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| Fusion 2: C1.1 – Elements and Compounds | | |
| National Curriculum Link up •1.1a, b. 2.1a, b, c. 2.2a, b. 2.3a. 3.2a, b. | | |
| Learning Objectives Pupils should learn: How materials can be grouped. To suggest the right material for a job. | Teaching / Learning activities Lesson structure Starter -Safety first If this is the first Chemistry lesson of the year, it may be a good time to remind pupils of their responsibilities while in a laboratory. Show a picture of an unsafe laboratory. Ask pupils to identify as many hazards as they can. If you choose to set up a situation, ensure that no-one can actually be harmed. Link any pupil responses back to your school's laboratory rules. (10 mins) Main Ask pupils to describe what a solid, a liquid and a gas are like. You may wish to extend this to discussing particle arrangements which pupils learned about in Fusion 1. Ask pupils to carry out the 'Classifying Materials' activity described in the pupil book. Any materials are suitable but some suggestions are given in the 'Practical Support' section. Once the pupils have completed their investigation, review their findings. Then, using books or an ICT resource, they should find a use of each of the materials seen. It is important for them to try to suggest a reason why that material is used for that purpose. Plenary - Designer materials Ask pupils what properties the material used to make the body of a spacecraft should have. [For example: low density so the rocket can take off more easily, high melting point so it won't melt as it enters a planet's atmosphere, easy to shape and join so the rocket can be manufactured, strong so the craft will keep its shape when subjected to large forces.] (5 mins) | Teaching suggestions • Learning styles. <i>Visual:</i> Making observations of materials. <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Carrying out practical work and using a computer. <i>Interpersonal:</i> Sharing ideas with other pupils. <i>Intrapersonal:</i> Understanding why a material is chosen for a particular purpose. • Special needs and Extension. Two differentiated activity worksheets would help pupils link different materials with their properties and suggested uses. • Homework. Find out what material is used to make the windows of space rockets. [Diamond, so it's hard enough to withstand the massive pressure differences between the inside and outside of the craft but is still transparent.] • Functional skills link-up. ICT Select and use appropriate ICT-based and other forms of information which match requirements (level 2). |
| Learning Outcomes <i>All pupils should be able to sort materials into groups.</i> <i>Most pupils should be able to name specific groups, such as solids, liquids and gases.</i> <i>Some pupils should also be able to explain why a material belongs to a particular group.</i> How Science Works Pupils should recognise that science is a communal activity (1.1a2). | Additional teachers notes Equipment and materials required Labelled samples of different materials, such as copper, steel, aluminium, a magnet, diamond (which could be represented by a picture or by a substitute colourless crystal, such as cubic zirconium – often used in jewellery), wood, cotton cloth, nylon cloth, wool, polyester, polycarbonate (Perspex), poly(ethene) (polythene), liquid glue. Details. Ask pupils to observe the materials and to complete the table. It may be best to place the materials around the room in small groups so that pupils can visit each 'station' as a circus. Safety. Do not use large pieces of metal which could injure feet if dropped. | |



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| Fusion 2: C1.2 – Building Blocks | | |
| National Curriculum Link up •1.1a. 3.2b. | | |
| Learning Objectives Pupils should learn: What matter is made from. What an element is. Why we use models in science. | Teaching / Learning activities Lesson structure Starter - Building blocks Pupils must guess how many different substances there are in the universe [billions] and how many different types of atom there are [about 100]. (5 mins) Main Show pupils a copy of the Periodic Table of the elements [This is the full title.] Explain to them that scientists believe that all the substances in the universe are made from just the elements in the Periodic Table. Establish that there are about 100 elements listed in the Periodic Table. Only elements are listed in the Periodic Table. Establish that each of the elements is made up of a different type of atom and that the definition of an elemental substance is that it contains only one type of atom. All the other substances in the universe are made from combinations of the elements. Get pupils to carry out the activity, 'Making a model of elements'. They could record their opinions about the suitability of each model in a table. With all the models pupils will not have successfully represented an element unless they choose pieces of one colour. Give pupils the opportunity to discuss their ideas with each other and to debate the merits of each model. Plenary - What's it like? Ask pupils to produce a poster to define an element, which could be put on the classroom wall. (10 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Some pupils may cope better with a more basic definition of an element: 'a substance is only an element if it is listed on the Periodic Table or if it can't be broken down into a simpler substance'. • Extension. Ask pupils to research the most recently discovered element.