**Checkpoint Science Scheme of Work**

**Chemistry – Year 3**

**Topic: Patterns of Reactivity**

**Aims**
That pupils should be able to:

- describe the reactivity of metals (with oxygen, water and dilute acids)
- understand the reactivity series
- give examples of displacement reactions

**Links**
Checkpoint curriculum – Cc 4
IGCSE Chemistry 10.2, IGCSE Combined Sciences Chemistry Topic Two, IGCSE Physical Science 8.2

**Words**
reactivity series, displacement reaction

**Activities**

| Objectives<br>Students should be able to: | Possible Activities | Health and safety/notes |
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| compare the rates of reaction of some metals with oxygen. | Small samples of a range of metals can be cleaned and left in air. They are checked at intervals for signs of oxidation The same range of metals can each be heated in air and placed in a gas jar of oxygen. | Safety goggles must be used.<br>Metals include copper, iron, magnesium, zinc.<br>Word equations should be used. |
| compare the rates of reaction of some metals with water. | Small pieces of metal are cleaned and left in water to observe changes after the next few days. Some may only react when heated in steam, some will not react at all. | The reaction of a small piece of sodium with water can be demonstrated by the teacher with the usual safety precautions.<br><br>Safety goggles must be used.<br>Word equations should be used. |
| compare the rates of reaction of some metals with dilute acid. | Small pieces of metals (NOT including sodium) are added to dilute hydrochloric acid and the reaction observed. The hydrogen gas can be tested. | Safety goggles must be used.<br>Word equations should be used.<br>Sodium is too vigorous to be used. |

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| construct a reactivity series for metals. | Students should collect their observations of reactions in a table and suggest an order of reactivity. This can be enhanced with research or supplied information about metals which have not been observed. | The reactivity series includes, in order of decreasing activity, sodium, magnesium, zinc, iron, copper. |
| make predictions about displacement reactions | This can be investigated in a simple way by putting a steel rod or blade into copper sulphate solution and a 'copper' coin into iron sulphate solution. When the idea of displacement is clear, students can predict, and confirm, the results of the reaction between other metals and solutions. Very small quantities can be used by carrying out the tests on a spotting tile. | Safety goggles must be used.<br>Word equations should be used.<br>Students will need to be shown how to look for crystals of metals growing. They need to be able to identify the colours of freshly produced metals. |
| state the essential contents of a cell | Students can create an emf using a fruit or vegetable and two different metals. These are connected up to a voltmeter. They can investigate which two metals produce the highest voltage and which is the anode. | Safety goggles must be used. |
| explain why the historical order of the discovery of metals is related to the reactivity series. | Different students can research the methods used for extracting named metals and the dates of their discovery. Group results can be used to relate the difficulty of extraction and history to position in the reactivity series. | |

## Resources

http://www.schoolsnet.com
http://www.science-house.org:80/learn/CountertopChem/exp10.html

**Topic: Preparing Salts**

**Aims**
That pupils should be able to:

- explain how to prepare some common salts by the reactions of metals or metal carbonates with acid
- use word equations to describe reactions

**Links**
Checkpoint curriculum – Cc 7
IGCSE Chemistry 8.3, IGCSE Co-ordinated Sciences C 9, IGCSE Combined Sciences Chemistry Topic Four, IGCSE Physical Science 6.3

**Words**
reactants, products

**Activities**

| Objectives<br>Students should be able to: | Possible Activities | Health and safety/notes |
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| revise work on the preparations of salts and use word equations to describe the reactions. | Students have probably encountered salts earlier in the course but will now need to learn techniques for the preparation of different types.<br>Revise neutralisation and the need to achieve neutral solutions before preparing crystals. | In using partially completed word equations students should be able to substitute products or reactants.<br>acid + base = salt + water<br>acid + metal = salt + hydrogen<br>acid + carbonate = salt + carbon dioxide+ water |
| revise the preparation of zinc chloride or zinc sulphate crystals. | Granulated zinc is added to dilute hydrochloric acid until no more dissolves. The excess is filtered off. Evaporate until some solid appears and then leave to cool. Filter. | Safety goggles must be worn.<br>Word equations should be used.<br>Zinc sulphate crystals may be prepared in the same way. |
| revise the preparation of calcium chloride. | Marble chips are added to dilute hydrochloric acid until no more dissolves. The excess is filtered off. Evaporate until some solid appears and then leave to cool. Filter. | Safety goggles must be worn.<br>Word equations should be used. |
| revise the preparation of copper sulphate. | Copper oxide is added to dilute sulphuric acid and warmed. When no more dissolves the excess is filtered off. Evaporate until some solid appears and then leave to cool. Filter.<br>Students might discuss ways of producing different sized crystals. | Safety goggles must be worn.<br>Word equations should be used. |

