



<p>Fusion 2: P2.1 – Heat and Sound</p> <p>National Curriculum Link up •1.1a, b. 2.1a, b, c. 3.1a. 3.2a.</p>		
<p>Learning Objectives Pupils should learn: That materials can feel warm or cool because of their physical properties as well as their actual temperature. That temperature is a measure of how hot an object is.</p>	<p>Teaching / Learning activities Lesson structure Starter - It's cold out How can you tell that it's cold outside by watching through a window? What are the signs? The pupils may come up with ideas like snow, ice, frosty breath, warm clothing and so on. What are the signs that it's warm outside? (5–10 mins) Main The pupils can move on to the first activity, 'Feeling warm'. This is a straightforward sorting task and the pupils should have no real difficulty in concluding that 'fluffy' materials feel warm whereas the metals feel cold. In this lesson it is important to point out that the materials only <i>feel</i> warm; most of them will be at room temperature. Thermocolour film is readily available and it provides an excellent way of 'visualising temperature' far beyond what thermometers can show. Demonstrate how it operates by placing your hand onto the film and showing the colour changes. Try to work out which colour represents the warmest area. Now let the pupils think up ideas for using the film with the 'Colourful heat' activity. Have some basic equipment available to allow them to test out their ideas. Finish off by showing the pupils the objects they used in the 'Feeling warm' activity again and demonstrating that they are all at the same temperature. Tell them that we need a better way of deciding if one object is hotter than another. Plenary - Product placement The pupils can think up commercial uses for the thermocolour film technology or similar. What products could it be used in and how would they market them? What about paints that change colour depending on the weather? (5–10 mins)</p>	<p>Teaching suggestions • Learning styles. <i>Visual:</i> Observing thermocolour film to detect temperature differences. <i>Auditory:</i> Describing how an object feels. <i>Kinaesthetic:</i> Feeling and sorting materials. <i>Interpersonal:</i> Discussing how thermocolour films can be used in an experiment. <i>Intrapersonal:</i> Thinking about what we mean by the words 'warm' and 'cold'. • Extension. The pupils can look at microscope slides and electron micrographs of natural and man-made fibres (search the Internet). Can they see which fibres are the 'fluffiest' and does this match how warm the material feels? • Homework. Humans have to maintain a body temperature very near to 37°C. The pupils can find out what the body does to try to keep in this narrow temperature range and what happens if we get too hot (hyperthermia) or too cold (hypothermia).</p>
<p>Learning Outcomes <i>All pupils should be able to</i> arrange a set of materials in order from coolest to warmest. <i>Most pupils should be able to</i> use thermocolour film to place objects in order of temperature. <i>Some pupils should also be able to</i> explain why it is inappropriate to describe objects as 'warm' or 'cool' when making a scientific measurement.</p>	<p>Additional teachers notes Feeling warm equipment and materials required for each group: a range of materials as shown in the pupil book. Safety. Take care with hot water. Colourful heat equipment and materials required for each group: thermocolour film and apparatus as requested. Details. The pupils need to think up ideas about using the film. These could include: measuring body temperature (placing a small strip on the forehead); showing that thermal energy passes into a book (place a sheet inside the book and a hot object on top); placing the material on the outside of a mug to measure the temperature of the contents; seeing if sunlight will heat up the film.</p>	



Fusion 2: P2.2 – Taking Temperatures		
National Curriculum Link up •3.1a.		
