# PLANNING SUPPORT BOOKLET

**J248, J250**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9–1) in Chemistry A and Combined Science A (Gateway Science).

***DISCLAIMER***

This resource was designed using the most up to date information from the specification at the time it was published. Specifications are updated over time, which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)

# Introduction

This support material is designed to accompany the new OCR GCSE (9-1) specification for first teaching from September 2016 for:

* [Chemistry A (Gateway Science – J248)](http://www.ocr.org.uk/Images/234598-specification-accredited-gcse-gateway-science-suite-chemistry-a-j248.pdf)
* [Combined Science A (Gateway Science – J250)](http://www.ocr.org.uk/Images/234596-specification-accredited-gcse-gateway-science-suite-combined-science-a-j250.pdf)

We recognise that the number of hours available in timetable can vary considerably from school to school, and year to year. As such, these ***suggested*** teaching hours have been developed on the basis of the experience of the Science Subject Specialist team in delivering GCSE sciences in school. The hours are what we consider ideal for providing the best opportunity for high quality teaching and engagement of the learners in all aspects of learning science.

While Combined Science is a double award GCSE formed from the three separate science GCSEs, the DfE required subject content is greater than a strict two-thirds of the separate science qualifications, hence the suggested hours here are greater than a strict two-thirds of the separate science hours.

The ***suggested*** hours take into account all aspects of teaching, including pre- and post-assessment. As a linear course, we would recommend on-going revision of key concepts throughout the course to support learner’s learning. This can help to minimise the amount of re-teaching necessary at the end of the course, and allow for focused preparation for exams on higher level skills (e.g. making conceptual links between the topics) and exam technique.

Actual teaching hours will also depend on the amount of practical work done within each topic and the emphasis placed on development of practical skills in various areas, as well as use of contexts, case studies and other work to support depth of understanding and application of knowledge and understanding. It will also depend on the level of prior knowledge and understanding that learners bring to the course.

The table follows the order of the topics in the specification. It is not implied that centres teach the specification topics in the order shown. Centres are free to teach the specification in the order that suits them.

Should you wish to speak to a member of the Science Subject Team regarding teaching hours and scheme of work planning, we are available at [scienceGCSE@ocr.org.uk](mailto:scienceGCSE@ocr.org.uk) or 01223 553998.

## Delivery guides

Delivery guides are individual teacher guides available from the qualification pages:

* <http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/>
* <http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-combined-science-a-j250-from-2016/>

These Delivery guides provide further guidance and suggestions for teaching of individual topics, including links to a range of activities that may be used and guidance on resolving common misconceptions.

## Practical work

Specification Topic C7 (Practical skills) is not included explicitly in the Planning Guidance table. The expectation is that the practical skills are developed throughout the course and in support of conceptual understanding.

Suggestions where the PAG activities can be included are given in the table below. This is by no means an exhaustive list of potential practical activities that can be used in teaching and learning of Chemistry.

Suggested activities are available under “Teaching and Learning Resources / Practical Activities” on the qualification page: <http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/#resources>.

An optional activity tracker is available at <http://www.ocr.org.uk/Images/323481-gcse-chemistry-practical-tracker.zip>.

An optional learner record sheet is available at <https://www.ocr.org.uk/Images/295630-gcse-chemistry-student-record-sheet.doc>.

A sample set of activities that gives learners the opportunity to cover all apparatus and techniques is available at <https://www.ocr.org.uk/news/example-set-of-chemistry-practicals/>.