[It will have an atomic number greater than 110 and will, almost certainly, have been discovered in a nuclear reaction such as those carried out at CERN, Switzerland.] • Learning styles. <i>Visual:</i> Making models of elements. <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Making models of elements. <i>Intrapersonal:</i> Understanding the concept that matter is made of atoms which are too small to see. • Homework. Pupils could find out as much as they can about a particular element. You could choose one yourself or allow pupils free choice. • Functional skills link-up. English Present information on complex subjects concisely and clearly (level 2) |
| Learning Outcomes <i>All pupils should be able to list examples of elements.</i> <i>Most pupils should be able to recall a definition of 'element'.</i> <i>Some pupils should also be able to explain why a given model is an example of an element and explain advantages and disadvantages of using a particular model.</i> How Science Works Describe more than one model to explain the same phenomenon and discuss the strengths and weaknesses of each model. Describe how the use of a particular model or analogy supports an explanation (1.1a1). | Additional teachers notes Equipment and materials required per group: selection of Lego bricks, of different sizes and colours; 2–3 golf-ball-sized lumps of Plasticine, each lump a different colour; molecular model kit (Moly-Mod or similar). Details Refer to pupil book and to lesson outline. If you do not have sufficient equipment for each group, stations could be placed around the room for the pupils to move between. Safety Normal laboratory rules apply. | |



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| Fusion 2: C1.3 – Elements and their Properties | | |
| National Curriculum Link up •1.2b. 2.1a, c. 2.3a. 3.2b. | | |
| Learning Objectives Pupils should learn: How to test and record the properties of elements. How to classify elements. | Teaching / Learning activities Lesson structure Starter - What the use? Show pupils a selection of materials and a list of possible uses. Ask them to match the material to the use. (10 mins) Main Discuss the fact that some elements are radioactive, in conjunction with the 'science @ work' section in the pupil book. [Radioactive elements are used in medicine, even though they may harm the patient. They may be given to a patient because the alternative is complex surgery which carries a greater risk of complications than a dose of radiation.] Allow students to complete the 'Studying elements' activity described in the pupil book. Ask pupils to decide which elements they think are metals and which are not, suggesting why. Establish that the Periodic Table is arranged to place elements with similar properties together and that all the metals are on the left-hand side while the non-metals are on the right. Ask pupils to debate the issue raised in the 'Great Debates' section. Draw out that without scientific research new discoveries are harder to come by and we would not be able to develop new medicines, materials or energy sources so easily. However, scientific research is slow, expensive and, as private companies make money from new products, they should pay for all the research themselves. Plenary - Metal mad Give pupils a paper Periodic Table and ask them to colour in the squares for any element they are sure is a metal. (10 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Instead of having a whole class debate, ask pupils to consider specific statements in small groups. Pupils may then feel able to join in with the whole class debate. • Extension. Give pupils some cards giving brief details about elements. Ask them to sort the cards into groups of their choosing and then compare their groups to the locations of elements on the Periodic Table. The aim of this activity is for pupils to realise that the Periodic Table was originally worked out in this way and that elements which are close together in the Periodic Table have similar properties. • Learning styles <i>Visual:</i> Making observations of elements. <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Carrying out practical work. <i>Interpersonal:</i> Taking part in the class debate. <i>Intrapersonal:</i> Understanding the idea that there may be more elements left to discover. • Homework Find out which non-metals conduct electricity. [Silicon and carbon are the main ones.] • Functional skills link-up. English Make significant contributions in discussions, helping to move discussion forward to reach decisions (level 2). |
| Learning Outcomes <i>All pupils should be able to</i> determine some properties of elements. <i>Most pupils should be able to</i> group elements into metals and non-metals. <i>Some pupils should also be able to</i> predict an element's properties based on its position in the Periodic Table. How Science Works Recognise that decisions about the use and application of science and technology are influenced by society and individuals and how these could impact on people and the environment (Great Debates) (1.1b). | Additional teachers notes Equipment and materials required per group: circuit to test electrical conductivity: 6 V power supply/cells, lamp and three wires, piece of charcoal/graphite, labelled 'Carbon' [non-metal], piece of 'Sulfur' [non-metal], sealed jar labelled 'Oxygen' [non-metal], small phial of 'Iodine' crystals (sealed) [non-metal], mercury thermometer, labelled 'Mercury' [metal], piece of 'Copper' foil [metal], piece of 'Magnesium' ribbon, [metal], 'Iron' nail, [metal], piece of 'Zinc' foil [metal]. Safety. Sulfur: CLEAPSS Hazcard 96A. Magnesium: CLEAPSS Hazcard 59A. Do not warm the iodine as it may vaporise. Do not touch iodine: CLEAPSS Hazcard 54A. | |



