# *PLANNING SUPPORT BOOKLET*

**J258, J260**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9–1) in Chemistry B and Combined Science B (Twenty First Century 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 B (Twenty First Century Science – J258)](http://www.ocr.org.uk/Images/234599-specification-accredited-gcse-twenty-first-century-science-suite-chemistry-b-j258.pdf)
* [Combined Science B (Twenty First Century Science – J260)](http://www.ocr.org.uk/Images/234597-specification-accredited-gcse-twenty-first-century-science-suite-combined-science-b-j260.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.

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-twenty-first-century-science-suite-chemistry-b-j258-from-2016/>
* <http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-combined-science-b-j260-from-2016/>

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

## Ideas about Science (C7) and Practical Work (C8)

Ideas about Science (C7) and Practical Skills (C8) are not explicitly referenced in the high level planning table below, as these ideas and skills are expected to be developed in the context of Chapters C1-C6. Links to Ideas about Science and suggested practical activities are included in the outline scheme of work. Indications of where PAG activities can be carried out should not be seen as an exhaustive list.

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-twenty-first-century-science-suite-chemistry-b-j258-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 on the webpage at <https://www.ocr.org.uk/Images/552881-practical-skills-booklets.zip>

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| Chapter | Suggested teaching hoursSeparate / Combined | Comments and PAG opportunities |
| --- | --- | --- |
| **Chapter C1: Air and water** | | |
| C1.1 How has the Earth’s atmosphere changed over time, and why? | 8 / 8 | PAG 2 – Gas tests |
| C1.2 Why are there temperature changes in chemical reactions? | 6 / 3 |  |
| C1.3 What is the evidence for climate change, why is it occurring? **AND** C1.4 How can scientists help improve the supply of potable water? | 6 / 6 | PAG 2 – Gas tests |
|  | **Total 20 / 17** |  |
| **Chapter C2: Chemical patterns** | | |
| C2.1 How have our ideas about atoms developed over time? | 2.5 / 2.5 |  |
| C2.2 What does the Periodic Table tell us about the elements? | 5 / 5 | PAG 1 – Group 7 reactivity trends |
| C2.3 How do metals and non-metals combine to form compounds? | 4.5 / 4.5 |  |
| C2.4 How are equations used to represent chemical reactions? | 2 / 2 |  |
| C2.5 What are the properties of the transition metals? (separate science only) | 2 / 0 |  |
|  | **Total 16 / 14** |  |
| **Chapter C3: Chemicals of the natural environment** | | |
| C3.1 How are the atoms held together in a metal? **AND** C3.2 How are metals with different reactivities extracted? | 7 / 7 |  |
| C3.3 What are electrolytes and what happens during electrolysis? | 6.5 / 6.5 | PAG 2 - Electrolysis |
| C3.4 Why is crude oil important as a source of new materials? | 10 / 6 | PAG 3 - Chromatography |
|  | **Total 23.5 / 19.5** |  |
| **Chapter C4: Material choices** | | |
| C4.1 How is data used to choose a material for a particular use? | 2.5 / 1.5 |  |
| C4.2 What are the different types of polymers? (separate science only) | 4 / 0 |  |
| C4.3 How do bonding and structure affect properties of materials? | 3 / 3 |  |
| C4.4 Why are nanoparticles so useful? | 4.5 / 4.5 |  |
| C4.5 What happens to products at the end of their useful life? | 5 / 4 |  |
|  | **Total 19 / 13** |  |
| **Chapter C5: Chemical analysis** | | |
| C5.1 How are chemicals separated and tested for purity? | 7 / 7 | PAG3, 4, 7 – Chromatography, distillation and production of salts |
| C5.2 How do chemists find the composition of unknown samples? (separate science only) | 6 / 0 | PAG 5 – Identification of unknown species |
| C5.3 How are the amounts of substances in reactions calculated? | 10 / 6.5 |  |
| C5.4 How are the amounts of chemicals in solution measured? | 10 / 7.5 | PAG 6 - Titration |
|  | **Total 33 / 21** |  |
| **Chapter C6: Making useful chemicals** | | |
| C6.1 What useful products can be made from acids? | 7.5 / 7.5 | PAG 7 – Production of salts |
| C6.2 How do chemists control the rate of reactions? | 11 / 9.5 | PAG 8 – Reaction rates |
| C6.3 What factors affect the yield of chemical reactions? **AND**  C6.4 How are chemicals made on an industrial scale? (separate science only) | 10 / 1.5 |  |
|  | **Total 28.5 / 18.5** |  |
| **GRAND TOTAL SUGGESTED HOURS – 140 / 103 hours** | | |

Separate science only learning outcomes are indicated throughout this document.

