

GCSE

Edexcel GCSE in Science Making Changes (Concept approach)

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Support material

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Scheme of work for Topic 6: Making Changes

LESSON 1: Oxygen and oxidation							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.6 C1a 6.16 C1a 6.17	9G Environmental chemistry. 9H Using chemistry.	Predictions can be made about the products of reactions, based on knowledge of similar situations. Addition of oxygen to a substance is oxidation and loss of oxygen from a substance is reduction.	Starter Demonstrate effect of burning magnesium in air and in oxygen. Define the term oxidation as an element gaining oxygen. Main Make oxygen (see activity sheet 6.1). Collect the gas by upward and downward delivery and over water to explore the relative density and solubility of oxygen. Plenary Write word and balanced formula equations for the decomposition of hydrogen peroxide and reactions of metals with oxygen. The collection of oxygen over water is possible because of its low solubility.	Magnesium ribbon. Gas jar of oxygen. Tongs. Experiment sheet 6.1: Making, collecting and testing for oxygen. www.wpbschoolhouse.brinternet.co.uk/page13/ChemicalTests/GasPreparation.htm Great site for lots of information for preparing and collecting gases.	Explain that the addition of oxygen to a substance is oxidation, eg the formation of magnesium oxide from magnesium and oxygen. Know how to test for oxygen. Know how to collect gases produced in reactions by upward and downward delivery, over water and using a gas syringe and relate this to the solubility and density of the gas.	WO: 2.2	See HAZCARDs. Warn students that magnesium burning in oxygen is exceedingly bright. Safety spectacles are essential.
Homework: Research websites for information on emergency/safety flares used at sea to help find people after being shipwrecked.							

Scheme of work for Topic 6: Making Changes

LESSON 2: Making and testing for hydrogen							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.16 C1a 6.17	9F Patterns of reactivity.	Predictions can be made about the products of reactions, based on knowledge of similar situations.	<p>Starter</p> <p>Demonstrate the test for hydrogen. Show the difference between impure and pure hydrogen to illustrate the dangers. Include carrying the flame on a tube of pure hydrogen to light another tube of hydrogen.</p> <p>Main</p> <p>Make hydrogen by adding zinc to a dilute acid, with a drop of copper sulphate to speed it up. Predict which is best; collecting the gas by upward delivery, downward delivery over water.</p> <p>Test for hydrogen collected by two different methods.</p> <p>Plenary</p> <p>Write word and balanced formula equations for the reaction of fairly reactive metals with dilute acid. Explain why some metals are too reactive to be used in the preparation of hydrogen. Generate a reactivity series of metals including hydrogen.</p>	Zinc granules or powder. Dilute sulphuric acid. Copper sulphate solution. Refer back to Experiment sheet 6.1 (Making, collecting and testing for oxygen) to illustrate methods of collecting gases.	<p>Know how to test for hydrogen.</p> <p>Know how to collect gases produced in reactions by upward and downward delivery, over water and using a gas syringe and relate this to the solubility and density of the gas.</p>	<p>C: 2.2 2.3</p> <p>WO: 2.1 2.2</p> <p>PS: 2.2</p>	<p>See HAZCARDs for using acids and testing for hydrogen.</p> <p>Safety spectacles are essential.</p>
<p>Homework: A thinking and predicting exercise: Carbon dioxide is one-and-a-half times as dense as air and is slightly soluble in water. Anhydrous copper sulphate is white but turns blue if any water or water vapour is present. Carbon dioxide is given off when a metal carbonate reacts with dilute acid. Describe two different experimental routes to obtain test tubes full of pure, dry carbon dioxide gas.</p>							

Scheme of work for Topic 6: Making Changes

LESSON 3: Did people always have metals or were they gradually discovered?							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.4 C1a 6.5 C1a 6.7 C1a 6.8 C1a 6.9	9F Patterns of reactivity.	Addition of oxygen to a substance is oxidation and loss of oxygen from a substance is reduction. Extraction of metals depends on their reactivity.	Starter The connection between discovery date and type of metal and the difficulty of extracting the metal: use webelements.com or RTZ booklet to research method of extraction. Demonstrate heating FeO with C using two Bunsens. Test with a magnet before and after. Main Heat CuO with C. Heat PbO with C. To the cool solids add concentrated hydrochloric acid to dissolve the oxide and leave a mix of metal and un-reacted carbon. Write word equations for these reactions. Plenary Generate a reactivity table for carbon, hydrogen and the metals. Confirm the term reduction as the reverse of oxidation.	RTZ metals booklet www.webelements.com/ Disposable test tubes or ceramic paper on which to heat the mixtures. See demonstration sheet 6.4.2 (Obtaining a metal from its oxide (ore)) for details to assist the practical. www.chemicalelements.com/show/dateofdiscovery.html has the periodic table with dates of discovery to show when metals discovered.	Explain that most metals have to be extracted from their ores, which are found in the Earth's crust. Explain that some metals occur as their oxides and can be extracted by reaction with carbon, eg iron, copper and lead. Explain that the loss of oxygen from a substance is reduction, eg the formation of copper from copper oxide. Recall that the least reactive metals are found uncombined in the Earth's crust. Relate the order of reactivity of metals to the stability of their ores, and the method used for their extraction.	C: 2.2 2.3 WO: 2.1 2.2	See HAZCARDs for heating metal oxides with carbon. Safety spectacles are essential.
Homework: Draw cartoons of carbon 'stealing' oxygen from metal oxide. Make dateline of metals discovery for Au Cu Fe Al and other metals.							

