Science Year 10 – Spring Term 2021/2022

	What? **When?** **Why?**			
	CHEMISTRY **C8 Acids & Alkalis**	**PHYSICS** **P4&5 Waves & EM spectrum**	**BIOLOGY** **B5 Health & disease**	**CHEMISTRY** **C9-12 Calculations & chemical change**
Lesson 1 Learning intentions	**Acids, indicators and pH** Describe the use of hazard symbols on containers a) to indicate the dangers associated with the contents b) to inform people about safe-working precautions with these substances in the laboratory. Recall that acids in solution are sources of hydrogen ions and alkalis in solution are sources of hydroxide ions. Recall that a neutral solution has a pH of 7 and that acidic solutions have lower pH values and alkaline solutions higher pH values. Recall the effect of acids and alkalis on indicators, including litmus, methyl orange and phenolphthalein.	**Describing waves** Recall that waves transfer energy and information without transferring matter. Describe evidence that with water and sound waves it is the wave and not the water or air itself that travels. Define and use the terms frequency and wavelength as applied to waves. Use the terms, amplitude, period and wave velocity as applied to waves. Describe the difference between longitudinal and transverse waves by referring to sound, electromagnetic, seismic and water waves.	**Health** Describe health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, as defined by the World Health Organisation (WHO) Describe the difference between communicable and non-communicable diseases. Explain why the presence of one disease can lead to a higher susceptibility to other diseases	**Relative formula mass** Calculate relative formula mass given relative atomic masses.

	(H) Recall that the higher the concentration of hydrogen ions in an acidic solution, the lower the pH; and the higher the concentration of hydroxide ions in an alkaline solution, the higher the pH.			
Lesson 2 Learning intentions	**<u>Looking at acids (higher tier only)</u>** **(H) Recall that as hydrogen ion concentration in a solution increases by a factor of 10, the pH of the solution decreases by 1.** **(H) Explain the terms dilute and concentrated, with respect to amount of substances in solution.** **(H) Explain the terms weak and strong acids, with respect to the degree of dissociation into ions.**	**<u>Wave speed</u>** Recall and use both the equations below for all waves: wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m) $v = f \times \lambda$ wave speed (metre/second, m/s) = distance (metre, m) ÷ time (second, s) $v = x/t$ Describe how to measure the velocity of sound in air and ripples on water surfaces	**<u>Non-communicable</u>** Describe that many non-communicable human diseases are caused by the interaction of a number of factors including cardiovascular diseases, many forms of cancer, some lung and liver diseases and diseases influenced by nutrition. Explain the effect of lifestyle factors on non-communicable diseases at local, national and global levels, including: a) … diet on … malnutrition… b) alcohol on liver diseases	**<u>Empirical formula</u>** Calculate the formulae of simple compounds from reacting masses and understand that these are empirical formulae. Deduce: a) the empirical formula of a compound from the formula of its molecule b) the molecular formula of a compound from its empirical formula and its relative molecular mass.
Lesson 3 Learning intentions	**<u>Bases & salts</u>** Recall that a base is any substance that reacts with an acid to form salt and water only. Explain the general reactions of aqueous solutions of acids with b) metal oxides	**<u>Reflection</u>** Explain how waves will be refracted at a boundary in terms of the change of direction **and speed** **(H) Recall that different substances may absorb, transmit,**	**<u>Cardiovascular disease</u>** Explain the effect of lifestyle factors on non-communicable diseases at local, national and global levels, including: a) exercise and diet on obesity and malnutrition, including BMI and waist:hip calculations using the BMI equation:	**<u>Empirical formula experiment</u>** Describe an experiment to determine the empirical formula of a simple compound such as magnesium oxide

	to produce salts Describe a neutralisation reaction as a reaction between an acid and a base. Explain why, if soluble salts are prepared from an acid and an insoluble reactant: a) excess of the reactant is added b) the excess reactant is removed c) the solution remaining is only salt and water. Recall the formulae of elements, simple compounds and ions. Write word equations Write balanced chemical equations, including the use of the state symbols (s), (l), (g) and (aq) Describe the use of hazard symbols on containers a) to indicate the dangers associated with the contents b) to inform people about safe-working precautions with these substances in the laboratory.	**refract, or reflect waves in ways that vary with wavelength** Recall and use both the equations below for all waves: wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m) $v = f \times \lambda$ wave speed (metre/second, m/s) = distance (metre, m) ÷ time (second, s) t $v = x/t$	$\text{BMI} = \frac{\text{weight (kg)}}{(\text{height (m)})^2}$ … c) smoking on cardiovascular diseases Evaluate some different treatments for cardiovascular disease including: a) life-long medication b) surgical procedures c) lifestyle changes	
Lesson 4 Learning intentions	**<u>Core Practical</u>** Core Practical: Investigate the preparation of pure, dry hydrated copper sulfate crystals starting	**<u>Refraction</u>** Explain how waves will be refracted at a boundary in terms of the change of direction **and speed.**	**<u>Pathogens</u>** Describe a pathogen as a disease-causing organism including viruses, bacteria, fungi and protists.	**<u>Conservation of mass</u>** Explain the law of conservation of mass applied to a) a closed system including a precipitation reaction in a closed flask

