Medium Term Planning - Topic: Rates and equilibrium

Curriculum Intent	**In addition to working further on objectives from Year __, pupils will be taught, following National Curriculum guidelines, the following this topic:**
Skills/National Curriculum Links	Rates and equilibria: Aiming for Grade 4 LOs: • Recall a definition for rate of reaction. • Safely describe and follow a method to monitor rate of reaction. • State the units for rate of reaction. Aiming for Grade 6 LOs: • Explain how there can be different units for measuring rate of reaction. • Calculate the mean rate of reaction. • Calculate the rate of reaction at a specific time. Aiming for Grade 8 LOs: • Plot and use a graph to calculate the gradient to measure the initial rate of reaction. • Justify a chosen method for a given reaction to monitor the rate of reaction. • Explain why there is more than one unit for rate of reaction. Collision theory and surface area: Aiming for Grade 4 LOs: • Describe how surface area of a solid can be increased. • State that chemical reactions can only occur when a collision occurs with enough energy. • List the factors that can affect the rate of a chemical reaction. Aiming for Grade 6 LOs: • Describe how changing the surface area changes the rate of reaction. • Describe what the activation energy of a reaction is. • Calculate the surface area to volume ratio. Aiming for Grade 8 LOs: • Use collision theory to explain in detail how increasing surface area increases the rate of reaction. • Use a graph to calculate the rate of reaction at specific times in a chemical reaction. • Explain why many collisions do not lead to a chemical reaction. The effect of temperature: Aiming for Grade 4 LOs: • Describe how temperature affects the rate of reaction. • Safely complete an experiment on how temperature affects the rate of a reaction. Aiming for Grade 6 LOs: • Use collision theory to explain how changing temperature alters the rate of reaction. • Calculate mean rates of reaction. Aiming for Grade 8 LOs: • Use a graph to calculate the rate of reaction at specific times in a chemical reaction. • Calculate 1 / t and plot a graph with a more meaningful line of best fit. The effect of concentration and pressure: Aiming for Grade 4 LOs: • Describe how changing concentration affects the rate of reaction. • Describe how changing pressure affects the rate of gas phase reactions. Aiming for Grade 6 LOs: • Use collision theory to explain how changing concentration or pressure alters the rate of reaction. • Calculate mean rates of reaction. • Explain how to change gas pressure. Aiming for Grade 8 LOs: • Interpret a rate of reaction graph, including calculating the rate of reaction at specific times in a chemical reaction. • Explain why changing pressure has no effect on the rate of reaction for some reactions. • Justify quantitative predictions and evaluate in detail their investigation into the effect of concentration on rate of reaction. The effect of catalyst:

	Aiming for Grade 4 LOs: • Define a catalyst • Describe how adding a catalyst affects the rate of reaction. • Describe and carry out a method to safely investigate which catalyst is best for a reaction. Aiming for Grade 6 LOs: • Use collision theory to explain how adding a catalyst alters the rate of reaction. • Explain, with an example, the industrial use of a catalyst. • Calculate the mean rate of reaction. Aiming for Grade 8 LOs: • Use a reaction profile diagram to explain in detail the effect of adding a catalyst. • Justify the use of catalysts in industry and in household products. • Explain what an enzyme is and how it works. Reversible reactions: Aiming for Grade 4 LOs: • Define a reversible reaction. • Write a word equation for a familiar reversible reaction. • State an example of a reversible reaction. Aiming for Grade 6 LOs: ammonium chloride • Explain, using a familiar example, how a reaction can be reversible. • Describe a familiar reversible reaction using a balanced symbol equation. • Predict the observations of a familiar reversible reaction when the conditions are changed. Aiming for Grade 8 LOs: • Describe an unfamiliar reversible reaction, using a balanced symbol equation with state symbols. • Justify the use of reversible reactions in the lab and items available in the home. • Justify the classification of a reaction as reversible. Energy and reversible reactions: Aiming for Grade 4 LOs: • State whether a reversible reaction is exothermic or endothermic in the reverse direction if the forward direction is