Learning Objectives Pupils should learn: That the temperature of an object can be measured using a thermometer. That there are a range of different types of thermometer and each type is suitable for differing types of measurement.	Teaching / Learning activities Lesson structure Starter - Instrumental Give the pupils a worksheet showing various scientific measuring instruments. They must describe the property the instrument measures, the range of the instrument and the precision. (5–10 mins) Main The 'Getting warmer' activity will show the pupils that we are fairly unreliable judges of temperature. The focus of the 'Looking at thermometers' activity should be to discuss what is meant by 'accuracy', 'sensitivity' and 'range' of scientific instruments. An <i>accurate</i> instrument gives a reading that is close to the true value. A <i>sensitive</i> instrument can detect small changes. The <i>range</i> of the thermometer is the difference between the highest and lowest temperature it can read. The pupils could draw up a table showing the accuracy, sensitivity and range of a few of the thermometers so that you can check that they clearly know the difference between the terms. Plenary - Temperature sorting Give the pupils a set of cards containing temperature readings. They have to match these to the objects at that temperature. (5–10 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. You may want to limit the range of thermometers a little. Some pupils will find digital thermometers far easier to read than liquid-in-glass. • Extension. A clinical thermometer has a few features designed to make it useful for measuring a person's temperature. What properties should the thermometer have? The pupils should come up with precision, limited range, robust (so it does not break), and responsive, so you don't have to wait a long time to get a reading. What other technologies are used to measure a patient's temperature? • Learning styles. <i>Visual:</i> Taking precise readings from thermometers. <i>Auditory:</i> Listening to explanation of the difference between range, sensitivity and accuracy. <i>Kinaesthetic:</i> Measuring the temperature of water. <i>Interpersonal:</i> Discussing which thermometer is most appropriate for a particular type of measurement. <i>Intrapersonal:</i> Thinking about what a 'good' scientific measurement is. • Homework. The pupils can find out about some temperature records and values. For example, the highest and lowest recorded temperatures in the UK. What temperature do ovens operate at and so on?
Learning Outcomes <i>All pupils should be able to use a liquid-in-glass thermometer to measure the temperature of a liquid.</i> <i>Most pupils should be able to use a range of thermometers to measure the temperature of a material.</i> <i>Some pupils should also be able to select a thermometer for a particular measuring task taking into account the range and precision of the thermometer.</i> How Science Works Use a range of scientific vocabulary and terminology consistently in discussions and written work (1.1c).	Additional teachers notes Getting warmer equipment and materials required: Three bowls of water: one cold, one room temperature and one warm. A towel to dry hands. Safety. Test the temperature of the water carefully and make sure that the pupils do not leave their hands in for too long; one minute should do. Looking at thermometers equipment and materials required: As wide a range of thermometers as possible; try to include a clinical thermometer and high temperature thermometer. Each group will also require a beaker for the water. Safety. Watch out for breakages. Mercury-based thermometers will leak mercury if broken so a clean up kit is required. See CLEAPSS handbook/CD-Rom sections 12.13 and 7.7.	



Fusion 2: P2.3 – Warming up, Cooling down		
National Curriculum Link up •3.1a.		
Learning Objectives Pupils should learn: That an object warms up when it gains thermal energy from its surroundings and cools down when it loses energy to its surroundings. That the temperature of an object is a measure of the average thermal energy of a particle in the object and the total thermal energy depends on this and the size of the object.	Teaching / Learning activities Lesson structure Starter - Yuck, it's gone cold Bring a cold cup of tea to the lab. Ask the pupil to explain why it has 'gone cold'. What processes have happened? Do the pupils know of any way you could have kept your tea warm for longer? (5–10 mins) Main Start by completing the 'Patterns of cooling' activity, as detailed in the pupil book. The pupils should design their own graph where possible, choosing the appropriate scales. Ideally this should be a line graph and the pupils should draw a clear curve through their data points. This will show rapid cooling at the start, slowing down at the end. Discuss why the rate of cooling changed, making sure that the pupils understand that it is the difference between the temperature of the water and the room that is important. They should appreciate that the cooling will stop when the water has reached room temperature; the curve becomes flat. Make sure that the pupils have a good grasp of the idea of thermal energy. Temperature is actually related to the kinetic energy of one of the particles in a substance, whereas the thermal energy has to take into account all of the particles; the mass. This means that more massive objects have more thermal energy than small ones, when they are at the same temperature. Plenary - Spotting anomalous results Show the pupils a table with a large set of data including several repeat measurements. They have to spot the anomalous results and calculate the average readings. (5–10 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. Provide supportive instruction for the cooling water task. This can include a table for the results and some pre-prepared axes for the graph plotting if required. • Extension. Discuss thermal energy in more depth with these pupils. An object reaches <i>thermal equilibrium</i> with its surroundings when the energy it is emitting is matched by the energy that it is absorbing from the surroundings. • Learning styles. <i>Visual:</i> Drawing accurate graphs. <i>Auditory:</i> Discussing patterns in results. <i>Kinaesthetic:</i> Recording measurements. <i>Interpersonal:</i> Working in groups during experiments. <i>Intrapersonal:</i> Imagining the flow of energy from one object to another. • Homework. Constructive criticism Give the pupils a set of graphs that all show the same data but all are flawed. The pupils have to explain the problems with the graphs and construct an improved graph from the raw data. (10–15 mins) <ul style="list-style-type: none"> • Functional Skills – Mathematics Collect and represent continuous data, using ICT where appropriate (level 2).
