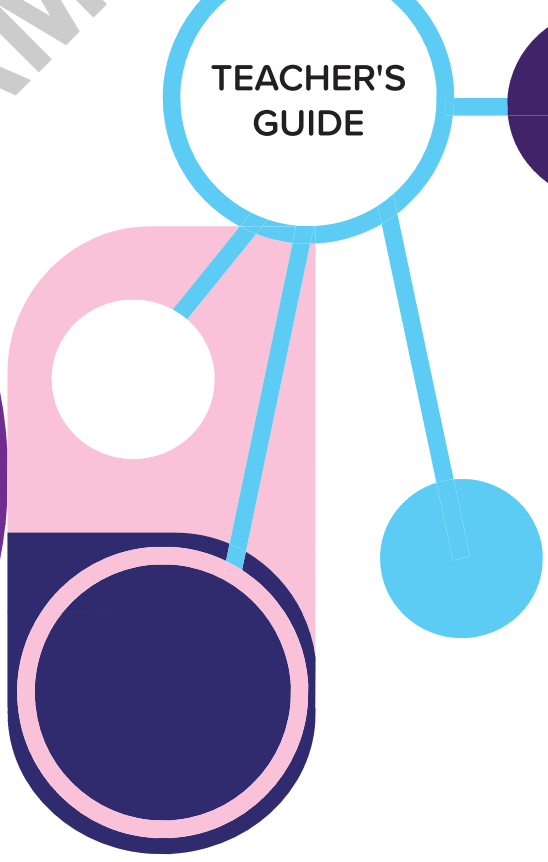
Marshall Cavendish Education

Cambridge Assessment International Education

Endorsed for teacher support

Cambridge IGCSE™ Chemistry

TEACHER'S GUIDE



Mark Grinsell

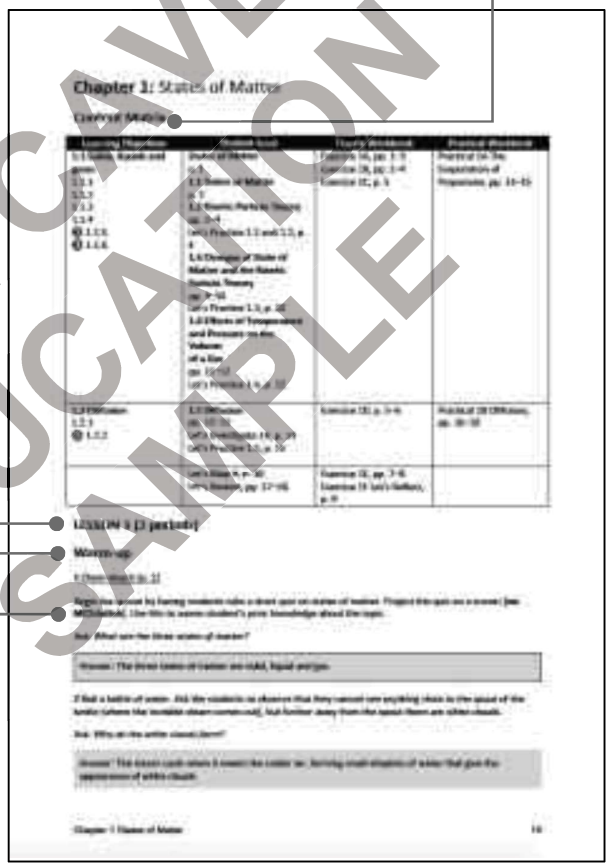
How to Use This Book

This **Teacher's Guide** is part of the Marshall Cavendish Education (MCE) suite of resources, designed and created to support you as you teach the Cambridge IGCSE Chemistry syllabuses (0620/0971).

The lesson plans in the Teacher's Guide are made available online in editable Word format for you to customise according to your classroom needs. The answer keys mentioned in the lesson plans are available online in MCEduHub (our online resource hub).

