

The Particle Model of Matter

Exploring how tiny particles explain solids, liquids, and gases

Audience: Grade 5 science students in an Alberta classroom

Grades: Grade 5

Subjects: Science

Time: about 60 minutes



Three containers showing ice, water, and a balloon representing solid, liquid, and gas.

Overview

This lesson introduces the particle model of matter, a way of explaining why solids, liquids, and gases behave so differently even though they are all built from the same tiny building blocks ([PDF p.1](#), [Understanding](#)). Students explore three big ideas: all matter is made of small particles, particles are always moving, and particles have spaces between them ([Knowledge](#), [Knowledge](#)).

Through a whole-class demonstration, a short video, and a hands-on Human Particles activity, students relate particle movement and arrangement to each state of matter and describe how attractive forces change from strongest in solids to weakest in gases ([Skills](#), [Skills](#), [Resource](#)). The lesson closes with a brief look at density and compressibility as physical properties of matter([Knowledge](#), [Skills](#)).

Outcomes covered

- Students investigate the particle model of matter in relation to the physical properties of solids, liquids, and gases. ([Outcome](#), [Outcome](#))
This outcome helps students move beyond simply naming solids, liquids, and gases to explaining why each state behaves the way it does, a skill they will use throughout science when reasoning about heating, cooling, and changes of state.
- Represent solids, liquids, and gases, using the particle model of matter. Relate the movement and arrangement of particles to the state of matter. Describe the impact that attractive forces have on the movement and arrangement of particles in solids, liquids, and gases. ([Skills](#), [Skills](#))
Being able to draw and describe particle arrangement gives students a tool to explain everyday events, like why ice melts or why a helium balloon fills a whole shape, using evidence instead of guesswork.
- The particle model of matter explains the behaviour of particles in matter. ([Understanding](#), [Understanding](#), [PDF p.1](#))
This big idea ties the whole lesson together: once students trust the model, they can predict how matter will behave in new situations they have not seen before.
- The movement and arrangement of particles affect the physical properties of matter. ([Understanding](#), [Understanding](#))
This understanding connects today's lesson to future work on mass, volume, density, and compressibility, since all of those properties trace back to how tightly and how quickly particles move.

Materials

- Three closed containers or picture cards showing an ice cube, a cup of water, and a balloon
- Whiteboard or chart paper and markers for the three-box particle diagram
- Device and screen to play [Resource](#), the particle movement video
- Open floor space for the Human Particles activity
- Paper and pencils for pair diagrams and exit tickets
- Two identical syringes with plugged tips, one holding air and one holding water, for the compressibility demonstration
- Two same-sized balls of different material, such as a metal ball and a foam ball, for the density comparison

Sequence of activities

1. What's Really There? Hook and Prediction (8 min, whole class)

1. Show three closed containers, or picture cards, labelled solid (an ice cube), liquid (a cup of water), and gas (a balloon).
2. Ask: "What do you think is inside matter if you could zoom in a billion times?" Take three or four guesses and write them on the board without judging them.
3. Tell students that today they will use the particle model of matter to explain why ice, water, and air behave so differently, even though all three are made of the same tiny building blocks ([Understanding](#), [PDF p.1](#)).

4. Introduce the learning intention: "I can use the particle model to explain how particles move and arrange themselves in solids, liquids, and gases."
5. Share the success criteria: I can name the three big ideas of the particle model. I can describe how particles behave in each state. I can explain how attractive forces change between states.

This is a quick prediction hook, not a place to correct misconceptions yet. Common early ideas include "there is nothing inside" or "particles are alive." Simply record ideas and revisit them at the end of the lesson during the exit ticket.

Sources: [Understanding](#), [PDF p.1](#)

2. Direct Teaching: The Three Big Ideas (10 min, whole class)

1. Explain the particle model of matter using three ideas from [PDF p.1](#) and [Knowledge](#): all matter is made of small particles, particles are always moving, and particles have spaces between them.
2. Draw three simple boxes on the board labelled Solid, Liquid, Gas. Sketch dots close together and neatly lined up for the solid, dots with a bit more space and no fixed pattern for the liquid, and a few scattered dots with lots of empty space for the gas.
3. For each box, describe the movement: solid particles vibrate in place, liquid particles slide past each other, gas particles move quickly in all directions ([Knowledge](#), [Knowledge](#)).
4. Introduce the term attractive force as the pull between particles that holds them together. Explain that this pull is strongest in solids and weakest in gases ([Knowledge](#), [Skills](#)).
5. Play [Resource](#), the short video on particle movement and arrangement, and ask students to watch for one new detail about how particles behave when matter melts or boils.
6. After the video, ask two or three students to share the detail they noticed and connect it back to the three big ideas.