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| revise the preparation of potassium chloride. | Where there is no solid to indicate that a reaction is complete an indicator must be used. In the reaction between dilute potassium hydroxide and dilute hydrochloric acid, litmus can be used. If litmus is added the colour can be removed with charcoal which is then filtered off. Evaporate until some solid appears and then leave to cool. Filter. | Safety goggles must be worn.<br>Word equations should be used. |
| revise the preparation of lead iodide. | This is included to show a method for preparing insoluble salts, though it would not be examined as it can not be classified as common. Lead nitrate and potassium iodide are mixed and a yellow precipitate observed.<br>This is lead iodide. It can be filtered off and dried. If reactants are available AgCl or AgBr could be prepared so that its reaction with light could be observed – the basis of photography. | All lead compounds are poisonous. For this reason teachers may prefer to demonstrate this preparation.<br>Safety goggles must be worn.<br>Word equations should be used. |

**Topic: Endothermic and exothermic reactions**

**Aims**
That pupils should be able to:
- explain the idea of exothermic and endothermic reactions.

**Links**
Checkpoint curriculum – Cc 3
IGCSE Chemistry 6, IGCSE Co-ordinated Sciences C 14, IGCSE Combined Sciences Chemistry Topic Six, IGCSE Physical Science 5.2

**Words**
exothermic, endothermic

**Activities**

| Objectives<br>Students should be able to: | Possible Activities | Health and safety/notes |
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| state the three requirements needed for a fire to start/remain alight. | By discussion identify the need for heat, fuel and oxygen to start / maintain a fire. Students should use this information to suggest ways of stopping different types of fire. | An imitation fire extinguisher can be demonstrated using carbon dioxide generated by a carbonate / acid reaction. If this is arranged in a wash bottle with a little added detergent it can convincingly put out a sawdust fire. |
| know that the process of burning gives out heat. | Students can observe the process of burning using dry bread or wooden splints. Burning a candle, they can more easily collect the products and test for carbon dioxide and water. They should note that energy is given off in each case. | Safety goggles must be worn.<br>Since oxygen is a requirement, students can see that the reaction is of the type<br>Fuel + oxygen = oxides (and energy)<br>The term “exothermic” can be used. |
| compare the values of different fuels. | Students can compare the energy released by different fuels by heating equal volumes of water using a known mass of each fuel. They will do this by comparing changes in temperature. They should design as accurate an investigation as possible. | Safety goggles must be worn.<br>Fuels could include alcohols (in spirit burners), wood, solid fuels, charcoal etc. For liquid fuels students should be warned about safe procedures. |
| suggest the best fuel for a purpose. | Students can research and report on which they consider to be the best fuel for a certain purpose | |

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| | such as cooking(camping) or (transport) ***. They should take into account factors such as convenience, cost, pollution, availability etc. | |
| understand links with respiration and photosynthesis. | The process of respiration can be reviewed to identify it as an exothermic reaction, suggest getting hot when running. The reverse reaction, that of photosynthesis, can then be described as endothermic.<br>Students can discuss the importance of this balance of gases in the atmosphere. | glucose + oxygen ⟶ carbon dioxide + water (and energy)<br>carbon dioxide + water (and energy) ⟶ glucose + water |
| identify an endothermic reaction. | An example of an endothermic reaction which students can check with a thermometer is that of dilute acid with potassium (or sodium) hydrogen carbonate, the basis of sherbet. | Safety goggles must be worn.<br>These reactions are much more rare but students should understand that both exothermic and endothermic signify a chemical reaction. |

## Resources

http://www.geocities.com/exothermicreactions/

**Topic: Rates of Reaction**

**Aims**

That pupils should be able to:

- Give a qualitative explanation of the effect on the rate of reactions of
  - concentration
  - particle size
  - temperature
  - catalysts

**Links**

Checkpoint curriculum – Cc 8

IGCSE Chemistry 7.1, IGCSE Co-ordinated Sciences C 10, IGCSE Combined Sciences Chemistry Topic Five, IGCSE Physical Science 5.3

**Words**

concentration, catalyst

**Activities**

| Objectives<br>Students should be able to: | Possible Activities | Health and safety/notes |
|---|---|---|
| recognise that reactions take place at different rates. | Provide a list of reactions and challenge students to select them as fast or slow and suggest ways of changing the rate. e.g. explosions, cooking, fermenting, burning different materials, developing photographs, rusting. | Safety considerations for any combustion which might involve risk.<br>Note that calculations on rates of reactions will not be tested at Checkpoint level. |
| show how rate of reaction depends on concentration of reactants. | Students can design and carry out an investigation into the speed of the reaction between calcium carbonate and dilute hydrochloric acid, varying the concentration of the acid. Gas can be collected in an inverted measuring cylinder or the time taken to fill a test tube. | Safety goggles must be worn. |
| show how rate of reaction depends on particle size. | This can be investigated using the reaction between marble chips and hydrochloric acid. The marble chips can be sorted into several sizes and bubbles of gas produced counted. | Safety goggles must be worn. |