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| Fusion 2: C1.4 – Symbols | | |
| National Curriculum Link up •2.1a. 3.2b. | | |
| Learning Objectives Pupils should learn: Why elements have symbols. How to find out the symbol for an element. | Teaching / Learning activities Lesson structure Starter - Metal or non-metal? Give pupils the names of some elements and ask them to sort them into metals or non-metals. (5 mins) Main Ask pupils why we use abbreviations and establish that they are a quick way of writing a long word or phrase. Introduce the idea that elements have a symbol which works like an abbreviation of their name. Give the pupils a copy of the Periodic Table and start to look at the symbols for the elements. Emphasise that where there is more than one letter in a symbol, only the first is capitalised and any others written in lower case. This is very important as, for example, Co is cobalt but CO is a compound called carbon monoxide. Make a set of cards with different symbols from the Periodic Tables. The pupils can use these to play snap. Pupils may ask about some of the symbols which don't appear to be related to the name, such as Pb for lead and Fe for iron. Explain that not all element symbols were decided by English speaking scientists and that many are based on other languages. Sometimes the obvious symbol is not chosen to avoid a clash. For example, sulfur and sodium can't both be 'S'. Plenary - Code name Ask pupils to try to write their name in code using element names. [For example, Nick could be Nickel carbon potassium. If there isn't a symbol they could take one symbol away from another, e.g. one way to get an 'm' is to say manganese — nitrogen.] (10 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Focus on the more obvious symbols first, such as S for sulfur and O for oxygen before moving on to the two letter symbols and, perhaps, to symbols which don't seem to match the name. • Extension. Ask pupils to research why elements don't have symbols which match their names, such as Ag, Pb and Fe. [Fe comes from the word 'ferrous'. Materials containing iron are often described as ferrous. Pb is from the latin word for lead which is <i>plumbum</i>. Water pipes used to be made of lead and the people who fitted them became known as 'plumbers' so the word does appear in English. Ag is from the Latin word for silver. Today the French word for money, which used to be made from silver, is <i>argent</i>.] • Learning styles <i>Visual:</i> Looking at the Periodic Table. <i>Auditory:</i> Reading element names and symbols. <i>Kinaesthetic:</i> Manipulating card sorts. |
| Learning Outcomes <i>All pupils should be able to recall that elements can be represented by a symbol as well as a name.</i> <i>Most pupils should be able to use the Periodic Table to find the name or symbol of an element.</i> <i>Some pupils should also be able to explain why the element symbols are useful for scientists.</i> How Science Works Use a range of scientific vocabulary and terminology consistently in discussions and written work (1.1c). | Additional teachers notes Use the pupil book to find out how the Periodic Table was developed. Pupils could extend this phase of the lesson by using other sources of information, such as the Internet. | |



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| Fusion 2: C1.5 – Compounds and their Elements | | |
| National Curriculum Link up •2.1a, b, c. 3.2b. | | |
| Learning Objectives Pupils should learn: What a compound is. How compounds are different from elements. | Teaching / Learning activities Lesson structure Starter -Odd one out Show pupils four pictures (or just give them the names) of: sulfur, iron, gold and water. Ask them to decide which one is the odd one out and why. [Water is not an element and does not appear on the Periodic Table.] (5 mins) Main Remind pupils of the work they have done on elements and symbols. Refer to work earlier in the unit about the existence of millions of different substances in the universe which are made from only a few (about 100) elements. Get pupils to make iron sulfide, as described in the activity 'Making a compound' in the pupil book. Review the practical with the pupils looking for evidence of differences between the properties of the elements and the compound formed. [The sulfur powder is yellow and the iron filings are slightly shiny and magnetic. The iron sulfide compound is dull in appearance and nonmagnetic. Un-reacted iron may mean that the compound appears to be magnetic still.] Plenary - Txt spk Ask the pupils to write what they have learned in this lesson as a text message. They can use text abbreviations if it helps but they must not use more than 100 characters, including spaces. (5 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Concentrate