**Emboldened statements will only be assessed in Higher Tier papers.**

The grand total suggested hours is slightly different compared with the Chemistry A Gateway suggested hours. This will be due to additional learning outcomes and a greater emphasis on Ideas about Science in the Twenty First Century Suite over and above those in Gateway, which help to exemplify the contexts in each chapter.

# Outline Scheme of Work: C1 – Air and water

## Total suggested teaching time – 20 / 17 hours (separate / combined)

|  |  |
| --- | --- |
| **Additional remote learning opportunities**  ***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** | |
| **Statement** | **Teaching activities** |
| C1.1.1 | [Interactive simulation](https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html) on states of matter. Students can change the temperature and observe the movement of particles. |
| C1.1.10 | An [interactive game](https://phet.colorado.edu/sims/html/balancing-chemical-equations/latest/balancing-chemical-equations_en.html) to practise balancing equations. |
| C1.1.12 | [Video](https://www.ocr.org.uk/Images/588244-c1-cup-elevate-video-hydrogen-test.mp4) showing the test for hydrogen. |
| C1.2.5 | Free [online video](https://www.youtube.com/watch?v=eExCBkp4jB4) explaining how to perform bond energy calculations. |
| C1 | A free [online learning platform](https://app.senecalearning.com/classroom/course/b151e0b0-16f2-11e8-ba22-0d7681702f4b/section/15d8a130-16f4-11e8-ba22-0d7681702f4b/session). Consists of revision questions. Covers the whole specification. You can choose which topics to answer questions on. |

