**Zooming in**

If you look at some nails with your eyes, this is what you may see.



You could look more closely at one nail with a magnifying glass or a microscope.

Imagine that you could zoom in even more closely.

1. Draw and label a diagram of what you think you would see.

*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*

|  |
| --- |
| **Diagnostic question** |
| **Zooming in** |

|  |  |
| --- | --- |
| 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: | Describe substances as being made up of parts that are too small to be seen without magnification |
| Question type: | diagram |
| Key words: | solid, liquid, state, particle |

**What does the research say?**

Johnson (1998) identifies three misconceptions held by students about the particulate nature of matter:

1. Substances are continuous (no recognition of particle ideas)
2. Particles are located within a continuous substance (rather than being the substance)
3. Particles are the substance (but macroscopic properties are given to the particles)

These contradict the standard particle model in which the particles are the substance, but the macroscopic properties of the substances arise collectively from the particles.

**Ways to use this question**

This question is designed to be undertaken by students individually, and unprompted, to find out if and how they include particles in their diagrams.

*Differentiation*

Any students who can draw an appropriate particle diagram could be challenged to describe the movement of the particles.

**Expected answers**

The expected answer is the standard particle diagram for a solid with the particles labelled as ‘iron particles’.

**How to respond - what next?**

Whilst there will be great variation in what students draw there are two key questions to ask about the diagrams:

1. Has the student attempted any representation of particles in their diagram?
2. Has the student drawn particles that are embedded within the substance (rather than being the substance)?

If students have misunderstandings about the particulate nature of matter it is important to introduce the concept of matter being made up of particles very carefully as well as the detail of the particle model for the solid and liquid states.

If students have met the idea of particles but have misunderstandings about particles being embedded in the matter it is important that the language used when teaching the particle model does not reinforce this misconception for example by referring to ‘particles in a solid’.

**Acknowledgments**

Developed by Helen Harden(UYSEG), from an idea by Philip Johnson (School of Education, University of Durham).

Images: Kazac Maxim (Pixabay)

**References**

Johnson, P. (1998). Progression in children’s understanding of a ‘basic’ particle theory: a longitudinal study. *International Journal of Science Education.* 20(4) 393-412

Johnson, P. (2012). Introducing particle theory. In Taber, K. (ed.) *ASE Science Practice: Teaching Secondary Chemistry.* New edition ed. London: Hodder Education.