Year 11
Subject: Chemistry
Topic/Unit: Rates of Reaction and Chemical Equilibri
When: Half Term 1

Huntington School
Learn and succeed

Overview: Why this? Why now?
This unit explores how quickly chemical reactions occur and how scientists can control them. In industry, the speed of a reaction determines how quickly a product can be sold for profit. Students will learn to balance speed, cost, and safety, specifically looking at how chemical engineers design efficient processes.

Building on...building to:
This unit builds on the concept of **activation energy** and the **conservation of mass**. It also connects to earlier studies of exothermic and endothermic energy changes. This knowledge leads to future studies on sustainability and the industrial manufacture of chemicals like fertilizers.

Sequence summary:
- **Measuring Rates:** Students calculate the rate of reaction by measuring the quantity of reactant used or product formed over time. They use methods such as timing a **precipitate** obscuring a cross, measuring mass loss on a balance, or collecting gas in a syringe.
- **Collision Theory:** Lessons cover how **surface area, concentration, temperature, and pressure** affect the frequency of successful collisions. Students learn that particles must collide with the correct orientation and sufficient activation energy.
- **Catalysts:** Students identify catalysts as substances that speed up reactions by providing an alternative pathway with a lower activation energy.
- **Reversible Reactions and Equilibrium:** Introduction to reactions where products can reform reactants, symbolized by ⇌. Students investigate **dynamic equilibrium** in closed systems where the forward and backward reaction rates are equal.
- **Le Chatelier's Principle:** Analysis of how systems at equilibrium shift to counteract changes in temperature, pressure, or concentration.
- **The Haber Process:** A case study on the industrial production of **ammonia** using an iron catalyst at 450°C and 200 atmospheres.

Key Vocabulary:
Rate of Reaction, Activation Energy, Collision Theory, Catalyst, Reversible Reaction, Equilibrium, Le Chatelier's Principle, Haber Process, Yield, Compromise.

Assessments:
- **Formative:** Calculating **gradients** on rate graphs to determine the reaction speed at specific times. Whiteboard tasks on predicting equilibrium shifts.
- **Summative:** Exam-style questions on the advantages and disadvantages of different rate-measuring techniques and the conditions used in the Haber Process.

Able and interested:
Students will evaluate the work of Fritz Haber and the role of biological catalysts (enzymes). They will also practice complex unit conversions, such as converting hours into seconds.

Inclusion, Personal Development and Wider Skills:
Practical work develops lab safety awareness, such as managing toxic gas release. Students build mathematical skills by interpreting graph steepness and calculating mean rates. They also explore the global economic importance of ammonia for food security.

Homework and Independent Learning:
Students will complete a task set on the SPARX online platform. The task is based on the current topic but also includes consolidation on previous topics. It will automatically adjust the level of challenge as the student complete the activities.