Particles and internal energy

Student activity • observation and reasoning

YEAR 11 / LESSON 68 / PHYSICS ONLY

The question

How can heating change a substance without always raising its temperature?

Use particle diagrams and energy-transfer arrows to compare warming with a change of state.

Equipment

- Booklet, pencil and reusable particle counters

Use large counters on the desk; do not place them in mouths or throw them. No heating, boiling water or particle sprays are used.

Course coverage: Physics only: 5.8P–5.10P. Particle arrangement, motion and changes of state.

Plan, model or apparatus sketch

Draw the relevant wavefront, particle or energy-transfer model and label its assumptions.

Method and reasoning

Read the whole sequence before starting

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1. Draw the same number of particles in solid, liquid and gas models. Show an ordered close arrangement for a simple crystalline solid, close disordered particles for a liquid and widely separated particles for a gas.

2. Add motion arrows: vibration about fixed positions in the solid, rearrangement in the liquid and rapid random motion in the gas. Do not draw the particles themselves expanding on heating.

3. For warming within one state, explain increased average particle kinetic energy and a rising temperature, while acknowledging that internal energy includes interactions as well as motion.

4. For melting at fixed pressure, draw energy entering while the arrangement changes. Explain why energy can increase particle potential energy without a temperature increase during an ideal phase change.

5. Compare evaporation at a liquid surface below boiling with boiling throughout the liquid at its boiling temperature for a given pressure. Explain cooling of a remaining liquid when higher-energy particles escape.

6. Correct claims that particles disappear on evaporation, a liquid has no forces between particles, or a melting plateau means no energy transfer. Keep the mass conserved for a closed system.

Cleanup

- Count and return counters; retain the corrected diagrams.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Internal energy is associated with microscopic kinetic and potential energies. Temperature is not total stored energy. Simple particle diagrams are models: spacing and particle size are not drawn to scale. Boiling temperature depends on pressure, and evaporation can occur below it.

State / change	Arrangement and motion	Energy explanation
Solid		
Liquid		
Gas		
Melting		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. How do solid particles move?

2. Why can a liquid flow?

3. Do particles become larger when heated?

4. Why can melting occur at constant temperature?

5. How do evaporation and boiling differ?

6. Is internal energy the same as temperature?