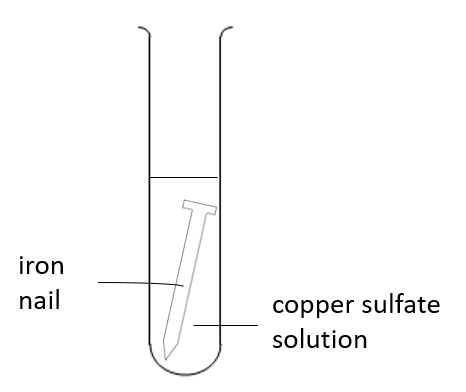
**Copper discussion**

Some blue copper sulfate solution was poured into a test tube.

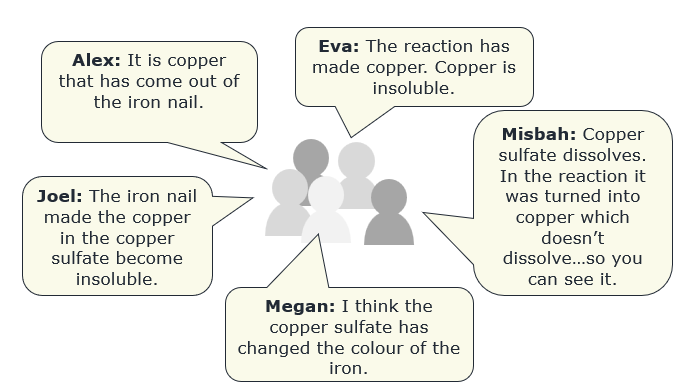
An iron nail was added.



An orange/brown solid gradually appeared.

1. Some students try to explain the appearance of an orange/brown solid.

Who do you agree with, and why?



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| --- |
| **Alex**  It is copper that has come out of the nail. |
| **Eva**  The reaction has made copper. Copper is insoluble. |
| **Misbah**  Copper sulfate dissolves. In the reaction it was turned into copper which doesn’t dissolve…so you can see it. |
| **Megan**  I think the copper sulfate has changed the colour of the iron. |
| **Joel**  The iron nail made the copper in the copper sulfate become insoluble. |

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

|  |
| --- |
| **Response activity** |
| **Copper discussions** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | 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. |
| Activity type: | talking heads |
| Key words: | dissolve, soluble, insoluble |

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

* Making silver?

**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. In this research the word displacement is used to mean movement from one position to another.

|  |  |  |
| --- | --- | --- |
| **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 activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. The statements are also provided as cut-out cards for students to physically organise and discuss.

It may help students to make them explicitly aware of some of the common alternative explanations categories that students have been found to use. Students could be asked to categorise the answers given.

Students could carry out the experiment or observe a demonstration.

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

*Differentiation*

The quality of the discussions may be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as a scribe. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

Eva correctly explains that copper is formed during the reaction. The fact that it is insoluble means that it is seen as a solid.

Misbah is almost correct but could be thinking in terms of transmutation as her wording says that the copper sulfate turns into copper. It is important that students understand that copper is formed as a result of the reaction between iron and copper sulfate.

Joel and Megan are both explaining the observations in terms of modification of the properties of either copper sulfate or iron, rather than the formation of a new substance with new properties.

Alex is attempting to explain the appearance of the orange/brown solid in terms of it moving from elsewhere.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden and Alistair Moore

**References**

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