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| **Year** | **Topic No.** | **Topic Name** | **Lesson No.** | **Lesson Name** |
| **4** | **4** | **Solids, liquids and gases** | **20** | **Solids, liquids and gases** |
| **Curriculum objectives** | C4.1A – Identify materials as solids, liquids or gases and distinguish between themC4.1B – Describe some common properties of solids, liquids and gases |
| **Learning focus** | What are solids, liquids and gases? |
| **Key vocabulary** | solid; keep; pour; container; compressed; squashed; contains; liquid; juice; pool; air; blowing; straw; bubble; balloon; helium  |
| **Page reference** | Pages 72–77 |
| **Resources supplied** | N/A |
| **Other resources needed** | A range of named solids, liquids and gases – some to show and some for learners to look at independently. Include an obvious solid such as a brick (see Introduction) and a cube (see Main activity)Honey, treacle or other viscous liquid with which to demonstrate flowDifferent shaped containers into which liquids can be pouredSurface on which to demonstrate pouring, spillage and flow of a liquid and a suitable liquidBubble wand and safe bubble blowing liquid (several if you use volunteers)Three A3 display sheets, or other method of building up a list of properties of solids, liquids and gases together – each headed Solids, Liquids or Gases, respectively |
| **Lesson Outline** |
| **Textbook reference:** pages 72 to 77**Before you teach:**In this lesson you will introduce learners to solids, liquids and gases and enable them to distinguish between them using their properties. From your display collection, use materials you do not want learners to handle for the demonstration so they are free to handle the remining items independently. To demonstrate flow use something like honey or treacle that will flow slowly enough. However, do not introduce viscosity here since it is introduced in a later lesson.The workbook tasks for this lesson should be done at the same time as the materials activity in the main activity –you may wish to spread the display out to avoid congestion when learners access them.Prepare in advance how you will summarise and display the properties of solids, liquids and gases – an A3 sheet is suggested but you may prefer to do this electronically, particularly if you wish to print them (see ‘support’ activity).**Introduction:**Show an example of an obvious solid, such as a brick. Tell learners that this brick is a **solid** and ask: *What do you think a solid is?* Do not refine answers at this stage but instead ask: *Can you show or name something that is not a solid*? Explain that today you will be looking at the properties of solids, like your brick and comparing them to the properties of **liquids** and **gases**.**Main activity:**Look at textbook pages 72 and 73 together, alongside some examples of solids you have brought. Demonstrate how solids **keep** their shape, even in different containers. Demonstrate pouring a solid cube from one **container** to another to show that it does not change shape. Attempt to **compress** a solid such as a brick and explain that compress means **squash**. Explain that solids cannot be compressed easily. Start to build up a list of properties of solids on your A3 sheets; they are shown in bold sentences on each textbook spread.Next look at textbook pages 74 and 75 together, alongside one example of a liquid you have brought. Demonstrate how the liquid can be **poured** and how it takes the shape of the container into which you pour it. Transfer some liquid between containers of different shapes to demonstrate this ensuring that you ‘accidentally’ spill some liquid on the final pouring. Point out the spilled liquid and describe it as making a **pool** now that it is not inside a container. Add the properties shown in bold to your A3 sheets.Next look at textbook pages 76 and 77 together as you, or some volunteers, blow some bubbles. Ask: *What are the bubbles filled with?* (Air.) Tell learners to cup their hands and blow air into them. Ask: *Can you feel the air moving?* Explain that this is evidence that the air is there even though they cannot see it. Look at the properties of gases shown by the examples in the textbook and any you have brought and add the properties shown in bold to your A3 sheets.Now give learners time to look at other examples from your display while completing the workbook pages. |

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| **Workbook reference:** Complete workbook pages 72 to 77.**Plenary:**Go back to your completed A3 sheets to summarise and compare the properties of solids, liquids and gases. Retain these for future lessons. |

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| **Support** | Some learners may find it easier to have a printed list of properties on their desk while accessing the workbook tasks. |
| **Extension** | Make a classroom wall display comprising pictures and properties of solids, liquids and gases. |
| **Homework / Follow-up** | Finish any incomplete workbook tasks from today’s lesson. |