Scheme of work for Topic 6: Making Changes

LESSON 4: Making salts							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.2	7H Solutions. 9E Reactions of metals and metal compounds.	Similar elements or compounds react in similar ways. Predictions can be made about the products of reactions, based on knowledge of similar situations.	<p>Starter</p> <p>Discuss from last lesson how the un-reacted metal dissolved because it formed a soluble salt (a chloride). Obtain ideas to get a dissolved solid back from solution.</p> <p>Main</p> <p>Have different groups use different methods and report back the findings.</p> <p>Making salts 1: metal and acid and testing for hydrogen.</p> <p>Making salts 2: oxide and acid including filtering excess oxide.</p> <p>Making salts 3: carbonate and acid including testing for carbon dioxide following the reaction till neutral with pH paper.</p> <p>Making salts 4: hydroxide and acid: using pH paper or a temperature probe.</p> <p>Plenary</p> <p>Write the word and balanced formula equations for the reaction of metal compounds with dilute acids.</p> <p>Explain about ammonia acting like a metal in ammonium hydroxide and forming ammonium salts as fertilisers. Provide a word equation and a balanced equation.</p>	<p>Demonstration sheet 6.4: Pure sample of a soluble salt to show making and separating a sample of a soluble salt.</p> <p>1M hydrochloric acid. 1M sulphuric acid. Test tubes. Splints. Pieces of magnesium, calcium, copper oxide, potassium carbonate and sodium hydroxide. Right angle bend delivery tube. Beakers. Limewater. Filter paper. Petri-dishes.</p>	Describe the reactions of dilute acids (sulphuric, hydrochloric) with metal oxides, carbonates and hydroxides.	<p>C: E2.2 E2.3</p> <p>WO: E2.1 E2.2</p> <p>PS: E2.2</p>	<p>Wear eye protection.</p> <p>See HAZCARDs for all chemicals used.</p>
<p>Homework: Complete all word equations and, if appropriate, balance equations for all combinations of acids with the metals and metal compounds.</p>							

Scheme of work for Topic 6: Making Changes

LESSON 5: Making insoluble salts							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.1 C1a 6.3 C1a 6.18	7H Solutions. 9E Reactions of metals and metal compounds.	Similar elements or compounds react in similar ways. Predictions can be made about the products of reactions, based on knowledge of similar situations.	<p>Starter</p> <p>Discuss from last lesson how to get a dissolved solid back from solution.</p> <p>Recall transition metal ion tests with hydroxides.</p> <p>Most carbonates and hydroxides are insoluble, so are made by precipitation from mixing two soluble salts and filtering. Link back to preparing crystals of a soluble salt and the need to wash the solid on the filter paper.</p> <p>Demonstrate some other transition metal precipitation reactions, eg add potassium iodide and silver nitrate solutions to get yellow precipitate.</p> <p>Add potassium chromate and silver nitrate solutions, to get red precipitate.</p> <p>Main</p> <p>Work out what to mix to obtain a variety of soluble salts and insoluble salts given information about solubility of groups of compound.</p> <p>Plenary</p> <p>Uses of soluble and insoluble salts for fertilisers, fireworks, pigments and catalysis of combustion of fuels. Refer to hazard labels.</p>	<p>0.1M KI 0.1M AgNO₃ 0.1M K₂CrO₄</p> <p>Activity sheet on making salts 6.5 is a high level thinking exercise predicting ways to make soluble and insoluble salts.</p> <p>www.gradelevelgold.co.uk/chemistry/redox.html takes you to a page of websites to check many areas of chemistry knowledge and understanding.</p> <p>www.science.education.org/classroom-activities/chlorine-compound/metal-chlorine, 'the science centre' for flame tests.</p> <p>Poster of hazard labels.</p>	<p>Describe how neutralisation can be used to make salts, some of which may be used in fertilisers, in fireworks, as colouring agents and to aid combustion of fuels.</p> <p>Describe the preparation of pure, dry samples of insoluble salts from solutions of soluble salts.</p> <p>Describe the use of hazard labels in the chemistry laboratory.</p>	C: 2.2 2.2	See HAZCARDs for all chemicals used.
<p>Homework: Complete the activity task, with word equations and balanced equations. Research on websites for elements used in fireworks and the colour effect of each one.</p>							

