**Making silver?**

1. A coil of copper wire is placed into a solution of silver nitrate.



Choose the statement that best explains the appearance of solid silver.

A Silver dissolved out of the copper when it was placed in the solution.

B Adding the copper wire made the silver in the solution insoluble.

C The product of the reaction between copper and silver nitrate is silver, which is insoluble.

*Chemistry > Big idea CCR: Chemical reactions > Topic CCR2: Understanding reactions > Key concept CCR2.1: Reactions in solution*

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| **Diagnostic question** |
| **Making silver?** |

**Overview**

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| Learning focus: | When two solutions react, a product may be insoluble, resulting in the formation of a precipitate. |
| Observable learning outcome: | Explain the appearance of a different metal during a displacement reaction. |
| Question type: | simple multiple choice |
| Key words: | soluble, insoluble, solution, product, reaction |

**What does the research say?**

A summary of research into students’ conceptions of matter (Andersson, 1990) developed five categories of the types of answers students gave when explaining chemical reactions, only the last is scientifically correct. The distractors in this question are derived from the categories ‘displacement’ and ‘modification’. The use of the word displacement in this research refers movement from one position to another.

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| **Category of explanation** | **Description** | **Example** |
| disappearance | The substance has simply gone. | Petrol is ‘used up’. |
| Displacement  (movement) | The new product has moved from somewhere else. | When solid lead nitrate and potassium iodide are mixed the yellow colour (lead iodide) comes out of the white grains of powder. |
| modification | The original substance keeps its identity, but its properties change. | When alcohol burns it turns into alcohol vapour. |
| transmutation | A substance changes into another substance or a substance is changed (partly) into energy. | When magnesium burns it turns into energy. |
| chemical interactions | Substances combine to form a new substance (or split up to create two or more substances). | Magnesium reacts with oxygen forming magnesium oxide. |

**Ways to use this question**

This question could be carried out as a pencil and paper exercise, however students may also benefit from being able to observe the reaction.

The experiment may be carried out using a coil of copper wire as shown in the question or it may be carried out in microscale, with copper wire being placed in a drop of silver nitrate solution.

At this stage the focus is on explaining macroscopic observations in terms of chemical change rather than the idea of chemical reactivity which forms a later key concept.

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**

C

**How to respond - what next?**

Selection of option A suggests that a student may be using the ‘displacement’ category of explanation as this suggests that the silver has ‘moved’ out of the copper.

A student choosing option B appears to think that a substance can change its properties as this suggests that previously soluble silver becomes insoluble.

If students have difficulties in explaining macroscopic observations of chemical reactions they may need to develop further their understanding of chemical change (see key concept CCR1: Chemical change). Students may also benefit from being made explicitly aware of the common alternative categories of explanation. Research (Talanquer, 2017) showed a positive effect on student performance when prompts were added to questions asking student to consider what incorrect answer another student may give. It was thought that this reduced ‘intuitive’ responses by students.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Copper discussion

**Acknowledgments**

Developed by Helen Harden (UYSEG).

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**References**

Andersson, B. (1990). Pupils' conceptions of matter and its transformations (age 12-16). *Studies in Science Education,* 18**,** 53-85.

Talanquer, V. (2017). Concept inventories: Predicting the wrong answer may boost performance. *Journal of Chemical Education,* 94**,** 1805-1810.