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| **Year** | **Topic No.** | **Topic Name** | **Lesson No.** | **Lesson Name** |
| **4** | **4** | **Solids, liquids and gases** | **21** | **Comparing properties of solids and liquids** |
| **Curriculum objectives** | C4.1A – Identify materials as solids, liquids or gases and distinguish between themC4.1B – Describe some common properties of solids, liquids and gasesC4.1C – Understand that solids consisting of very small particles can behave as liquids in some waysLSE3.2 – Investigating: Set up simple enquiries, comparative and fair testsEither: LSE3.2 – Investigating: Make systematic and careful observations (observation approach to comparative test)Or: LSE3.2 – Investigating: Take measurements, using a range of scientific equipment, with increasing accuracy and precision (quantitative approach to comparative test)LSE3.3 – Obtaining and presenting evidence: Record data using scientific diagrams, keys, tables, bar graphs and line graphsLSE3.4 – Conclusions: Use results to draw simple conclusions and to predict new values (comparative test)LSE3.4 – Conclusions: Identify scientific evidence that has been used to support or refute their own conclusions and those of others (support/refute sand as a liquid)LSE3.5 – Evaluating: Identify limitations to investigations and suggest how an investigation might be improved |
| **Learning focus** | Comparing some properties of solids and liquids |
| **Key vocabulary** | fizzy; grain; tiny; pile; syrup; honey; drip; viscous |
| **Page reference** | Pages 78–81 |
| **Resources supplied** | N/A |
| **Other resources needed** | Sand, sugar or salt, and also a liquid such as thin honey, to show the demonstration on textbook page 79For class activity, per pair of learners:four named viscous liquids of differing viscosities, for example, tomato sauce, treacle, syrup, liquid soap, hand creamflat board or plate with pre-drawn start lineoptional stopwatches (see ‘Before you teach’ section) |
| **Lesson Outline** |
| **Textbook reference:** Pages 78 to 81.**Before you teach:**In this lesson you will look more closely at specific properties of solids and liquids to clearly establish a boundary between these two states of matter. Ensure that you are *clarifying* and *not confusing* when comparing sand, sugar or salt to a liquid. Be quite clear at the start that these are *not* liquids and then put the case for why ‘some people’ (but not us, of course) might mistakenly think they are liquids. Do not let this first section of the lesson occupy too much time so learners have enough time to do the practical activity carefully. If you have extra help with clearing up, you could opt to do the practical activity first and teach the rest while clearing up takes place.Choose a range of liquids with different viscosities for the practical activity. Depending on how easy it will be to make the start a fair test on the board/plate used, you may need to draw a pencil start line on each in advance. Water or vinegar will be too fast, so ensure that all four liquids are viscous enough to start off as a blob and not run into each other before the surface is tipped. Nevertheless, encourage learners to make all four blobs quickly, especially if in a warm climate. You can choose whether to do this quantitatively by timing the liquids or by observation only, as indicated in the curriculum objectives. There is a results table on workbook page 81 for learners to complete.**Introduction:**Look at textbook page 78 together and ask: *Can you name some solids? Liquids? Gases?* Now move on to textbook page 79 and look at it together, along with showing your sand and honey. Point out that ‘some people’ might try to say that sand is a liquid. Demonstrate pouring the sand from hand to hand and then let it fall into an obviously peaked pile. Do the same hand to hand with the liquid honey then let it form a pool near the pile of sand. Observe the pile and the pool together and ask: *How could you use this evidence to show that sand is not a liquid?* Elicit the words pile and pool and then point out that sand is a pile of lots of tiny solids. The same is true of sugar and salt.**Main activity:**Follow on from the ‘introductory’ section by returning to the idea that liquids can flow. Remind learners about the honey you just used and how fast it flowed.Ask: *Can you think of any liquids that are difficult to get out of the bottle or container?* If necessary, prompt with: *Can you think of things where you have to shake the bottle or turn it upside down to get the last bit out?* Now ask: *Can you think of liquids that spread out everywhere if they spill?* Prompting, if needed, with a scenario of what happens if a glass of water is knocked over. (Water spreads over the table, goes under table mats and may run off the table onto the floor.)Develop this into the idea of viscosity, by explaining that the viscosity of a liquid is a measure of how quickly or slowly it flows. Liquids have different viscosities, so some flow more easily than others; the more viscous the liquid, the slower it flows. Suggest that they could compare the viscosity of four different liquids and ask for suggestions about how they might do this. Pick up on any answers that refer to time/timing then look at textbook pages 80 and 81 together. Ask:* *If you want to find the most viscous liquid, then what are you going to change?* (The liquid.)
* *What will you observe or measure?* (Idea of how long it takes to flow.) Point out that they could time this or they could just observe which flows fastest. Make it clear which you want them to do or give a choice.