Scheme of work for Topic 6: Making Changes

LESSON 6: How the bubbles get into the cake – 1							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.11 C1a 6.14 C1a 6.16 C1a 6.17	9H Using chemistry.	Similar elements or compounds react in similar ways. Predictions can be made about the products of reactions, based on knowledge of similar situations.	<p>Starter</p> <p>Heat sodium hydrogen carbonate, sodium carbonate and copper carbonate. Test for carbon dioxide being evolved by using a hanging drop of limewater.</p> <p>Observe the colour change and then test for carbonate with acid and carbon dioxide given off, pouring the heavier gas from the reaction tube into the limewater tube.</p> <p>Explain the thermal stability of sodium carbonate but the instability of the sodium hydrogen carbonate and its use as baking powder in cake/scone making.</p> <p>Main</p> <p>Investigate where sodium hydrogencarbonate is used in cooking and foodstuffs.</p> <p>Investigate citric acid and sodium hydrogencarbonate with water to show reactants need to be dissolved for the reaction to occur.</p> <p>Plenary</p> <p>Discuss how baking powder reacts with vinegar.</p> <p>Give a wide range of examples of how raw food changes as it cooks, eg egg white and yolk, meat and fish changing as the protein in these products alters and long protein molecules break. Make students aware that cooking also changes some vitamins and destroys them.</p>	<p>Sodium hydrogen carbonate.</p> <p>Sodium carbonate.</p> <p>Copper carbonate.</p> <p>Limewater.</p> <p>Sodium hydrogencarbonate.</p> <p>Citric acid.</p> <p>pH paper.</p> <p>www.uyseg.org/greener-industry/pages/ethanoic-acid — Ethanoic acid is one of the world's most important chemicals and serves as an intermediate in the production of a vast range of products. Also has a pie chart of uses.</p> <p>http://sci-toys.com/ingredients/citric-acid.html</p> <p>Uses for citric acid.</p>	<p>Describe the use of sodium hydrogen carbonate as baking powder.</p> <p>Recognise cooking processes as chemical changes leading to new products.</p> <p>Know how to test for carbon dioxide.</p> <p>Know how to collect gases produced in reactions by upward and downward delivery, over water and using a gas syringe and relate this to the solubility and density of the gas.</p>	PS: 2.2	See HAZCARDs for all chemicals used.

Scheme of work for Topic 6: Making Changes

LESSON 6: How the bubbles get into the cake – 1 (continued)
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Homework: Examine the labels for foodstuffs in the kitchen cupboards at home to find common compounds and patterns between contents.

Scheme of work for Topic 6: Making Changes

LESSON 7: How the bubbles get into the cake – 2							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.12 C1a 6.17	9H Using chemistry.	Similar elements or compounds react in similar ways. Predictions can be made about the products of reactions, based on knowledge of similar situations.	<p>Starter</p> <p>Continue the theme from the last lesson. Demonstrate that sodium hydrogen carbonate decomposes on heating gently, collect the gas evolved in a syringe and show that the gas is carbon dioxide.</p> <p>Main</p> <p>Investigate the thermal decomposition of sodium hydrogen carbonate (baking powder) to answer the question: How can cooks get more bubbles in cakes?</p> <p>Students carry out a series of experiments, to find at what temperature baking powder starts to thermally decompose. They collect the gas in a syringe if heating the solid or counting the rate of bubble formation. They determine the variables.</p> <p>Plenary</p> <p>Collect and share all the results from the class to allow homework to be undertaken. Discuss ways to present results and to check the reliability of the data.</p> <p>Write word and balanced formula equations for the reactions.</p>	<p>Test tubes. Right angle bend delivery tubes. Beakers. Sodium hydrogen carbonate. Boiling tubes. Small syringes. Tongs.</p> <p>See activity 6.6: Decomposing baking powder.</p>	<p>Recall that when carbonates and hydrogen carbonates are heated they release carbon dioxide gas and that this is called thermal decomposition.</p> <p>Be able to write word equations for the reactions.</p> <p>Know how to collect gases produced in reactions by upward and downward delivery, over water and using a gas syringe and relate this to the solubility and density of the gas.</p>	WO: E2.2	<p>See HAZCARDs.</p> <p>For heating sodium hydrogen carbonate and using small syringes to collect gas.</p>
<p>Homework: Obtain scattergraph of results and undertaking frequency distributions for class set of data. Use a spreadsheet to create charts and graphs.</p>							