on the concrete idea that compounds do not have the same properties as the elements they are made from, rather than the much more conceptual issue of molecule formation. • Extension. Challenge pupils to explain why water doesn't burn. [Burning is generally thought of as an oxidation reaction. Since, in forming water (H₂O), hydrogen must have already reacted with oxygen in some sort of 'burning' reaction and cannot, therefore, burn again. Oxygen, contrary to popular belief, does not burn as it cannot react with oxygen.] • Learning styles <i>Visual:</i> Making observations. <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Carrying out practical work to make a compound. <i>Intrapersonal:</i> Understanding the concept that atoms can join together to form molecules of elements or compounds. • Homework. The pupils could find out who Alchemists were. [Alchemists were early chemists, usually considered to have been working around the 1600s to 1700s. Many were attempting to turn metals into gold.] |
| Learning Outcomes <i>All pupils should be able to</i> give examples of compounds. <i>Most pupils should be able to</i> recall a definition of a compound and recognise a model of a compound. <i>Some pupils should also be able to</i> explain why a model of a compound represents a compound. How Science Works Explain how to take action to control the risks to themselves and others, and demonstrate competence in their practical techniques (1.2c). | Additional teachers notes Equipment and materials required per group: half a spatula of sulfur powder, half a spatula of fine iron filings, magnifying glass, magnet, ignition tube (use old tubes as they will be broken during the experiment), small piece of mineral wool to plug ignition tube, Bunsen burner and flame-proof mat, spatula, test tube holder, matches, eye protection. For class teacher: small hammer, old rag (to prevent broken ignition tube pieces from escaping), eye protection. Safety. Sulfur: CLEAPSS Hazcard 96A. See L195. Only fill ignition tube one-quarter full. Ensure the room is well ventilated, especially if there are asthma sufferers in the room. Plug tube with mineral wool. If the sulfur ignites, sulfur dioxide will be produced, which is an irritant. Ensure no sulfur is on the outside of the ignition tubes before it is put into the flame. Beware of fragments of glass from broken ignition tubes. | |



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| Fusion 2: C1.6 – Compound Names | | |
| National Curriculum Link up •3.2b. | | |
| Learning Objectives Pupils should learn: How to name a compound. To state the elements in a compound from the compound name. | Teaching / Learning activities Lesson structure Starter - Word up! Make as many words as you can using the letters contained in the words 'magnesium oxide'. (10 mins) Main Remind pupils of the work they have done on elements and compounds and explain that the name of a compound can tell you what is in it. This lesson is essentially about learning the 'rules' for naming compounds and much of it can be achieved by following the pupil book. Demonstrate the reaction between magnesium and oxygen (air). Explain that the white powder formed is magnesium oxide and is so called because it contains only magnesium and oxygen. This would be a very good opportunity to reinforce the idea that compounds are different to the elements they are formed from, which the pupils learned in the last lesson. Ask the pupils to refer to the 'rules' for naming compounds described in the pupil book and to discuss why the rules are necessary. [They are important so that scientists developing new compounds can describe what they have made to others without confusion.] Plenary - Sort it out! Give pupils cards with element names and compound names on them and ask them to match them up. (10 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Avoid moving onto compounds of three elements, such as 'ates'. Ensure pupils can understand the elemental origins of basic compounds like magnesium oxide and iron sulfide. It may be better to use the plenary card sort as the main activity. • Extension. Find out the difference between carbon dioxide and carbon monoxide. [Carbon dioxide (CO₂) contains two oxygen atoms, while carbon monoxide (CO) only contains one.] • Learning styles. <i>Auditory:</i> Describing and discussing the rules for naming compounds. <i>Kinaesthetic:</i> Card sort. <i>Interpersonal:</i> Discussing with others. <i>Intrapersonal:</i> Understanding that names have an origin. • Homework. Pupils could find out what elements are contained in the compound ethane. [Carbon and hydrogen.] |
| Learning Outcomes <i>All pupils should be able to</i> recognise the metal and non metal in an -ide compound. <i>Most pupils should be able to</i> name simple compounds. <i>Some pupils should also be able to</i> name the elements in more complex compounds, such as -ates How Science Works Use a range of scientific vocabulary and terminology consistently in discussions and written work (1.1c). | Additional teachers notes Equipment and materials required For teacher: magnesium ribbon (2 cm strip, heatproof mat, tongs, Bunsen burner, eye protection. Details Hold the ribbon in tongs and ignite in a Bunsen flame. Remove ribbon from the Bunsen flame as soon as it lights. Safety Magnesium ribbon: CLEAPSS Hazcard 59A. Warn pupils not to look directly at flame. Pupils should observe the reaction through blue glass. | |