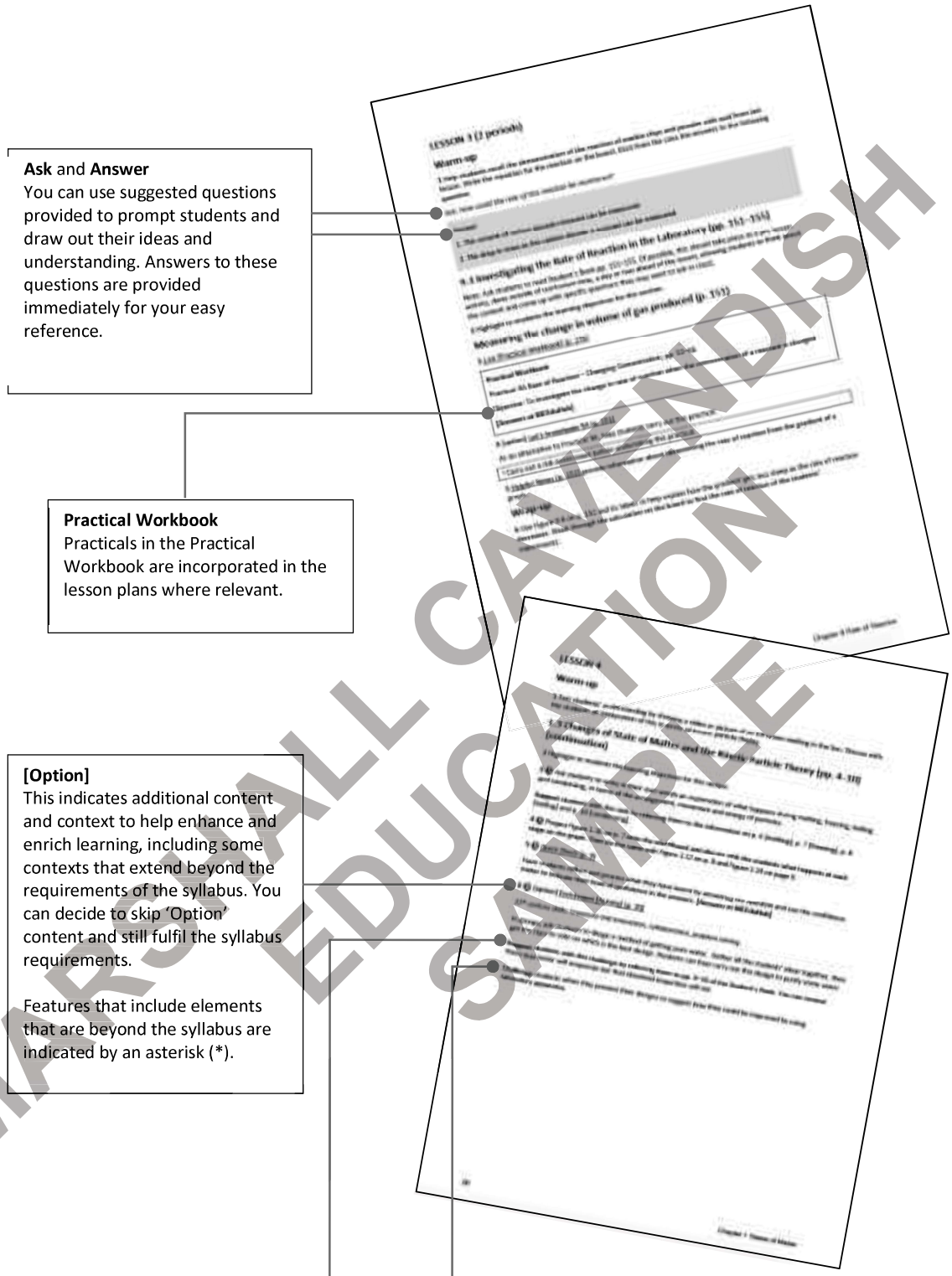
Content Matrix
The Content Matrix serves as a directory to help you to easily locate the contents in the Student's Book, Theory Workbook and Practical Workbook that are relevant to each Learning Objective grouping.

Lesson Plan
Each chapter includes several Lesson Plans to help you conduct your lessons. If you are new to the syllabus, the Lesson Plan is written in such a way that gets you up and running quickly. If you are an experienced teacher, the editable Lesson Plans allow you to customise your lessons, making use of selected parts of the Teacher's Guide to support your teaching flow and include your own teaching ideas.



Warm-up
This section helps you begin your lesson with a variety of teaching ideas. For example, to start off a new chapter, you are provided with teaching ideas to engage your students using the Chapter Opener, which includes *Chem Watch* and *Questions*.