### C1.1 How has the Earth’s atmosphere changed over time, and why? (8 hours – separate and combined)

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| --- | --- |
| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * chemical symbols and formulae for elements and compounds * combustion reactions * conservation of mass changes of state and chemical reactions. * oxidation reactions * reactions of acids with metals to produce a salt plus hydrogen * representing chemical reactions using formulae and using equations * the composition of the atmosphere * the production of carbon dioxide by human activity and the impact on climate. * the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure | |
| Links to Mathematical Skills  * M1a * M1c | Links to Practical Activity Groups (PAGs)  * PAG 2 – Gas tests |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C1 – Topic 1 – Part 1  3 hours (separate and combined) | C1.1.1. recall and explain the main features of the particle model in terms of the states of matter and change of state, distinguishing between physical and chemical changes and recognise that the particles themselves do not have the same properties as the bulk substances  C1.1.2. explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres  C1.1.3. use ideas about energy transfers and the relative strength of forces between particles to explain the different temperatures at which changes of state occur  C1.1.4. use data to predict states of substances under given conditions  C1.1.5. interpret evidence for how it is thought the atmosphere was originally formed  C1.1.6. describe how it is thought an oxygen-rich atmosphere developed over time  IaS3 : use the particle model to explain state changes  IaS3: distinguish data from explanatory ideas in accounts of how the atmosphere was formed | Reviewing learners understanding of the particle model from KS3 and building on this to increasingly detailed atomic models. A circus of KS3 activities related to change of state/chemical change would support this transition.  The Particles Delivery Guide provides a number of activities [here](http://www.ocr.org.uk/Images/283349-particles-delivery-guide.pdf), [here](https://www.ocr.org.uk/Images/220999-particles-atoms-and-elements-learner-activity.docx), [here](https://www.ocr.org.uk/Images/220996-particles-atoms-and-elements-checkpoint.docx) and [here](https://www.ocr.org.uk/Images/220971-particles-atoms-and-elements-checkpoint-instructions.pdf).  Practical: measure temperature against time and plot a cooling curve for [stearic acid](http://www.rsc.org/learn-chemistry/resource/res00001747/melting-and-freezing-stearic-acid?cmpid=CMP00005262) or heating curve for ice.  RSC AfL package [Particle models: gas, liquid, solid.](https://www.rsc.org/Education/Teachers/Resources/Aflchem/resources/20/index.htm)  [Notes](http://www.docbrown.info/page17/2016ocr21chemB1.htm#C1.1) about the atmosphere from the legacy specification.  A wide ranging [website](http://www.windows2universe.org/Earth/cmmap/fun.html) on all aspects of the Earth and Atmosphere.  A [short video](https://www.youtube.com/watch?v=6Db2WAG-VVs), [here](https://www.youtube.com/watch?v=Gyn754vw8ZQ) and [here](https://www.youtube.com/watch?v=sturoUChNo4) on the evolution of the Earth’s atmosphere. | The quality of our air and water is a major world concern. Chemists monitor our air and water, and work to minimise the impact of human activities on their quality.  In Topic C1.1, the context of changes in the Earth’s atmosphere is used to explore the particle model and its limitations when explaining changes of state, and the principles of balancing equations for combustion reactions.  The Earth, its atmosphere and its oceans are made up from elements and compounds in different states. The particle can be used to describe the states of these substances and what happens to the particles when they change state. The particle model can be represented in different ways, but these are limited because they do not accurately represent the scale or behaviour of actual particles, they assume that particles are inelastic spheres, and they do not fully take into account the different interactions between particles.  The formation of our early atmosphere and oceans, and the state changes involved in the water cycle, can be described using the particle model. Explanations about how the atmosphere was formed and has changed over time are based on evidence, including the types and chemical composition of ancient rocks, and fossil evidence of early life (IaS3).  Explanations include ideas about early volcanic activity followed by cooling of the Earth resulting in formation of the oceans. The evolution of photosynthesising organisms, formation of sedimentary rocks, oil and gas, and the evolution of animals led to changes in the amounts of carbon dioxide and oxygen in the atmosphere. |