Look at the textbook image on page 81. Then consider fair testing by asking:* *If we use four blobs of different liquids, what must be kept the same?* (Size of blob/volume used/start position, type and angle of surface.)
* *How will we know which is the most viscous liquid?* (Blob will move least.)

Reinforce the previous point by stating that the liquid reaching the bottom of the surface *first* will be the *least* viscous.Group learners in pairs and give out the equipment needed. Now give learners time to carry out this comparative test alongside workbook pages 80 and 81. They can then complete the remaining workbook tasks on pages 78 to 79. |

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| **Workbook reference:** Complete workbook pages 78 to 81.**Plenary:**As a whole group discuss the results of the comparative test; ask: *Which liquid was the most viscous and which was the least viscous?* *Can you put the four liquids in an order of viscosity*? *Can you suggest any improvements to you investigation?* (For example, timing, if they did not; co-ordinating the start of timing if they did; accuracy of making blobs the same; reference to repeats; ways to keep the surface still.) |

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| **Support** | Ensure that less dextrous learners have a supportive partner when setting up the blobs of liquid and timing. |
| **Extension** | Investigate the viscosity of other liquids, or the same liquids that have been refrigerated or not. |
| **Homework / Follow-up** | Finish any workbook tasks from today’s lesson. |

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| **Year** | **Topic No.** | **Topic Name** | **Lesson No.** | **Lesson Name** |
| **4** | **4** | **Solids, liquids and gases** | **22** | **Temperature** |
| **Curriculum objectives** | C4.1D – Understand that temperature is a measure of how hot or cold something is and is measured in degrees Celsius (°C) using a thermometerLSE3.2 – Investigating: Take measurements, using a range of scientific equipment, with increasing accuracy and precision |
| **Learning focus** | How do thermometers work? |
| **Key vocabulary** | temperature; hot; cold; thermometer; increasing; degrees Celsius / °C; numbered; scale; below; 0 / zero; electronic |
| **Page reference** | Pages 82–85 |
| **Resources supplied** | N/A |
| **Other resources needed** | Display of different types of thermometer, as availableClass set of simple laboratory style thermometers with °C scaleBeaker of water |
| **Lesson Outline** |
| **Textbook reference:** Pages 82 to 85.**Before you teach:**Today you introduce the concept of temperature as a measure of how hot or cold something is. From the outset, ensure that learners do not think that heat and temperature are interchangeable words – correct this every time it occurs in order to set good foundations. For the same reason, ensure you correct the writing of °C in any other format but the correct one.A key outcome today is for learners to go away with an understanding of how relatively hot/cold things around them are. A useful mental marker for them is often the room temperature at school and/or the outside temperature if they differ widely. Although not absolute values, learners can use these as their own reference points more easily than the temperature of boiling water, which they cannot touch, or the freezing point of water which they may not often experience. So, going forward, ask each day for an estimate of today’s room temperature and/or outside temperature and then ask someone to measure it.If you intend setting the ‘homework/follow-up’ activity, you may wish to research suitable websites, apps or other reference sources in advance, or print out some local and world temperature bar graphs.