# 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

# 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 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: C4 – Predicting and identifying reactions and products

## Total suggested teaching time – 16 / 7 hours (separate / combined)

### C4.1 – Predicting chemical reactions (8 hours – separate and combined)

|  |  |
| --- | --- |
| Links to KS3 Subject content* chemical reactions as the rearrangement of atoms
* displacement reactions
* how patterns in reactions can be predicted with reference to the Periodic Table
* representing chemical reactions using formulae and using equations
* the Periodic Table: periods and groups; metals and non-metals
* the properties of metals and non-metals
* the varying physical and chemical properties of different elements
* thermal decomposition
 | Links to Practical Activity Groups (PAGs)* PAG C1: Displacement reactions of halogens with halides
* PAG C1, C5, C8: Investigation of transition metals
* PAG C1, C7, C8: Displacement reactions involving metals and metal salts
* PAG C1, C7, C8: Reaction of metals with water, dilute hydrochloric acid
 |
| Links to Mathematical Skills* M1a
* M1c
 | Links to Working Scientifically* WS1.1b
* WS1.2a
* WS1.3e
* WS1.4a
* WS1.4c
* WS2a
 |

| Suggested timings | Statements [to include]þ - separate science only**bold – Higher Tier only** | Teaching activities | Notes |
| --- | --- | --- | --- |
| C4Topic 18 / 6 hours (separate / combined) | CM4.1i - arithmetic computation and ratio when determining empirical formulae, balancing equations [M1a, M1c]C4.1a – recall the simple properties of Groups 1, 7 and 0 [physical and chemical properties]C4.1b – explain how observed simple properties of Groups 1, 7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups [ease of electron gain or loss; physical and chemical properties]C4.1c þ – recall the general properties of transition metals and their compounds and exemplify these by reference to a small number of transition metals [melting point, density, reactivity, formation of coloured ions with different charges and uses as catalysts]C4.1d – predict possible reactions and probable reactivity of elements from their positions in the periodic tableC4.1e – explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ionC4.1f – deduce an order of reactivity of metals based on experimental results | The properties of alkali metals can be [demonstrated](http://www.rsc.org/learn-chemistry/resource/res00000731/alkali-metals?cmpid=CMP00004756), covering reaction trend with water, alkalinity of solution etc. Heating the alkali metals in air and chlorine can also be [demonstrated](http://www.rsc.org/learn-chemistry/resource/res00000732/heating-group-1-metals-in-air-and-in-chlorine?cmpid=CMP00005145). Many [videos](https://www.youtube.com/watch?v=uixxJtJPVXk) exist of demonstrations of the properties of alkali metals, but be selective (the often used [Brainiac demonstations](https://www.youtube.com/watch?v=m55kgyApYrY) were [faked towards the end](http://www.badscience.net/2006/07/brainiac-fake-experiments-scandal-make-it-to-the-evening-standard/), providing a useful discussion point on scientific communication).Properties and trends of Group 0 is a useful independent learning/research activity, and learners should be directed towards high quality sources such as [WebElements](https://www.webelements.com/) and the [RSC Periodic Table](http://www.rsc.org/periodic-table/) in the first instance.Properties of the halogens can be investigated using Classic Chemistry Experiment #19 the [Nuffield](http://www.rsc.org/learn-chemistry/resource/res00000733/reactions-of-halogens-as-aqueous-solutions?cmpid=CMP00006118) practical. These practicals are also the basis of one of the suggested OCR PAG3 activities. Students can be extended using the [Halogens pack](http://www.rsc.org/learn-chemistry/resource/res00000844/halogens?cmpid=CMP00000954) from the RSC G&T resource.Balancing