[MCE Cambridge IGCSE App]
You can download this App to your computer or mobile device. Using this App, you can choose to project digital resources from *Chem Watch* on the screen for the class. Please refer to www.mceapps.com for user guide and further information.



Ask and **Answer**
You can use suggested questions provided to prompt students and draw out their ideas and understanding. Answers to these questions are provided immediately for your easy reference.

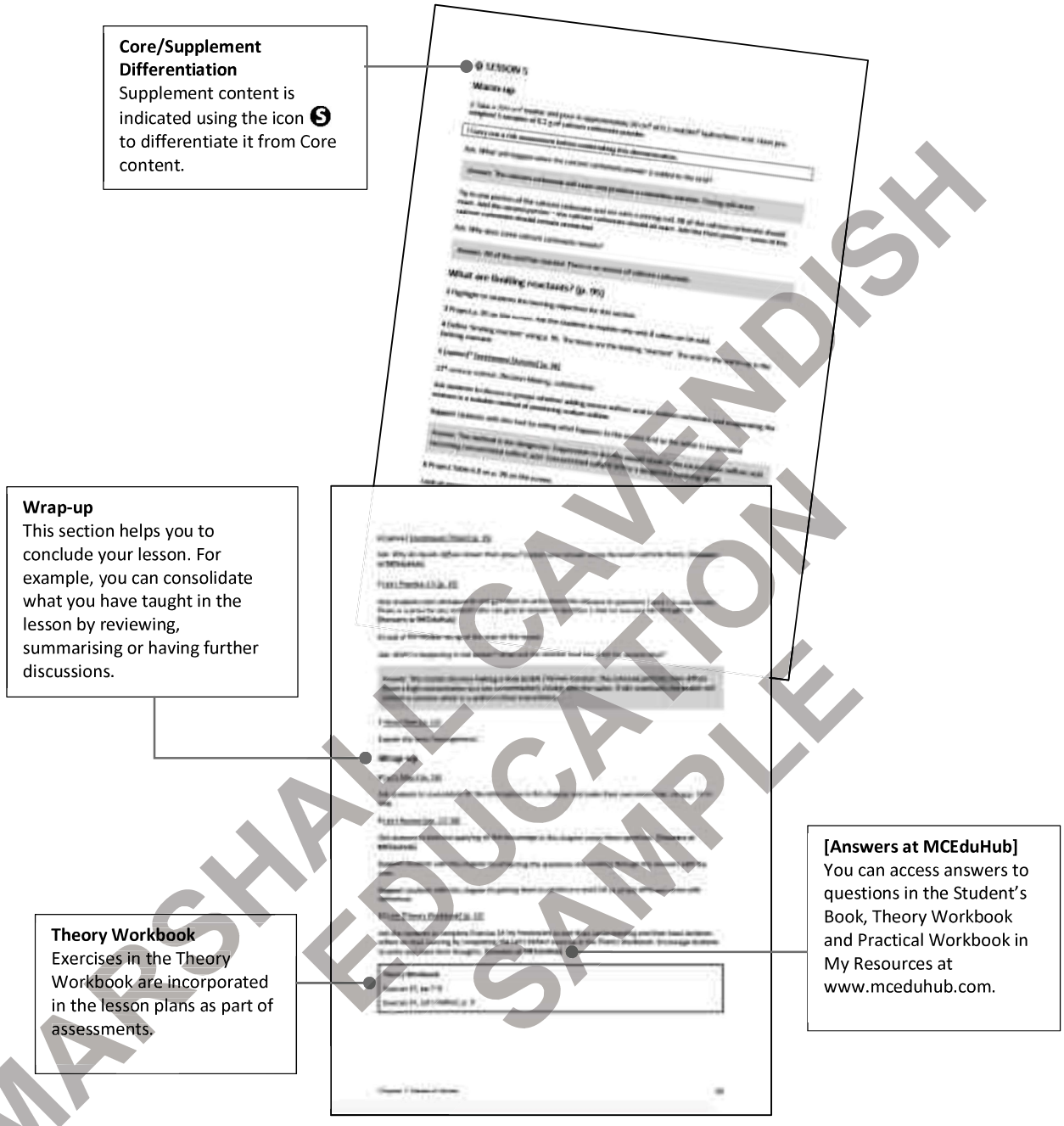
Practical Workbook
Practicals in the Practical Workbook are incorporated in the lesson plans where relevant.