Scheme of work for Topic 6: Making Changes

LESSON 8: Are there chemicals in food?							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.10 C1a 6.15	9H Using chemistry.	<p>Predictions can be made about the products of reactions, based on knowledge of similar situations.</p> <p>Food is chemicals: some artificial chemicals are identical to the natural, some are different.</p> <p>Prepared foods which we purchase may have too much fat or salt added.</p>	<p>Starter</p> <p>What are the main food groups?</p> <p>Illustrate that a carbohydrate can be separated into carbon and water by removing the water through the action of concentrated sulphuric acid on sugar. Define this as dehydration.</p> <p>Main</p> <p>Taste test: diet cola and regular cola using a blindfold.</p> <p>Smell test: artificial vanilla and natural vanilla.</p> <p>Research artificial sweeteners and natural and synthetic sugars.</p> <p>Burn Trebor™ or Polo™ mint.</p> <p>Try to burn a sugar cube: (roll the cube in ash, a catalyst is needed).</p> <p>Burn castor sugar.</p> <p>Use the net to investigate natural and artificial foodstuffs such as sweeteners, food colours and preservatives.</p> <p>Plenary</p> <p>Link the combustion of carbohydrate to respiration. Give word and formula equations.</p> <p>Discuss: Are too many crisps, too much barbecued food or too much salt bad for you? If so why, if not why not?</p> <p>Discuss the main causes of dental caries.</p>	<p>Selected students take taste test, marked cups, blindfolds.</p> <p>Trebor™ mints, tongs, sugar cube and sugar.</p> <p>Vanilla essence and a vanilla pod.</p> <p>Sugar, 400 ml beaker, concentrated sulphuric acid.</p> <p>Fume cupboard.</p>	<p>Discuss the differences between 'natural' and 'artificial' substances, including whether they can be distinguished or are chemically different, and any impacts on health.</p> <p>Interpret data linking a chemical in food with a health impact, recognising that a correlation does not imply a cause.</p>	WO: E2.2	<p>The dehydration of sugar must be done in a fume cupboard.</p> <p>Note that it sometimes takes a few minutes to start.</p> <p>Special care must be taken when undertaking the taste tests; these must be done in a normal classroom or home economics room and use chemicals reserved for this.</p>

Scheme of work for Topic 6: Making Changes

LESSON 8: Are there chemicals in food? (continued)

<p>Homework: Is chocolate a healthy option, eg newspaper extract Daily Mail Tues July 26th 2005 page 20. Prepare a presentation on a comparison of an artificial foodstuff and the natural foodstuff such as saccharin and sucrose (cane sugar) drawing out the benefits and risks of both.</p>

Scheme of work for Topic 6: Making Changes

LESSON 9: It's a gas!							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1a 6.16 C1a 6.20	9H Using chemistry.	<p>Predictions can be made about the products of reactions, based on knowledge of similar situations.</p> <p>Tests for the main gases including ammonia and chlorine, as well as carbon dioxide hydrogen and oxygen.</p>	<p>Starter</p> <p>Ammonium chloride formed in long glass tube from concentrated ammonia and concentrated hydrochloric acid.</p> <p>Give word and balanced formula equations.</p> <p>Demonstrate tests by holding moist red litmus paper near the neck of the bottle of concentrated ammonia solution and damp blue litmus over an open bottle of concentrated hydrochloric acid.</p> <p>Show what happens when damp red and blue litmus is added to a test tube containing chlorine.</p> <p>Main</p> <p>Use books or the web to find three different uses for each of the following:</p> <ul style="list-style-type: none"> • ammonia • citric acid • ethanoic acid (vinegar) • hydrochloric acid • phosphoric acid • water. <p>Plenary</p> <p>Establish a table of positive tests for the main gases. Distinguish between chlorine and hydrogen chloride.</p> <p>Recall the use of water as solvent and reaction medium.</p>	<p>Concentrated ammonia solution.</p> <p>Concentrated hydrochloric acid.</p> <p>Long glass tube and bungs.</p> <p>Cotton wool.</p> <p>Teat pipettes.</p> <p>Test tube containing chlorine gas or one that has been swilled with bleach and one drop of acid added.</p> <p>www.science.education.org/classroom-activities 'the science centre' for uses of hydrochloric acid.</p> <p>www.pamf.org/teen/health/nutrition/sportnutrition.html for use of carbohydrates and need for water.</p>	<p>Know how to test for:</p> <ul style="list-style-type: none"> • ammonia • chlorine. <p>Investigate and identify the uses of the following common compounds:</p> <ul style="list-style-type: none"> • ammonia • citric acid • ethanoic (acetic) acid • hydrochloric acid • phosphoric acid • water. 		HAZCARDS for ammonia, hydrogen chloride and chlorine solution.

Scheme of work for Topic 6: Making Changes

LESSON 9: It's a gas! (continued)
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<p>Homework: Complete the table of collection and testing of gas. Complete research into the uses of ammonia, citric acid, ethanoic acid (vinegar), hydrochloric acid, phosphoric acid, sodium chloride and sodium hydroxide.</p>
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Scheme of work for Topic 6: Making Changes