| C1 – Topic 1 – Part 2  5 hours (separate and combined) | C1.1.7 – describe the major sources of carbon monoxide and particulates (incomplete combustion), sulfur dioxide (combustion of sulfur impurities in fuels), oxides of nitrogen (oxidation of nitrogen at high temperatures and further oxidation in the air)  C1.1.8 – explain the problems caused by increased amounts of these substances and describe approaches to decreasing the emissions of these substances into the atmosphere including the use of catalytic converters, low sulfur petrol and gas scrubbers to decrease emissions  C1.1.9 – use chemical symbols to write the formulae of elements and simple covalent compounds  C1.1.10 – use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations  C1.1.11 – use arithmetic computations and ratios when balancing equations  C1.1.12 – describe tests to identify oxygen, hydrogen and carbon dioxide  C1.1.13 – explain oxidation in terms of gain of oxygen  IaS4 – unintended impacts of burning fossil fuels on air quality  IaS4 – catalytic converters, low sulfur petrol and gas scrubbers as positive applications of science | Some notes on air pollution are [here](http://www.docbrown.info/page04/OilProducts04.htm).  This [website](https://uk-air.defra.gov.uk/) from the DEFRA gives the current state of air quality in the UK and other useful resources.  Demonstration – burning sulfur in an oxygen gas jar – add a little water and universal indicator solution beforehand and demonstrate the increasing acidity of the water as SO2 is formed.  Short practical: Heating boiling tubes of water with the different Bunsen flames – observe the outside of the tube, and temperature change to demonstrate the incomplete combustion (yellow flame) producing soot and less energy than the roaring blue flame.  Website information about [gas scrubbers](http://www.engineeringtoolbox.com/scrubbers-air-washers-d_139.html), [catalytic convertors](http://auto.howstuffworks.com/catalytic-converter.htm) and [low sulphur petrol](http://www.ukpia.com/industry_issues/fuels/sulphur-free-petrol-diesel-and-non-road-fuels.aspx).  An interesting blog about a [conservation of mass lesson](https://dockristy.wordpress.com/2016/02/14/reflecting-on-that-magical-lesson/) – practical work and construction of knowledge/alternative conceptions.  [Chemical Jigsaws](http://www.timstar.co.uk/mo84200-chemical-jigsaws.html) are useful for teaching of balancing equations.  Teaching how to balance equations formalistically at this early stage – resources available [here](http://www.ocr.org.uk/Images/179563-balancing-equations-activity.doc), [here](http://www.ocr.org.uk/Images/179630-balancing-equations-activity-powerpoint.ppt) and [here](http://www.ocr.org.uk/Images/179564-balancing-equations-teacher-instructions.pdf). More able students should be able to handle more complex formulae, e.g. Ca(OH)2.  [Practical instructions](http://www.rsc.org/learn-chemistry/resource/res00000693/generating-collecting-and-testing-gases?cmpid=CMP00006610) for generating, collecting and testing gases. A [clear website](http://chemstuff.co.uk/analytical-chemistry/tests-for-gases/) with information on the gas tests. This [activity](https://www.stem.org.uk/elibrary/resource/33695/test-gas) from the RSC ‘In Search of More Solutions’ will develop problem solving skills and teamwork! Students can make hydrogen using magnesium and hydrochloric acid for testing, carbon dioxide with calcium carbonate and hydrochloric acid. The Elephant’s Toothpaste [demonstration](http://science.cleapss.org.uk/Resource/SRA011-Spectacular-decomposition-of-hydrogen-peroxide-to-produce-a-foam-catalysed-by-potassium-iodide-elephant-s-toothpaste.pdf) produced bubbles of oxygen which will relight a glowing splint. | Our modern lifestyle has created a high demand for energy. Combustion of fossil fuels for transport and energy generation leads to emissions of pollutants.  Carbon monoxide, sulfur dioxide, nitrogen oxides and particulates directly harm human health. Some pollutants cause indirect problems to humans and the environment by the formation of acid rain and smog. Scientists monitor the concentration of these pollutants in the atmosphere and strive to develop approaches to maintaining air quality (IaS4).  The combustion reactions of fuels and the formation of pollutants can be represented using word and symbol equations. The formulae involved in these reactions can be represented by models, diagrams or written formulae. The equations should be balanced.  When a substance chemically combines with oxygen it is an example of oxidation. Combustion reactions are therefore oxidation.  Some gases involved in combustion reactions can be identified by their chemical reactions. |

