SCIENCE

Year 8
Answers

Lesson 6

Topic: The particle model of matter

Exploring states of matter

Lesson concepts

- The properties of the different states of matter can be explained
- Investigation types including experiments can be collaboratively conducted ensuring safety guidelines are followed
- Data from investigations can be summarised and scientific understanding can be used to identify relationships and draw conclusions
- Ideas, findings can be communicated using scientific language and representations

Learning alerts

Be aware of:

- Students confusing mass and volume.

Suggested next steps for learning:

- Explain that mass is the amount of a substance and volume is the space a substance occupies.

Science start-up notes

Students recall what they already know about the states of matter — solid, liquid, gas, plasma — and classifying matter using the properties of materials.

Lesson notes

In this lesson students will explore and describe physical properties of substances and physical changes.

Practical Information

Students should assemble their materials for **Sheet 5 — Investigating physical properties** before the lesson.

A disposable plastic syringe without the needle is required for this investigation. These are available at chemists, home/hardware stores or cooking shops.

Science start-up answers

1. For example:

	States of matter			
	Solid	**Liquid**	**Gas**	**Plasma**
Everyday examples	ice wood steel	water milk vinegar	water vapour oxygen carbon dioxide	glowing gas in a fluorescent light tube stars auroras

Lesson answers

2. a. Personal response required.
   Students should justify their groups by identifying what property is shared by the members of one group that makes them different from the members of another group. For example: those with written letters on them and those without; rectangular shaped and other; things you can use to communicate with people or those you can't; etc.

   b. Students should indicate items don't always fit neatly into a category because they have features that cross over more than one, for example: the laptop has both sight and sound applications; it also involves touch in the use of the keyboard or touchscreen.

3. **Sheet 5 Answers — Investigating physical properties** (attached).

4. a.

Physical change	
Description	**Term**
In winter, in some countries, water in lakes becomes solid ice.	freezing
On a hot, windy day the water level in Jenny's fish pond drops.	evaporation
When Tara puts butter in the warm pan, it becomes runny.	melting
Matthew has a hot shower and the bathroom mirror 'fogs up'.	condensation or evaporation and condensation
Ben mixes jelly crystals with hot water.	dissolving
Talei makes candles by using heated wax in different shaped moulds.	solidification or melting and solidification

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5. a.

	Physical properties of states of matter		
	Gas	Solid	Liquid
Shape	Assumes the shape of its container	Has a fixed shape	Assumes the shape of part of the container it occupies
Volume	Fills the volume of its container	Has a fixed volume	Has a fixed volume
Compressibility	Easily compressed	Not easily compressed	Not easily compressed
Flow	Flows easily	Does not flow	Flows easily

Lesson 7

Topic: The particle model of matter

Introducing the particle model of matter

Lesson concepts

- The properties of the different states of matter can be explained in terms of the motion and arrangement of particles
- Representations can be constructed and can be used to represent relationships
- Ideas can be communicated using scientific language

Lesson alerts

Be aware of:

- Students thinking that particles change size when they change state.

Suggested next steps for learning:

- Explain that particle size remains constant but the distances between particles change.

Science start-up notes

Students are introduced to the use of models in science, and then specifically, the particle model of matter.

Lesson notes

Students will understand and describe the particle model of matter and use it to explain changes of state due to the transfer of heat energy to and from particles.

Science start-up answers

1. a–d. Personal response required.

Lesson answers

2. a. No answer required.

   b.

	State of matter		
Particles	**Solids**	**Liquids**	**Gases**
Arrangement	packed in ordered arrangement	loosely arranged	no arrangement
Movement	vibrate in fixed position	move fast and slide past each other	move rapidly and randomly in all directions
Space	very close together	close together, but further apart than solids	particles are very far apart
Forces of attraction	very strong holding particles together	weaker and particles are not held in place	weakest and particles move about freely
Physical properties	fixed volume fixed shape not easily compressed	fixed volume flows not easily compressed	variable volume flows easily compressed

3. Solids have fixed shape and volume, which is related to the particles in a solid being closely packed together and held in place by strong forces of attraction. Liquids are able to flow and take the shape of their container, but have a fixed volume, which is related to the particles in a liquid being loosely held together and free to move past one another. Gases are able to flow easily. They can expand and be compressed to assume the shape and volume of the container in which they are held. These properties are related to the particles in a gas being far apart and moving rapidly.

4. a.