| Fusion 2: C1.7 – Compound Formulas | | |
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| National Curriculum Link up •2.1a. 3.2b. | | |
| <p>Learning Objectives Pupils should learn: How to write the formula for a compound. How to recognise the atoms in a compound from its formula.</p> | <p>Teaching / Learning activities Lesson structure Starter -Tessellation mania Ask pupils to tessellate hexagons on a page and then to try to do the same thing with octagons. [They will find that octagons leave small squares between them.] This starter will link to the idea that atoms can only be joined together in certain ways. (5 mins) Main - Demonstrate the electrolysis of water using a Hofmann voltameter. Pupils may well know that the formula for water is H₂O. Explain that this means that each molecule of water has two atoms of hydrogen and one atom of oxygen. This is shown by the results of the electrolysis experiment. Ask pupils to work in groups of six and use themselves as atoms to make up some molecules using the 'hands' suggestion in the pupil book. You will need to tell pupils what atoms are involved and how many of each. Lower attaining pupils may find the activity suggested above more accessible if Moly-Mod kits are used. Explain to pupils that molecules can only have one formula as the atoms can only be joined together in a certain way. Run through the 'rules' for reading formulas. Give pupils some examples of formulas and ask them to describe what atoms and how many of each type are present. For example MgO contains one magnesium atom and one oxygen atom, C₂H₆ contains 2 carbon atoms and 6 hydrogen atoms. Plenary - Rules is rules Ask pupils to summarise the rules for writing and reading a chemical formula, in five bullet points. (10 mins)</p> | <p>Teaching suggestions • Special needs. Bond formation between atoms is a highly conceptual idea. Lego can provide a simpler model. Ask pupils to assemble a 'wall' two bricks high by 10 dots (Lego bricks have dots on top) long. There are only certain ways they can do this. Tell them that this is one compound and that another compound might be two bricks high and 15 dots long. Whilst this model is a good way to teach that only certain combinations of blocks (atoms) will work the flaw lies in the fact that, unlike a compound, there is more than one way to make a given sized wall. • Extension. Use the 'Stretch yourself' section described in the pupil book. • Learning styles <i>Visual:</i> Making observations. <i>Auditory:</i> Describing the rules for reading formulas. <i>Kinaesthetic:</i> Forming molecules using themselves as atoms. <i>Interpersonal:</i> Working with others to form molecules. <i>Intrapersonal:</i> Understanding the concept that atoms can only bond in a certain way. • Functional skills link-up. Mathematics Solve simple problems involving ratio, where one number is a multiple of the other (level 1). • Homework. Pupils could research who August Wilhelm von Hoffman was. Ask pupils to find out about what his contribution to chemistry was. [He was the first director of the Royal College of Chemistry, London and did much work on dyes and organic chemistry.]</p> |
| <p>Learning Outcomes <i>All pupils should be able to name the elements in a compound from its formula.</i> <i>Most pupils should be able to state the number and type of particle from a compound formula.</i> <i>Some pupils should also be able to generate the formula of a compound from its name.</i> How Science Works Use a range of scientific vocabulary and terminology consistently in discussions and written work (1.1c).</p> | <p>Additional teachers notes Equipment and materials required Hofmann voltameter and power supply, 100 cm³ 0.5 mol/dm³ sulfuric acid (tell the pupils it's water), two test tubes, matches, splints, eye protection. Safety. Do not leave equipment operating unattended, as a build-up of explosive hydrogen will occur. Equipment is fragile. See CLEAPSS handbook/CD-Rom 11.4.2. Sulfuric acid. CLEAPSS hazard card 98A. No naked flames. Use eye protection when filling.</p> | |



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| Fusion 2: C1.8 – Properties of Compounds | | |
| National Curriculum Link up •2.1a, b, c. 3.2b. | | |
| Learning Objectives Pupils should learn: How to make a compound from elements. Whether the properties of a compound depend upon how it is made. | Teaching / Learning activities Lesson structure Starter - Word up! Ask pupils to make as many words as they can using the letters from 'compound' and 'element'. Longest list wins. (5 mins) Main - Pose the question: 'Are the properties of a compound different if it's made different ways?' Invite pupils to discuss the matter in pairs or small groups for a few moments and then gather the class' opinion and their reasons for their ideas. Get pupils to carry out the 'Making carbon dioxide' activity described in the pupil book. They will make carbon dioxide by two different methods and show that, however it is made, it behaves the same. Remind pupils that the formula of carbon dioxide is CO ₂ . Ask them if they can now, having seen the evidence, explain why carbon dioxide always reacts with limewater in the same way. Plenary - Mix and match Give pupils the names of the gases oxygen, hydrogen and carbon dioxide, along with the tests