# Outline Scheme of Work: C1 – Air and water

## Total suggested teaching time – 20 / 17 hours (separate / combined)

### C1.2 Why are there temperature changes in chemical reactions? (6 / 3 hours – separate / combined)

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| --- | --- |
| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * combustion, thermal decomposition, oxidation and displacement reactions * exothermic and endothermic chemical reactions (qualitative). * representing chemical reactions using formulae and using equations | |
| Links to Mathematical Skills  * M1a * M1c * M1d | Links to Mathematical Skills  * M1a * M1c * M1d |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C1 – Topic 2  6 / 3 hours (separate / combined) | C1.2.1. distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings  C1.2.2. draw and label a reaction profile for an exothermic and an endothermic reaction, identifying activation energy  C1.2.3. explain activation energy as the energy needed for a reaction to occur  C1.2.4. interpret charts and graphs when dealing with reaction profiles  C1.2.5. calculate energy changes in a chemical reaction by considering bond breaking and bond making energies  C1.2.6. carry out arithmetic computations when calculating energy changes  C1.2.7. describe how you would investigate a chemical reaction to determine whether it is endothermic or exothermic (separate science only)  C1.2.8. recall that a chemical cell produces a potential difference until the reactants are used up (separate science only)  C1.2.9. evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses (separate science only)  IaS4: fuel cells as a positive application of science to mitigate the effects of emissions | The [Whoosh bottle demonstration](http://www.rsc.org/learn-chemistry/resource/res00000708/the-whoosh-bottle-demonstration?cmpid=CMP00005923) is a nice introduction to exothermic reactions. The [ammonium chloride/barium hydroxide demonstration](http://www.rsc.org/learn-chemistry/resource/res00000739/endothermic-solid-solid-reactions?cmpid=CMP00005021) is a nice introduction to endothermic reactions.  [Investigate different chemical reactions](http://www.rsc.org/learn-chemistry/resource/res00000406/exothermic-or-endothermic?cmpid=CMP00005103) to find out if they are exothermic or endothermic, by measurement of temperature changes. (Re)Introducing data loggers (if available) can be done here to discuss instrumental analysis.  A useful website on reaction energetics is [here](http://www.docbrown.info/page03/3_51energy.htm).  Carrying out [calorimetry](http://www.rsc.org/learn-chemistry/resource/res00000397/energy-values-of-food?cmpid=CMP00005022) of different fuels is useful to link between combustion of fuels and energetics (or here with [foods](http://www.rsc.org/learn-chemistry/resource/res00000397/energy-values-of-food?cmpid=CMP00005022)).  Calculating energy changes from bond energies – many worksheets are available, for example [here](http://www.chalkbored.com/lessons/chemistry-11/bond-energies-worksheet.pdf) and [here](http://www.docbrown.info/page03/3_51energyC.htm) These values can then be compared with literature values and experimental values, and allow discussion of experimental design and uncertainties.  The [Exploding Soap Bubbles](https://edu.rsc.org/exhibition-chemistry/exploding-soap-bubbles/2020051.article#:~:text=Procedure%3A,should%20collect%20on%20the%20surface.) demonstration is an interesting way of introducing the reaction between hydrogen and oxygen. Toy hydrogen fuel cell cars (for example [here](http://www.horizoneducational.com/juniorproducts/h-racer/) and [here](http://www.amazon.co.uk/Horizon-FCJJ-11-Hydrogen-Fuel-cell-Toy-Car/dp/B000Z9C8O2)) can be useful for introducing fuel cell technology. A fuel cell to make in the classroom is described [here](https://www.stem.org.uk/elibrary/resource/33583/a-hydrogen-oxygen-fuel-cell). Many website discuss fuel cells, for example [here](http://auto.howstuffworks.com/fuel-efficiency/alternative-fuels/fuel-cell.htm) and [here](https://www.youtube.com/watch?v=u392lUwhnZU), and they can make interesting [research projects](http://www.nasa.gov/centers/glenn/technology/fuel_cells.html). | As a development of ideas about burning fuels, Topic C1.2 considers bonding in small molecules and temperature changes in chemical reactions.  When a fuel is burned in oxygen the surroundings are warmed; this is an example of an exothermic reaction. There are also chemical reactions that cool their surroundings; these are endothermic reactions.  Energy has to be supplied before a fuel burns. For all reactions, there is a certain minimum energy needed to break bonds so that the reaction can begin. This is the activation energy. The activation energy, and the amount of energy associated with the reactants and products, can be represented using a reaction profile.  Atoms are rearranged in chemical reactions. This means that bonds between the atoms must be broken and then reformed. Breaking bonds requires energy (the activation energy) whilst making bonds gives out energy.  Energy changes in a reaction can be calculated if we know the bond energies involved in the reaction.  Using hydrogen fuel cells as an alternative to fossil fuels for transport is one way to decrease the emission of pollutants in cities (IaS4). The reaction in the fuel cell is equivalent to the combustion of hydrogen and gives the same product (water) but the energy drives an electric motor rather than an internal combustion engine. However, hydrogen is usually produced by electrolysis, which may use electricity generated from fossil fuels so pollutants may be produced elsewhere. There are difficulties in storing gaseous fuel for fuel cells which limits their practical value for use in cars. |

# Outline Scheme of Work: C1 – Air and water

## Total suggested teaching time – 20 / 17 hours (separate / combined)

### C1.3 What is the evidence for climate change, why is it occurring? AND C1.4 How can scientists help improve the supply of potable water? (6 hours – separate and combined)