| Topics | Suggested teaching hoursSeparate / Combined | Comments and PAG opportunities |
| --- | --- | --- |
| **Topic C1: Particles** | | |
| C1.1 The particle model | 4 / 4 |  |
| C1.2 Atomic structure |  |
|  | **Total 4 / 4** |  |
| **Topic C2: Elements, compounds and mixtures** | | |
| C2.1 – Purity and separating mixtures | 10 / 10 | PAG C3: Using chromatography to identify mixtures of dyes in an unknown ink.  PAG C3: Thin layer chromatography.  PAG C4: Distillation of mixtures.  PAG C4, C7: Separation of mixtures and purification of compounds. |
| C2.2 – Bonding | 8 / 8 |  |
| C2.3 – Properties of materials | 10 / 6 | PAG C8: Dissolving tablets. |
|  | **Total 28 / 24** |  |
| **Topic C3: Chemical reactions** | | |
| C3.1 – Introducing chemical reactions | 11 / 11 |  |
| C3.2 – Energetics | 6 / 6 | PAG C8: Measuring the temperature change in reactions. |
| C3.3 – Types of chemical reactions | 10 / 10 | PAG C6: Neutralisation reactions.  PAG C6: Determining pH of unknown solutions.  PAG C6: Use of pH probes.  PAG C7: Production of pure dry sample of salt. |
| C3.4 – Electrolysis | 4 / 4 | PAG C2: Electrolysis of sodium chloride solution.  PAG C2: Electrolysis of copper sulfate solution. |
|  | **Total 31 / 31** |  |
| **Topic C4: Predicting and identifying reactions and products** | | |
| C4.1 – Predicting chemical reactions | 8 / 6 | PAG C1: Displacement reactions of halogens with halides.  PAG C1, C5, C8: Investigation of transition metals.  PAG C1, C7, C8: Reaction of metals with water, dilute hydrochloric acid.  PAG C1, C7, C8: Displacement reactions involving metals and metal salts. |
| C4.2 – Identifying the products of chemical reactions | 8 / 1 | PAG C5: Flame tests.  PAG C5: Testing unknown solutions for cations and anions.  PAG C5: Tests for anions using silver nitrate and barium sulfate.  PAG C5: Tests for cations using sodium hydroxide. |
|  | **Total 16 / 7** |  |

| Topics | Suggested teaching hoursSeparate / Combined | Comments and PAG opportunities |
| --- | --- | --- |
| **Topic C5: Monitoring and controlling chemical reactions** | | |
| C5.1 – Monitoring chemical reactions | 12 / 1 | PAG C6: Acid/alkali titrations.  PAG C8: Measurement of gas volumes and calculating amount in moles. |
| C5.2 – Controlling reactions | 10 / 10 | PAG C1, C7, C8: Marble chip and acid or magnesium and acid experiments either measuring reaction time or the volume of gas over time.  PAG C1, C8: Catalysis of hydrogen peroxide with various black powders including MnO2.  PAG C1, C8: Catalysis of reaction of zinc with sulfuric acid using copper powder.  PAG C1, C8: Magnesium and acid, marble chip and acid.  PAG C1, C8: Rate of reaction experiments.  PAG C1, C8: Reaction of magnesium and acid with different temperatures of acid – measure reaction times.  PAG C1, C8: Varying surface area with marble chips and hydrochloric acid.  PAG C8: Disappearing cross experiment. |
| C5.3 – Equilibria | 3 / 3 |  |
|  | **Total 25 / 14** |  |
| **Topic C6: Global challenges** | | |
| C6.1 – Improving processes and products | 16 / 7 | PAG C1: Extraction of copper by heating copper oxide with carbon.  PAG C2: Electrolysis of aqueous copper sulfate solution.  PAG C2: Electrolysis of aqueous sodium chloride solution.  PAG C6: Preparation of potassium sulfate or ammonium sulfate using a titration method. |
| C6.2 – Organic chemistry | 12 / 4 |  |
| C6.3 – Interpreting and interacting with earth systems | 8 / 7 |  |
|  | **Total 36 / 18** |  |
| **GRAND TOTAL SUGGESTED HOURS – 140 / 98 hours** | | |

þ This symbol indicates content that is found only in the chemistry separate science qualification.

Statements shown in **bold** type will only be tested in the Higher Tier papers. All other statements will be assessed in both Foundation and Higher Tier papers.

# Outline Scheme of Work: C5 – Monitoring and controlling chemical reactions

## Total suggested teaching time – 25 / 14 hours (separate / combined)

### C5.1 – Monitoring chemical reactions (12 / 1 hours – separate / combined)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * defining acids and alkalis in terms of neutralisation reactions * representing chemical reactions using formulae and using equations | Links to Practical Activity Groups (PAGs)  * PAG C6: Making standard solutions and acid/alkali titrations * PAG C8: Measurement of gas volumes and calculating amount in moles |
| Links to Mathematical Skills  * M1a * M1b * M1c * M1d * M2a * M3b * M3c | Links to Working Scientifically  * WS1.2a * WS1.2b * WS1.2c * WS1.2d * WS1.3c * WS1.3f * WS1.4a * WS1.4b * WS1.4c * WS1.4d * WS1.4f * WS2a * WS2b |

