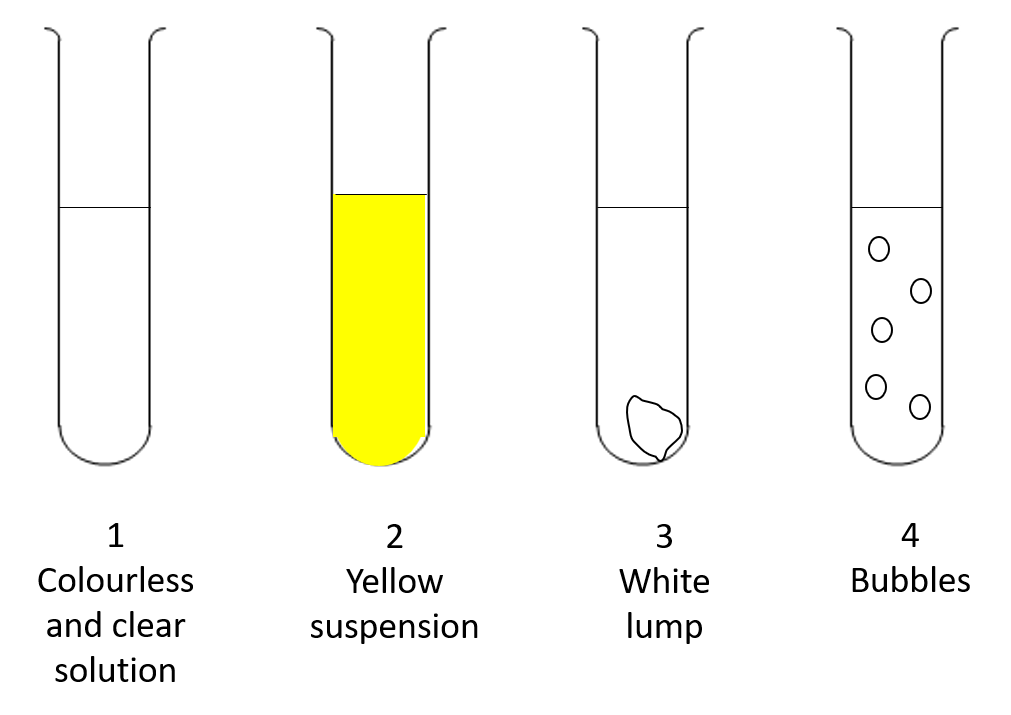
**State symbol observations**

1. Which state symbol represents the substance described in each observation?



A (s)

B (l)

C (g)

D (aq)

*Chemistry > Big idea CPS:Particle and structure > Topic CPS4: Understanding reactions > Key concept CPS4.1: Representing reactions*

|  |
| --- |
| **Response activity** |
| **State symbol observations** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | A chemical reaction can be summarised by a chemical equation. |
| Observable learning outcome: | Match a chemical formula and state symbol to a macroscopic observation. |
| Activity type: | application and practice |
| Key words: | state symbol, solid, liquid, gas, aqueous |

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

* State symbols

**What does the research say?**

Johnstone (1991) used a triangle to summarise three levels of representation that he proposed are needed in order to understand chemistry.



*Figure 1 Johnstone’s triangle*

Johnstone (2000) highlights how in chemistry teaching students are often introduced to all three levels of representation simultaneously. Whilst an experienced chemist may be able to manipulate all three, he suggests that this may overload the “working space” (working memory) of school students.

Jaber and BaJaoude (2012) build on previous work (Treagust, Chittleborough and Mamiala, 2003) that links levels of understanding to the use of different levels of representation in chemistry.

They propose that at an instrumental level of understanding (knowing how) students learn chemical concepts at the three levels separately. This may lead to fragmented and compartmentalised knowledge.

They then suggest that in order to acquire a relational level of understanding (knowing why) students need to develop ways to move easily and skilfully within Johnstone’s triangle.

The researchers then compared an experimental group with a control group where the experimental group received:

* explicit teaching at and about macro, micro and symbolic levels and the interplay between them
* use of multiple schematic and symbolic representations
* explicit teaching about models

In conclusion, the research recommends the adaption of a macro-micro-symbolic approach to instructions and suggests that this should become a ‘habit of teaching’.

This response activity provides additional practice for students in relating state symbols to macroscopic observations.

**Ways to use this activity**

This activity gives students the opportunity to practise applying their understanding and to clarify their thinking through discussion. To support this, students should answer the question in pairs or small groups.

*Differentiation*

Some student may benefit from observing real life examples. A suspension may be demonstrated to contain a solid by filtering the mixture.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Expected answers**

1 (aq), 2 (s), 3 (s), 4 (g)

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden and Alistair Moore

**References**

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