equations may need to be consolidated – use of mini-white boards for rapid feedback/formative assessment might be appropriate here.Discussing the link between reactivity and loss/gain of electrons (and hence redox) and distance of the outer shell from the nucleus is a core part of the theoretical work here. Learners can be helped to construct concise and valid explanations using the ideas within activities from the Chemical Misconceptions resource ([Stability](http://www.rsc.org/learn-chemistry/resource/res00001102/chemical-stability), [Stability and Reactivity](http://www.rsc.org/learn-chemistry/resource/res00001103/stability-and-reactivity), [Explanations](http://www.rsc.org/learn-chemistry/resource/res00001109/scaffolding-explanations)).Properties of transition metals and their compounds can be investigated with [Classic chemistry experiments #88](http://www.rsc.org/learn-chemistry/resource/res00000472/properties-of-the-transition-metals-and-their-compounds?cmpid=CMP00000542) or a [Microscale version](https://edu.rsc.org/resources/the-transition-elements/518.article) . Simple investigations into physical properties (hardness, electrical conductivity, density) provide opportunities to develop investigative and problem solving skills, and links to Physics teaching. Links can be made forward in the course to qualitative analysis with respect to cation precipitation. Demonstration of the catalytic properties provides opportunities for memorable demonstrations such as ‘[elephants tooth paste’](http://www.rsc.org/learn-chemistry/resource/res00000831/hydrogen-peroxide-decomposition?cmpid=CMP00002415) and [Traffic Light](http://www.rsc.org/education/eic/issues/2005July/Exhibitionchemistry.asp) reaction ([RSC’s Exhibition Chemistry](https://eic.rsc.org/classroom/exhibition-chemistry) provides a useful archive of demonstations).While investigation of the displacement reactions of metals is likely a repeat of practicals carried out in Key Stage 3, it is still worth repeating, focussing now on careful observation and recording skills, linking to ideas of rate of reaction. Learners should be able to develop word and symbol equations and make predictions about which reactions will occur, supported by this the Chemical Misconceptions [Word equation resource](http://www.rsc.org/learn-chemistry/resource/res00001087/word-equations).Reactions of metals in acids can be investigated with the Nuffield ‘[Metals and acids experiment’](http://www.rsc.org/learn-chemistry/resource/res00000446/metals-and-acids-experiment?cmpid=CMP00005351). | This is a demonstration/practical heavy topic, with plenty of time suggested to allow the learners to engage well both minds-on and hands-on with these aspects. Demonstration of the Group 1 properties is a perennially favourite and part of the course learners seem to remember best. They should investigate the displacement reactions of halogen solutions with metal halides and observe the properties of the halogens. Demonstration of the direct reaction of alkali metals with halogens nicely brings these two groups together.Separate science learners will extend their studies to the transition metals, and many practical opportunities present themselves.Explaining the chemical and physical properties of these groups brings many aspects of chemistry together including periodicity, electronic structure, energetics and balanced equations, providing opportunity to consolidate previous learning and introduce other topics.Higher level candidates might during this part of the unit ask why the transition metal ions have different charges/why the charge does not simply increase by 1+ as we move across the period. Dependent upon the ability of the group allow the discussion to continue to show how the model of the atom that they are studying at the moment does not answer all of the questions and that there are other factors that they will need to appreciate if they continue their studies in chemistry. |