LESSON 10: Getting plastered							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
6.13 6.20	9G Environmental chemistry. 9H Using chemistry.	Predictions can be made about the products of reactions, based on knowledge of similar situations. Understanding dehydration and hydration, reversible reactions exothermic and endothermic reactions.	Starter Heat copper sulphate blue powdered crystals, then add water to cooled crystals to illustrate a reversible reaction; use the terms dehydration and hydration. Note the exothermic nature of the hydration as the opposite of endothermic to drive off the water. Write a word equation for the reaction. Cement and plaster are everyday substances that need water to react. Explain why you must keep plaster and cement dry. Main Investigate mixtures of sand and cement (or use Plaster of Paris) in disposable containers to determine temperature changes on the addition of water. Do not leave thermometers in the setting plaster or cement as they will get stuck. Role play the joining of 'molecules' to each other to form a giant structure with water acting as links. Plenary Discuss everyday home, food and industrial uses of: Carbon dioxide Sodium hydroxide Carbohydrates (sugars).	Blue powdered crystals, water, dropper. Plaster of Paris. bbc.bitesize for graphic of the uses of limestone and its derivatives. http://geo.msn.edu/geo333/gypsummining.html 'the rock nobody knows' a short description of the uses of gypsum. http://www.cement.ca history of development of Portland cement. http://instruct.uwo.ca/earth-sci/089g/newmonuments.pdf historic monuments, p8 and 9 about chemistry of cement and concrete. http://www.pamf.org/teen/health/nutrition/sportnutrition.html for use of carbohydrates and need for water. www.answers.com for uses of caustic soda. http://www.saltinstitute.org/16.html for concise uses of salt, with pie chart.	Describe the following chemical reactions: <ul style="list-style-type: none">• hydration• dehydration Investigate and identify the uses of the following common compounds: <ul style="list-style-type: none">• carbohydrates• carbon dioxide• caustic soda• sodium chloride (common table salt).		Check HAZCARDS for heating copper sulphate and setting plaster and cement.

Scheme of work for Topic 6: Making Changes

LESSON 10: Getting plastered (continued)

<p>Homework: Present an argument that cement and plaster have changed the world more than any other discovery. Research the history of cement and plaster from websites. Add the following to the research undertaken as homework for the last Lesson: carbon dioxide, sodium hydroxide and carbohydrates (sugars).</p>
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Experiment 6.1: Making, collecting and testing for oxygen

What you will learn from this experiment

In this experiment you will learn:

- 1 how to find and generate oxygen
- 2 how to collect a pure sample of oxygen
- 3 how to test for oxygen.

What you will know when you finish this experiment

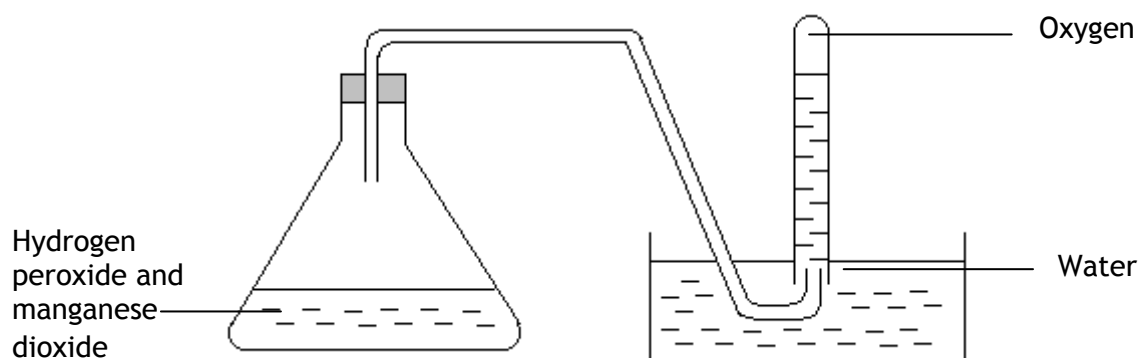
- 1 Pure oxygen makes glowing splints catch fire.
- 2 Oxygen is almost insoluble in water.
- 3 Oxygen has almost the same density as air.

How you may be assessed

- 1 The accuracy of your observations.
- 2 How you put your apparatus together.
- 3 Your ability to evaluate your results and draw conclusions.

What you do

- 1 Into a conical flask pour about 25 cm³ of hydrogen peroxide solution.
- 2 Add a half a spatula of manganese dioxide (manganese IV oxide).
- 3 Immediately push in the delivery tube cork.
- 4 Collect the gas by upward delivery by placing an upturned test tube that is full of water over the outlet of the delivery tube as shown in the following diagram:



- 5 Cork the test tube.
- 6 Collect two more tubes of gas and cork them.
- 7 Place the outlet of the delivery tube in an upside down test tube that does not contain water and collect a tube of gas (upward delivery). Cork the tube.
- 8 Repeat step 6 for another tube of gas.
- 9 Place the outlet of the delivery tube in a test tube the normal way up and collect the gas (downward delivery).
- 10 Collect another tube of gas in the same way.

Experiment 6.1: Making, collecting and testing for oxygen

- 11 Light a splint then blow out the flame.
- 12 Test the first and subsequent tubes by placing the glowing splint in the tubes.
- 13 Record your observations using the table below.
- 14 The formula for hydrogen peroxide is H_2O_2 . Write a balanced equation for its decomposition into oxygen molecules, O_2 and water.
- 15 Which method gives the purest oxygen? Explain why.
- 16 Oxygen is almost insoluble in water. What evidence, from the world around you, suggests that some oxygen dissolves in water?

