Recall that: a) most metals are extracted from ores found in the Earth's crust b) unreactive metals are found in the Earth's crust as the uncombined elements. Explain why the method used to extract a metal from its ore is related to its position in the reactivity series and the cost of the extraction process, illustrated by a) heating with carbon (including iron) b) electrolysis (including aluminium) (knowledge of the blast furnace is not required) **(H) Evaluate alternative biological methods of**	**<u>More about resistance</u>** Explain how current varies with potential difference for the following devices and how this relates to resistance a) filament lamps b) diodes c) fixed resistors Describe how the resistance of a light-dependent resistor (LDR) varies with light intensity Describe how the resistance of a thermistor varies with change of temperature (negative temperature coefficient thermistors only) Explain how the design and use of circuits can be used to explore the variation of resistance in the following devices	**<u>Transpiration & Translocation</u>** Explain how the structures of the xylem and phloem are adapted to their function in the plant, including: a) lignified dead cells in xylem transporting water and minerals through the plant b) living cells in phloem using energy to transport sucrose around the plant. Describe how water and mineral ions are transported through the plant by transpiration, including the structure and function of the stomata. Describe how sucrose is transported around the plant by translocation Explain the effect of environmental factors on the

	the number of electrons and is therefore neutral		**metal extraction (bacterial and phytoextraction)**	a) filament lamps b) diodes c) thermistors d) LDRs	rate of water uptake by a plant, to include light intensity, air movement and temperature. Demonstrate an understanding of rate calculations for transpiration
Lesson 6 Learning intentions	**<u>Electrons & orbits</u>** Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus. Explain that electrons change orbit when there is absorption or emission of electromagnetic radiation. Explain how atoms may form positive ions by losing outer electrons. Describe how and why the atomic model has changed over time including reference to the plum pudding model and Rutherford alpha particle scattering leading to the Bohr model	**<u>Type 2 diabetes</u>** Explain the cause of type 2 diabetes and how it is controlled. Evaluate the correlation between body mass and type 2 diabetes including BMI and waist:hip calculations using the BMI equation: $\text{BMI} = \frac{\text{weight (kg)}}{(\text{height (m)})^2}$	**<u>Oxidation & Reduction</u>** **(H)Explain displacement reactions as redox reactions, in terms of gain or loss of electrons.** Explain oxidation as the gain of oxygen and reduction as the loss of oxygen. Recall that the extraction of metals involves reduction of ores. Explain how a metal's relative resistance to oxidation is related to its position in the reactivity series	**<u>Core Practical</u>** Core Practical: Construct electrical circuits to: a) investigate the relationship between potential difference, current and resistance for a resistor and a filament lamp b) test series and parallel circuits using resistors and filament lamps	
Lesson 7 Learning intentions	**<u>Background radiation</u>** Explain what is meant by background radiation.		**<u>Recycling</u>** Evaluate the advantages of recycling metals, including economic implications and	**<u>Transferring energy</u>** Recall that, when there is an electric current in a resistor,	

	Describe the origins of background radiation from Earth and space. Describe methods for measuring and detecting radioactivity limited to photographic film and a Geiger–Müller tube.		how recycling can preserve both the environment and the supply of valuable raw materials. Describe that a life time assessment for a product involves consideration of the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of the product when it is no longer useful. Evaluate data from a life cycle assessment of a product.	there is an energy transfer which heats the resistor Explain that electrical energy is dissipated as thermal energy in the surroundings when an electrical current does work against electrical resistance Explain the energy transfer (in 10.22 above) as the result of collisions between electrons and the ions in the lattice Explain ways of reducing unwanted energy transfer through low resistance wires Describe the advantages and disadvantages of the heating effect of an electric current Use the equation: energy transferred (joule, J) = current (ampere, A) × potential difference (volt, V) × time (second, s) $E = I \times V \times t$	
Lesson 8 Learning intentions	**<u>Types of radiation</u>** Recall the relative masses and relative electric charges of protons,		**<u>Dynamic equilibria</u>** Recall that chemical reactions are reversible and the use of the symbol ⇌ in equations and that	**<u>Power</u>** Describe power as the energy transferred per	

	neutrons, electrons and positrons. Recall that an alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation. Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise. Recall that alpha, β– (beta minus), β+ (positron), gamma rays and neutron radiation are emitted from unstable nuclei in a random process. Recall that alpha, β– (beta minus), β+ (positron) and gamma rays are ionising radiations.		the direction of some reversible reactions can be altered by changing the reaction conditions. Explain what is meant by dynamic equilibrium Describe the formation of ammonia as a reversible reaction between nitrogen (extracted from the air) and hydrogen (obtained from natural gas) and that it can reach a dynamic equilibrium. Recall the conditions for the Haber process as: a) temperature 450°C b) pressure 200 atmospheres c) iron catalyst **(H) Predict how the position of a dynamic equilibrium is affected by changes in:** **a) temperature** **b) pressure** **c) concentration**	second and recall that it is measured in watts Recall and use the equation: power (watt, W) = energy transferred (joule, J) ÷ time taken (second, s) $P = E/t$ Explain how the power transfer in any circuit device is related to the potential difference across it and the current in it Recall and use the equations: electrical power (watt, W) = current (ampere, A) × potential difference (volt, V) $P = I \times V$ electrical power (watt, W) = current squared (ampere^2, A^2) × resistance (ohms, Ω) $P = I^2 \times R$	
Lesson 9 Learning intentions	**<u>Radioactive decay</u>** Describe the process of β^- decay (a neutron becomes a proton plus an electron)			**<u>Transferring energy by electricity</u>** Describe how, in different domestic devices, energy is transferred from batteries	

	Describe the process of β^+ decay (a proton becomes a neutron plus a positron) Explain the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays (α, β, γ and neutron emission) Recall that nuclei that have undergone radioactive decay often undergo nuclear rearrangement with a loss of energy as gamma radiation. Use given data to balance nuclear equations in terms of mass and charge.			and the a.c. mains to the energy of motors and heating devices Explain the difference between direct and alternating voltage Describe direct current (d.c.) as movement of charge in one direction only and recall that cells and batteries supply direct current (d.c.) Describe that in alternating current (a.c.) the movement of charge changes direction Recall that in the UK the domestic supply is a.c., at a frequency of 50 Hz and a voltage of about 230 V Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use	
Lesson 10 Learning intentions	**Half-Life** Describe how the activity of a radioactive source decreases over a period of time.			**Electrical safety** Explain the difference in function between the live and the neutral mains input wires.	

	Recall that the unit of activity of a radioactive isotope is the Becquerel, Bq. Explain that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay or the activity of a source to decay by half. Explain that it cannot be predicted when a particular nucleus will decay but half-life enables the activity of a very large number of nuclei to be predicted during the decay process. Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations			Explain the function of an earth wire and of fuses or circuit breakers in ensuring safety. Explain why switches and fuses should be connected in the live wire of a domestic circuit. Recall the potential differences between the live, neutral and earth mains wires. Explain the dangers of providing any connection between the live wire and earth.	
Lesson 11 Learning intentions	**<u>Dangers of radioactivity</u>** Describe the dangers of ionising radiation in terms of tissue damage and possible mutations and relate this to the precautions needed.				

	Explain the precautions taken to ensure the safety of people exposed to radiation, including limiting the dose for patients and the risks to medical personnel. Describe the differences between contamination and irradiation effects and compare the hazards associated with these two.				