[Option]
This indicates additional content and context to help enhance and enrich learning, including some contexts that extend beyond the requirements of the syllabus. You can decide to skip 'Option' content and still fulfil the syllabus requirements.

Features that include elements that are beyond the syllabus are indicated by an asterisk (*).

Support
This suggests ideas for you to facilitate understanding of the concepts to be learnt.

Challenge
This suggests ideas for you to challenge your students and foster a deeper understanding of the topic.



Additional Teacher's Resources

In addition, MCEduHub contains further teacher's resources, as listed below:

- **Scheme of Work (SOW) –** in editable Word format
- **PowerPoint Slides –** covering key concepts, to support frontal teaching in the classroom or for online lessons
- **Question Bank –** providing you with an online resource of questions from the Student's Book and Theory Workbook, as well as some additional questions. Questions are in Word format, for easy editing and customisation

These additional teacher's resources are not endorsed by Cambridge Assessment International Education.

Contents

Chapter 1: States of Matter

Content Matrix

Learning Objectives	Student Book	Theory Workbook	Practical Workbook
1.1 Solids, liquids and gases 1.1.1 1.1.2 1.1.3 1.1.4 S 1.1.5 S 1.1.6	**States of Matter** p. 1 **1.1 States of Matter** p. 2 **1.2 Kinetic Particle Theory** pp. 2–4 Let's Practise 1.1 and 1.2, p. 4 **1.3 Changes of State of Matter and the Kinetic Particle Theory** pp. 4–10 Let's Practise 1.3, p. 10 **1.4 Effects of Temperature and Pressure on the Volume of a Gas** pp. 11–12 Let's Practise 1.4, p. 12	Exercise 1A, pp. 1–2 Exercise 1B, pp. 2–4 Exercise 1C, p. 5	Practical 1A The Evaporation of Propanone, pp. 13–15
1.2 Diffusion 1.2.1 S 1.2.2	**1.5 Diffusion** pp. 12–15 Let's Investigate 1A, p. 14 Let's Practise 1.5, p. 15	Exercise 1D, p. 5–6	Practical 1B Diffusion, pp. 16–18
	Let's Map It, p. 16 Let's Review, pp. 17–18	Exercise 1E, pp. 7–8 Exercise 1F Let's Reflect, p. 9	

LESSON 1 (2 periods)

Warm-up

1 *Chem Watch (p. 1)*

Begin the lesson by having students take a short quiz on states of matter. Project the quiz on a screen [**via MCEduHub**]. Use this to assess student's prior knowledge about the topic.

Ask*: What are the three states of matter?*

Answer: The three states of matter are solid, liquid and gas.

2 Boil a kettle of water. Ask the students to observe that they cannot see anything close to the spout of the kettle (where the invisible steam comes out), but further away from the spout there are white clouds.

Ask*: Why do the white clouds form?*

Answer: The steam cools when it meets the colder air, forming small droplets of water that give the appearance of white clouds.

3 Questions (p. 1)

After the demonstration, invite the students to consider the questions.

Answers:

- I would feel hot. / I would feel the droplets of water in the air.
- Water can exist in the solid state such as ice, snow or hailstones.
- There are many changes of state possible, try to get the students to think of at least one of each type. Examples:

  solid → liquid: butter melts when heated

  liquid → gas: rainwater evaporates in the Sun

  gas → liquid: in a rice cooker, steam turns to liquid water on the inside of the lid

  liquid → solid: water turns to ice in a freezer

Support students with these questions by giving them an example of a change of state and asking them to identify the state before and after the change.

1.1 States of Matter (p. 2)

Note: Have students read Student's Book pp. 2–5. (This can take place as a pre-lesson activity, done outside of curriculum time, a day or two ahead of the lesson.)

4 Highlight to students the learning objectives for this section.

5 Discuss the properties of solids, liquids and gases in terms of shape (Is it fixed or not?), volume (Is it fixed or not?) and compressibility. (Can the state be compressed or not?) Summarise with Table 1.1 on p. 2.

6 Word Alert (p. 2)

Explain the term 'compressed'.