Gas	Liquid	Solid

   b. When heat energy is transferred to particles in matter, it makes them move faster and break free of the forces of attraction holding them together. They move further apart and move more freely.

   c. When heat energy transfers out of the particles, the reverse happens. They slow down and the forces of attraction become stronger, pulling them closer together.

5. No response required.

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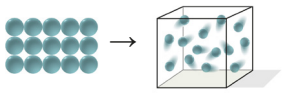
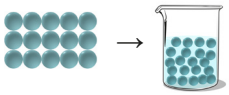
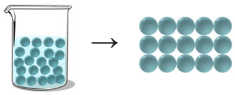
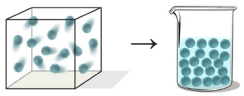
6.

	Change of state	Particle model representation	Name of process	Example
✓	solid → gas		sublimation	iodine sublimates to form iodine gas
✓	solid → liquid		melting	ice block left out of the freezer
☐	liquid → solid		evaporation	water heated in a kettle
✓	gas → liquid		condensation	drops of water form on a cold mirror after a hot shower

7. **Sheet 6 Answers — Applying the particle model of matter** (attached).

8. a. It uses the same type of particle (popcorn) in each state of matter. There is more movement in 'liquid' popcorn and 'gas' popcorn compared to 'solid' popcorn. The 'gas' and 'liquid' popcorn take the shape of the container.

   b. The particles of popcorn as shown in a 'gas', are larger than those in a 'liquid' or 'solid'. It could be misunderstood from this model, that the structure or appearance of the particles change during a change of state, rather than just their motion and arrangement.

Lesson 8

Topic: The particle model of matter

Using changes of state in everyday applications

Lesson concepts

- The properties of the different states of matter can be explained in terms of the motion and arrangement of particles
- Science contributes to finding solutions to a range of contemporary issues
- Science understanding influences the development of practices in areas of human activity
- Data from secondary sources can be summarised and science understanding can be used to draw conclusions
- The quality of the data collected can be evaluated
- Ideas, findings can be communicated using scientific language and representations

Learning alerts

Be aware of:

- Students may think that all secondary sources are of equal relevance, reliability and credibility because they are in the public domain.

Suggested next steps for learning:

- Explain that the credibility of information sources depends on their intended use and audience.

Science start-up notes

A gas lighter is used as an example of the application of change of state in everyday life.

Lesson notes

In this lesson, students will research and describe an everyday application of a change of state. As they do this they will also evaluate an internet source of secondary information, for validity, credibility and relevance. Follow the refrigeration example provided, to learn how to interpret information about change of state applications as well as how to conduct a website evaluation.

Practical information

Students need access to the internet to collect secondary information. If internet access is not available, they should contact their teacher for advice on alternative sources of secondary information.

Science start-up answers

1. a. Liquid

   b. A large volume of gas can be compressed into a small volume of liquid, so the storage container is small and portable.

Lesson answers

2. Personal response required.

3–6. **Sheet 7 Answers — Everyday applications of changes of state** (attached).

Investigating physical properties

Sheet 5 Answers

Instructions

In this investigation, you will experiment with water as a solid (ice) and as a liquid; air; and a mixture of gases, to explore some of the properties of the main states of matter.

This is a sample investigation. Answers should be consistent with students' own findings.

Background Write definitions for solid, liquid and gas. Draw a diagram or flowchart to show your understanding of the difference between solids, liquids and gases.	Solid — state of matter with a fixed shape regardless of the container it is in. Liquid — state of matter which takes the shape of its container and occupies a fixed volume of the container. Gas — state of matter that occupies the entire volume of a container. Diagram might show that solids can hold their shape without a container, liquids and gases cannot. Liquids take the shape of the container and gases can only be held in a sealed container. Students may draw a circular flowchart to show the relationship between the states of matter.
Aim What do you want to find out?	What are some of the differences in the properties of different states of matter?
Risk assessment How will you do the experiments safely?	**Personal safety** ☑ Safety glasses ☐ Gloves ☑ Protective outer clothing ☑ Hair tied back ☑ Closed shoes **Other** ☑ Report all spills and breakages.