for the gases and the outcomes of those tests mixed up. The challenge is to sort them out. (5 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. The idea of molecules is highly conceptual but pupils may find it much easier to handle the concrete evidence that carbon dioxide gas behaves the same however it is formed. • Extension. Ask pupils to use molecular model kits to demonstrate why the carbon dioxide formed is the same in each part of the practical. • Learning styles <i>Visual:</i> Making observations. <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Carrying out practical work. <i>Interpersonal:</i> Working with others during the practical and discussing ideas with other pupils. <i>Intrapersonal:</i> Understanding that as the molecules are always the same, a compound has constant properties. • Homework. Pupils to find out why sherbet is fizzy. [When it gets wet, carbon dioxide is produced.] |
| Learning Outcomes <i>All pupils should be able to produce carbon dioxide by two different methods.</i> <i>Most pupils should be able to recognise that carbon dioxide as the same properties however it is produced.</i> <i>Some pupils should also be able to explain why compounds have the same properties however they are made.</i> How Science Works Explain how to take action to control the risks to themselves and others, and demonstrate competence in their practical techniques (1.2c). | Additional teachers notes Method 1: Reaction of calcium carbonate with hydrochloric acid equipment and materials required per group: 3 cm ³ of 0.5 mol/dm ³ hydrochloric acid, half a spatula of calcium carbonate powder (precipitated), spatula, 2 test tubes, bung to fit test tube with delivery tube attached, limewater, test tube rack, eye protection. Method 2: Thermal decomposition of calcium carbonate per group: 3–4 spatulas full of calcium carbonate powder (precipitated), spatula, Bunsen burner, matches, retort stand, boss and clamp, boiling tube, bung to fit boiling tube with delivery tube attached, test tube, limewater, test tube rack, eye protection. Safety. Eye protection must be worn. Limewater is an irritant: CLEAPSS Hazcard 18. Hydrochloric acid: CLEAPSS Hazcard 47A. Care must be exercised when heating the calcium carbonate powder to avoid fluidisation. Do not heat strongly initially. The boiling tube containing the limewater must be taken away from the delivery tube before the heat source is removed from the carbonate or 'suck-back' will occur. | |



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| Fusion 2: C1.9 – Word Equations | | |
| National Curriculum Link up •2.1a, b, c. 3.2b. | | |
| Learning Objectives Pupils should learn: How to use a word equation to describe a chemical reaction. What a word equation is. How to write a risk assessment. | Teaching / Learning activities Lesson structure Starter - Sum it up Write <i>one sentence</i> to describe how to boil an egg and what happens to the egg when you do. (5 mins) Main – Ask pupils to plan and then carry out the ‘Describing chemical reactions’ activity from the pupil book. Establish that, in general, a word equation is written: Starting materials or reactants --> Finishing materials or products Explain to pupils that they must try to write these on one line, just as they would a mathematical equation. You could encourage them to write them correctly by starting with the arrow in the middle of the line on the page. Ask pupils to identify the reactants from the reactions they have just carried out. Then get them to start to write the word equations. Plenary - What do you know? Ask pupils to write an answer to the learning objective questions in the pupil book. (5 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Pupils could use the cards for the ‘What happened?’ plenary on their own to sort out the equations. • Extension. Pupils could find out how scientists and engineers try to ensure nuclear power stations are safe. Ask pupils to write a risk assessment for Homer Simpson’s job. You could show them the opening credits to <i>The Simpsons</i> as inspiration. • Learning styles <i>Visual:</i> Making observations. <i>Auditory:</i> Describing their observations and writing word equations. <i>Kinaesthetic:</i> Carrying out practical work. <i>Interpersonal:</i> Working with others during practical. <i>Intrapersonal:</i> Understanding how to work safely. • Homework. Pupils could write word equations for household tasks such as baking a cake and making toast. Pupils should not aim to describe what is happening chemically but to explain the overall process. |
| Learning Outcomes <i>All pupils should be able to</i> make and record observations, recording simple hazards. <i>Most pupils should be able to</i> write simple word equations and a simple risk assessment. <i>Some pupils should be able to</i> list reactants and products from a given word equation, and write a detailed risk assessment. How Science Works Explain how to take action to control the risks to themselves and others, and demonstrate competence in their practical techniques (1.2c). Explain how the observation and recording methods are appropriate to the tasks (1.2d). | Additional teachers notes Equipment and materials required for Station 1: 2 cm long piece of magnesium ribbon, Bunsen burner and heat mat, matches, tongs, pieces of blue glass, eye protection. Safety. Flame should be observed