**Introduction:**Look at textbook page 82 together and discuss the hot and cold things there. Introduce the comparatives terms– **hot/hotter/hottest** and **cold/colder/coldest**. Now use an appropriate example of how we sometimes find it difficult to judge how hot or cold something is, for example, water in a swimming pool may seem much colder when we get into it feeling very hot ourselves. If we are very cold, a hot drink may feel much warmer than the same drink might feel on a hot day. State that *measuring* how hot or cold something would be a more scientific approach.**Main activity:**Show a wall thermometer or simple laboratory thermometer. Explain that **temperature** is a measure of how hot or cold something is and that the measuring equipment used to measure temperature is called a **thermometer**. Point to the red liquid inside the thermometer and explain that this is inside a long thin tube. Point to the bulb of the thermometer, stating that ‘there is more of the red liquid in here’. Explain that the red liquid takes up more and more space when it gets hotter and hotter so it moves up the thin tube as the temperature **increases**. Look at textbook page 83 together so learners can see this more clearly. Challenge them by asking: *Why is a thin tube better than a wider one*? (The red liquid will move further up a thin tube so it is easier to see changes in temperature and to read the scale more accurately.)Look at textbook pages 84 and 85 together and give everyone a thermometer to look at. Explain that a thermometer has marks on it to make a **scale**, which is **numbered**. On a thermometer like this (hold up a simple laboratory thermometer and tell learners to look at theirs too) the scale is numbered in tens. It usually starts at **zero** and goes up to 100, but there are often a few numbers and/or marks above and **below** these too. The unit we use for temperature is **degrees Celsius** which we write as **°C** as shown in the textbook. Make it clear how this unit is written at the outset i.e. a superscript o followed by a full size capital letter C.Measure the air temperature to demonstrate how to read the thermometer at eye level. Now put the thermometer into a beaker of water. Explain that if you take the thermometer out to read it at eye level then it will be measuring air temperature, not the temperature of the water. Ask: *What should I do differently?* (Bend knees and look at it at eye level on the desk.) They may suggest picking the beaker up; if so, ask: *What is problem with doing that if the water is very hot?* (Too hot to pick up and you may not know this because you have not yet measured its temperature.)Optionally give learners time to measure the temperature of a few things; more opportunities follow in other lessons. Examples might include the air temperature indoors and outdoors or the temperature of water in a beaker taken from the cold tap and then from the hot tap (if not too hot).  |

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| **Workbook reference:** Complete workbook pages 82 to 85.**Plenary:**Show any other thermometers you may have brought and talk through their uses and how this affects the range of the scale, for example, a jam-making thermometer or a clinical thermometer. |

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| **Support** | Some learners may need additional help to interpret and number thermometer scales. |
| **Extension** | Make a temperature chart to record the daily temperatures in your classroom and/or outdoors. |
| **Homework / Follow-up** | Look up climate data for the place where you live and compare it with temperatures somewhere in another part of the world. How do the annual temperatures vary through the year? Do yours vary more or less? In which month(s) are the highest temperatures usually recorded? |