7 Quick Check (p. 2)

Have students reflect and process what they have learnt by answering the question and use the confidence meter to indicate their level of confidence in the answers. **[Answers at MCEduHub]**

8 [option] ***Enrichment [Info] (p. 2)**

21st century skills: Information Literacy, ICT Literacy

Challenge students to research the other two states of matter.

Wrap-up

9 Review the lesson by filling a jar half–full of water and adding a lid.

Ask*: What states of matter are present in the jar? Are any changes of state occurring?*

Answer: Solid (the jar), liquid (the water) and gas (air).

Some of the water will evaporate, so water vapour will also build up. (The original air will also have contained some water vapour).

Support students with a second question.

Ask*: What happens to a jar of water when it is left at room temperature?*

Answer: The water evaporates.

LESSON 2

Warm-up

1 Introduce the idea of widely spaced particles in a gas by demonstrating the ease of compressing a syringe full of gas and one full of liquid. There is a diagram of compressing a gas in a syringe on p. 3.

1.2 Kinetic Particle Theory (pp. 2–4)

2 Highlight to students the learning objectives for this section.

3 Ask students to draw a two-dimensional diagram of:

a solid, with all the particles of equal size and arranged regularly

a liquid, with all the particles of equal size, close together and arranged randomly

a gas, with all the particles of equal size, far apart and arranged randomly

Support students with this task by referring them to Figures 1.1 on p. 2 and Figures 1.2 and 1.3 on p. 3.

Ask*: How does this model explain the properties of a solid?*

Answer: The particles do not move around, so the shape and volume are fixed. The particles are close together, so solids cannot be compressed.

Support students with this question by showing them a three-dimensional model of a solid and discussing this answer.

4 Discuss with the students, using the information on pp. 2–3, how the particles are arranged, and the strength of the forces between the particles, in a solid, in a liquid and then in a gas. Use the regular, close arrangement and strong forces in a solid to explain why a solid has a fixed shape and volume. Then get the students to explain why liquids and gases have different properties from solids based on the information in pp. 2–3.

5 *Link [forward] (p. 3)*

Students will learn more about the effect of pressure on the volume of a gas in Section 1.4 of this chapter.

6 Quick Check (p. 3)

Have students reflect and process what they have learnt by answering the question and use the confidence meter to indicate their level of confidence in the answers. **[Answers at MCEduHub]**

7 [option] *Enrichment [Activity] (p. 3)

Animations and simulations can be found on the internet. Students can use these to explore the arrangement of particles in the three states of matter. One site is found at https://phet.colorado.edu/en/simulation/states–of–matter.

8 Worked Example 1A (p. 4)

Have the students discuss the differences between solids, liquids and gases, and then go through the example.

Support students with this question by first asking them whether each substance is a solid, liquid or gas.

Challenge students to explain why the temperature has been given in this question.

9 *Link* [Theory Workbook] *(p. 4)*

Put the students into pairs. Ask them to complete the questions. Then two pairs get together and swap answers, and peer mark the other pair's work. **[Answers at MCEduHub]**

Theory Workbook

Exercise 1A, pp.1–2

Wrap-up

10 Let's Practise 1.1 and 1.2 (p. 4)

Ask students to work on the exercise for a few minutes. Then go through answers together as a whole class. **[Answers at MCEduHub]**

LESSON 3

Warm-up

1 Encourage students to share what they know about the idea of a physical change. Ask the students in pairs to look at Figure 1.5 on p. 4 to discuss why the changes of state of water are physical changes. Discuss the students' answers to make sure that they have understood the points that:

- changes of state are reversible
- no new substance is made.

2 Word Alert (p. 4)

Explain the term 'reversible'.

1.3 Changes of State of Matter and the Kinetic Particle Theory (pp. 4–10)

Note: Have students read Student's Book pp. 4–10. (This can take place as a pre-lesson activity, done outside of curriculum time, a day or two ahead of the lesson.)

3 Highlight to students the learning objectives for this section.

4 Helpful notes (p. 5) for useful information about melting and freezing points and gases.

5 Ask the students to explain to you the difference between boiling and evaporation based on the information [Table 1.3] on p. 5.

Ask*: If a puddle disappears due to heat from the Sun, is this boiling or evaporation?*

Answer: It is evaporation, because it occurs at below 100 °C, the boiling point of water.