Learning Outcomes <i>All pupils should be able to</i> explain cooling in terms of energy loss to the surroundings. <i>Most pupils should be able to</i> carry out an experiment to measure the rate of cooling of a liquid. <i>Some pupils should also be able to</i> describe the difference between temperature and thermal energy. How Science Works Describe ways in which the presentation of experimental results through the routine use of tables and line graphs makes it easier to see patterns and trends (1.2d).	Additional teachers notes Equipment and materials required: Kettles to heat the water. Per group: a 250 cm ³ beaker, a thermometer (0–100°C with 0.5° sensitivity). Data-logging equipment can also be used; a retort stand, boss and clamp, can be useful to hold the sensor in place, use pieces of rubber or polystyrene to protect thermometers when clamping. The pupils will also need graph drawing equipment. Safety. The starting water does not have to be boiling, but take care; 70–80°C should be adequate to show a cooling pattern.	



Fusion 2: P2.4 – Thermal Conduction and Insulation		
National Curriculum Link up •3.1a. 3.2a.		
Learning Objectives Pupils should learn: That a thermal conductor is a material that transfers thermal energy quickly and metals are good thermal conductors. That a thermal insulator is a material that transfers thermal energy slowly and that examples include wool, plastics and wood.	Teaching / Learning activities Lesson structure Starter - Siberian survival The pupils have unfortunately become stranded in coldest Siberia during a badly planned field trip. Give them a list of materials that are available and ask them to design clothing and a shelter. (10–15 mins) Main Demonstrate the ‘Comparing metals’ experiment to show the flow of energy through a material. Use the same materials as you did for P2.1 again. You can discuss the properties of these materials paying particular attention to the trapped air in the wool and other fibres. You could see if the pupils know anything special about metals. Bring out a metal ruler and a similar plastic one from a refrigerator (as you may have in an earlier lesson). The metal ruler will feel very cold compared to the plastic ruler, but placing them both on thermocolour film or using a temperature sensor should show that they are the same temperature. Use this to discuss why one feels cold; it is the loss of energy from our bodies that our senses detect. A material that feels warm is simply not allowing thermal energy to pass through. Plenary – Natural or artificial The pupils can design a test to see which material is the best thermal insulator, a natural fibre like wool or an artificial one like nylon. They should focus on making the test as fair as possible. (10–15 mins)	Teaching suggestions <ul style="list-style-type: none"> • Extension. Measuring temperature by placing something in contact with the object has a few problems. The contact causes cooling and sometimes we cannot touch the object. How can we measure the temperature using just the light (or infra-red radiation) coming from the object? The pupils can find some thermal images and explain how they are made. • Learning styles. <i>Visual:</i> Watching the ‘Comparing metals’ demonstration. <i>Auditory:</i> Listening to definitions of insulators and conductors. <i>Kinaesthetic:</i> Handling and describing different materials. <i>Interpersonal:</i> Discussing what we mean by the terms ‘hot’ and ‘cold’ in relation to materials. • Homework. The pupils can look for objects that are designed to transfer heat or reduce heat flow around their home. They can make a list of conductors and insulators from this information. Alternatively they can research information about which materials are the best conductors and which are the best insulators.