Keep the board diagram visible for the rest of the lesson so students can refer back to it during the activity and exit ticket. If time is tight, the video can run at 1.25x speed or be paused partway through with a quick turn-and-talk.

Sources: [PDF p.1](#), [Knowledge](#), [Skills](#), [Knowledge](#), [Resource](#)

3. Human Particles: Acting Out States of Matter (20 min, whole class)

1. Clear a space in the classroom or move to the gym if available. Explain that students will become particles.
2. Round 1, Solid: students stand shoulder to shoulder in a tight cluster and gently vibrate on the spot without moving their feet, showing how solid particles are close together with strong attractive forces ([Knowledge](#), [Skills](#)).
3. Round 2, Liquid: students spread out slightly and walk slowly, sliding past classmates without bumping, showing weaker attractive forces than a solid.
4. Round 3, Gas: students spread across the whole space and move quickly in random directions, showing large spaces and the weakest attractive forces ([Knowledge](#), [Skills](#)).
5. Call out state names in random order ("Solid! Gas! Liquid!") and have students switch their arrangement and movement each time.
6. Stop after each round and ask one volunteer: "How close are the particles right now? How strong is the pull between them?" Expect answers like "very close and strong pull" for solid or "far apart and weak pull" for gas.
7. Return to seats. In pairs, students draw a three-box diagram (solid, liquid, gas) showing particle arrangement with dots, and label which state has the strongest and weakest attractive forces ([Skills](#), [Skills](#)).

Set clear physical boundaries before starting so the gas round stays safe. A signal such as freezing when you say "freeze" helps manage transitions. Pair drawings become a quick formative check of the skill in [Skills](#): representing states using the particle model.

Sources: [Knowledge](#), [Skills](#), [Skills](#)

4. Connecting to Everyday Density and Compressibility (12 min, pairs)

1. Hold up two identical syringes with plugged tips, one holding air and one holding water. Ask: "Which one can you squish smaller, the water or the air?" Let students try gently squeezing both.
2. Explain that gases can be compressed into a smaller volume because their particles have large spaces between them, but liquids like water are much harder to compress because their particles are already close together ([Knowledge](#), [Skills](#)).
3. Introduce density in plain words: density compares how much mass is packed into a certain volume. A denser object has more mass squeezed into the same amount of space ([Knowledge](#)).
4. Show two same-sized balls, one heavier (such as a metal ball) and one lighter (such as a foam ball). Ask pairs to predict which is denser and explain their thinking using the word particles.
5. Reveal the answer: the heavier ball has more tightly packed particles for the same volume, so it is denser. **Note for teachers: This is a Grade 5 simplification. In reality, particles of different materials can have different masses themselves. Help students avoid the misconception that all denser materials simply have closer-packed particles by pointing out that the particles in the metal ball are also heavier than the particles in the foam ball.** ([Knowledge](#), [Skills](#))
6. In pairs, students answer on paper: "Why can you squish air but not water?" using the sentence starter "Air is easier to compress because..."

This activity links the particle model to physical properties named in [Knowledge](#) without requiring full mass or volume measurement, which can be extended in a follow-up lesson with balance scales and graduated cylinders as described in [Skills](#).

Sources: [Knowledge](#), [Skills](#)

5. Exit Ticket: Explain It With Particles (10 min, individual)

1. Hand out a small exit slip with two questions.
2. Question 1: Draw and label the particle arrangement in a solid, a liquid, and a gas. Include at least one word about movement for each.
3. Question 2: In one or two sentences, explain why the attractive force is strongest in a solid and weakest in a gas ([Knowledge](#), [Skills](#)).
4. Give students five minutes to complete the drawing and writing independently.
5. Collect slips as students leave, or place them in a bin, to check individual understanding before the next lesson.
6. Quickly revisit the predictions written on the board at the start of the lesson and ask the class which ideas turned out to be closest to the particle model.

Use this exit ticket as the main formative assessment. Look for correct spacing in drawings (close, medium, far apart) and correct direction of the attractive force claim (strongest in solid, weakest in gas), matching [Knowledge](#) and [Skills](#).

Sources: [Knowledge](#), [Skills](#)

Differentiation

Extension

- Ask students to research and draw what happens to particle arrangement during melting and boiling, then explain the change in one sentence using the word attractive force.
- Challenge students to design a simple diagram comparing the compressibility of a gas-filled balloon and a water-filled balloon, predicting which shrinks more under gentle pressure and why ([Knowledge](#), [Skills](#)).
- Invite students to compare the density of two same-volume objects from home, such as a wooden block and a metal spoon, and explain which is denser using particle language.