6 *Link* [Practical Workbook] *(p. 9)*

This is a straightforward practical that includes practising graph drawing. As an alternative, the students can produce a cooling curve of stearic acid.

Practical Workbook

Practical 1A The Evaporation of Propanone, pp. 13–15

Objective: To measure the temperature change when a liquid evaporates

[Answers at MCEduHub]

Wrap-up

7 Ask students to apply their knowledge of solids, liquids and gases and explain to them how to tell whether a substance is a solid, liquid or gas at a given temperature. Look at Table 1.4 on p. 5.

Ask*: What state are each of the substances* at −200 °C and 200 °C?

Answers:

−200 °C: Oxygen liquid, the others are solid.

200 °C: Iron solid, the others are gas.

Support students with this question by using Figure 1.8 on p. 6.

8 *Link [forward] (p. 5)*

Students will learn how they can use the melting and boiling points of a substance to determine the purity of a substance in Chapter 20.

9 Quick Check (p. 6)

Have students reflect and process what they have learnt by answering the question and use the confidence meter to indicate their level of confidence in the answers. **[Answers at MCEduHub]**

LESSON 4

Warm-up

1 Test students' understanding by showing a video or picture of an ice-cream melting in the Sun. Discuss with the students an explanation of this in terms of kinetic particle theory.

1.3 Changes of State of Matter and the Kinetic Particle Theory (pp. 4–10) (continuation)

2 Highlight to students the learning objectives for this section.

3 Ask students to write in their own words an explanation of what happens during melting, freezing, boiling and condensing, in terms of the arrangement, movement and energy of particles.

Support students with this task by referring them to the information on p. 6 (melting), p. 7 (freezing), p. 8 (boiling) and p. 10 (condensing).

4 Project Figure 1.10 on p. 7 onto the whiteboard and discuss with the students what happens at each stage on the graph. Then do the same with Figure 1.12 on p. 8 and Figure 1.14 on page 9.

5 Quick Check (p. 9)

Have students reflect and process what they have learnt by answering the question and use the confidence meter to indicate their level of confidence in the answers. **[Answers at MCEduHub]**

6 [option] Enrichment [Activity] (p. 10)

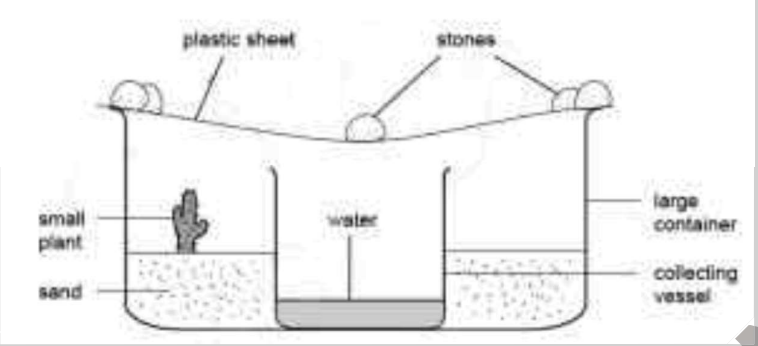
21st century skills: Creativity and Innovation, collaboration, problem solving

In groups, ask students to design a method of getting pure water. Gather all the students' ideas together, then get the class to vote on which is the best design. Students can then carry out this design to purify some water.

Support students with this challenge by referring them to pp. 9–10 of the Student's Book. You can remind them that water will evaporate but that dissolved impurities will not.

Challenge students when they present their designs to suggest how they could be improved by using laboratory apparatus.

Answer: Students might suggest something like this:



The plant is placed at the side in the large container. The collecting vessel is placed in the middle of the large container. The plastic sheet is used to cover the large container. Stones are used to hold the plastic sheet in place. Place a stone on the plastic sheet just above the collecting vessel.

The plant gives out water vapour. The water vapour condenses on the underside of the plastic sheet. The water droplets are collected in the collecting vessel.

Challenge students to research methods of purifying water on the internet, and to present their findings to the class. They could also consider the water needs in their country (e.g. for agriculture) and water sources used in their country.

7 *Link* [Theory Workbook] *(p. 10)*

Get students to complete the questions to test their understanding. This exercise includes useful practice of drawing a graph.