stated. • Write a word equation for the reversible reaction of dehydration/hydration of copper • sulfate. Aiming for Grade 6 LOs: • Explain why the energy change in a reversible reaction is exothermic in one direction and endothermic in the reverse direction. • Generate balanced symbol equations for reversible reactions from information provided. • Make predictive observations of familiar reversible reactions when information is supplied. Aiming for Grade 8 LOs: • Explain in detail the energy changes in an equilibrium system. • Suggest and explain a simple laboratory test which could be completed using a reversible reaction. • Make predictive observations of unfamiliar reversible reactions when information is supplied. Dynamic equilibrium: Aiming for Grade 4 LOs: • Define a dynamic equilibrium • Describe a closed system Aiming for Grade 6 LOs: • Describe how to achieve dynamic equilibrium. • Describe how rate of the forward reaction compares to rate of the backward reaction in a dynamic equilibrium. • Describe Le Chatelier's Principle. Aiming for Grade 8 LOs: • Explain dynamic equilibrium. • Explain why the concentration of chemicals in a dynamic equilibrium remains constant. • Predict the effect on the rate of forward and reverse reactions by applying the Le Chatelier's Principle when the conditions of a dynamic equilibrium are changed. Altering conditions: Aiming for Grade 6 LOs: • Explain how changing conditions for a system at dynamic equilibrium affects the rate of the forward and reverse reactions. • Predict the effect on yield of changing temperature, concentration, or pressure I a given equilibrium system. Aiming for Grade 8 LOs: • Explain why changing pressure has no effect on some systems. • Justify, in detail, the compromise conditions chosen in given industrial processes.
Spiritual, moral, social, and cultural development	**SMSC:** group work from practical activities in this section. Also pupils can work in groups to produce a timeline for the development of the periodic table.

	PSHE/British Values: The history of the is important development of the atom when learning about british values and world values. Students will complete teamwork, leadership and put science into everyday situations. They will show mutual respect during classwork. **Skills Builder:**Listening (Receiving, retaining and processing info), Speaking (The oral transmission of info and ideas), Problem solving (Find a solution to a situation or challenge), Creativity (imagination and generation of new ideas), Staying positive (The ability to use tactics and strategies to overcome setbacks), aiming high (Set clear and tangible goals), Leadership and teamwork
Numeracy	
Literacy	**Vocabulary Tier 2:** combustion, concentration, increases, decreases, energetic, proportion, effective, conserves, impurities, continuously, gaseous. **Vocabulary Tier 3:** activation energy, anhydrous, catalyst, climate change, closed system, collision theory, equilibrium, hydrated, le chateliers principle, precise, precision, reversible reaction. **Reading:** Following a written method and read risk assessments. Students may be directed to the textbook; this could be in lesson or at home on Kerboodle. **Writing:** Describing and explaining scientific phenomenon, free response writing for describing precautions taken, use of word mat to promote sentence formation. **Oracy:** inclusion of BEST resources which are research evidence on common misunderstandings in science, effective diagnostic questioning and formative assessment, constructivist approaches to building understanding, and effective sequencing of key concepts that promote metacognitive talk and dialogue.
Becoming future ready	**Careers/Employability:** Scientist Chemist Drug development Teacher Post-doctoral researcher
Adaptation **QFT/SEND Provision**	Throughout this topic, quality first teaching will provide differentiation: **By product:** Linear assessments and differentiated practical work. **By resource:** Lessons are differentiated per class and students, worksheets are available if support and assessments are linear. **By Intervention**: by providing different levels of supervision and support **By Progressive Questioning:** exploring pupils' understanding through interactive dialogue. **By Grouping:** according to prior attainment, gender, social preference, preferred learning style. **By Offering Optional Activities:** In class or as homework, to extend learning. This QFT/SEND provision will be explicit within the lesson-by-lesson schemes of work.