Support

- Provide a partially completed three-box diagram with solid and gas already drawn so the student only needs to complete the liquid box.
- Offer sentence starters for the exit ticket, such as "In a solid, the particles are... In a gas, the particles are..."
- Pair students who need more support with a peer during the Human Particles activity and the diagram task so they can check their movements and drawings together.

Inclusive supports

- Allow students who find large group movement overwhelming to observe the Human Particles activity from the side and describe what they see, or to act out the states using small manipulatives like beads on their desk instead.
- Provide picture cards showing solid, liquid, and gas particle diagrams for students who benefit from visual anchors during the direct teaching segment.
- Give students extra processing time before calling on them during whole-class questioning, and allow written or drawn responses as an alternative to spoken answers.

Assessment

Formative. During the Human Particles activity, observe student arrangement and movement in each round and question volunteers about closeness of particles and strength of attractive force.

Look for: Students correctly cluster tightly and vibrate for solid, spread and slide for liquid, and spread widely with fast random movement for gas, and can state that attractive force is strongest in solid and weakest in gas. ([Knowledge](#), [Skills](#))

Formative. Review the paired three-box diagrams drawn after the Human Particles activity.

Look for: Diagrams show particles close together for solids, more spaced for liquids, and widely spaced for gases, with a correct label of strongest and weakest attractive force. ([Skills](#), [Skills](#))

Formative. Exit ticket with a labelled particle drawing for solid, liquid, and gas plus a written explanation of attractive force strength.

Look for: Drawing shows correct relative spacing and movement words for each state, and the written explanation correctly links closer particle spacing to stronger attractive force. ([Knowledge](#), [Skills](#), [Understanding](#))

Vocabulary

- **particle:** A very small piece of matter that is far too tiny to see with your eyes, a magnifying glass, or even a classroom microscope. All matter, including solids, liquids, and gases, is made of particles ([PDF p.1](#), [Knowledge](#)).
- **particle model of matter:** An idea scientists use to explain how matter behaves, based on the facts that all matter is made of small particles, those particles are always moving, and there are spaces between them ([Understanding](#), [PDF p.1](#)).

- **attractive force:** The pull between particles that holds them together. This pull is strongest in solids, where particles are packed closely, and weakest in gases, where particles are far apart ([Knowledge](#), [Skills](#)).
- **density:** A comparison of how much mass is packed into a certain amount of volume. An object with more mass squeezed into the same space is denser ([Knowledge](#)).
- **compressibility:** The ability of a liquid or gas to be squeezed into a smaller volume when pressure is applied. Gases compress much more easily than liquids because their particles start out farther apart ([Knowledge](#), [Skills](#)).

For families

- Ask your child to point to something solid, something liquid, and something gas at home, like an ice cube, a glass of juice, and the air in a bicycle tire, and explain how the tiny particles behave differently in each one.
- At bath time or while cooking, ask your child why steam rises and spreads while ice stays in a solid shape, and see if they mention that particles move faster and spread out more as matter heats up.
- Let your child gently squeeze a sealed plastic bottle full of air and then one full of water, and ask them to explain why the air compresses more easily using the word particles.

Sources

- [Guiding question](#): "How can states of matter and other physical properties be explained using the particle model of matter?"
- [Outcome](#): "Students investigate the particle model of matter in relation to the physical properties of solids, liquids, and gases."
- [Knowledge](#): "In solids, the particles are close together and vibrate in place."
- [Skills](#): "Describe the impact that attractive forces have on the movement and arrangement of particles in solids, liquids, and gases."
- [Understanding](#): "The particle model of matter explains the behaviour of particles in matter."
- [Knowledge](#): "Density is a comparison of the mass of a solid, liquid, or gas to its volume."
- [Skills](#): "Compare the compressibility of air and water."
- [Understanding](#): "The movement and arrangement of particles affect the physical properties of matter."
- [Outcome](#): "Students investigate the particle model of matter in relation to the physical properties of solids, liquids, and gases."
- [Knowledge](#): "Attractive forces between particles are strongest in solids and weakest in gases."
- [Skills](#): "Represent solids, liquids, and gases, using the particle model of matter."
- [Understanding](#): "The movement and arrangement of particles affect the physical properties of matter."
- [Understanding](#): "The particle model of matter explains the behaviour of particles in matter."
- [Guiding question](#): "How can states of matter and other physical properties be explained by using the particle model of matter?"
- [PDF p.1](#): "All matter is made up of small particles. Particles of matter are always moving. Particles of matter have spaces between them."
- [Resource](#): "Explore how particles move and arrange in different states of matter."

All content, images, and physical movement activities are age-appropriate for grade 5 students and free of culturally sensitive or unsafe material, with clear boundaries set for the movement-based

Human Particles activity.

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