| Suggested timings | Statements [to include] þ - separate science only bold – Higher Tier only | Teaching activities | Notes |
| --- | --- | --- | --- |
| C5  Topic 1 Part 1  7 / 1 hours  (separate / combined) | **CM5.1i þ – calculations with numbers written in standard form when using the Avogadro constant [M1b]**  CM5.1ii þ – provide answers to an appropriate number of significant figures [M2a]  CM5.1iii þ – convert units where appropriate **particularly from mass to moles** [M1c]  CM5.1iv þ – arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry [M1a, M1c, M1d]  CM5.1vi þ – change the subject of a mathematical equation [M3b, M3c]  **C5.1a þ – explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution**  C5.1b þ – describe the technique of titration  **C5.1c þ – explain the relationship between the volume of a solution of known concentration of a substance and the volume or concentration of another substance that react completely together [titration calculations]**  **C5.1f – explain how the mass of a solute and the volume of the solution is related to the concentration of the solution** | Discuss use and conversion of units , specifically dm3, cm3, L and mL – it may be worth speaking to the Maths department about how they teach these and related concepts. Discuss the units of concentration, specifically mol/dm3 and g/dm3 and how dilution affects concentration. Use of visual demonstrations and everyday contexts – diluting orange squash, medicines, cleaning products etc can help.  The ‘[Calculating concentrations](http://chemistry.about.com/od/lecturenotesl3/a/concentration.htm)‘ website would be of interest to higher ability students. This ‘[Concentration of solutions calculations’](http://www.ausetute.com.au/concsols.html) website includes brief discussions and some worked examples. The ‘[Quantitative Chemistry’](http://www.rsc.org/learn-chemistry/resource/res00000954/starters-for-ten?cmpid=CMP00001405) section on the Starter for 10 resource contains useful example questions.  A lesson on using the burette and pipette with just water is worthwhile to reduce the cognitive load for the learners when it is all put together for carrying out a titration. Demonstrating and insisting on good technique early pays dividends later on.  [Making a standard solution](https://www.creative-chemistry.org.uk/documents/N-ch1-35.pdf) helps make the conceptual link between the macroscopic mass-world and the microscopic moles-world for the learners.  The Practical Project ‘[Titrating sodium hydroxide with hydrochloric acid’](http://www.rsc.org/learn-chemistry/resource/res00000697/titrating-sodium-hydroxide-with-hydrochloric-acid?cmpid=CMP00005972) activity provides instructions for carrying out a strong acid/alkali titration. An explanation/demonstration of the use of different indicators would be useful, for example the Practical Chemistry project ‘[Universal indicator ‘rainbow’](http://www.rsc.org/learn-chemistry/resource/res00000700/universal-indicator-rainbow?cmpid=CMP00005976)‘ activity.  [David Read](https://www.youtube.com/user/lowlevelpanic999/videos) has a range of useful videos available on many aspects of practical work including [performing titrations](https://www.youtube.com/watch?v=-x-q8hLB_rg) and [using volumetric pipettes](https://www.youtube.com/watch?v=5oTyJWdQ174). The Royal Society of Chemistry [Titration Screen experiment](http://www.rsc.org/learn-chemistry/resource/res00002077/titration-screen-experiment?cmpid=CMP00007002) is useful for pre and post-lesson learning and consolidation.  Graph plotting skills can be consolidated and the shapes of titration curves practically investigated by carrying out step-by-step titrations, measuring the pH of the mixture on addition of 1 cm3 aliquots of acid to alkali, and plotting the volume added against pH graph. The ‘[pH (titration) curves’](http://www.chemguide.co.uk/physical/acidbaseeqia/phcurves.html) page from chemguide.co.uk provides useful reading.  The OCR ‘[Amount of Substance and the Mole delivery](https://www.ocr.org.uk/Images/170250-amount-of-substance-and-the-mole.pdf) guide’ contains many other useful links and discussion.  An OCR delivery guide for this [whole topic](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/delivery-guide/) is available on the [qualification page](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/). | This topic tackles the relationship of moles with the concentration of a solution and the volume of a gas. It also tackles the calculation of the mass of a substance in terms of its molarity. The topic then moves on to look at using equations to make predictions about yield and to calculate atom economy.  If C3 has been studied, learners should be familiar with the mole and know that it measures the amount of substance. They should be familiar with representing chemical reactions using formulae and using equations.  The most common problem learners’ encounter with these calculations is their lack of understanding of ratios. Also most learners think that the mole and mass are the same thing. This is reinforced by use of phrases such as ‘1 mole is 12 g of carbon,’1 mole is the relative atomic mass in grams’ or ‘1 mol = 12 g C’ in teaching and in textbooks, equating amount of substance to mass, portion of substance, number of particles (Avogadro’s number) or number of moles. All these phrases reinforce the idea that amount of substance is a measure of mass or a number.  