Implementation Curriculum Delivery Learning Outcomes **(Core Knowledge)**	To be able to: 6.1.1 **The rate of a chemical reaction can be found by measuring the quantity of a reactant used or the quantity of product formed over time: mean rate of reaction = quantity of reactant used / time taken mean rate of reaction = quantity of product formed / time taken** The quantity of reactant or product can be measured by the mass in grams, by a volume in cm3 . The units of rate of reaction may be given as g/s or cm3 /s. For the Higher Tier, students are also required to use quantity of reactants in terms of moles and units for rate of reaction in mol/s. Students should be able to: • **calculate the mean rate of a reaction from given information** about the quantity of a reactant used or the quantity of a product formed and the time taken • **draw, and interpret, graphs** showing the quantity of product formed or quantity of reactant used up against time • draw tangents to the curves on these graphs and use the slope of the tangent as a measure of the rate of reaction • H calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time. 6.1.2 **Factors which affect the rates of chemical reactions i**nclude the surface area of solid reactants. Students should be able to **recall how changing these factors affects the rate of chemical reactions**. 6.1.3 **Collision theory explains how various factors affect rates of reactions. According to this theory, chemical reactions can occur only when reacting particles collide with each other and with sufficient energy. The minimum amount of energy that particles must have to react is called the activation energy.** Increasing the surface area of solid reactants increases the frequency of collisions and so increases the rate of reaction. Students should be able to explain the effects on rates of reaction of: • changes in the size of pieces of a reacting solid in terms of surface area to volume ratio • use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction. 6.1.2 Factors which affect the rates of chemical reactions include the temperature. Students should be able to recall how changing these factors affects the rate of chemical reactions. 6.1.3 Collision theory explains how various factors affect rates of reactions. According to this theory, chemical reactions can occur only when reacting particles collide with each other and with sufficient energy. The minimum amount of energy that particles must have to react is called the activation energy. **Increasing the temperature increases the frequency of collisions** and makes the collisions more energetic, and so increases the rate of reaction. Students should be able to: • predict and explain using collision theory the effects of changing temperature on the rate of a reaction • use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction.

	6.1.2 Factors which affect the rates of chemical reactions include the concentrations of reactants in solution and the pressure of reacting gases. **Required practical: Investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour or turbidity. This should be an investigation involving developing a hypothesis.** 6.1.3 Collision theory explains how various factors affect rates of reactions. According to this theory, chemical reactions can occur only when reacting particles collide with each other and with sufficient energy. The minimum amount of energy that particles must have to react is called the activation energy. Increasing the concentration of reactants in solution and the pressure of reacting gases increases the frequency of collisions and so increases the rate of reaction. Students should be able to: • predict and explain using collision theory the effects of changing conditions of concentration and pressure on the rate of a reaction • use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction. 6.1.2 Factors which affect the rates of chemical reactions include the presence of catalysts. Students should be able to recall how changing these factors affects the rate of chemical reactions. 6.1.3 Collision theory explains how various factors affect rates of reactions. According to this theory, chemical reactions can occur only when reacting particles collide with each other and with sufficient energy. The minimum amount of energy that particles must have to react is called the activation energy. 6.1.4 **Catalysts change the rate of chemical reactions but are not used up during the reaction**. Different reactions need different. catalysts. Enzymes act as catalysts in biological systems. **Catalysts increase the rate of reaction by providing a different pathway for the reaction that has a lower activation energy**. 6.2.1 **In some chemical reactions, the products of the reaction can react to produce the original reactants. Such reactions are called reversible reactions and are represented: A + B ⇋ C + D** The direction of reversible reactions can be changed by changing the conditions. 6.2.2 **If a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction**. The same amount of energy is transferred in each case. 6.2.3 When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate. 6.2.4 **The relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction**. If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change. **The effects of changing conditions on a system at equilibrium** can be predicted using Le Chatelier's Principle. Students should be able to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. 6.2.4 The relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change. The effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. Students should be able to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. 6.2.5 If the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again. If the concentration of a reactant is increased, more products will be formed until equilibrium is reached again. If the concentration of a product is decreased, more reactants will react until equilibrium is reached again. Students should be able to interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium. 6.2.6 If the temperature of a system at equilibrium is increased: • the relative amount of products at equilibrium increases for an endothermic reaction • the relative amount of products at equilibrium decreases for an exothermic reaction. If the temperature of a system at equilibrium is decreased: • the relative amount of products at equilibrium decreases for an endothermic reaction • the relative amount of products at equilibrium increases for an exothermic reaction. Students should be able to interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium. 6.2.7 For gaseous reactions at equilibrium: • an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction • a decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction. Students should be able to interpret appropriate given data to predict the effect of pressure changes on given reactions at equilibrium.
Current learning to be developed in the future within:	A level chemistry students will again covered in greater depth, with the topic of rates and equilibrium in the physical side of A level chemistry.
Assessment	Refer to assessment maps for formative and summative assessment opportunities.
Impact	Attainment and Progress – Refer to assessment results / data review documentation.