Lesson 2.3 The kinetic particle model of matter

Recommended teaching time for this lesson: 0.5 x 60 minute period

• 20 minutes of explicit teaching

• 10 minutes of suggested classroom activities

• 30 minutes homework

Getting started

Learning intentions & success criteria

|  |  |
| --- | --- |
| I will: | I can: |
| understand the kinetic particle model of matter. | * describe kinetic particle model of matter.
 |
| understand the characteristics of solids, liquids and gases. | * state the names of the three states of matter.
* Describe:
	+ the characteristics of solids, liquids and gases in terms of their shape and volume as related to the container shape.
	+ the characteristics of solids, liquids and gases in terms of their kinetic energy (types of motion).
	+ the characteristics of solids, liquids and gases in terms of the intermolecular forces between particles.
 |

Key ideas

* The kinetic particle theory of matter states that all matter is made of particles that are in constant random motion.
* The behaviour of particles in solids, liquids and gases differs due to their kinetic energy.

Curriculum links

Science understanding

* Describe the kinetic particle model of matter.

Advice for teaching this lesson

Things to know before you start teaching

You may have taught the particle theory of matter and states of matter in junior science, and this content is not significantly different from where you left off in lower grades. Understanding the types of motion available to liquids and gases will help with your explanations, as well as the bonds between the particles in the different phases.

Common misconceptions

* Students may think that the amount of energy for each phase is equal to each other, or that temperature is the only manifestation of thermal energy. These concepts will be explained in detail in future chapters, but it is worth pointing out to students during teaching that we are examining each phase separately at this point and the full relationship will be covered in Module 3.

Differentiation strategies

Emphasise the use of graphical summaries of content to help students condense information-dense sections such as the characteristics of the states of matter. The table at the end of the chapter is a good summary, but pictorial representations of the concepts can benefit students who have difficulty remembering blocks of text.

Starter activity: Recalling energy

Approximate time: 5 minutes

**Activity placement:** Place directly above “What is kinetic theory?”

**Activity summary:** A teacher-led discussion to prompt students about appropriate vocabulary, and to prepare them for the theory of the lesson.

Notes for the teacher

Have students try to recap the observations of the previous practical using terms from Lesson 2.1 (heat, energy, temperature).

Note there was no thermal equilibrium in the experiment because while the temperature stopped at 100°C, this was a phase change and not equilibrium with the environment.

If Practical lesson 2.2 has not been done yet, ask students to propose what they think will happen instead.

Ask students to suggest how the temperature of the water might be connected to the kinetic energy of the particles.

This activity could be done in small groups or as a whole class. The student-facing instructions have been written as if the student discussions are in pairs/small groups.

Instructions for students

Step 1: Look back at your notes or Lesson 2.1 to refresh the terms ‘heat’ and ‘energy’.

Step 2: You have completed a practical, or will complete a practical shortly, where you heat water on a hot plate and track the temperature change over time.

* 1. Describe what would happen to the temperature, using the words ‘heat’ and ‘energy’.
	2. You learnt in Grade 8 that ‘kinetic energy’ means ‘moving energy’. As the water gets hotter, what might be happening to the kinetic energy of the particles in the water?

Step 3: When prompted, share your answers with the class.

Helpful hints

* When you move around a lot during sport classes, what happens to your temperature? Does this relationship go the other way?

Answers

Student responses will vary, but the following concepts should appear.

<Note to production: restart numbering below at ‘a.’>

* 1. That as energy went into the water, the temperature increased; that heat energy is given to the water from the hotplate.
	2. That kinetic energy increases as the water gets hotter.

Classroom activity: Remembering phases of matter

Approximate time: 10 minutes

**Activity placement:** Place directly above “What are the phases of matter?”

**Activity summary:** A quick physical activity to activate prior learning from junior science about the states of matter and provide a reference experience for your teaching.

Notes for the teacher

Students can sometimes feel reluctant to physically get up and engage with learning tasks. Overenthusiasm can help smooth out this barrier.

When encouraging students into gas behaviour, remind them of safety issues with moving quickly around the lab – you may prefer to go outside if there is equipment out for other reasons.

The instructions are written for the students, but it may be easier to facilitate for you to read the instructions out to them or choose an organiser student to lead them through the task.

Help students overcome the logistical choices quickly, by giving them details about how to stand for solids.

At the end of the activity, ask them what phase of matter each ‘stage’ represented. To extend students, ask what characteristics of the activity suggests these answers.

Instructions for students

Step 1: Stand with your classmates in a neat, organised fashion, such as in a 3 × 5 grid pattern. Your teacher may suggest an arrangement based on the number of students in the class.

Step 2: Ensure you are close to each other; you want to be approximately 5 to 10 centimetres from each other.

Step 3: Lean side to side and back to front. Do you bump into each other?

Step 4: Have each corner student take one small step to the side out of the box to enlarge the space you are in. They should stand still for the next phase.

Step 5: Each student inside the box should try to move past each other to attempt to get to each corner. Whenever you bump into someone, change direction. Do this for 1 minute.

Step 6: Finally, use a larger space and move around it quickly. If you come close to bumping into another student, change direction as if you ‘bounced off’ each other. For safety, do not collide with other students.

Helpful hints

* Be careful when bumping into other students. Be sensible.
* Pay attention to how quickly you can move and the ways you are able to move.

Answers

Student behaviour will vary, but students should demonstrate the particles of a solid (Step 3), a liquid (Step 5) and a gas (Step 6) by representing the spacing of their particles, the magnitude of their movement, and potentially their movement types (translate, rotate, vibrate).