Table for observations

Glowing splint added to first test tube of gas	Glowing splint added to second test tube of gas	Glowing splint added to third test tube of gas	Glowing splint added to fourth test tube of gas

Experiment 6.1: Making, collecting and testing for oxygen

Notes for teachers and technicians

Aim

The aim of this investigation is to find, make, collect and test for pure (but damp) oxygen.

Previous skills, knowledge and understanding required

Safe ways of working with hazardous chemicals.

Skills, knowledge and understanding

Students will learn:

- 1 how to observe and record observations
- 2 how to organise observations collected from their experiment
- 3 to write word and formula equations for the changes they observe.

Equipment and chemicals required

- 1 20 volume hydrogen peroxide solution.
- 2 Manganese IV oxide (manganese dioxide).
- 3 Test tubes.
- 4 Conical flask with bung and delivery tube.
- 5 Beakers.
- 6 Shaped delivery tubes with cork.

Health and safety issues

Check HAZCARDs for all chemicals being used.

Links with KS3

This experiment builds on the following skills, knowledge and understanding from KS3:

- SC3. 3.g The same atoms are present, although combined in different ways
- 7F Simple chemical reactions
- 9E Reactions of metals and metal compounds
- 9H Using chemistry.

Demonstration 6.4.1: Pure sample of a soluble salt

What you will learn from this demonstration

How to obtain a pure sample of a soluble salt from a reaction.

What you will know after you see this demonstration

- 1 How to make soluble salts by different methods.
- 2 How to obtain crystals of the salt.
- 3 How ensure that the salt is dry and pure.

Activity

You will demonstrate how to produce a pure sample of a soluble salt. You should make notes on the procedure taken.

Demonstration 6.4.1: Pure sample of a soluble salt

Notes for teachers and technicians

Aim

In this demonstration students will find out how to obtain a dry pure sample of a soluble salt made by a variety of neutralisation reactions.

Skills, knowledge and understanding

- 1 Neutralising an acid with a base.
- 2 Avoiding wasting materials by using the minimum needed.
- 3 Working in an accurate manner.

Previous skills, knowledge and understanding required

Neutralisation of an acid.

Equipment and chemicals required

- 1 1M hydrochloric, sulphuric and optionally nitric acids.
- 2 Beakers.
- 3 Bunsen burner.
- 4 Thermometer or temperature probe.
- 5 pH or Universal indicator paper.
- 6 Magnesium ribbon.
- 7 Calcium carbonate powder or as limestone chippings.
- 8 Copper oxide.
- 9 Potassium carbonate solid or 1M solution.
- 10 1M sodium hydroxide solution.
- 11 Safety glasses/goggles.

Health and safety issues

Check HAZCARD for using dilute acids and alkalis.

Delivery strategies

This could be done by students; if so different groups in the class should use different methods and discuss their findings afterwards.

- 1 Obtain neutral solutions of the appropriate salts by either:
 - a) adding excess magnesium ribbon or copper oxide to a test tube one third full of the chosen acid
 - b) following the neutralisation using calcium or potassium carbonate or sodium hydroxide solution until the pH is neutral using pH paper (as an extra, a thermometer or probe may be used to follow the temperature change).

Demonstration 6.4.1: Pure sample of a soluble salt

- 2 Warm the mixture gently to make sure the reaction is complete. If excess solid is added this is filtered off to leave the neutral solution.
- 3 Concentrate neutral solutions until first indication of solid appears on the wall of the beaker or evaporating basin.
- 4 Allow the hot saturated solution to cool and crystals to form.
- 5 Filter off the solid.
- 6 Wash the solid with a little distilled water whilst still in the filter paper (not too much as it may dissolve all the solid).
- 7 Take clean pure crystals and allow them to dry gently or slowly.
- 8 Check that they are dry by ensuring that each crystal is able to move independently.

Links with KS3

This demonstration builds on the following skills, knowledge and understanding from KS3:

- Sc3.3a How metals react with acids and what the products of these reactions are
- 7H Solutions
- 9E Reactions of metals and metal compounds.

Demonstration 6.4.2: Obtaining a metal from its oxide (ore)

What you will learn from this demonstration

- 1 Carbon removes oxygen from oxides of some metals.
- 2 How to obtain a sample of a not very reactive metal, eg iron, from its oxide.

What you will know after you see this demonstration

- 1 Where carbon fits into the reactivity series.
- 2 How to obtain evidence of iron in a complex mixture.

