



Fusion 1: HSW – Finding the answers to questions (1)		
National Curriculum Link up •2.1a.		
Electronic resources: Generic HSW sheets – Investigating planning prompt sheets, Worksheets to support – Before my practical work, During my practical work and After my practical work, AT1 – How Science Works level descriptions, Worksheets – Collecting evidence through observations, Worksheets - Asking scientific questions		
Learning Objectives Pupils should learn: That there are a variety of ways to gather scientific evidence.	Teaching / Learning activities Lesson structure Starter - Where are we now? Gather pupils' ideas about what we mean by scientific enquiry / investigation. How have they solved scientific problems in primary school? Some may well be obsessed with 'fair testing', but stress that this is just one of the ways we can carry out scientific enquiries. (5 mins) Main Pupils should have realised from the starter that there is no one way that scientists work to solve problems. At this point you can start to go through some of the approaches that can be used. Follow the order of the pupil book and start with general observation and exploration to gather data. Mention the importance of data-logging equipment in helping scientists observe changes that happen very quickly or over long periods of time. Then go on to using secondary sources of information to gather data needed. Pupils will be familiar with this approach, e.g. from their work on the Earth, Moon and Sun in Key Stage 2. The activity in the pupil book 'Research a problem' allows pupils to choose an area of interest to delve into and to present their findings to others. Finally look at classifying and identifying as a means of answering scientific questions. The use of keys will have been covered in Key Stage 2. Plenary - States of matter key Pupils to try Summary question 2 in pairs. Then test out their key on a neighbouring pair to see if it works using some examples from around the room. (5 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. For lower attaining pupils, you may wish to give them practice in framing questions themselves. • Extension. Suggest investigations in which data-logging equipment could be essential to the work of a scientist. • Learning styles. <i>Visual:</i> Observing a selection of materials. <i>Auditory:</i> Listening to the outcomes of the research exercise. <i>Kinaesthetic:</i> Testing materials in order to classify them. <i>Interpersonal:</i> Working in groups to research and classify. <i>Intrapersonal:</i> Thinking back to their Key Stage 2 work. <ul style="list-style-type: none"> • Functional skills link-up – English. Use appropriate search techniques to locate and select relevant information. (Level 1) See 'Research a problem'
Learning Outcomes <i>All pupils should be able to</i> list three different ways to collect evidence to answer scientific questions. <i>Most pupils should be able to</i> choose a suitable method to gather the data to answer particular scientific questions. <i>Some pupils should also be able to</i> identify and carry out different methods to gather data to answer scientific question How Science Works Recognise that science cannot yet explain everything. (1.1a2) Describe an appropriate approach to answer a scientific question using a limited range of information and making relevant observations or measurements. (1.2a)	Additional teachers notes Equipment and materials required Per group: blocks of a variety of materials to include some metals (not just iron or steel); magnet, cell, wires, crocodile clips and bulb to test electrical conductivity; plastic beaker (250 cm ³). Details The pupils should observe and test materials to see if they have metallic or non-metallic properties. Do not allow pupils to heat the samples of materials. Some might suggest a density test in water which can easily be carried out. Make sure all test the electrical conductivity. Some pupils will also think that all metals are magnetic so have a magnet available to test the metals on display.	



Fusion 1: HSW – Finding the answers to questions (2)		
National Curriculum Link up •2.1a.		
Electronic resources: Worksheets - Sample sizes		
Learning Objectives Pupils should learn: That there are a variety of ways to gather scientific evidence.	Teaching / Learning activities Lesson structure Starter - Matching Ask pupils to identify an approach from the previous lesson to answer each of the following questions: What type of tree has this leaf come from? [Identifying] What type of animals live in the deepest oceans? [Research] How does the temperature in a classroom change over a day? [Observation] Discuss answers with pupils. (5 mins) Main Pupils can be asked to define what a fair test is, and introduce the word ‘variables’. Now introduce the pattern seeking enquiries that rely on data from large sample sizes to improve reliability. Discuss reliability in terms of the trust or faith you can put in data collected and therefore in any conclusions drawn from that data. Pupils can then try the ‘Looking for patterns’ enquiry. Identify any patterns or anomalous data in small groups then discuss as a whole class. Ask the class about any models they have used to help explain things in science. The second in-text question b prompts them to think about the movement of water as a model for electric current. Finally, the pupils are asked to consider solving problems by devising a sequence of steps or designing a system. Plenary - Model pupils In groups of four, ask the class to discuss the behaviour of an elastic band, using themselves as a model for the particles that make up the rubber. Circulate and choose one group to act out their model. (10 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. Help can be given in the plotting of the data on a scatter graph in the ‘Looking for patterns’ activity. • Extension. Higher attaining pupils can find out how new drugs are developed and tested before being passed as safe for the public to use. A shorter exercise could be to find out and explain the use of a placebo in drug testing. • Learning styles. <i>Visual:</i> Looking at points on a scatter graph to spot any patterns. <i>Auditory:</i> Listening to ideas of others about fair testing. <i>Kinaesthetic:</i> Carrying out the pattern-seeking enquiry. <i>Interpersonal:</i> Discussing sample sizes. <i>Intrapersonal:</i> Reflecting on the reliability of data collected. <ul style="list-style-type: none"> • Functional skills link-up – ICT Create and develop charts and graphs to suit the numerical information, using suitable labels. (Level 2) See ‘Looking for patterns’.
Learning Outcomes <i>All pupils should be able to</i> state fair testing, pattern seeking, using models and evaluating techniques as ways of collecting evidence to answer scientific questions. <i>Most pupils should be able to</i> choose a suitable method to gather the data to answer particular scientific questions from the range of approaches available. <i>Some pupils should also be able to</i> explain why a particular method is chosen to gather data to answer a scientific question. How Science Works Describe an appropriate approach to answer a scientific question using a limited range of information and making relevant observations or measurements. (1.2a)	Additional teachers notes Equipment and materials required Per group: tape measures, graph paper. Details The pupils should use the tape measure to find hand spans. They can use it to measure the length of people’s feet or use shoe size for size of feet.	