	from copper oxide including the use of a water bath.	**(H) Recall that different substances may absorb, transmit, refract, or reflect waves in ways that vary with wavelength.** Recall and use both the equations below for all waves: wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m) $v = f \times \lambda$ wave speed (metre/second, m/s) = distance (metre, m) ÷ time (second, s) t $v = x/t$	Describe some common infections, including: a) cholera (bacteria) causes diarrhoea b) tuberculosis (bacteria) causes lung damage c) chalara ash dieback (fungi) causes leaf loss and bark lesions d) malaria (protists) causes damage to blood and liver e) HIV (virus) destroys white blood cells, leading to the onset of AIDS f) stomach ulcers caused by Helicobacter (bacteria) g) Ebola (virus) causes haemorrhagic fever	b) a non-enclosed system including a reaction in an open flask that takes in or gives out a gas
Lesson 5 Learning intentions	**<u>Alkalis & balancing equations</u>** Explain the general reactions of aqueous solutions of acids with c) metal hydroxides to produce salts Recall the formulae of elements, simple compounds and ions. Write word equations. Write balanced chemical equations, including the use of the state symbols (s), (l), (g) and (aq)	**<u>Core Practical</u>** Core Practical: Investigate the suitability of equipment to measure the speed, frequency and wavelength of a wave in a solid and a fluid.	**<u>Spreading pathogens</u>** Explain how pathogens are spread and how this spread can be reduced or prevented, including: a) cholera (bacteria) – water b) tuberculosis (bacteria) – airborne c) chalara ash dieback (fungi) – airborne d) malaria (protists) – animal vectors e) stomach ulcers caused by Helicobacter (bacteria) – oral	**<u>Calculating the mass of reactants and products</u>** Calculate masses of reactants and products from balanced equations, given the mass of one substance.

	Recall that alkalis are soluble bases		transmission f) Ebola (virus) – body fluids	
Lesson 6 Learning intentions	**Core practical** Core Practical: Investigate the change in pH on adding powdered calcium hydroxide or calcium oxide to a fixed volume of dilute hydrochloric acid	**Electromagnetic waves** Recall that all electromagnetic waves are transverse, that they travel at the same speed in a vacuum. Explain, with examples, that all electromagnetic waves transfer energy from source to observer. Recall that our eyes can only detect a limited range of frequencies of electromagnetic radiation. Explain the effects of differences in the velocities of electromagnetic waves in different substances.	**Physical and chemical defences** Describe how the physical barriers and chemical defences of the human body provide protection from pathogens, including: a) physical barriers including mucus, cilia and skin b) chemical defence including lysozymes and hydrochloric acid	**Concentration** Calculate the concentration of solutions in g dm^{-3}
Lesson 7 Learning intentions	**Alkalis & neutralisation** Explain an acid-alkali neutralisation as a reaction in which hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the alkali to form water. Explain why, if soluble salts are prepared from an acid and a soluble reactant: a) titration must be used b) the acid and the soluble reactant are then mixed in the	**Core Practical** Core practical: Investigate refraction in rectangular glass blocks in terms of the interaction of electromagnetic waves with matter **.**	**Immune system** Explain the role of the specific immune system of the human body in defence against disease including: a) exposure to pathogen b) the antigens trigger an immune response which causes the production of antibodies c) the antigens also trigger production of memory lymphocytes d) the role of memory	**Moles (higher tier only)** **(H) Recall that one mole of particles of a substance is defined as:** **a) the Avogadro constant number of particles (6.02 x 10^{23} atoms, molecules, formulae or ions) of that substance** **b) a mass of 'relative particle mass' g**