Learning Outcomes <i>All pupils should be able to</i> give examples of thermal conductors and thermal insulators. <i>Most pupils should be able to</i> describe an experiment to compare a range of thermal conductors. <i>Some pupils should also be able to</i> explain why materials at the same temperature can feel warm or cool in terms of their thermal conductivity. How Science Works Describe and identify key variables in an investigation and assign appropriate values to these (1.2b).	Additional teachers notes Comparing metals (demonstration) equipment and materials required: Two metal rods of the same length and diameter. A Bunsen burner, two (or four) retort stands, boss and clamps, and two temperature sensors. Safety. The metal bars will become very hot; allow time for them to cool before touching.	



Fusion 2: P2.5 – Expansion and Contraction		
National Curriculum Link up •3.1a. 3.2a.		
Learning Objectives Pupils should learn: That when materials are heated the particles in the material gain energy and move further apart. That thermal energy can be transferred through a material by conduction processes.	Teaching / Learning activities Lesson structure Starter -Safety first The pupils should draw up a table to note down the hazards and safety precautions that are taken through the lesson. They should start by noting any unnecessary risks already present in the laboratory; for example trip hazards. At the end they will give you a safety rating for the lesson. (5–10 mins) Main The demonstration the 'Observing expansion and contraction' activity. Discuss the demonstrations again and ask the pupils what they think is happening inside the materials; why do they expand when they get hotter? This should lead to two main ideas: the particles expand or they move further apart. There are a number of useful simulations of particle behaviour you can use to reinforce the idea of expansion. Use one if you have it. The pupils should be able to see that the particles vibrate more as the material heats up and so they take up more space. You now need to move on to using the particle model to explain thermal conduction. The description should explain why it takes some time for energy to be passed through a material. The key idea is that energy is passed from one particle to its near neighbours. The energy is transferred slowly because of this. Plenary - Cartoon conductor The pupils must draw a short cartoon showing clearly what happens to the particles in a metal rod when it is heated at one end. No words are allowed in the cartoon. (5–10 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. Provide the pupils with a set of diagrams showing the particle behaviour during expansion and conduction so that they can concentrate on adding brief notes. • Extension. Why are metals particularly good thermal conductors? The pupils can find out about the role that electrons play in the conduction process. How is expansion and contraction taken into account when designing large structures such as bridges? • Learning styles. <i>Visual:</i> Drawing diagrams of the particle model. <i>Auditory:</i> Describing the behaviour of particles in detail. <i>Kinaesthetic:</i> Examining the apparatus before use. <i>Interpersonal:</i> Discussing what can be concluded from the demonstrations. <i>Intrapersonal:</i> Imagining the behaviour of particles in a material. • Homework. Can the pupils think up any models that are similar to the way conduction or expansion in solids work? They should try to think up ideas to explain the concepts to Year 6 pupils. A typical one for conduction involves packing pupils together and pushing one, creating a sort of 'chain reaction' of energy that is passed on. (5–10 mins) • Functional Skills – English Present information on complex subjects concisely and clearly (level 2).
Learning Outcomes <i>All pupils should be able to state that materials expand when they are heated.</i> <i>Most pupils should be able to describe expansion in terms of a particle model.</i> <i>Some pupils should also be able to describe thermal conduction in terms of a particle model.</i> How Science Works Describe how the use of a particular model or analogy supports an explanation (1.1a1).	Additional teachers notes Equipment and materials required: A bimetallic strip, model Archimedes' thermometer (round-bottomed flask filled with coloured liquid as shown in the pupil book), ball and ring expansion apparatus, bar and gauge apparatus. Safety. All of the metal objects will become very hot, do not allow pupils to touch them. Use safety screens and eye protection.	



Fusion 2: P2.6 – Radiation and Convection		
National Curriculum Link up •3.1a. 3.2a.		