Support students with the graph question by giving them the axes to use on their graph. **[Answers at MCEduHub]**

Theory Workbook

Exercise 1B, pp. 2–4

Wrap-up

8 Let's Practise 1.3 (p. 10)

Give students mini whiteboards and ask them to complete each question in turn and them hold up their answer. The mind map can be completed for homework. **[Answers at MCEduHub]**

LESSON 5

Warm-up

1 Demonstrate placing a balloon half full of air in a container of hot water. Follow this by applying pressure to air in a bicycle pump that is sealed at the open end.

! Carry out a risk assessment before undertaking this demonstration.

Ask*: What happens when the gas in a balloon is heated? What happens when air in a bicycle pump has pressure applied?*

Answers:

1. The gas in the balloon that is heated expands.
2. The air in the sealed bicycle pump decreases in volume when pressure is applied.

1.4 The effects of Temperature and Pressure on the Volume of a Gas (pp. 11–12)

Note: Have students read Student's Book pp. 11–12. (This can take place as a pre-lesson activity, done outside of curriculum time, a day or two ahead of the lesson.)

2 Highlight to students the learning objectives for this section.

3 Ask students to explain the effects in the warm-up activities using the text on pp. 11–12.

4 Let's Practise 1.4 (p. 12)

Divide the students into pairs, then ask one person in each pair to look at question 1 or 2. Get each student to explain their answer to the other student in the pair. They can work on the mind map together. **[Answers at MCEduHub]**

1.5 Diffusion (pp. 12–15)

5 Highlight to students the learning objectives for this section.

6 [option] Introduce the idea of diffusion by spraying an air freshener or perfume in one corner of the room. Students raise their hand when they can detect the smell.

Ask*: What is happening to cause the smell to spread through the room?*

Answer: The particles with the smell are a gas so they move at random, colliding with the air molecules. This causes them to spread out at random.

7 Ask students to give examples of diffusion and to explain these in terms of particle movement in gases. Examples could include cooking smells travelling through a house and when a teabag is left in hot water the brown substances spread into the hot water.

8 [option] Diffusion

Link [Practical Workbook] *(p. 4)*

Practical Workbook

Practical 1B Diffusion pp. 16–18

Objective: To observe evidence that diffusion occurs, and to see what affects the rate of diffusion

[Answers at MCEduHub]

9 [option] *Chem Watch (p. 12)*

21st century skills: Information literacy, communication

Have students watch a clip-on diffusion. Project the clip on a screen **[via MCEduHub]**. Initiate a discussion and encourage students to share what they have understood from the clip.

Ask*: What is diffusion?*

Answer: Diffusion is the movement of particles from a region of **higher concentration** to a region of **lower concentration**. This causes gases to spread out and completely mix.

10 Project the **left–hand side** of Figure 1.19 on p. 13 (cover up the right side) (or describe the set up) and ask students to predict what will happen. You can describe what happens, then show the whole of Figure 1.19. You can find videos of this experiment on the internet. Students should explain what is happening in terms of diffusion.

11 S Explain how the rate of diffusion depends on the relative molecular mass of the gas.

12 [option] *Link [forward] (p. 13)*

Students learn how the relative molecular masses of a substance is calculated in Chapter 3.

13 [option] S *Enrichment [Think] (p. 13)

21st century skills: Problem solving

Ask*: What other factor do you think affects the rate of diffusion? Explain how this factor affects the rate of diffusion.*

Answer: Temperature also affects the rate of diffusion. At a higher temperature, the gas particles have more energy and can diffuse faster.

14 S Let's Investigate 1A (p. 14)

[option] If practical 1B has not been carried out, you may wish to demonstrate the diffusion of ammonia and hydrogen chloride with this investigation.

! Carry out a risk assessment before undertaking this demonstration.

Alternatively, you can find videos of this demonstration on the internet.

Ask*: Why does the white ring appear closer to the concentrated hydrochloric acid end?*

Answer: The ammonia molecules have a lower relative molecular mass, so they diffuse faster and travel further.

14 [option] S Enrichment [Think] (p. 14)

21st century skills: Critical Thinking

Ask*:*

1 Why must the tube be horizontal and stoppered?

2 Why does the white ring not appear immediately?

Answers:

1 The tube is horizontal to minimise the effects of gravitational force. The tube is stoppered to prevent the gas particles from escaping from the tube.