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| **Year** | **Topic No.** | **Topic Name** | **Lesson No.** | **Lesson Name** |
| **4** | **4** | **Solids, liquids and gases** | **23** | **Changing state** |
| **Curriculum objectives** | C4.1F – Understand that different substances change state at different temperaturesLSE3.2 – Investigating: Set up simple enquiries, comparative and fair testsLSE3.2 – Investigating: Take measurements, using a range of scientific equipment, with increasing accuracy and precisionLSE3.3 – Obtaining and presenting evidence: Record data using scientific diagrams, keys, tables, bar graphs and line graphs |
| **Learning focus** | What does changing state mean? |
| **Key vocabulary** | matter; change state; heated; cooled |
| **Page reference** | Textbook pages 86–87 and pages 92–93 for extension |
| **Resources supplied** | N/A |
| **Other resources needed** | Per pair of learners:thermometersmall beakerstopwatchsupply of ice cubesA4 paper and pencil for results table or printed results table you have preparedoptional squared or graph paper – see ‘homework/follow-up’ section |
| **Lesson Outline** |
| **Textbook reference: P**ages 86–87 and pages 92–93 for extension**Before you teach:**Today you will introduce the *principle* of changing state i.e. that matter changes state when heated or cooled. Note that the only change of state being named today is ‘melting’ – keep the others for the next lesson.In the class practical, learners are measuring how temperature changes as ice melts. They will only need a few ice cubes each, for example, three to five; this will depend on the size of the beaker as they should be reasonably closely packed so the thermometer bulb can go within. Work through the start of the lesson at a pace to suit how long the ice melting activity will take in your climate. Theory work can be split either side of the activity so learners can focus on timing and taking their measurements. You may wish to prepare a results table in advance to save time. If you intend learners to make a line graph of their results, work out the scale, axes and suitable sized paper in advance – see ‘homework/follow-up’ activity.The practical task is not just scale-reading practice. The discussion before it is intended to introduce learners to thinking about the *accuracy* of their measurements and is followed up later with a theoretical task about this in the textbook – see ‘extension’ activity.**Introduction:**Remind learners that temperature is a measure of how hot or cold something is. Tell them that they will be measuring temperature again today. Look at textbook page 86 together. Introduce the term **matter** and point out that solids, liquids and gases are different states of matter.**Main activity:**Still with textbook pages 86 and 87 as a visual aid, explain that the same type of matter can exist in different states. Use butter as an example: when it is taken out of a refrigerator, it is a solid and hard and difficult to spread; when it is warmed, however, it starts to melt and becomes a liquid. We say that it **changes state** from a solid to a liquid. Repeat with a similar discussion about ice cream. Explain that a solid must be **heated** to change into a liquid and this change of state from solid to liquid is called melting.Still using textbook page 86 for images, look at other changes of state but do not name these until the next lesson. Explain that the red-hot molten metal shown is a liquid, when the liquid metal is cooled it changes state and becomes a solid. Using the image of the ice cream as visual stimulus, ask: *How could the warm liquid ice cream be made into solid ice cream again?* (Cool it in a freezer.) *What about the melted butter*? (Cool it in a refrigerator or freezer.)Group learners in pairs and give each pair an empty beaker, a thermometer and a stopwatch. Remind them about looking at the thermometer scale at eye level and give them time to look at the scale now so they know what each mark represents. Give further guidance if required. Now tell the class that they should measure the temperature of the ice every 2 minutes (adjust this according to climate, but 1 minute is likely to be too fast for them to manage effectively). One person should do timing and the other should do measuring. Ensure they realise that they should not start and stop the stopwatch but leave it running and say ‘now’ when their partner must record a temperature. Discuss how to make this as accurate as possible; for example, they could give their partner a ‘get ready’ warning before the ‘now’. Explain that otherwise the 2-minute intervals might vary according to how ready their partner was. Tell them to stir the ice/water before measuring the temperature. They can do this on the ‘get ready’ signal.Give out the results tables or direct learners to make one while you give out the ice cubes. They can then start the measuring activity and record their results in the table. |

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| **Workbook reference:** Complete workbook pages 86 to 87.**Plenary:**Look at textbook page 87 together to summarise changes of state. Start by looking at the generic diagram of heating and cooling and explaining what it shows. Then compare the chocolate with the metal pan by asking the questions there. Point out that chocolate melts at a much lower temperature than metal. A pan made from chocolate would melt before the food in it was cooked. |

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| **Support** | Some learners may need additional help to interpret the thermometer scale. |
| **Extension** | Do the end of topic questions on textbook pages 92 and 93. This is likely to need your input to go through the information on page 92 first, particularly the example about Monday’s temperature. Page 93 could then be done in pairs or as a teacher-led class discussion. |
| **Homework / Follow-up** | Optionally draw a line graph showing the results from the ice-melting experiment (you will need to give guidance on axes and scales). |