What are the risks?	How will you manage them?
Spilling water	Inform an adult Clean up as directed
Using the syringe (without the needle)	Do not point at others' faces Only use as directed

Sheet 5 Answers

Experiment 1: Investigating a solid	
Materials What will you need?	• 100 mL beaker (or small glass jar) • ice cubes • ruler • plastic forceps, tweezers (or tongs) • white tile (or plate)
Method Remember this should be written in steps using the third person.	1. Place the ice cube on the white tile and measure the length, height and width of the ice cube and record the measurements. 2. Place the ruler on the top of the ice cube and try to compress (squash) it. Record observations. 3. Use tweezers to put the ice cube into the beaker. Draw a diagram of the ice cube in the beaker.
Results and observations	Measurements of the ice cube: Measurements should be in mm for accuracy. Height Length Width Compression observations: No compression observed. Diagram of ice cube in the beaker: Diagram should show ice cube inside beaker.
Analysis of results and observations	Calculate the volume of the ice cube: Volume = length × height × width = = cm^3 Could the ice cube be compressed? Could it's volume be decreased? The ice cube could not be compressed. When the ice cube is moved into the beaker, what, if any, immediate changes do you observe in the shape and/or volume of the ice? The ice cube shape remains the same, melting occurred later.

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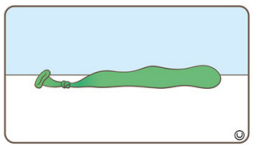
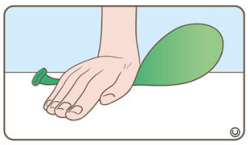
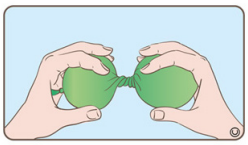
Experiment 2: Investigating a liquid	
Materials What will you need?	• 50 mL beaker (or small glass jar) • 10 mL graduated measuring cylinder (or measuring cup) • water • syringe (without needle) • rubber stopper (or eraser, cork or reusable adhesive putty) • ruler • white tile (or plate)
Method Remember this should be written in steps using third person.	1. Place 10 mL of water in the measuring cylinder. Draw a diagram of the water in the measuring cylinder. Use the ruler to measure the height of the water. Record this on the diagram. 2. Pour the water from the measuring cylinder into the beaker. Draw a diagram of the water in the beaker. Use the ruler to measure the height of the water. Record this on the diagram. 3. Fill the syringe with 10 mL of water. Draw a diagram of the water in the syringe. Use the ruler to measure the height of the water. Record this on the diagram. 4. Place the rubber stopper on the white tile. Hold the syringe so the nozzle is pressed against the rubber stopper. Try to compress the water in the syringe by gently pressing the plunger down. Record observations.
Results and observations	**Diagrams of water in different containers** Students should draw an outline diagram of each vessel with water level indicated. **Measuring cylinder** | **Beaker** | **Syringe** Compression observations: No compression observed.
Analysis of results and observations	Describe what happened to the shape of the water as it was moved from one container to a different container. As the water changes containers, the shape of the water changes. Does the volume of water change when it is moved to different-shaped containers? No, the quantity of water does not change from container to container. It is 10 mL in all containers. Could the water be compressed? No compression observed.

Sheet 5 Answers

Experiment 3: Investigating a gas	
Materials What will you need?	• balloon • rubber stopper (or eraser, cork or reusable adhesive putty) • syringe (without the needle) • white tile (or disposable plate)
Method Remember this should be written in steps using the third person	1. Half fill a balloon with air and tie a knot in the opening. Draw a diagram of the balloon. 2. Squash the air in the balloon down to one end of the balloon. Draw a diagram of the balloon. 3. Twist the balloon halfway so that the air is in two sections of the balloon. Draw a diagram of the balloon. 4. Fill an empty syringe with air. Place the rubber stopper on the tile and rest the syringe nozzle on it. Try to compress the gas by gently compressing the syringe. Record your observations.
Results and observations	**Diagrams of air in different balloon shapes**  Air/gas occupies all of the space it is given   Compression observations: Compression observed.
Analysis of results and observations	Did the amount of gas in the balloon change? The amount of gas in the balloon stayed the same. Did the volume of the gas in the balloon change? Explain your answer. The volume changed as the shape of the balloon changed. The same amount of air could occupy a smaller volume when the balloon was squashed. Describe what happens to the shape of the air as the balloon changes shape. As the balloon changes shape, the shape of the air in it also changes shape to match the shape of the balloon. Could the air be compressed? Yes the air was compressible.