Learning Objectives Pupils should learn: That thermal energy can be transferred by radiation and this is the only way thermal energy can travel through a vacuum. That convection currents carry thermal energy through fluids owing to changes in density.	Teaching / Learning activities Lesson structure Starter - Light refreshment What are the properties of light? The pupils have five minutes to make a summary diagram of what they remember from P1 earlier. (10 mins) Main A Leslie's cube filled with freshly boiled water can be used to let the pupils feel the radiation being emitted by a hot object. Once you have established that infra-red radiation exists you can try to detect it with a camera using 'Seeing infrared radiation'. Allow the pupils to carry out the 'A model convection current' experiment. Give the pupils a hazard card for the potassium manganate (VII) before they start and ask them to note down two hazards and how they will be avoided. Convection currents in gases can be shown by using a smoke chimney. The smoke particles are dragged downwards from one chimney and then back up another. It is again important that the particle model is used to explain these changes. The pupils will need to picture the material expanding when it is heated; and becomes less dense and so the material rises upwards. As the material cools down it contracts, becomes denser and sinks again. Plenary - Risk management Ask the pupils to match up a set of risks with the action or action taken to control the risk. (5–10 mins)	Teaching suggestions <ul style="list-style-type: none"> • Special needs. Provide a diagram of a convection current for the pupils to label with key phrases. • Extension. You may wish to use the term 'electromagnetic radiation' when discussing light and infra-red radiation. The pupils could look at other parts of the electromagnetic spectrum. Alternatively they could make a plan to see which surfaces are the best absorbers or emitters of IR radiation. • Learning styles. <i>Visual:</i> Watching the action of a convection current. <i>Auditory:</i> Listening to or describing a convection current in detail. <i>Kinaesthetic:</i> Carrying out practical activity. <i>Interpersonal:</i> Carrying out group work. <i>Intrapersonal:</i> Recalling previous work. • Homework. Knowledge of thermal energy transfer is essential in fire fighting. The pupils could produce a report showing how fire fighters need to understand radiation and convection currents. Areas that could be covered include shiny suits, flashover, backdrafts and so on. • Functional Skills – English Present information on complex subjects concisely and clearly (level 2).
Learning Outcomes <i>All pupils should be able to</i> state that heat can only pass through a vacuum by radiation and that fluids (liquids and gases) can transfer energy by convection. <i>Most pupils should be able to</i> describe how infra-red radiation can be detected. <i>Some pupils should also be able to</i> describe a convection current in terms of particle behaviour and density changes. How Science Works Describe how the use of a particular model or analogy supports an explanation (1.1a1).	Additional teachers notes Seeing infra-red radiation equipment and materials required: Video camera sensitive to infra-red radiation. Safety. The pupils must not be able to touch the hot objects. A model convection current equipment and materials required for each group: a large beaker (at least 500 cm ³), Bunsen burner, heat-resistant mat, tripod, gauze, forceps, water and a small potassium manganate (VII) crystal. Safety. Potassium manganate (VII) is an oxidising agent and harmful. Handle crystals with forceps or tweezers. See CLEAPSS Hazcard 81. The pink solution is low hazard. The pupils do not need to boil the water so the Bunsen should be turned off once the concept has been demonstrated.	



<p>Fusion 2: P2.7 – Seeing Sounds.</p> <p>National Curriculum Link up •3.1a. 3.2a.</p>		
<p>Learning Objectives Pupils should learn: That the amplitude of a sound is its loudness. That the pitch of a sound wave is related to its frequency; the number of vibrations each second.</p>	<p>Teaching / Learning activities Lesson structure Starter -Music maestro please Borrow a range of instruments from the music department, e.g. guitar, drum, flute and so on. Play a note on each of them and ask the pupils to describe what is happening. Lead them to the idea that a part of the instrument is vibrating. Ask how a louder note can be played and what this does to the vibration. (10 mins) Main Demonstrate the ‘Sounds on screen’ activity. The pupils must understand the relationship between the pitch and the frequency (vibration per second) and also amplitude and volume. The pupils can then attempt to capture the waveforms from some sounds in the ‘Capturing sounds’ activity. They should find that simple instruments can produce fairly simple patterns, but a voice is very complex in its waveform. They can sketch these waves and see if they can make a link between the shapes and the way instruments sound. You can also provide some tuning forks for the pupils to use; these should be struck gently to prevent damage to them. They should give a simple waveform. After the experiments you can discuss the findings. Try to find some images of traces in advance, just in case the pupils do not have clear ones. Plenary - Noted Can the pupils match up the waveforms with the instrument that created it? Show a set of six instruments and six waves and get the pupils to match them up. (5–10 mins)</p>	<p>Teaching suggestions</p> <ul style="list-style-type: none"> • Extension. The pupils can find out more about the connection between music and the waveforms instruments produce. Is there a connection between the frequency and the scales used in music? • Learning styles. <i>Visual:</i> Making detailed observations about waves. <i>Auditory:</i> Listening to musical instruments. <i>Kinaesthetic:</i> Drawing waveforms. <i>Interpersonal:</i> Collaborating in collection of sounds. <i>Intrapersonal:</i> Relating sound wave patterns to the actual sounds. • Homework. The pupils can find out about how various musical instruments operate, from the obvious drum and piano to the Theremin.