Titration theory and practice bring together many aspects of Chemistry including mole calculations, acid-base chemistry, manipulative skills and problem solving. A solid understanding of ratio, use of the Periodic Table and manipulation of algebraic equations is also important.  Gradual introduction of the theoretical and practical aspects will help students deal with the large amount of new information they need to process. For example, using simple amount of substance calculations before full titration questions, and allowing them to practice use of burette and pipette individually with water before carrying out actual titrations.  Dilution theory and practice should also be covered in relation to making and use of standard solutions.  Plenty of practice of titration calculations will be required to embed understanding and confidence – this can be spread out over time. |
| C5  Topic 1 Part 2  2 hours  (separate only) | **C5.1d þ – describe the relationship between molar amounts of gases and their volumes and vice versa**  **C5.1e þ – calculate the volumes of gases involved in reactions using the molar gas volume at room temperature and pressure (assumed to be 24 dm3)** | The ‘[Rate of reaction of magnesium with hydrochloric acid’](http://www.rsc.org/learn-chemistry/resource/res00001916/the-rate-of-reaction-of-magnesium-with-hydrochloric-acid?cmpid=CMP00006119) practical can be simplified to focus just on the volume of hydrogen produced from a known amount of magnesium, hence helping the learner make conceptual links between the macroscopic mass-world and the microscopic moles-world, and between moles of solid and gaseous substances. When repeated later on with respect to rates of reaction, the learners will be familiar with the experimental set-up, allowing them to focus more closely on measuring volumes of gas over time.  Wilson Flood’s [‘Moles Calculations in Chemistry: The Unit Label Method’](https://www.scribd.com/doc/292478948/Mole-Calculations-in-Chemistry-Flood) document and docbrown.info’s ‘[Molar gas volume](http://www.docbrown.info/page04/4_73calcs09mvg.htm)‘ page contains many worked examples of molar gas calculations.  The OCR ‘[Amount of Substance and the Mole delivery](https://www.ocr.org.uk/Images/170250-amount-of-substance-and-the-mole.pdf) guide’ contains many other useful links and discussions. |  |
| C5  Topic 1 Part 3  3 hours  (separate only) | CM5.1v þ – arithmetic computation when calculating yields and atom economy [M1a, M1c]  C5.1g þ – calculate the theoretical amount of a product from a given amount of reactant  C5.1h þ – calculate the percentage yield of a reaction product from the actual yield of a reaction  C5.1i þ – define the atom economy of a reaction  C5.1j þ – calculate the atom economy of a reaction to form a desired product from the balanced equation  **C5.1k þ** – **explain why a particular reaction pathway is chosen to produce a specified product given appropriate data [data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by- products]** | Various simple practical activities/investigations can be used. For example   * Reaction of lead nitrate and potassium iodide – good demonstration of conservation of mass * Heating set amounts of magnesium ribbon (e.g. 0.5, 1.0, 1.5, 2.0g etc) and weighing the magnesium oxide product – plotting the mass data and identifying the directly proportional correlation. * Decomposition of metal carbonates, predicting and measuring the expected mass of resultant metal oxide * Reaction of metal carbonates with acid solutions, predicting and measuring the expected final mass of the solution.   The concepts around yield can be introduced with the fun, if a little messy activity, of mining chocolate chip cookies (learners weigh cookies, ‘extract’ the chips and weigh, then calculate the yield). The theoretical yield can also be determined if the ingredients show enough detail.  Gideon Lyon’s ‘[Breaking Bad’](https://www.tes.com/teaching-resource/breaking-bad-percentage-yield-investigation-11002685) themed investigation gives a new twist to yield determination.  Chemguide contains a [good summary](http://www.chemguide.co.uk/physical/equilibria/haber.html) of the compromise conditions used in the Haber process for the production of ammonia.  The University of York [Essential Chemical Industry](http://www.essentialchemicalindustry.org/index.php) online provides an excellent resource for research/independent/project work to look at other examples of compromises necessary in the chemical industry.  The OCR ‘[Atom economy and percentage yield’](https://www.ocr.org.uk/Images/233797-atom-economy-and-percentage-yield.pdf) delivery guide, although an A-level resource, still contains many resources that would be relevant and useful. | This part again provides rich opportunities for linking between the macroscopic, microscopic and symbolic. It is worth keeping in mind that as teachers we can switch easily between these domains, but for learners the process can be hard and can cause/reinforce misconceptions. Being explicit about the different ways of viewing and describing reactions occurring may be helpful.  A [detailed review](http://pubs.rsc.org/En/content/articlelanding/2013/rp/c3rp00012e/unauth#!divAbstract) of these ideas is available from the RSC Chemistry Education Research and Practice journal.  C5.1k is a wide ranging learning outcome, and will be revisited in C5.3 and C6.1, so full teaching and learning isn’t necessarily required here. |