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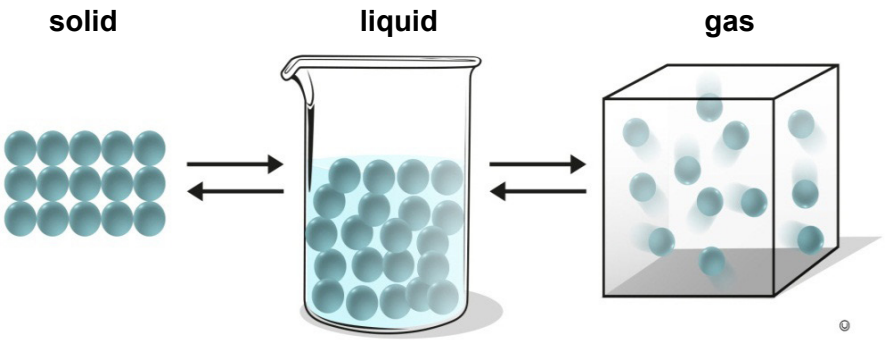
Experiment 1, 2, 3 Discussion	
Discussion Write your answers in sentence form.	Which state/s of matter changed shape when their container changed shape? Explain why you think this occurred. Liquids and gases both changed shape when they were placed in different shaped containers. This could be because both these states of matter can flow and don't have a fixed shape. Which state/s of matter can be easily compressed? Gases can be compressed, but liquids and solids cannot. Which state/s of matter changed their volume when the volume of the container changed? Gases changed their volume easily and they can be compressed.
Conclusion Sentences relating to the investigation questions.	Each state of matter has different properties. Solids can't be compressed and keep their shape regardless of the shape of the container that holds them. Liquids cannot be compressed and can flow so they change their shape to fit the container they are in. Liquids always sit at the bottom of the container. Gases can be compressed and move to change their shape and volume to match the contain they are in.

Applying the particle model of matter

Sheet 6 Answers

Instructions

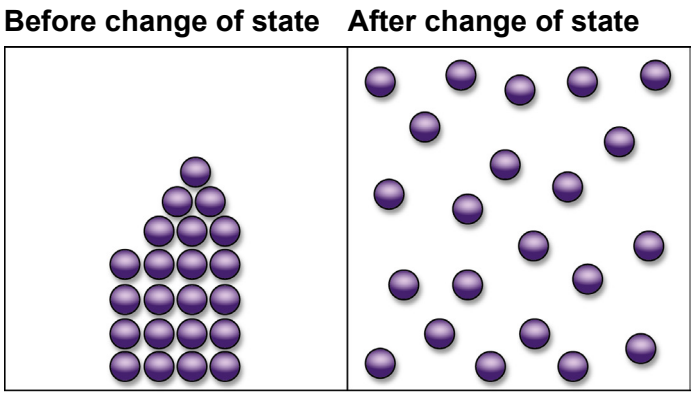
Complete the questions by referring to the particle model of matter. Use the representations of solids, liquids and gases shown below:



1. a. The diagram shows a before and after representation of a substance in a closed container. The boundary of the container is shown, and the spheres represent particles.

   What change of state process is represented in the diagram below?

   Sublimation.



   b. Use the particle model of matter to explain what has happened to the substance shown in the diagram.

   The substance starts as a solid. All the particles are strongly attracted to each other and are closely packed. The particles in the solid will be vibrating. The solid was heated and as the particles absorbed heat energy they began to move more quickly and separated from each other to form a gas, without first forming a liquid. This process is called sublimation. The particles in the gas are moving randomly and rapidly in three dimensions so the gas is spread throughout the container.

Sheet 6 Answers

2. Soft drinks contain bubbles of a gas called carbon dioxide. If the lid is left off the bottle of soft drink, it goes flat. Use the particle model to explain why this happens.

   The particles of gas move within the liquid until they reach the surface where they leave the liquid and move into the air space above the liquid. They collide with each other, the surface, and the walls of the bottle until they move out through the opening. The loss of gas particles means there is not enough left to form bubbles and the soft drink is said to be flat or not bubbly.

3. Brathen's mum often uses an air freshener in their family room because she loves the smell of roses. Brathen can smell the air freshener as soon as he enters the house. Use the particle model of matter to explain why.

   The air freshener gas particles move rapidly and randomly in all directions to spread out through the house. When Brathen walks in the door and breathes in, some of the air freshener particles enter his nose where they are smelled.

4. Jaymee noticed that her washing dries more quickly when the temperature is 26 °C than when the temperature is 16 °C. Use the particle model of matter to explain her observation.

   For washing to dry, the water needs to evaporate. That is, the water particles need to change from a liquid to a gas and leave the clothing. This will happen more quickly when the temperature is 26 °C and so the washing will dry more quickly on a hotter day.