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| **Year** | **Topic No.** | **Topic Name** | **Lesson No.** | **Lesson Name** |
| **4** | **4** | **Solids, liquids and gases** | **24** | **Water changing state** |
| **Curriculum objectives** | C4.1E – Understand that water exists in three states and changes from one to another at different temperatures |
| **Learning focus** | What other changes of state are there? |
| **Key vocabulary** | ice; melt; melting; water vapour; evaporation; condensation; frozen; freezing; boils; indoors; outdoors |
| **Page reference** | Pages 88–91 |
| **Resources supplied** | N/A |
| **Other resources needed** | For demonstration:heatproof beaker containing icestirring thermometermethod of heating, for experiment, tripod/gauze/Bunsen or similarcold plate or other surface on which condensation will form – see ‘Before you teach’ section |
| **Lesson Outline** |
| **Textbook reference:** Pages 88 to 91.**Before you teach:**In this lesson you are introducing freezing, evaporating and condensing in relation to water, in addition to freezing already covered. You are also linking these changes of state to the Celsius scale. If there was no time to do the ‘extension’ activity last lesson then aim to do it today or make it into an extra lesson along with some more temperature reading/accurate timing practice. Do not extend today’s work into the water cycle as this is covered later in the course.When you do the heating ice and water demonstration, either plan to do it near a surface on which condensation will form or have a cold plate on which to allow the water vapour to condense.**Introduction:**Remind learners that they have already met the idea of changes of state and looked at melting as an example. Refer to the diagram on textbook page 87 showing that changes of state require heating or cooling. Point out that today they will be learning more about the changes of state of water.**Main activity:**Set up the beaker of ice ready to heat and ask:* *What will happen to this ice when I start to heat it?* (Melts.)
* *What change of state will this be?* (Solid to liquid.)
* *How should I read the thermometer?* (At eye level with the bulb remaining in the ice/water; stir the contents of the beaker first.)

When the ice has melted, point out that there is now a liquid in the beaker and ask: *What will happen if I continue to heat this water?* (It will change to a gas/it will change to water vapour/the water level will go down.) If you get any answers that include the idea of disappearing, completely ignore this misconception for now – there will be an opportunity to show evidence that the water has not disappeared when you demonstrate condensation, which will be more convincing than anything you try to say now.Keep heating the water, giving commentary as you do so by pointing out bubbles in the water showing that it is boiling and point out that, on the Celsius scale, 100 °C is the boiling point of (pure) water. Explain that as water leaves the beaker and goes into the air, it changes state from a liquid to a gas. Describe this change of state as evaporation. Start to point out condensation forming on a surface or hold the cold plate so that learners can see condensation forming. Describe this as a change of state from gas to liquid. Now address any earlier misconceptions about the water disappearing – the water has not disappeared, it is still here and this is the evidence that supports this.Stop heating before the beaker is dry and leave the equipment to cool. Ask: *How can you make the remaining liquid water in the beaker change state to become a solid?* (Freeze it/put it into a freezer.) Tell them that you will do that between now and next lesson as the beaker will be too hot now. Describe this change of state, from a liquid to a solid, as freezing. Point out that, on the Celsius scale, 0 °C is the temperature at which (pure) water freezes.Summarise what you have demonstrated by looking textbook pages 88 to 91 together. Spend time looking at the thermometer diagram on textbook page 91 to ensure that learners now understand the Celsius scale and the anchor temperatures for water on which it was devised. Ensure they also understand that (pure) water is a liquid between 0 °C and 100 °C. |

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| **Workbook reference:** Complete workbook pages 88 to 91.**Plenary:**Go back to the diagram on textbook page 90 or workbook page 90 showing the changes of state of water. This is an important diagram for them to understand and be able to complete so spend time looking at the coloured arrows and what they represent as well as the three states of matter and the names of them that apply to water. Check they have these arrows labelled correctly on workbook page 90. |

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| **Support** | Nothing specific required. |
| **Extension** | Go back to the key vocabulary on workbook page 71 and do the task there. |
| **Homework / Follow-up** | Complete the self-assessment task on workbook pages 92 and 93.If doing a topic test, consolidate learning and key vocabulary. |