through blue glass as it is so bright. Magnesium ribbon: CLEAPSS Hazcard 59A. Highly flammable. Equipment and materials required for Station 2: 50 cm ³ of 0.1 mol/dm ³ nitric acid, 50 cm ³ of 0.1 mol/dm ³ sodium hydroxide, few drops of universal indicator, boiling tube, rack for boiling tube, 2 pipettes, 10 cm ³ measuring cylinder, eye protection. Safety. Eye protection must be worn. Ensure pupils behave with pipettes. Nitric acid is an irritant: CLEAPSS Hazcard 67. Sodium hydroxide is an irritant: CLEAPSS Hazcard 91. Universal indicator may be flammable. Equipment and materials required for Station 3: 3–4 spatulas full of copper carbonate powder, spatula, Bunsen burner, matches, retort stand, boss, clamp, boiling tube, bung to fit boiling tube with delivery tube attached, test tube, limewater, test tube rack, eye protection. Safety. Eye protection must be worn. Care must be exercised when heating the copper carbonate powder to avoid fluidisation. Do not heat strongly initially. Use a loose mineral wool plug. Limewater is an irritant: CLEAPSS Hazcard 18. | |



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| Fusion 2: C1.10 – Symbol Equations | | |
| National Curriculum Link up •2.1a, b, c. 3.2b. | | |
| Learning Objectives Pupils should learn: What a symbol equation is. How to balance a symbol equation. | Teaching / Learning activities Lesson structure Starter - Elementary Give pupils a quick-fire element name and symbol quiz. If you give them the name, they must respond with the symbol. (5 mins) Main - Discuss with pupils the purpose of a word equation and then some of the drawbacks. The principle problem is that a word equation doesn't tell you how much of a chemical is needed and so doesn't make a good 'recipe'. It's a bit like a cake recipe which reads just: eggs, flour and butter. Introduce the idea that we need an equation that shows us what happens to the atoms during a chemical reaction. Explain that, during a chemical reaction, no atoms are made or destroyed. Whatever is present at the start must be there at the end. Show pupils how to balance an equation. Establish that the same number of each type of atom must appear on each side of the equation. Ask pupils to complete a cut and stick equation balancing exercise. Stress to them that only whole molecules are acceptable and they must add a whole extra molecule if they need just a part of it. Ask pupils to complete further equation balancing exercises on a worksheet. Encourage them to make use of a tally chart to account for the atoms of each type. Plenary - Balancing act Show pupils some symbol equations and ask them to say whether they are balanced or not. If they are not, ask pupils to suggest what is wrong. (5 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. This lesson is highly conceptual and may be missed by lower attaining pupils. Focus on the more concrete aspects of the lesson. • Extension. Ask pupils to add state symbols to their symbol equations, after each substance. [(s) for solids, (l) for liquids, (g) for gases and (aq) for solutions in water (aqueous).] • Learning styles <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Completing a cut and stick equation balancing exercise. <i>Intrapersonal:</i> Understanding that atoms are not created or destroyed during a reaction. • Homework. Pupils could write a story imagining what might happen to an oxygen atom when breathed in. [During respiration the atom would become part of, either a carbon dioxide molecule which could take part in photosynthesis, or a water molecule which could be breathed out and form part of the water cycle.] |
| Learning Outcomes <i>All pupils should be able to understand that atoms are not created or destroyed in a reaction, just rearranged.</i> <i>Most pupils should be able to recognise when a simple symbol equation is balanced.</i> <i>Some pupils should also be able to balance a symbol equation by themselves.</i> How Science Works Use a range of scientific vocabulary and terminology consistently in discussions and written work (1.1c). | Additional teachers notes | |



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| Fusion 2: C1.11 – Mixtures | | |
| National Curriculum Link up •2.1a, b, c. 3.2b. | | |
| Learning Objectives Pupils should learn: The difference between elements and mixtures. The difference between compounds and mixtures. | Teaching / Learning activities Lesson structure Starter - Mix it up Pupils to plan a procedure to separate sand from water and salt from water. (5 mins) Main - Ask pupils to recall different ways to separate mixtures which they met in Year 7, such as filtering, evaporation and distillation. Ask them to suggest differences in the properties of mixtures, compounds and elements, referring to earlier lessons in this unit. Ask pupils what the melting point and boiling point of water are. Establish that they are 0°C and 100°C, respectively. Ask pupils why we put salt onto roads and establish that it makes it less likely that the roads will freeze in the winter. [Salt lowers the melting point of water and so it freezes at a temperature lower than 0°C.] Explain that impure substances (mixtures) have different melting points and boiling points from their pure substances and melt over a range of temperature rather than at one sharp point. Ask pupils to plan and carry out activity 'Identifying compounds and