<p>Learning Outcomes <i>All pupils should be able to state that the larger the amplitude a sound wave has the louder it will be.</i> <i>Most pupils should be able to compare oscilloscope traces to determine which sound has the highest amplitude and frequency.</i> <i>Some pupils should also be able to describe the patterns they find in waveforms produced in musical instruments.</i></p>	<p>Additional teachers notes Sounds on screen equipment and materials required: Signal generator, cathode ray oscilloscope and loudspeaker. Safety. Do not let the pupils listen to loud noises for too long. Capturing sound equipment and materials required: Data-logging software, computer and microphone. Wobble equipment and materials required: A rectangular sheet of flexible material measuring approximately 80 cm by 50 cm. Thin hardboard (high density fibreboard) works best. Safety. Make sure the edges are not sharp.</p>	



<p>Fusion 2: P2.8 – How Sound Travels.</p> <p>National Curriculum Link up •3.1a. 3.2a.</p>		
<p>Learning Objectives Pupils should learn: That sound will travel through all materials but it cannot travel through a vacuum. That sound travels as a wave of compressions through a medium. That sound travels more quickly through dense materials as the particles are closer together.</p>	<p>Teaching / Learning activities Lesson structure Starter - Moving through solids The pupils need to explain, or draw a set of diagrams showing how thermal energy is conducted through a solid material. (5–10 mins) Main - Demonstrate 'In space no-one can hear the doorbell'. You now need to discuss the wave nature of sound. The pupils need to be able to imagine the behaviour of the particles in the material. These oscillate and push other particles and so on. Traditionally you can use a 'Slinky' spring. Stretch this out a bit and place a sticker on one of the coils half way along. If you move one end in and out you will produce a longitudinal wave and the pupils will be able to see the compressions. They should also note that while the sticker 'waves' back and forth it doesn't actually go anywhere; this shows that while energy is being transferred there is no material transferred. Once the pupils have a firm grasp of the movement of sound you can move on to the 'Sound and solids' activity. The pupils have to consider how to make the experiment fair. Plenary - Evaluation time Give the pupils a plan for comparing the insulation properties of three materials along with the results produced. The pupils must work in pairs, spot problems and suggest improvements. (10 mins)</p>	<p>Teaching suggestions</p> <ul style="list-style-type: none"> • Special needs. Pupils can be provided with a plan for the 'Sound and solids' task so that they can focus on gathering and analysing results. • Extension. With some pupils you might want to describe the sound wave in more detail using terms like longitudinal wave, compression and rarefaction. You could mention the idea of pressure and emphasise that particles in gases are already moving randomly; the sound wave is super-imposed on top of this random movement. • Learning styles. <i>Visual:</i> Watching simulations or demonstrations of wave movement. <i>Auditory:</i> Listening to sound waves through materials. <i>Kinaesthetic:</i> Measuring sound levels with a sensor. <i>Interpersonal:</i> Working in groups and discussing plans of action. <i>Intrapersonal:</i> Understanding how sound travels through a medium. • Homework. Summary question 5 works well as a homework task.
