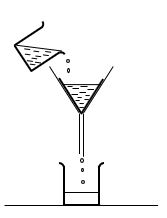
**Filtering a mixture**

A suspension of a red insoluble powder is mixed with a clear yellow solution. The mixture is filtered.



1. What will the filtrate look like?

A clear and colourless

B clear yellow

C cloudy red

D clear orange

*Chemistry > Big idea CPS: Particles and structure> Topic CPS1: Substances and mixtures > Key concept CPS1.2: Particles in solutions*

|  |
| --- |
| **Diagnostic question** |
| **Filtering a mixture** |

|  |  |
| --- | --- |
| Learning focus: | Understand how a particle model of matter can be used to describe and explain solutions. |
| Observable learning outcome: | Predict and explain the filtrate and residue when a mixture (suspension or solution) is filtered. |
| Question type: | simple multiple choice |
| Key words: | filter, filtrate, residue, particle, clear, cloudy, suspension, solution |

**What does the research say?**

Johnstone (1991) explains the difficulties that many students face in understanding science as the degree of ‘multilevel’ though required. In chemistry students are frequently required to think about very different types of thing all at once.

Johnstone presented this in the form of a triangle:



*(after Johnstone, 1991, p78)*

In order to fully understand and use sub-microscopic explanations students need to recognise the difference in terms of scale between ‘particles’ in the everyday macroscopic sense, as found in a suspension, and the sub-microscopic particles in a solution. Students must also know how the size of the holes in the filter paper compares to the particle sizes.

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion.

*Differentiation*

It may help some students to show them an example of a coloured suspension and a coloured solution.

**Expected answers**

B

**How to respond - what next?**

Selection of option D suggests that the student has not recognised the size difference between the particles in the red suspension and those in the yellow solution. The student has concluded that both will pass through. This also suggests a lack of understanding of the purpose of filtration.

Selection of option C implies that the student does not understand that the particles in the red suspension are too large to pass through the filter. There is also no recognition that the dissolved particles will pass through (although the student may think that the red colour will obscure the yellow).

Selection of option A is worth further exploration with the student by asking what is left in the filter paper. The student may think that only the water will pass through or they may have recalled learning that solutions can pass through a filter but may have incorrectly inferred that all solutions are colourless.

If students have misunderstandings about the relative sizes of particles and which are able to pass through filter paper it may be helpful to demonstrate more visibly using a sieve as a model for the filter paper. This may help students to observe how the relative size of the pieces and the holes in the sieve determine which pass through. The following BEST ‘response activity could be used in follow-up to this diagnostic question:

* Sieving and filtering

**Acknowledgments**

Developed by Helen Harden (UYSEG). The question is an amended version of Evidence-based Practice in Science Education project (EPSE) diagnostic question M1-21.

Images: Filtering diagram (York Science)

Triangle (after Johnstone, 1991, p78)

**References**

Johnstone, A. H. (1991). Why is chemistry difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning*, 7, 75-83

Taber, K.S. (2013). Revisiting the chemistry triplet: drawing upon the nature of chemical knowledge and the psychology of learning to inform chemistry education. *Chemistry Education Research and Practice*, 14, 156

Talanquer, V. (2011). Macro, sub-micro and symbolic: The many faces of the chemistry “triplet”. *International Journal of Science Education*, 33:2, 179-195

Jabar, L.Z., Boujaoude, S. (2012). A macro-micro-symbolic teaching to promote relational understanding of chemical reactions. *International Journal of Science Education*, 34:7, 973-998