5. Callum's dad works in an air conditioned office. When his dad leaves the office on a hot, humid Queensland summer day, his glasses fog up. Explain the process that causes this to happen.

   On a hot humid day, there are a lot of gaseous water particles in the air. Callum's dad's glasses are probably cold from being in the air conditioning. When he walks outside some of the gaseous water particles collide with his glasses. The cool surface makes them lose energy, slow down and move closer together, condensing on his glasses so they fog up.

6. Peta's mum was making chocolate swirl pancakes for breakfast. To get the swirl effect, she stirs the chocolate sauce into the pancake mix before she cooks it. If she cooks the mixture straight away the pancakes are stripy, but if she does not cook the pancakes straight away they do not have swirls. Use the particle model of matter to explain what happens in the mixture before cooking.

   In a liquid, the particles can move around each other. When Peta's mum leaves the pancake mix before cooking it the chocolate sauce particles and the pancake mix particles have time to move around and mix giving brown not stripy pancakes.

7. Why is it extremely dangerous to heat an unopened can of soup directly on a hotplate?

   Canned soup contains liquid and solids. When a liquid is heated, its particles gain energy and move more rapidly as it changes state to a gas. If this happens in a sealed container the force of the gas particles colliding with the walls of the container becomes large enough to cause the can to explode.

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Everyday applications of changes of state

Sheet 7 Answers

Instructions:

In this research task, you will investigate an application of a change of state such as from a liquid to a gas or a gas to a liquid. You should answer the research questions by finding useful websites. These websites will be evaluated in Part C.

Part A: Research an everyday application of changes in state

1. Open a new document on your computer and save it using the title 'An everyday application of change of state'.
2. Choose one of the everyday applications listed below as a topic of research:
   - aerosol cans
   - smoke machines
   - moth balls
   - air fresheners
   - LPG gas bottles for your BBQ
   - eucalyptus oil inhalation
   - other.

   Students select a single one of the above or another example of the use of a change of state, that they have found; for example, refrigerant.
3. Use the internet to locate information about your everyday use. Some useful questions to guide your research are the following:
   - What is the name of the material undergoing a change in state?
   - What is the change of state? (for example, from solid to liquid)
   - Why is this change of state useful?

   The information located should in some way be related to how the change in state of the material is used. (Refer to the example below.)
4. Read the example response on refrigeration provided below.
   (Example is provided to the student as a part of the sheet.)
5. Insert the table shown below into your document. Record your information in this table and name it after your chosen everyday use.

Website title: _____		
URL: _____		
Date accessed: _____		
Original information	**Summary of information**	**In my own words**
Cut and paste your information from the website here.	Summarise the information in dot points.	Write your dot points in sentences using your own words.

Example response on refrigeration provided on **Sheet 7.**

Sheet 7 Answers

Part B: Explaining the change of state

Write two to three paragraphs explaining the change of state you investigated. Your paragraphs should include:

- a description of the change of state, identifying the properties of the different states of matter

  Students should identify the change/s of state using appropriate terminology (for example, evaporation). They should describe the physical properties of the materials involved which are consistent with states of matter before and after the change/s of state.

- labelled diagram/s explaining the differences in the states of matter, in terms of the particle model of matter

  Diagrams should be consistent with particle model diagrams used previously in the unit. They should be labelled with the states of matter involved and descriptions of changes to the motion and arrangement of particles during the change of state.

- an explanation of how the change of state is used

  Students should explain how the change of state is used, such as the relationship between the change of state and how a machine works to produce a required effect. (For example: the change of state from gas to liquid in the refrigerator evaporator coils, absorbs heat from warm air, cooling the refrigerator.)

- a justification for how and why the change of state is suited to this use.

  Students should make a judgment about why the change of state has been chosen as the way to carry out the function (for example, refrigeration). It will be particularly helpful if they can draw on any comparisons or contrasts that they know of. For instance the student may be aware of other technologies used for cooling that do not involve change of state.

Part C: Evaluate the website

1. Go to the **Website — The 5W's of Website Evaluation** (Kathy Schrock) http://www.schrockguide.net/uploads/3/9/2/2/392267/5ws.pdf.
2. Choose one question from each heading and transcribe it into your document.
3. Use these questions to evaluate the website you accessed in **Part A**. Write your answers in sentence form under the questions you chose.
4. Write a short statement summarising how credible, reliable and valid you believe the site to be. Justify your opinion with evidence collected during your evaluation.

   Example response on refrigeration provided on **Sheet 7.**

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