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| 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 * simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography * the production of carbon dioxide by human activity and the impact on climate. | |
| Links to Mathematical Skills  * M2c * M4a * M2h | Links to Mathematical Skills  * M1a * M1c * M1d |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C1 – Topic 3 and 4  6 hours (separate / combined)  C1 – Topic 3 and 4  6 hours (separate / combined) continued | C1.3.1. describe the greenhouse effect in terms of the interaction of radiation with matter  C1.3.2. evaluate the evidence for additional anthropogenic causes of climate change, including the correlation between change in atmospheric carbon dioxide concentration and the consumption of fossil fuels, and describe the uncertainties in the evidence base  C1.3.3. describe the potential effects of increased levels of carbon dioxide and methane on the Earth’s climate, including where crops can be grown, extreme weather patterns, melting of polar ice and flooding of low land  C1.3.4. describe how the effects of increased levels of carbon dioxide and methane may be mitigated, including consideration of scale, risk and environmental implications  C1.3.5. extract and interpret information from charts, graphs and tables  C1.3.6. use orders of magnitude to evaluate the significance of data  C1.4.1. describe the principal methods for increasing the availability of potable water, in terms of the separation techniques used, including the ease of treating waste, ground and salt water including filtration and membrane filtration; aeration, use of bacteria; chlorination and distillation (for salt water)  C1.4.2. describe a test to identify chlorine (using blue litmus paper)  IaS3: Use ideas about correlation and cause, about models and the way science explanations are developed when discussing climate change  IaS4: Risks, costs and benefits of fuel use and its sustainability and effects on climate.  IaS4: technologies to increase the availability of potable water can make a positive difference to people’s lives  IaS4: access to treated water raises issues about risk, cost and benefit and providing treated water for all raises ethical issues  IaS4: public regulation of targets for emissions and reasons why different decisions on issues related to climate change might be made in view of differences in personal, social, or economic context | Investigate climate change models – both physical models and computer models. Lots of activities area available [here](http://climatechoices.co.uk/pages/activities0.htm). This [website](http://www.climateprediction.net/education/21st-century-science/) provides activities for the world’s largest climate modelling experiment.  This activity from OCR helps develops learners skills in drawing conclusions ([here](http://www.ocr.org.uk/Images/71507-skill-up-lesson-what-s-the-conclusion-teachers-guide.doc), [here](http://www.ocr.org.uk/Images/70031-skill-up-lesson-what-s-the-conclusion-student-sheets.ppt) and [here](http://www.ocr.org.uk/Images/75921-skill-up-lesson-what-s-the-conclusion-presentation.ppt)).  Provision of potable water provides good opportunities for small group research and presentation. Plenty of videos are available for initial stimulus (for example [here](https://www.youtube.com/watch?v=9z14l51ISwg) and [here](https://www.youtube.com/watch?v=8isr9nSDCK4)). Divide learners into groups (3-4), assign each a technique as detailed in the statement to research and produce a 1-2 presentation on, then have the group combine the work into a complete presentation. Randomly select some of the groups to present to the whole class, and have other groups peer assess for quality of presentation, science etc.  Chlorine can be [synthesised](http://www.rsc.org/learn-chemistry/resource/res00000466/the-electrolysis-of-solutions?cmpid=CMP00000536) by electrolysis by the learners, and the chlorine tested with damp blue litmus paper (PAG2). | Topic C1.3 explores the evidence for climate change, asking why it might be occurring and how serious a threat it is. Learners consider environmental and health consequences of some air pollutants and climate change, and learn how scientists are helping to provide options for improving air quality and combatting global warming.  Some electromagnetic radiation from the Sun passes through the atmosphere and is absorbed by the Earth warming it. The warm Earth emits infrared radiation which some gases, including carbon dioxide and methane, absorb and re-emit in all directions; this keeps the Earth warmer than it would otherwise be and is called the greenhouse effect. Without the greenhouse effect the Earth would be too cold to support life.  The proportion of greenhouse gases in the Earth’s atmosphere has increased over the last 200 years as a result of human activities. There are correlations between changes in the composition of the atmosphere, consumption of fossil fuels and global temperatures over time. Although there are uncertainties in the data, most scientists now accept that recent climate change can be explained by increased greenhouse gas emissions.  Patterns in the data have been used to propose models to predict future climate changes. As more data is collected, the uncertainties in the data decrease, and our confidence in models and their predictions increases (IaS3).  Scientists aim to reduce emissions of greenhouse gases, for example by reducing fossil fuel use and removing gases from the atmosphere by carbon capture and reforestation. These actions need to be supported by public regulation. Even so, it is difficult to mitigate the effect of emissions due to the very large scales involved. Each new measure may have unforeseen impacts on the environment, making it difficult to make reasoned judgments about benefits and risks (IaS4). Link to P1.3 (What is global warming and what is the evidence for it?)  Finally, Topic C1.4 explores the need for increasing the amount of potable water worldwide, and techniques for obtaining potable water from ground, waste and salt water.  The increase in global population means there is a greater need for potable water. Obtaining potable water depends on the availability of waste, ground or salt water and treatment methods.  Chlorine is used to kill microorganisms in water. The benefits of adding chlorine to water to stop the spread of waterborne diseases outweigh risks of toxicity. In some countries the chlorination of water is subject to public regulation, but other parts of the world are still without chlorinated water and this leads to a higher risk of disease (IaS4). |

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