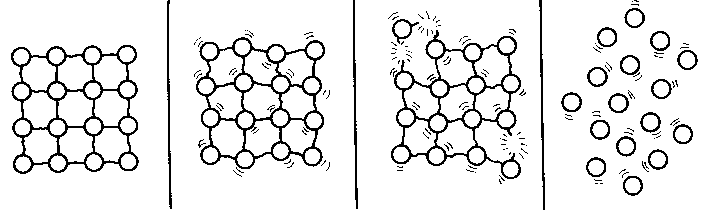
**Particle explanations- melting**

It is impossible to represent the particles of substances in the solid, liquid and gas state accurately in a diagram. So, all drawings show some aspects of the particle model well, and others not so well.

This diagram from a textbook illustrates the particle model of a substance in the solid state melting so that the sample is in the liquid state:



State three ways in which you think the diagram is a **good representation** of a substance melting so that it changes from the solid state to the liquid state:

1

2

3

State three ways in which you think the diagram is **not an accurate representation** of a substance melting:

1

2

3

*Chemistry > Big idea CPS: Particles and structure Topic CPS1: Substances and mixtures > Key concept CPS1.1: Particle model for the solid, liquid and gas states*

|  |
| --- |
| **Response activity** |
| **Particle explanations - melting** |

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| --- | --- |
| Learning focus: | Understand a basic particle model of matter that can explain the properties of substances in the solid and liquid states. |
| Observable learning outcome: | Use the particle model to explain why substances have different melting points. |
| Activity type: | critiquing a representation |
| Key words: | solid, liquid, state, particle, melting |

This activity can help develop students’ understanding by addressing the misunderstandings revealed by the following diagnostic question:

* Explaining melting

**What does the research say?**

Research by Johnson and Papageorgiou (2010) recommends that the particle model is used to explain why substances melt at different temperatures. These differences arise from differences between the forces of attraction between particles. The state of a substance results from how these forces of attraction compare with the energy of the movement of the particles (which depends upon the temperature). When a substance melts the particles have sufficient energy to overcome these forces and move, whilst still staying close together.

It should be noted that use of the term ‘attraction’ is inconsistent with later understanding of a chemical bond as a balance between attraction and repulsion. For this reason, Johnson suggests that alternative terminology, such as ‘ability to hold’ may be preferable.

Teaching students to classify substances as being solids, liquids or gases can lead to the misunderstanding that solids, liquids and gases are different types of substance. This approach, that focuses on the particles, reinforces that it is one substance that changes state and that the temperature at which this happens is dependent upon the forces of attraction between the particles.

**Ways to use this activity**

Students could discuss this activity in small groups. The ideas from groups could be combined to create a class response. Students could then be asked how the representation could explain differences in melting point (by indicating a difference in how strongly the particles are held together in two different solids).

Having critiqued this representation students could then be asked to reflect upon their answers to the diagnostic question. They could be asked whether this model has caused them to change their minds and why.

*Differentiation*

Students could be provided with possible responses to sort into ways in which the diagram is a good representation and ways that it is not an accurate representation.

**Expected answers**

Answers could include:

**Good representation**

1 Shows the particle vibrating more and therefore having sufficient energy to overcome the forces of attraction between particles in the solid state.

2 The particles are ordered in the solid but disordered in the liquid.

3 The particles in the liquid are free to move around.

**Not an accurate representation**

1 Suggests that there are no forces of attraction between particles in a liquid.

2 The particles in the solid are not vibrating.

3 The particles are too far apart in the solid and in the liquid.

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Developed by Helen Harden (UYSEG), from an idea by Andrew Hunt drawn from research by the Evidence-based Practice in Science Education project. (EPSE diagnostic question M2-14)

Images: EPSE

**References**

Johnson, P. and Papageorgiou, G. (2010). Rethinking the Introduction of Particle Theory: A Substance-based framework. *Journal of Research in Science Teaching.* 42(2) 130-150