	correct proportions c) the solution remaining, after reaction, is only salt and water. Describe how to carry out simple acid-alkali titrations, using burette, pipette and a suitable indicator, to prepare a pure, dry salt.		lymphocytes in the secondary response to the antigen.	**(H) Calculate the number of:** **a) moles of particles of a substance in a given mass of that substance and vice versa** **b) particles of a substance in a given number of moles of that substance and vice versa** **c) particles of a substance in a given mass of that substance and vice versa**
Lesson 8 Learning intentions	**<u>Reactions of acids with metals and carbonates</u>** Explain the general reactions of aqueous solutions of acids with: a) metals d) metal carbonates to produce salts Describe the chemical test for: a) hydrogen b) carbon dioxide (using limewater) **(H) Write balanced ionic equations**	**<u>Electromagnetic Spectrum</u>** Recall the main groupings of the continuous electromagnetic spectrum including (in order) radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, X-rays and gamma rays. Describe the electromagnetic spectrum as continuous from radio waves to gamma rays and that the radiations within it can be grouped in order of decreasing wavelength and increasing frequency **(H)Recall that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength**	**<u>Immunisation</u>** Explain the body's response to immunisation using an inactive form of a pathogen.	**<u>Limiting reactants and chemical equations (Higher tier only)</u>** **(H) Explain why, in a reaction, the mass of product formed is controlled by the mass of the reactant which is not in excess** **(H) Deduce the stoichiometry of a reaction from the masses of the reactants and products.**

Lesson 9 Learning intentions	**Solubility** Recall the general rules which describe the solubility of common types of substances in water: a) all common sodium, potassium and ammonium salts are soluble b) all nitrates are soluble c) common chlorides are soluble except those of silver and lead d) common sulfates are soluble except those of lead, barium and calcium e) common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium Predict, using solubility rules, whether or not a precipitate will be formed when named solutions are mixed together, naming the precipitate if any. Describe the method used to prepare a pure, dry sample of an insoluble salt	**Using long wavelengths** Describe some uses of electromagnetic radiation a) radio waves: including broadcasting, communications and satellite transmissions b) microwaves: including cooking, communications and satellite transmissions c) infrared: including cooking, thermal imaging, short range communications, optical fibres, television remote controls and security systems d) visible light: including vision, photography and illumination **(H) Recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits.** **(H) Recall that different substances may absorb, transmit, refract, or reflect EM waves in ways that vary with wavelength.** Explain the effects of differences in the velocities of EM waves in different substances.	**Antibiotics** Explain that antibiotics can only be used to treat bacterial infections because they inhibit cell processes in the bacterium but not the host organism.	**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 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 10 Learning intentions		**Using short wavelengths** Describe some uses of electromagnetic radiation e) ultraviolet: including security marking, fluorescent lamps,	**New medicines & drug trials** Describe that the process of developing new medicines, including antibiotics, has many stages including discovery,	**Core Practical** Core Practical: Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes

		detecting forged bank notes and disinfecting water f) X-rays: including observing the internal structure of objects, airport security scanners and medical X-rays g) gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment **(H) Recall that different substances may absorb, transmit, refract, or reflect electromagnetic waves in ways that vary with wavelength** Explain the effects of differences in the velocities of electromagnetic waves in different substances	development, preclinical and clinical testing.	
Lesson 11 Learning intentions		**<u>EM radiation dangers</u>** Describe the harmful effects on people of excessive exposure to electromagnetic radiation, including: a) microwaves: internal heating of body cells b) infrared: skin burns c) ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions d) X-rays and gamma rays: mutation or damage to cells in the body	**<u>STI's</u>** Explain how sexually transmitted infections (STIs) are spread and how this spread can be reduced or prevented, including: a) Chlamydia (bacteria) b) HIV (virus)	**<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 b) sodium chloride solution c) sodium sulfate solution d) water acidified with sulfuric acid e) molten lead bromide (demonstration)

		Recall that the potential danger associated with an electromagnetic wave increases with increasing frequency Recall that changes in atoms and nuclei can a) generate radiations over a wide frequency range b) be caused by absorption of a range of radiations		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
Lesson 12 Learning intentions				**<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, 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
Lesson 13 Learning intentions				**<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 metal extraction (bacterial and phytoextraction)**
Lesson 14 Learning intentions				**<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
Lesson 15 Learning intentions				**<u>Recycling</u>** Evaluate the advantages of recycling metals, including economic

				implications and 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.
Lesson 16 Learning intentions				**<u>Dynamic equilibria</u>** Recall that chemical reactions are reversible and the use of the symbol ⇌ in equations and that 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**