What to do

- 1 Observe your teacher demonstrating how to extract lead from lead oxide.
- 2 Repeat the demonstration using copper oxide: You can use dilute hydrochloric acid to dissolve the un-reacted copper oxide as copper is below hydrogen in the reactivity series.
- 3 Now you will extract iron from iron oxide.
 - a) Mix a little iron oxide and carbon on a V-shaped piece of incombustible paper or crucible.
 - b) Check that there is no elemental iron in the mix with a magnet.
 - c) Heat the mixture strongly for two minutes with a Bunsen also aimed down on the mixture.
 - d) Allow the mixture to cool.
 - e) Test with the magnet to see if any bits stick to the magnet.
 - f) Put everything in a pestle and mortar with water and grind it up.
 - g) Filter.
 - h) Check to see what now sticks to the magnet.
- 4 Complete the word equations for each reaction:

copper oxide + carbon →

lead oxide + carbon →

iron oxide + carbon →

Suggestions for further work

You could use the same method as demonstrated to get iron from iron(II) oxide. You would first prove there was no iron present to start with but there was some present afterwards. Do not do the experiment but complete the word equation.

Iron(III) oxide + carbon →

Write balanced formula equations where possible.

Demonstration 6.4.2: Obtaining a metal from its oxide (ore)

Notes for teachers and technicians

Aim

In this demonstration students will find out how to obtain a metal from its oxide by reduction with carbon.

Skills, knowledge and understanding

This demonstration will enable students to gain the following skills and understanding:

- 1 avoiding wasting materials by using the minimum needed
- 2 working in careful manner.

Previous skills, knowledge and understanding required

The reactivity series and displacement reactions.

Equipment and chemicals required

- 1 Ceramic paper.
- 2 Bunsen burner.
- 3 Iron(II) oxide.
- 4 Carbon powder.
- 5 Magnet.
- 6 Filter paper.
- 7 Filter funnel.
- 8 Safety glasses/goggles.
- 9 Tongs.
- 10 Pestle and mortar.
- 11 Copper oxide.
- 12 Lead(II) oxide.
- 13 Concentrated hydrochloric acid.
- 14 Dilute hydrochloric acid.

Health and safety issues

Check HAZCARD for using acids and hot materials.

What to do

- 1 Mix a little lead oxide and carbon on a V-shaped piece of incombustible paper or crucible.
- 2 Heat the mixture strongly for two minutes with a Bunsen aimed down on the mixture.
- 3 Allow the mixture to cool.
- 4 You may be able to find a globule of lead as it has a low melting point and runs together.
- 5 Use concentrated hydrochloric acid to dissolve any unreacted lead oxide.

Demonstration 6.4.2: Obtaining a metal from its oxide (ore)

Links with KS3

This demonstration builds on the following skills, knowledge and understanding from KS3:

- 1 Sc3.1d Magnetic properties of iron metals
- 2 7H Solutions
- 3 9E Reactions of metals and metal compounds.

Activity 6.5: Using solubility data when making insoluble salts

What you will learn from this activity

What to mix to obtain a variety of insoluble salts given information about solubility of groups of compounds.

What you will know when you finish this activity

- 1 Patterns of solubility in the periodic table.
- 2 Mixing two soluble substances leads to a precipitate if the parts are present to form an insoluble compound.
- 3 Transition metal hydroxides and carbonates are insoluble and usually coloured.
- 4 Group 1 metal compounds are usually soluble and colourless.

How you may be assessed

You may be assessed on concluding, predicting and evaluating skills.

What you do

Use the information about solubility and insolubility patterns in the periodic table to predict how to make a number of salts.

Activity 6.5: Using solubility data when making insoluble salts

Use this information and a periodic table to fill in the spaces below

Information

- All metal nitrates are soluble.
- All ammonium compounds are soluble.
- Most metal chlorides are soluble.
- Most metal sulphates are soluble. However in Group 2 only magnesium sulphate is soluble.
- All Group 1 metal hydroxides are soluble, as are those at the bottom of Group 2. All other metal hydroxides are insoluble.
- All metal oxides are insoluble except those in Group 1 and Group 2, which react with water to form soluble hydroxides.

You have to decide what will be formed, an insoluble precipitate that can be filtered off, washed and dried or a soluble salt that has to be crystallised then washed and dried.

For each substance write a word equation to show its formation from two other compounds (not elements). They will react to produce what you want. State if the product you want is soluble or insoluble. Remember if the product is soluble you need one of the reactants to be insoluble otherwise you will only have a mixture.

1 calcium sulphate

2 copper nitrate

3 sodium chloride

4 iron hydroxide

5 zinc chloride

6 copper hydroxide

7 barium sulphate

8 chromium nitrate

9 ammonium chloride

10 magnesium chloride

Write balanced formula equations for the reactions.

Activity 6.5: Using solubility data when making insoluble salts

Notes for teachers and technicians

Aim

To use patterns of information to predict specific outcomes.

Skills, knowledge and understanding

Students may be assessed on concluding, predicting and evaluating skills.

Previous skills, knowledge and understanding required

The periodic table.

Delivery strategies

Use the sheet on the previous page for reinforcement and as a gatherer of information covered in the topic. It could then be used to form a set of slides using a presentation package.

Links with KS3

This activity builds on the following skills, knowledge and understanding from KS3:

- Sc3 2a,b and c Physical changes.