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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** |
| 1  | C4.1a | [Video](https://revisionworld.com/gcse-revision/chemistry/periodic-table/group-1-metals) showing the reactions of group 1 metals with water.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: C4 – Predicting and identifying reactions and products

## Total suggested teaching time – 16 / 7 hours (separate and combined)

### C4.2 – Identifying the products of chemical reactions (8 / 1 hours – separate / combined)

|  |  |
| --- | --- |
| Links to KS3 Subject content* chemical reactions as the rearrangement of atoms
* reactions of acids with metals to produce a salt plus hydrogen
* representing chemical reactions using formulae and using equations
 | Links to Practical Activity Groups (PAGs)* PAG C2: Electrolysis (gas tests)
* PAG C5: Tests for cations using sodium hydroxide
* PAG C5: Tests for anions using silver nitrate and barium sulfate
* PAG C5: Flame tests
* PAG C5: Testing unknown solutions for cations and anions
 |
| Links to Mathematical Skills* M4a – Translate information between graphical and numeric forms
 | Links to Working Scientifically* WS1.1e – applications of science
* WS1.2b – planning experiments
* WS1.2c – selecting techniques, apparatus etc
* WS1.2d – use of sampling
* WS1.2e – evaluating methods
* WS1.3e – interpreting observations and data
* WS1.4a – use of scientific language
* WS2a – carry out experiments
* WS2b – making and recording observations/measurements
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| Suggested timings | Statements [to include]þ - separate science onlybold – Higher Tier only | Teaching activities | Notes |
| --- | --- | --- | --- |
| C4Topic 28 / 1 hours (separate / combined) | CM4.2i þ – interpret charts, particularly in spectroscopy [M4a]C4.2a – describe tests to identify selected gases [oxygen, hydrogen, carbon dioxide and chlorine]C4.2b þ – describe tests to identify aqueous cations and aqueous anions [calcium, copper, iron (II), iron (III) and zinc using sodium hydroxide; carbonates and sulfates using aqueous barium chloride followed by hydrochloric acid; chloride, bromide and iodide using silver nitrate ]C4.2c þ – describe how to perform a flame testC4.2d þ – identify species from test resultsC4.2e þ – interpret flame tests to identify metal ions [the ions of lithium, sodium, potassium, calcium and copper]C4.2f þ – describe the advantages of instrumental methods of analysis [sensitivity, accuracy and speed ]C4.2g þ – interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set of data in the same form | A detailed page of notes and diagrams on [instrumental techniques](http://www.docbrown.info/page01/ExIndChem/ExIndChemd.htm) is available from docbrown.info. [SpectraSchool](http://www.rsc.org/learn-chemistry/collections/spectroscopy) provides lots of extra resources and ideas. Details on [generating large volumes](http://www.rsc.org/learn-chemistry/resource/res00000693/generating-collecting-and-testing-gases?cmpid=CMP00006610) of gas for demonstrating testing are available from the RSC. Gas tests are covered in the OCR PAG 2 (Electrolysis) activities.The ion tests can be carried out by traditional means ([Classic Chemistry Experiment #80](http://www.rsc.org/learn-chemistry/resource/res00000464/testing-salts-for-anions-and-cations?cmpid=CMP00000534)) or [microscale](https://www.youtube.com/watch?v=oizwWsm43lY). The OCR PAG 5 (Identification of species) also covers these tests. Flame testing is covered by an [RSC practical](http://www.rsc.org/learn-chemistry/resource/res00001875/flame-tests-using-metal-salts?cmpid=CMP00004545) and a [dramatic demonstration.](https://www.youtube.com/watch?v=d8hpUtRnsYc)Investigative skills can be developed here after the various tests have been taught by providing a sample of unknown composition and directing the learners to discover its identify by use of ion and flame testing. While aimed at A-level learners, this OCR ‘[Identifying Unknowns](https://www.ocr.org.uk/Images/208563-identifying-unknowns.pdf)’ delivery guide may be of use to extend the able and interested learner.Ideas about precipitation can be consolidated using the Chemical Misconceptions ‘[Precipitation](http://www.rsc.org/learn-chemistry/resource/res00001096/precipitation)’ activity.Discussion on careers in chemistry can start with the RSC [175 Faces of Chemistry](http://www.rsc.org/diversity/175-faces/?s=1) project. | Qualitative and quantitative analysis provides plenty of opportunities for practical work and linking various concepts within chemistry. A generous suggested hours is given here so as to allow for development of competency in practical work, especially close observation and problem solving.All learners need to know how to carry out the simple gas tests, whilst only separate science learners cover the ion tests and discussions of instrumental techniques.While instrumental techniques is covered at a basic level here, this is a strong ‘hook’ concept in to further study of chemistry, with spectroscopy covered in greater detail at A-level. Linking to careers might be interesting, with opportunities to use case studies of analytical scientists, and the role of analysis in wide areas of our lives, from medicines, to food and environmental safety and the oil industry. |

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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 | C4.2a | [Video](https://www.ocr.org.uk/Images/587816-c4-cup-elevate-video-hydrogen-test.mp4) showing the test for hydrogen. |
|  | C4.2b | [Video](https://www.youtube.com/watch?v=mWTgHjdea4Y&list=PLidqqIGKox7WeOKVGHxcd69kKqtwrKl8W&index=74&t=0s) explaining the tests for anions. |
|  | C4.2a – C4.2g | [Structured question sheet](https://www.teachitscience.co.uk/resources/ks4/chemical-analysis/chemistry/chemical-analysis-structured-questions/32912) on chemical analysis, answers provided. The website does have a subscription option, but there is a free option also, where resources can be downloaded as a pdf. |
|  | C4.2f | An [RSC video](https://www.youtube.com/watch?v=NEIm41cKXf8) showing the day in the life on an analytical chemist. In addition to giving some advantages of instrumental methods of analysis, it also provides a careers link. |
|  | C4.2g | Three [RSC activities](https://edu.rsc.org/download?ac=15092) that could be used to teach spectroscopy. Involves analysing spectra, answers provided. |



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