<p>Learning Outcomes <i>All pupils should be able to state that sound requires a medium (material) to travel through.</i> <i>Most pupils should be able to describe how sound travels as a wave through materials.</i> <i>Some pupils should also be able to explain why sound travels faster through solid materials than gases in terms of particle movement.</i> How Science Works Describe and identify key variables in an investigation and assign values to these (1.2b). Describe and suggest, with reasons, how planning and implementation could be improved (1.2e).</p>	<p>Additional teachers notes In space, no-one can hear the doorbell (demonstration) equipment and materials required: An electric bell in a bell jar, a vacuum pump and power supply. Safety. Use safety screens and keep pupils well back. Risk of implosion and flying glass. Sound and solids equipment and materials required: A sound source, this could be a loudspeaker connected to a signal generator or any other source that can produce a reasonably constant loudness. A decibel meter or other sound meter. A range of test materials: expanded polystyrene, metal sheets, cotton wool, wool, plywood and so on. Safety. Avoid loud sounds.</p>	



<p>Fusion 2: P2.9 – Noise Annoys</p> <p>National Curriculum Link up</p> <p>•3.1a. 3.2a.</p>		
<p>Learning Objectives Pupils should learn: That the ear can detect only a limited range of frequencies and can be damaged by loud sounds. That sound intensity is measured in decibels. That sound levels can be reduced by insulation.</p>	<p>Teaching / Learning activities Lesson structure Starter - Stop, children what's that sound? Let the pupils take part in a mystery noise quiz. Play ten sample noises and get them to write down what they think the noise is. (10–15 mins) Main – Take part in the 'Hearing Test' activity; your hearing range should be a bit more limited than that of the pupils. Some pupils may not want to take part in the hearing test so don't make it compulsory. You might find a few pupils can still hear the sound even with the equipment turned off! A large model ear or diagram is essential to explain how we hear. Point out how sensitive and fragile the parts of the ear are and give some ideas about how they can be damaged. The pupils will generally be able to put sounds in order of loudness. You may not want to use the dB abbreviation for decibel with the pupils. To show how annoying noise can be, you can play a background noise for a few minutes while the pupils are trying to concentrate. The pupils can have a look at a sound meter again with 'Keep that noise down'. They should notice that the readings can be erratic, and that to get an accurate picture of noise levels they would need to take a series of measurements over a period of time. Plenary - Sound off Question students about how the particle model can be used to explain thermal energy transfer and sound. (5–10 mins)</p>	<p>Teaching suggestions</p> <ul style="list-style-type: none"> • Special needs. Provide the pupils with a help sheet showing the parts of the ear for them to label. • Extension. The pupils could plan and carry out a full investigation into which materials provide the best sound insulation for a particular job. This could be focussed on how many layers of glass it is economical to use for windows, or which material is the best for reducing echoes from walls in sound studios. • Learning styles. <i>Visual:</i> Looking at the parts of a model ear. <i>Auditory:</i> Taking part in a range of listening activities. <i>Kinaesthetic:</i> Operating a sound meter. <i>Interpersonal:</i> Discussing the importance of noise reduction. <i>Intrapersonal:</i> Thinking about the effects of hearing loss. • Homework. Does listening to music on personal music players and mobile phones cause ear damage? The pupils can find recent articles or newspaper stories and write a short report on the issue.
<p>Learning Outcomes <i>All pupils should be able to state that humans can only detect a limited range of frequencies and other animals can detect different ranges.</i> <i>Most pupils should be able to explain how the loudness of sound is measured and describe measures to reduce noise pollution.</i> <i>Some pupils should also be able to describe how the ear detects sound.</i> 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 (1.1b). Describe an appropriate approach to answer a scientific question (1.2a).</p>	<p>Additional teachers notes Hearing test equipment and materials required: Signal generator and loudspeaker. Safety. Do not use overly loud sounds, particularly at frequencies the ear is most sensitive to. Keep that noise down! equipment and materials required: A sound-level meter. Safety. Do not use very loud sounds.</p>	