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| show how rate of reaction depends on temperature. | The marble and hydrochloric reaction can be carried out at different temperatures to investigate the effect on speed. The reagents should be warmed in a water bath. | Safety goggles must be worn. |
| show how rate of reaction depends on the presence of a catalyst. | Hydrogen peroxide can be decomposed into water and oxygen. Students observe the rate of the reaction before and after the addition of a small quantity of manganese(IV) oxide.<br>Students should investigate the use of a catalyst in industry and find out how it relate to energy, cost and pollution issues. | Safety goggles must be worn. |
| know that enzymes are biological catalysts. | The decomposition of hydrogen peroxide can also be catalysed by biological catalysts such as those found in liver and many vegetables. This reaction is vigorous.<br>Students can look for washing powders containing enzymes. They can consult recommended temperatures for use and compare the effectiveness of washing stained cloths with biological and non-biological powder.<br>Also information about catalytic converters can be sought. | Safety goggles must be worn.<br>Consider the energy and environmental gains from the use of these powders. |
| use the kinetic theory to explain effects on rates of reaction. | Through diagrams, students can use their earlier ideas about particle theory to explain the effects of the different variables on the speed of reactions, i.e. that concentration increases the number of particles, that temperature increases their speed and that increased lump size decreases the area for particles to approach one another. A good context is found in recipes where cooking times vary for, e.g., potatoes depending on area exposed. | Descriptions of the ‘lock and key’ mechanism are not needed. |

**Topic: Periodic Table**

**Aims**

That pupils should be able to:

- describe the structure of atoms
- relate structure to the first twenty elements of the Periodic Table
- describe trends in groups and periods

**Links**

Checkpoint curriculum – Cp 1, Cp 2

IGCSE Chemistry 9, IGCSE Co-ordinated Sciences C 2, IGCSE Combined Sciences Chemistry Topic Two, IGCSE Physical Science 7

**Words**

nucleus, proton, neutron, electron, electronic shell (orbit), atomic (proton) number

**Activities**

| Objectives<br>Students should be able to: | Possible Activities | Health and safety/notes |
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| recognise the symbols for the first 20 elements | Students should revise the symbols for the first twenty elements.<br>Each group of students can make a poster of the structure of a chosen element. | |
| arrange the first 20 elements into the Periodic Table | The arrangement of the first twenty elements, with atomic (proton) numbers, is provided in a simple table.<br>A game of cards can be played. Each card has a symbol and as they are drawn from a pile they are laid out on a blank copy of the table.<br>The winner completes his table first (in the style of Bingo). | Students can make a set of cards and each has a blank table. The piles, face down, consist of three copies of each symbol and must be thoroughly mixed to begin with. |
| know the basic structure of an atom. | Students should look at the information given for each element on the Periodic Table and relate this to atomic structure. | |

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| | Diagrams show the arrangement of electrons in their shells around the nucleus. Students can learn to build them up with increasing atomic number. | |
| recognise Groups and Periods | Students can familiarise themselves with the layout of the Periodic Table by colouring in according to the properties of the elements eg.metals and non-metals or solids, liquids and gases (at room temperature). | |
| consider the similarities in the elements of a Group | Students look at the vertical pairs of elements and seek similarities, e.g. inert gases, alkali metals, halogens. A third member of the group (not to be memorised at this stage) can be added to show that properties continue to show similarity. | |
| consider the chemical trends within a Group | Compare reactivity between vertical pairs of elements where appropriate. i.e. the reaction of lithium / sodium with water, magnesium and calcium with dilute acid, physical properties of chlorine, bromine and iodine. | Safety goggles must be worn and screens used for sodium.<br>Demonstration only<br>Demonstration only |
| relate atomic structure to Periods | Use diagrams to show the electron shells and relate these to position of elements in the Periodic Table | |
| recognise the unique position of hydrogen | Hydrogen can be presented as being unique.<br>Investigate electrolysis of acidified water to give hydrogen and oxygen.<br>Students can do the test for hydrogen.<br>Hydrogen can be given off from an acid / magnesium reaction and tested. | Suggest the possibilities of hydrogen as a non-polluting fuel. Emphasise the quantities of hydrogen present on Earth but cost of extraction.<br>Clips of the Hindenberg / Challenger disasters are found on ENCARTA.<br>Safety goggles must be worn for all reactions involving an acid. |

## Resources

http://www.bam.ie/bambrat/periodic-table.html
http://www.webelements.com/