mixtures' as described in the pupil book. Pupils may need reminding that melting and freezing points are the same thing, but the name used is usually chosen to indicate the direction of the change of state. Plenary - True or false Ask pupils if some statements about elements, mixtures and compounds are true or false. (5 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Use a jumbled-up suggested method for the investigation that the pupils need to sort. • Extension. Write an instruction manual for the use of a melting point apparatus. Equipment and materials required per group: organic compound with a low melting point, such as salol or stearic acid, eye protection. Refer to manual supplied with your melting point apparatus. Wear eye protection. Salol is an irritant: CLEAPSS Hazcard 52. • Learning styles <i>Visual:</i> Making observations. <i>Auditory:</i> Describing their observations. <i>Kinaesthetic:</i> Carrying out practical work. <i>Interpersonal:</i> Working with others during practical work. • Functional skills link-up. English Present information concisely and logically (level 2). • Homework. Pupils could find out how scientists use melting points to identify compounds. |
| Learning Outcomes <i>All pupils should be able to</i> list examples of mixtures and compounds. <i>Most pupils should be able to</i> recall definitions of elements, compounds and mixtures in words and diagrams. <i>Some pupils should also be able to</i> explain the properties of compounds and mixtures when considering the elements that make them. How Science Works Describe an appropriate approach to answer a scientific question using sources of evidence and, where appropriate, making relevant observations or measurements using appropriate apparatus (1.2a). | Additional teachers notes Equipment and materials required per group: 200 cm ³ distilled water, 200 cm ³ of brine solution labelled 'tap water' (doctored to ensure pupils see a difference), two 250 cm ³ beakers, two 100 cm ³ beakers, two thermometers (-10°C to 110°C), Bunsen burner, tripod, gauze and heat mat, plastic bowl, filled with ice, 50 g of sodium chloride, eye protection. Safety Pupils must not drink the water. Take care with boiling water. Wear eye protection. | |



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| Fusion 2: C1.12 – Discovering Oxygen | | |
| National Curriculum Link up •1.2a. 2.1a. 3.2b. | | |
| Learning Objectives Pupils should learn: How we know about oxygen. How ideas about burning have changed over time. | Teaching / Learning activities Lesson structure Starter - Magic teabag Show pupils how a teabag can be made to fl oat up on its own convection current when it is burned. (5 mins) Main - Find out what pupils know about burning. They should say that a fuel and oxygen are needed. Ask pupils how they know that oxygen is needed and lead on to a discussion about how people found out about oxygen. Using the pupil book as a starting point, ask pupils to assemble a strip cartoon or timeline about the history of peoples' understanding of burning. They will need access to other sources of information, such as the Internet. They could produce their work as a PowerPoint presentation rather than hand-written. Plenary - Famous last words Ask pupils to write an epitaph for Joseph Priestley, who, along with Antoine Lavoisier, discovered oxygen. (10 mins) | Teaching suggestions <ul style="list-style-type: none"> • Special needs. Give pupils some of the key facts about the people involved so they don't have to do so much research, which is a high level skill. • Extension. Pupils should find out how scientists developed our understanding of what atoms are like, from Dalton through Rutherford, Bohr and Chadwick. Encourage them to find out about work that is still being done in places like Harwell, Oxfordshire and in CERN, Switzerland. • Learning styles <i>Visual:</i> Preparing the timeline. <i>Auditory:</i> Writing text for the timeline. <i>Intrapersonal:</i> Understanding that the scientific development is slow and ideas often change over time. • Functional skills link-up. English Use a range of different styles of writing for different purposes (level 2). ICT Produce information that is fit for purpose and audience, using accepted layouts and conventions as appropriate (level 1). |
| Learning Outcomes All pupils should be able to recognise burning and recall what is needed. Most pupils should be able to understand that ideas about elements have changed over time. Some pupils should also be able to explain why scientific ideas change over time. How Science Works Identify a range of scientific data and other evidence to back an argument and the counterclaim in more complex and/or less familiar contexts (1.1a3). Describe how scientific evidence from different sources carries different weight in supporting or disproving theories (1.1a3). | Additional teachers notes Equipment and materials required for demonstration: teabag (of the type which is folded up and has a tag), heat mat, matches. Details Undo the teabag carefully and remove the tea. You should be left with a cylinder of paper which can be opened out and stood on its end. Light the top of the cylinder. The heat generated by the flame will cause a convection current which will lift the very light bag off the desk. Safety Pupils should be kept well back in case any burning embers drop onto them. | |