Fusion 1: HSW – The skills of investigation (1)		
National Curriculum Link up •2.1b, c.		
Electronic resources: Worksheets – Hazard symbols, Worksheets – Risk Assessment Form		
Learning Objectives Pupils should learn: How to plan a fair test. How to plan a safe test.	Teaching / Learning activities Lesson structure Starter - What car? Gather pupils' ideas about the factors (variables) a consumer takes into account when choosing a new car, and how the decision making process works. Some photos are a good way to stimulate discussion. Link this real-life manipulation of variables to a fair test pupils have done recently. (5 mins) Main Allow students to complete the pendulum investigation, is 'How does the length of the string affect the number of swings in 20 seconds?' Using the planning frame, introduce the terms 'independent variable', 'dependent variable' and 'control variables' and identify them for the pendulum investigation. Discuss the structure of the question with the whole class, i.e. 'How does the [independent variable] affect the [dependent variable]?' Finish off the spread by introducing safety requirements to consider, including the hazard symbols in the pupil book. Show the class a copy of a risk assessment form to fill in for an investigation. Plenary - Matching symbols Ask the class to close their textbooks and then match the hazard symbols to their meanings. Open the books to check their own answers. (5 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. For lower attaining pupils you may wish to use the planning frame to change the independent variable, swapping it with one of the control variables and asking pupils to name the new question being investigated. • Extension. Higher attaining pupils can use the planning frame to devise their own questions to investigate and fill in the appropriate variables. • Learning styles <i>Visual:</i> Observing the movement of Post-its on the planning frame. <i>Auditory:</i> Listening to explanations of different types of variable. <i>Kinaesthetic:</i> Sticking Post-its onto the planning frame. <i>Interpersonal:</i> Working in groups to identify key variables and hazards. <i>Intrapersonal:</i> Reflecting on the structure of a fair test in terms of variables.
Learning Outcomes <i>All pupils should be able to fill in a planning framework for a fair test with support and list some hazards associated with an investigation with prompting.</i> <i>Most pupils should be able to fill in a planning framework for a fair test and list some hazards associated with an investigation.</i> <i>Some pupils should also be able to identify key variables in a simple investigation, classify variables and list hazards associated with an investigation, making suggestions on how to control them.</i> How Science Works Recognise the range of variables involved in an investigation and decide which to control. (1.2b) Explain how action has been taken to control obvious risk and how methods are adequate for the task. (1.2c)	Additional teachers notes Per group: the planning frame (Planning a fair test worksheet from previous lesson), six small Post-its, risk assessment form (optional).	



