



Inspiring excellence, empowering global minds

Course Outline

Chemistry Year 10

Overview

The Chemistry Syllabus at GEMS Wesgreen International Secondary School aims to develop well rounded chemists who can not only explain complex theoretical concepts but can investigate them practically for themselves. Investigative skills and techniques are at the heart of chemistry at Wesgreen International and we have embedded frequent opportunities for our learners to develop these at all stages of the curriculum. Throughout the year we will build upon prior knowledge and challenge students to work independently and autonomously, be resilient and have the confidence and determination to overcome significant challenges.

Learning Outcomes

The aims of the Chemistry Syllabus are to:

- Arouse learner's curiosity in chemistry and by extension the natural world enabling them to use scientific ideas to explain physical phenomena, fostering a deeper understanding and appreciation of chemistry in their everyday lives.
- Develop student scientific knowledge by building progression atop core ideas from KS2 throughout KS3 & KS4 via logical sequencing of the curriculum.
- Provide students the opportunities to work scientifically through experimentation, data analysis, making inferences and drawing conclusions in line with results.
- Develop students critical thinking skills enabling them to make logical and informed decisions based on information presented to them.
- Develop student understanding of the relationship between mathematical concepts and scientific ideas.
- Develop independent, resilient, and reflective learners through self-study, adequate challenge and personalized feedback.
- To equip learners with the skills and understanding they need to be scientifically literate citizens and to pursue the study of chemical sciences at higher levels should they so wish.

Topic Overviews

Term 1

Topic 1 – Principles of chemistry

Approximate length: 29 lessons

In this topic, students will look at the particle model and how particles are arranged in the three states of matter. The interconversions of these three states are also explored, defining the key principles of melting, boiling and freezing points of a substance. The very fabric of the universe itself will be investigated by the study of atomic structure, where protons, neutrons and electrons are defined. Building on from this we will delve into the different combinations of these elements and how to correctly distinguish between an element, compound, and mixture. In this module we will also look at the separating techniques chemists carry out to investigate the chemical composition of a mixture.

Specific objectives with the Edexcel syllabus covered:

- Understand the three states of matter in terms of the arrangement, movement, and energy of the particles.
- Understand the interconversions between the three states of matter.
- Understand how the results of experiments involving the dilution of colored solutions and diffusion gases can be explained.
- Know what is meant by the terms: Solvent, solution, solute and saturated solution.
- Understand how to plot and interpret solubility curves
- Investigate the solubility of a solid in water at a specific temperature
- Understand how to classify a substance as an element, compound, or mixture.
- Understand that a pure substance has a fixed melting and boiling point, but that a mixture may melt or boil over a range of temperatures.
- Describe experimental techniques for the separation of mixtures.
- Understand how a chromatogram provides information about the composition of a mixture.
- Understand how to use the calculation of R_f values to identify the components of a mixture.
- Know what is meant by the term's atom and molecule
- Know the structure of an atom in terms of the positions, relative masses and relative charges of sub-atomic particles.
- Know what is meant by the terms atomic number, mass number, isotopes and relative atomic mass (A_r)
- Be able to calculate the relative atomic mass of an element (A_r) from isotopic abundances.
- Understand how elements are arranged in the periodic table.
- Understand how to deduce the electronic configurations of the first 20 elements and their positions in the Periodic Table.
- Understand how to use electrical conductivity and the acid-base character of oxides to classify elements as metals or non-metals.
- Identify an element as a metal or a non-metal according to its position in the Periodic Table.