Resources

<http://chemlab.pc.maricopa.edu/periodic/foldedtable.html>

Activity 6.6: Decomposing baking powder

What you will learn from this activity

The temperature at which sodium hydrogen carbonate starts to decompose and gives off carbon dioxide.

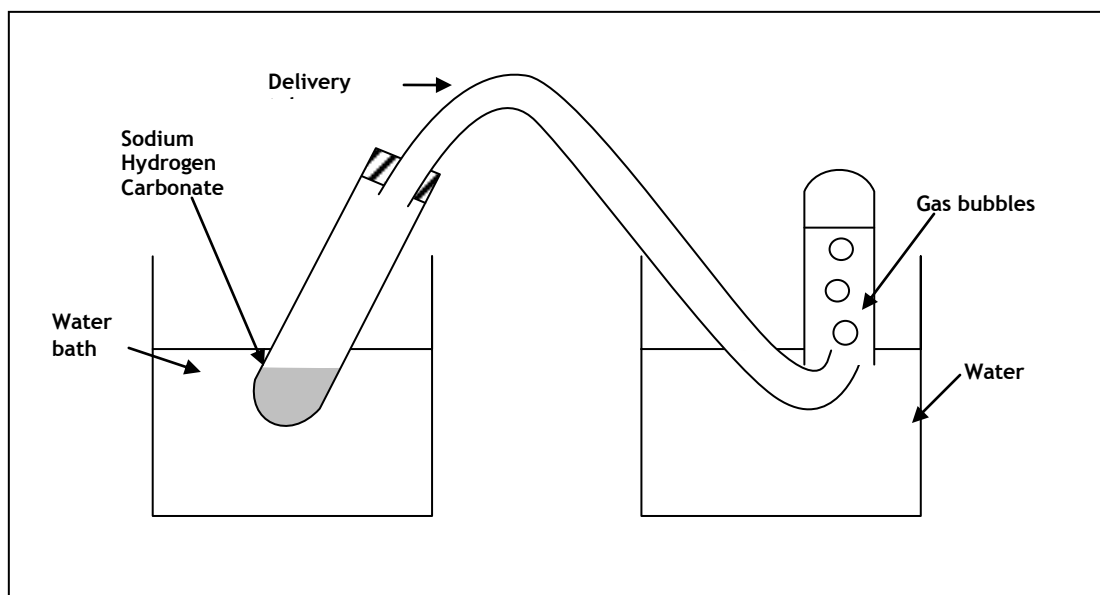
What you will know when you finish this activity

- 1 The temperature needed to decompose sodium hydrogen carbonate.
- 2 How temperature affects the rate at which sodium hydrogen carbonate decomposes and gives off carbon dioxide.
- 3 The reliability of an individual reading and the usefulness of gathering a number of readings to remove anomalies and obtain an average reading.

What you do

- 1 Heat a boiling tube containing 20 g sodium hydrogen carbonate connected to a small plastic syringe. Use a small Bunsen flame. When the syringe starts to move back, as the gas is given off, remove the tube from the heat and disconnect it from the syringe. Quickly insert a thermometer capable of reading over 360°C into the powder. Record the temperature at which the 'baking powder' starts to thermally decompose.
- 2 Get the results for the remainder of the class and ignoring any obvious wrong results find the average temperature.
- 3 Place 20 g of sodium hydrogen carbonate in a boiling tube.
- 4 Put 150 cm^3 of tap water into a 250 cm^3 beaker. This will be used as a water bath.
- 5 Put the boiling tube in the water bath at 20°C and heat it.
- 6 Count how many bubbles are given off in one minute. Repeat the experiment at different temperatures.
- 7 Test the gas given off to prove that it is carbon dioxide.
- 8 Explain what the results tell you about the effect of heat on sodium hydrogen carbonate and its use in cooking.

The apparatus should be set up as shown in the diagram below



Activity 6.6: Decomposing baking powder

Notes for teachers and technicians

Aim

In this activity students will find out how temperature affects how quickly sodium hydrogen carbonate decomposes and gives off carbon dioxide.

Skills, knowledge and understanding

This activity will enable students to gain the following skills, and/or knowledge and understanding:

- 1 Making observations.
- 2 Recording observations in a table.
- 3 Drawing conclusions.

Materials required

Class set of:

- 1 250 cm³ beaker x 2
- 2 boiling tube
- 3 -10 to 110°C thermometer
- 4 0 to 360°C thermometer
- 5 delivery tube
- 6 sodium hydrogen carbonate
- 7 balance
- 8 test tube
- 9 bunsen burner
- 10 gauze, tripod, heatproof mat.

Health and safety issues

- 1 Wear safety glasses.
- 2 Care with hot glassware and beaker.
- 3 Sodium hydrogen carbonate completely decomposes at 270°C and more slowly at cooler temperatures.

Links with KS3

This experiment builds on the following skills, knowledge and understanding from KS3:

- 7F Simple chemical reactions
- 9H Using chemistry.

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