Fusion 1: HSW – The skills of investigation (2)		
National Curriculum Link up •2.1c. 2.2a.		
Electronic resources: Worksheets – Reading scales, Worksheets - Sort it out, Worksheets – Working backwards, Worksheets – Carrying out trial runs		
Learning Objectives Pupils should learn: How to obtain data from investigations. How to record data from investigations.	Teaching / Learning activities Lesson structure Starter - Reading scales Give the pupils a sheet showing a variety of scales from analogue measuring instruments. Working individually, ask them to read each one, then quickly give out the answers. (5 mins) Main Discuss the measurements you need to take in the pendulum investigation. What instruments are needed? How precise will measurements need to be? Go on to consider how to record their data systematically in a table. Use the planning frame to show how the independent variable usually goes into the first column of your table (with units included in the heading). Discuss how repeating measurements can improve reliability if they show close agreement, whilst pointing out that this in itself does not guarantee more accurate (true value) data. Develop the two-column table into one that can accommodate repeat readings and the mean value by showing pupils how the second column can be divided up. Let the pupils carry out some trial runs with the pendulum to help fill in the detail of their planning. Plenary - Working backwards Give the class some table headings and ask them to write down the title of the investigation (in the form of a question) that each table was designed to record data for. (10 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. For lower attaining pupils, you may wish to use the planning frame and tables with no headings to practise physically moving relevant Post-its from the planner to the table. • Extension. Higher attaining pupils can devise tables to cater for repeat readings and means. • Learning styles <i>Visual:</i> Observing scales on measuring instruments. <i>Auditory:</i> Listening to explanations of what we mean by ‘reliability’, ‘precision’ and ‘accuracy’. <i>Kinaesthetic:</i> Carrying out trial runs of the pendulum investigation. <i>Interpersonal:</i> Working in groups to design tables. <i>Intrapersonal:</i> Reflecting on the design of tables to record data from investigations.
Learning Outcomes <i>All pupils should be able to</i> read simple measuring equipment. <i>Most pupils should be able to</i> plan a simple table to record data collected from an investigation, carrying out trial runs to decide on a suitable range. <i>Some pupils should also be able to</i> design tables to record repeat readings and choose measuring equipment with sufficient precision for the task. They use trial runs to inform their decisions. How Science Works Describe and record observations and evidence systematically. (1.2d) Recognise that the presentation of experimental results through the routine use of tables ... makes it easier to see patterns and trends. (1.2d)	Additional teachers notes Equipment and materials required Per group: the planning frame (Planning a fair test worksheet from previous lesson), six small Post-its, string, scissors, Plasticine, stop-clock, balance, tape measure/ruler, clamp stand.	



Fusion 1: HSW – The skills of investigation (3) National Curriculum Link up •2.1c. 2.2a, b.		
Electronic resources: Technician notes – Carrying out a fair test, Worksheets - Spotting patterns, Worksheets - Evaluating		
Learning Objectives Pupils should learn: How to present and analyse data graphically. How to evaluate investigations.	Teaching / Learning activities Lesson structure Starter - Name that investigation Show the pupils a line graph and ask them to discuss, in pairs, which investigation had been carried out to gather the data for the graph. Ask them to phrase the title of the investigation as a question. (5 mins) Main Pupils have the opportunity to carry out the full pendulum investigation. Stress why some data can be presented on line graphs and others on bar charts. This should involve introducing the terms ‘continuous variable’ and ‘categorical variable’. After the data gathering, get pupils to show their data on a line graph, explaining how to use a line of best fit. Go over the type of things you should consider when evaluating your investigation using the second part of the spread. Stress that although an evaluation is often written down at the end of an investigation, the process is actually on-going and we need to think about the issues raised as soon as we start. Ask pupils to do the Summary question and evaluate their pendulum investigation. Pupils will raise their level of attainment by explaining why their suggested improvements are needed. Plenary - Spotting patterns Show the pupils a series of line graphs and ask them to discuss, in pairs, the patterns shown (if any). Go over the graphs as a whole class. (5 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. For lower attaining pupils you may wish to use a writing frame to help phrase the relationship between variables, e.g. ‘The longer the string, the . . . the pendulum swings.’ • Extension. Higher attaining pupils can display all their repeat data on a graph and consider the spread within sets of repeat readings in terms of reliability. • Learning styles <i>Visual:</i> Looking at different graphs. <i>Auditory:</i> Listening to others when discussing the patterns shown by a line graph. <i>Kinaesthetic:</i> Carrying out the pendulum investigation. <i>Interpersonal:</i> Discussing graphs in pairs. <i>Intrapersonal:</i> Reflecting on their own investigation, suggesting improvements. • Functional skills link-up – Mathematics Collect and represent discrete and continual data, using ICT where appropriate. (Level 2)
Learning Outcomes <i>All pupils should be able to</i> describe a pattern from a graph and suggest an improvement to an investigation. <i>Most pupils should be able to</i> begin to explain the patterns they spot in data and suggest several ways to improve an investigation. <i>Some pupils should also be able to</i> explain the patterns they spot in data and suggest several ways to improve an investigation, explaining their reasoning. How Science Works Recognise that the presentation of experimental results through the routine use of tables, bar charts and simple graphs makes it easier to see patterns and trends. (1.2d) Describe patterns and trends in results ... (1.2e) Describe and suggest how planning and implementation could be improved. (1.2e)	Additional teachers notes Equipment and materials required Per group: string, scissors, Plasticine, stop-clock, balance, tape measure/ruler, clamp stand.	

