

The Particle Detective: Solid, Liquid, or Gas?

This brain teaser lets you apply the particle model of matter to identify unknown samples of matter, matching the Grade 5 guiding question of how states of matter can be explained through particle behaviour ([Guiding question](#)). The puzzle draws on the learning outcome that asks you to investigate the particle model in relation to solids, liquids, and gases ([Outcome](#)), and on the specific facts about particle arrangement, movement, and attractive forces described in the curriculum ([Details](#)).



Figure 1: Three sealed glass containers on a lab bench, each holding a different substance rendered as tiny glowing dots at different spacing and

The puzzle

A lab technician has three sealed containers, labelled X, Y, and Z. Each holds a sample of matter, one solid, one liquid, and one gas, but the labels have fallen off. Use the eight clues below to identify which container holds which state of matter, then rank the three samples from highest density to lowest density.

1. In container X, the particles vibrate in fixed positions and do not move from place to place ([Details](#)).
2. In container Y, the particles are constantly moving in all directions and are separated by large spaces ([Details](#)).
3. In container Z, the particles are separated by small spaces and can slide past one another ([Details](#)).
4. The attractive forces between particles are strongest in container X ([Details](#)).
5. The attractive forces between particles are weakest in container Y ([Details](#)).
6. The sample with the particles closest together has the highest density, and the sample with the particles farthest apart has the lowest density ([Details](#)).
7. One of the three samples can be compressed easily when placed under pressure. That sample is not X and not Z ([Details](#)).
8. The sample that flows and takes the shape of the bottom of its container, without spreading out to fill the whole container, is not X and not Y ([Details](#)).

Identify the state of matter in container X, container Y, and container Z. Then list the three containers in order from highest density to lowest density.

Hints

Hint 1: Start with the particle spacing described in each clue. Solids have particles close together, liquids have particles with some space between them, and gases have particles with large spaces between them ([Details](#)).

Hint 2: Clue 4 tells you which container has the strongest attractive forces between particles. According to the particle model, attractive forces are strongest in solids and weakest in gases ([Details](#)). Use this to pin down two of the three containers before checking the third against the compressibility and flow clues.

Hint 3: Compressibility applies to liquids and gases, but gases compress far more easily than liquids because their particles have much more space between them ([Details](#)). Clue 7 eliminates two containers from being the gas. Combine this with clue 8, which describes a liquid's tendency to take the shape of the bottom of its container, to confirm your final answer.

Answer key

Container X is a solid. Clue 1 describes particles vibrating in fixed positions, which matches the solid state ([Details](#)). Clue 4 confirms this, since attractive forces are strongest in solids ([Details](#)).

Container Y is a gas. Clue 2 describes particles moving constantly in all directions with large spaces between them, which matches the gas state ([Details](#)). Clue 5 confirms this, since attractive forces are weakest in gases ([Details](#)).

Container Z is a liquid. Clue 3 describes particles with small spaces between them that can slide past one another, which matches the liquid state ([Details](#)).

Clue 7 confirms Y as the gas, since gases are the most compressible state and the clue rules out X and Z. Clue 8 confirms Z as the liquid, since liquids take the shape of the bottom of their container, and the clue rules out X (a solid keeps its own shape) and Y (a gas fills its entire container).

Density ranking, highest to lowest: X, then Z, then Y.

This follows from the particle model: particles closest together produce the highest density, and particles farthest apart produce the lowest density ([Details](#)). Solids have the smallest spacing between particles, so container X has the highest density. Liquids have somewhat more spacing, so container Z ranks second. Gases have the largest spacing, so container Y has the lowest density.