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| Additional remote learning opportunities As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020. | | |
| **Part** | **Statement** | **Teaching activities** |
| 1 | C5.1b | A [video](https://www.youtube.com/watch?v=vn3Rx3g1VPk&list=PLAd0MSIZBSsEygAZyDRkK0PgQZ6uiC98F&index=8&t=0s) showing the technique for carrying out a titration. |
|  |  | A free [online learning platform](https://app.senecalearning.com/classroom/course/96e31cd0-163e-11e8-8f0b-c709585e9621/section/fd1126e0-164e-11e8-b52e-dd62726b4526/session). Consists of revision questions. Covers the whole specification. You can choose which topics to answer questions on. |

# Outline Scheme of Work: C5 – Monitoring and controlling chemical reactions

## Total suggested teaching time – 25 / 14 hours (separate / combined)

### C5.2 – Controlling reactions (10 hours – separate and combined)

|  |  |  |
| --- | --- | --- |
| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * representing chemical reactions using formulae and using equations * what catalysts do | Links to Practical Activity Groups (PAGs)  * PAG C8: Disappearing cross experiment. * PAG C8: Magnesium and acid, marble chip and acid. * PAG C1, C7, C8: Marble chip and acid or magnesium and acid experiments either measuring reaction time or the volume of gas over time. * PAG C1, C8: Varying surface area with marble chips and hydrochloric acid. * PAG C1, C8: Reaction of magnesium and acid with different temperatures of acid – measure reaction times. * PAG C1, C8: Catalysis of hydrogen peroxide with various black powders including MnO2. * PAG C1, C8: Catalysis of reaction of zinc with sulfuric acid using copper powder | |
| Links to Mathematical Skills  * M1a * M1c * M4b * M4c * M4d * M4e | Links to Working Scientifically  * WS1.2b * WS1.2c * WS1.2d * WS1.3a * WS1.3b * WS1.3c * WS1.3d * WS1.3e | * WS1.3f * WS1.3g * WS1.3h * WS1.3i * WS1.4a * WS1.4c * WS2a * WS2b |