- Understand how the electronic configuration of a main group element is related to its position in the Periodic table.
- Understand why elements in the same group of the Periodic Table have similar chemical properties.
- Understand why the noble gases (Group 0) do not readily react.
- Write word equations and balanced chemical equations
- Calculate relative formula masses (including relative molecular masses) (M_r) from relative atomic masses (A_r)
- Know that the mole (mol) is the unit for the amount of a substance.
- Understand how to carry out calculations involving amount of substance, relative atomic mass (A_r) and relative formula mass (M_r)
- Calculate reacting masses using experimental data and chemical equations
- Calculate percentage yield
- Understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallization
- Know what is meant by the terms empirical formula and molecular formula
- Calculate empirical and molecular formulae from experimental data
- Understand how to carry out calculations involving gas volumes and the molar volume of a gas (24 dm^3 and $24\,000 \text{ cm}^3$ at room temperature and pressure (rtp))
- Understand how to carry out calculations involving amount of substance, volume and concentration (in mol/dm^3) of solution

Term 2

Topic 2 – Inorganic Chemistry (Parts a and b)

Approximate length: 7 lessons

In this topic, students will investigate the reactivity of metals with a variety of substances and how their reactivity can be used to construct a reactivity series. Additionally, they will learn how to use the reactivity series to determine how metals are extracted, looking deeper into these methods.

Specific objectives with the Edexcel syllabus covered:

- Understand how metals can be arranged in a reactivity series based on their reactions with water, dilute hydrochloric or sulfuric acid
- Know the order of reactivity of these metals: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, copper, silver, gold
- Investigate reactions between dilute hydrochloric and sulfuric acids and metals (e.g. magnesium, zinc and iron)
- Understand how metals can be arranged in a reactivity series based on their displacement reactions between: metals and metal oxides, metals and aqueous solutions of metal salts
- Understand the terms: oxidation, reduction, redox, oxidising agent, reducing agent in terms of gain or loss of oxygen and loss or gain of electrons.

- Know the conditions under which iron rusts.
- Understand how the rusting of iron may be prevented by: barrier methods, galvanizing and sacrificial protection.
- Know that most metals are extracted from ores found in the Earth's crust and that unreactive metals are often found as the uncombined element
- Explain how the method of extraction of a metal is related to its position in the reactivity series, illustrated by carbon extraction for iron and electrolysis for aluminium
- Be able to comment on a metal extraction process, given appropriate information.
- Explain the uses of aluminium, copper, iron and steel in terms of their properties the types of steel will be limited to low-carbon (mild), high-carbon and stainless
- Know that an alloy is a mixture of a metal and one or more elements, usually other metals or carbon
- Explain why alloys are harder than pure metals

Topic 3 – Physical Chemistry (Part a)

Approximate length: 5 lessons

In this topic, students will focus on exothermic and endothermic reactions, using the reactions to be able to calculate temperature change and molar enthalpy change. Additionally, students will carry out a series of experiments to investigate temperature changes.

Specific objectives with the Edexcel syllabus covered:

- Know that chemical reactions in which heat energy is given out are described as exothermic, and those in which heat energy is taken in are described as endothermic
- Draw and explain energy level diagrams to represent exothermic and endothermic reactions
- Calculate the heat energy change from a measured temperature change using the expression $Q = mc\Delta T$
- Calculate the molar enthalpy change (ΔH) from the heat energy change, Q
- Know that bond-breaking is an endothermic process and that bond-making is an exothermic process
- Use bond energies to calculate the enthalpy change during a chemical reaction
- Describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralization
- Investigate temperature changes accompanying some of the following types of change: salts dissolving in water, neutralisation reactions, displacement reactions and combustion reactions.

Topic 4 - Inorganic Chemistry (Parts c and d)

Approximate length: 10 lessons

In this topic, students will continue to look at the inorganic chemistry side of the course. This will involve investigating acids and alkalis, along with the various methods of determining pH. Students will learn about neutralization reactions between a series of acids and metals in various forms. Furthermore, students will be able to carry out a series of neutralization practicals.

Specific objectives with the Edexcel syllabus covered:

- Understand acids and bases in terms of proton transfer
- Understand that an acid is a proton donor and a base is a proton acceptor
- Know that metal oxides, metal hydroxides and ammonia can act as bases, and that alkalis are bases that are soluble in water
- Know that acids in aqueous solution are a source of hydrogen ions and alkalis in an aqueous solution are a source of hydroxide ions
- Describe the use of litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions
- Understand how to use the pH scale, from 0–14, can be used to classify solutions as strongly acidic (0–3), weakly acidic (4–6), neutral (7), weakly alkaline (8–10) and strongly alkaline (11–14)
- Describe the use of universal indicator to measure the approximate pH value of an aqueous solution
- Describe the reactions of hydrochloric acid, sulfuric acid and nitric acid with metals, bases and metal carbonates (excluding the reactions between nitric acid and metals) to form salts
- Know that alkalis can neutralise acids
- Describe how to carry out an acid-alkali titration
- Describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an acid and alkali
- Prepare a sample of pure, dry hydrated copper(II) sulfate crystals starting from copper(II) oxide
- Describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an insoluble reactant
- Prepare a sample of pure, dry lead(II) sulfate
- Describe an experiment to prepare a pure, dry sample of an insoluble salt, starting from two soluble reactants
- Know the general rules for predicting the solubility of ionic compounds in water: common sodium, potassium and ammonium compounds are soluble, all nitrates are soluble, common chlorides are soluble, except those of silver and lead(II), common sulfates are soluble, except for those of barium, calcium and lead(II), common carbonates are insoluble, except for those of sodium, potassium and ammonium, common hydroxides are insoluble except for those of sodium, potassium and calcium (calcium hydroxide is slightly soluble).

Topic 4 - Organic Chemistry (Parts a, b, c and d)**Approximate length: 7 lessons**

In this topic, students will look at alkanes and alkenes and the role they play in real world application of crude oil, fractional distillation and cracking. Students will continue to understand the negative impacts pollutants released from burning fuels has on the planet.

Specific objectives with the Edexcel syllabus covered:

- Know that a hydrocarbon is a compound of hydrogen and carbon only
- Know the general formula for alkanes
- Explain why alkanes are classified as saturated hydrocarbons

- Know what is meant by the terms homologous series, functional group and isomerism
- Understand how to draw the structural and displayed formulae for alkanes with up to five carbon atoms in the molecule, and to name the unbranched-chain isomers
- Know that alkenes contain the functional group $>C=C<$
- Know the general formula for alkenes
- Explain why alkenes are classified as unsaturated hydrocarbons
- Understand how to draw the structural and displayed formulae for alkenes with up to four carbon atoms in the molecule, and name the unbranched-chain isomers
- Know the general formula for alkanes
- Describe the reactions of alkanes with halogens in the presence of ultraviolet radiation, limited to mono-substitution
- Describe the reactions of alkenes with bromine to produce dibromoalkanes
- Describe how bromine water can be used to distinguish between an alkane and an alkene
- Know that crude oil is a mixture of hydrocarbons
- Describe how the industrial process of fractional distillation separates crude oil into fractions
- Know the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen
- Know the trend in colour, boiling point and viscosity of the main fractions
- Describe how long-chain alkanes are converted to alkenes and shorter-chain alkanes by catalytic cracking (using silica or alumina as the catalyst and a temperature in the range of 600–700 °C)
- Explain why cracking is necessary
- Know that a fuel is a substance that, when burned, releases heat energy
- Know the possible products of complete and incomplete combustion of hydrocarbons with oxygen in the air
- Understand why carbon monoxide is poisonous, in terms of its effect on the capacity of blood to transport oxygen references to haemoglobin are not required
- Know that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming oxides of nitrogen
- Explain how the combustion of some impurities in hydrocarbon fuels results in the formation of sulfur dioxide
- Understand how sulfur dioxide and oxides of nitrogen contribute to acid rain

Term 3

Following the conclusion of topic 4, for the remainder of the academic year prior to the IGCSE examinations, students will be revising content from throughout the chemistry syllabus, the sequence will be determined by highlighting any gaps in knowledge and misconceptions identified during lessons and the mock examination series.

Textbook – Pearson Edexcel International GCSE Chemistry

Assessment

Formative: Throughout the chapters, the students will complete end of chapter assessments, quizzes and problem-solving activities which will allow the teacher to assess the students' progress and inform their planning.

Summative: Students will be assessed on their understanding of each chapter with end of topic assessments. At the end of each term, we will complete internal assessments which will be based on certain chapters. Students will also complete standardized tests such as the GL. This allows us to measure the students' attainment throughout the term and year.