2 The particles of ammonia and hydrogen chloride need time to diffuse from the ends of the tube to the other parts of the tube. When ammonia and hydrogen chloride react, then a white ring will be formed.

15 [option] S Quick Check (p. 14)

Have students reflect and process what they have learnt by answering the question and use the confidence meter to indicate their level of confidence in the answers. **[Answers at MCEduHub]**

Wrap-up

16 *Link* [Theory Workbook] *(p. 12, p. 15)*

Check students' understanding using the exercises. **[Answers at MCEduHub]**

Theory Workbook

Exercise 1C, p. 5

Exercise 1D, pp. 5–6

LESSON 6

Warm-up

1 Set up some potassium manganate(VII) crystals at the bottom of a beaker of water at the start of the lesson. Alternatively, pour boiling water onto a teabag in a large beaker. Ask students to predict what they will see.

1.5 Diffusion (pp. 12–15) (continuation)

2 Highlight to students the learning objectives for this section.

3 Worked Example 1B (p. 15)

Discuss with students the explanation of the bromine diffusion experiment that was covered in the last lesson – the bromine molecules move from an area of high concentration to an area of low concentration. Encourage them to apply these ideas to the dissolving of sugar, then go through the Worked Example.

4 [option] Enrichment [Think] (p. 15)

Ask*: Why do liquids diffuse slower than gases? Explain your answer using the kinetic particle theory.* **[Answers at MCEduHub]**

5 Let's Practise 1.5 (p. 15)

Give students mini whiteboards and get them to write down the answers to questions 1 and 2 in one minute. There is a prize for any student who can give an answer to question 1 that no one else has thought of. **[Answers at MCEduHub]**

6 Look at the beaker set up at the start of the lesson.

Ask*: What is happening in the beaker? What will the solution look like if left for several days?*

Answer: The crystals dissolve making a deep purple / brown solution. The coloured particles then diffuse (from a high concentration to a low concentration), mixing with the water. If left, eventually the beaker will contain a solution which is a uniform colour everywhere.

7 Word Alert (p. 13)

Explain the term 'homogeneous'.

Wrap-up

8 Let's Map it (p. 16)

Ask students to consolidate all the information in this chapter and make their own mind map, using p. 16 to help.

9 Let's Review (pp. 17–18)

Get students to practise applying all the knowledge in this chapter using these questions. **[Answers at MCEduHub]**

Support students with this chapter by projecting the questions and working through the answers with the class.

Support students with this chapter by getting them to produce a word list of all the different terms with definitions.

10 *Link* [Theory Workbook] *(p. 15)*

Ask the students to complete Exercise 1E for homework to test their understanding and then have students reflect on their learning by completing the Let's Reflect exercise in the Theory Workbook. Encourage students to write and share their thoughts. **[Answers at MCEduHub]**

Theory Workbook

Exercise 1E, pp.7–8

Exercise 1F, Let's Reflect, p. 9

For over 60 years Marshall Cavendish Education has been empowering educators and students in over 80 countries with high-quality, research-based, Pre-K-12 educational solutions. We nurture world-ready global citizens by equipping students with crucial 21st century skills through our resources for schools and education centres worldwide, including Cambridge schools, catering to national and international curricula.

The *Marshall Cavendish Education Cambridge IGCSE™ Chemistry* series is designed for students preparing for the 0620/0971 syllabuses. The series translates insights from educational psychology classic "How People Learn" into highly effective learner-centred classroom practices.

TG The **Teacher's Guide** contains step-by-step lesson plans to support teachers. The lesson plans include suggestions for classroom activities and discussions. Warm-up and wrap-up activities are provided to stimulate discussion and check understanding, while the challenge and support features provide for differentiated instruction.

Answer keys to questions in the Student's Book, Theory Workbook and Practical Workbook are available in My Resources at www.mceduhub.com.

This resource is endorsed by Cambridge Assessment International Education

- ✓ Provides teacher support for the Cambridge IGCSE and IGCSE (9–1) Chemistry syllabuses (0620/0971) for examination from 2023
- ✓ Has passed Cambridge International's rigorous quality-assurance process
- ✓ Developed by subject experts
- ✓ For Cambridge schools worldwide

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