| Suggested timings | Statements [to include] þ - separate science only bold – Higher Tier only | Teaching activities | Notes |
| --- | --- | --- | --- |
| C5  Topic 2  10 hours  (separate and combined) | CM5.2i – arithmetic computation, ratio when measuring rates of reaction [M1a, M1c]  CM5.2ii – drawing and interpreting appropriate graphs from data to determine rate of reaction [M4b, M4c]  CM5.2iii – determining gradients of graphs as a measure of rate of change to determine rate [M4d, M4e]  CM5.2iv – proportionality when comparing factors affecting rate of reaction [M1c]  C5.2a – suggest practical methods for determining the rate of a given reaction  C5.2b – interpret rate of reaction graphs [1/t is proportional to rate and gradients of graphs (not order of reaction)]  C5.2c – describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction  C5.2d – explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles  C5.2e – explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio  C5.2f – describe the characteristics of catalysts and their effect on rates of reaction  C5.2g – identify catalysts in reactions  C5.2h – explain catalytic action in terms of activation energy [reaction profiles]  C5.2i – recall that enzymes act as catalysts in biological systems | The rates of reaction topic usually allows for lots of practical work to be carried out, data collected and interpreted, and for good use of modelling to explain chemical principles.  A [series of articles](http://www.rsc.org/eic/2015/12/chemical-reaction-rates-part-one) by Steve Hacker published in Education in Chemistry contain useful background and ideas, including on rates and equilibrium.  Commonly used practicals allow for measuring of rates of reaction, focussing on a variety of different factors:   * [effect of concentration](http://www.rsc.org/learn-chemistry/resource/res00000743/the-effect-of-concentration-on-reaction-rate) * [effect of temperature](http://www.rsc.org/learn-chemistry/resource/res00000448/the-effect-of-temperature-on-reaction-rate) * [effect of concentration and temperature](http://www.rsc.org/learn-chemistry/resource/res00000413/the-effect-of-concentration-and-temperature-on-reaction-rate) * [measuring gas volume](http://www.rsc.org/learn-chemistry/resource/res00001916/the-rate-of-reaction-of-magnesium-with-hydrochloric-acid?cmpid=CMP00006119) * [iodine clock investigation](http://www.rsc.org/learn-chemistry/resource/res00000744/iodine-clock-Investigate)   Additionally, the effect of surface area on the rate of reaction can easily be demonstrated with three identical setups of a conical flask with acid on a balance, adding equal masses of large, small and powdered marble chips and monitoring the changes in mass over time.  Practical/demonstrations involving changes in pressure are not commonly carried out, but learners can understand the concept by relation to concentration.  Graph plotting can be a perennial problem for some students, and back to basics tutoring of some may be necessary to ensure they are getting this key skill right. The OCR Maths Skills Handbook for GCSE Sciences includes a useful section on graph drawing. Measuring rates by drawing tangents to curves will likely prove challenging for many at the start, but plenty of practice and working in small groups usually helps the learners to understand and develop this skill.  The ‘[Reactions and rates’](https://phet.colorado.edu/en/simulation/reactions-and-rates) pHET demonstration can be useful before, during and after lessons for pre and post lesson learning and consolidation.  Many good activities exist for demonstrating the effect of catalysts, including the [decomposition of hydrogen peroxide](http://www.rsc.org/learn-chemistry/resource/res00000831/hydrogen-peroxide-decomposition?cmpid=CMP00002415).  Collision theory can be effectively demonstrated with modelling using the learners as particles moving around a large contained area – halls or gyms work well. Collisions are modelled as high-fiving as they ‘collide’ and conditions can be altered by changing the number of learners, their speed and the available area for them to move. Counting the number of high-fives in a fixed time, and looking for the patterns allows for a fun introduction to collision theory. The effect of particle density and speed of particle movement in relation to successful collision per second (rate of reaction) can then be made clear.  The RSC [Assessment for Learning](http://www.rsc.org/Education/Teachers/Resources/Aflchem/) resource contains a useful section on [Rate of reaction graphs](http://www.rsc.org/learn-chemistry/resource/res00000095/afl-rate-of-reaction-graphs?cmpid=CMP00000123).  An OCR delivery guide for this [whole topic](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/delivery-guide/) is available on the [qualification page](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/). | The rate and yield of a chemical reaction can be altered by changing the conditions of reaction  Learners should be familiar with the action of catalysts in terms of rate of reaction. They should know the term surface area and what it means.  Learners often misinterpret rate graphs and think that catalysts take part in reactions and then run out/get used up.  A generous amount of time has been suggested for this topic to allow time for developing good competency in the key skills. |

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| Additional remote learning opportunities ***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** | | |
| **Topic** | **Statement** | **Teaching activities** |
| 2 | C5.2a – C5.2d | [Video and teaching pack](https://ocr.org.uk/rpgchem4) for the practical: Effect of changing the concentration of hydrochloric acid on the rate of reaction with calcium carbonate. This includes advice for an actual and virtual practical. It also includes preparation worksheets and a summary quiz. |
|  | C5.2c – C5.2d | [Online interactive simulation](https://lab.concord.org/embeddable.html#interactives/sam/chemical-reactions/2-concentration-and-reaction-rate.json) where students can control the concentration of particles and then measure the rate of reaction. Allows students to gather results at home to analyse.  [Online interactive simulation](https://lab.concord.org/embeddable.html#interactives/sam/chemical-reactions/3-temperature-and-reaction-rate.json) where students can control the temperature of particles and then measure the rate of reaction. Allows students to gather results at home to analyse. |

# Outline Scheme of Work: C5 – Monitoring and controlling chemical reactions

## Total suggested teaching time – 25 / 14 hours (separate / combined)

### C5.3 – Equilibria (3 hours – separate and combined)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * representing chemical reactions using formulae and using equations | Links to Practical Activity Groups (PAGs)  * N/A |
| Links to Mathematical Skills  * M1a * M1c * M4b * M4c * M4d * M4e | Links to Working Scientifically  * WS1.2a * WS1.2b * WS1.2c * WS1.4c * WS2a * WS2b |

| Suggested timings | Statements [to include] þ - separate science only bold – Higher Tier only | Teaching activities | Notes |
| --- | --- | --- | --- |
| C5  Topic 3  3 hours  (separate and combined) | CM5.3i – arithmetic computation, ratio when measuring rates of reaction [M1a, M1c]  CM5.3ii – drawing and interpreting appropriate graphs from data to determine rate of reaction [M4b, M4c]  CM5.3iii – determining gradients of graphs as a measure of rate of change to determine rate [M4d, M4e]  CM5.3iv – proportionality when comparing factors affecting rate of reaction [M1c]  C5.3a – recall that some reactions may be reversed by altering the reaction conditions  C5.3b – recall that dynamic equilibrium occurs in a closed system when the rates of forward and reverse reactions are equal  **C5.3c – predict the effect of changing reaction conditions on equilibrium position and suggest appropriate conditions to produce as much of a particular product as possible [Le Chatelier’s principle concerning concentration, temperature and pressure]** | Various Youtube videos are available to introduce the ideas around equilibrium, for example from [FuseSchool](https://www.youtube.com/watch?v=wlD_ImYQAgQ) (and [here](https://www.youtube.com/watch?v=7zuUV455zFs) and [here](https://www.youtube.com/watch?v=XhQ02egUs5Y) specifically on Le Chatelier’s principle) and [CrashCourse](https://www.youtube.com/watch?v=g5wNg_dKsYY). The [BBC Bitesize website](https://www.bbc.co.uk/bitesize/guides/z334pbk/revision/1) also provides some brief notes.  An alternative method is to use the pHET [Reaction and Rates](http://phet.colorado.edu/en/simulation/legacy/reactions-and-rates) app and this [lesson plan](https://phet.colorado.edu/en/contributions/view/3055) (free signin required) to allow learners a chance to engage with the ideas before consolidating in class. An additional pHET activity ([Reversible Reactions](http://phet.colorado.edu/en/simulation/legacy/reversible-reactions)) is a similar simple modelling app.  The OCR Lesson Element ‘[Equilibrium’](http://www.ocr.org.uk/Images/179798-equilibrium-activity.doc) (and [here](http://www.ocr.org.uk/Images/179794-equilibrium-activity-game-and-pieces-.pdf) and [here](http://www.ocr.org.uk/Images/179799-equilibrium-activity-teacher-instructions.pdf)) has some short starter activities and a board game that helps introduce and consolidate the ideas around equilibrium.  The [equilibrium between chromate and dichromate ions](http://www.rsc.org/learn-chemistry/resource/res00001710/an-equilibrium-involving-chromate-vi-and-dichromate-vi-ions?cmpid=CMP00005224) and how it can be affected by the addition of hydrogen ions and hydroxide ions is useful teacher demonstration of what is happening as the equilibrium point is being reached.  Changing the effect of pressure/concentration is generally more easily understood than that of temperature. The Haber process is usually used when discussing this, and further detail is required in C6. Examination of yield data on changing conditions in the process helps to reinforce ideas on how the equilibrium position can be changed. . The set of pages on reversible reactions based on Haber from [BBC Bitesize](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/chemreac/reversiblereacrev1.shtml) contain some potentially useful animations.  An OCR delivery guide for this [whole topic](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/delivery-guide/) is available on the [qualification page](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/). | In a reaction, when the rate of the forward reaction equals the rate of the backwards reaction, the reaction in a closed system is said to be in equilibrium. Learners will be familiar with representing chemical reactions using formulae and using equations. Learners often do not recognise that when a dynamic equilibrium is set up in a reaction the concentration of the reactants and products remain constant. They think that they are equal. Learners also sometimes perceive a dynamic equilibrium as two reactions.  C5.3c links with on-going teaching on choice of reaction from C5.1k and C6.1. |



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