**Is copper soluble?**

1. Some copper, copper carbonate and copper sulfate are added to water.

Look at the results below.

  

copper copper carbonate copper sulfate

What do the observations tell you?

A Copper is never soluble in water.

B Copper is sometimes soluble in water.

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

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| **Diagnostic question** |
| **Is copper soluble?** |

**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: | Recognise that a compound has properties (including solubility) that are distinct from its constituent elements. |
| Question type: | simple multiple choice |
| Key words: | soluble, insoluble |

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| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas from a previous key concept (CS2.1: Atoms and molecules) in order to aid transition from earlier stages of learning. |

**What does the research say?**

Research (Talanquer, 2007) suggests that a key difficulty of students in integrating macroscopic with sub-microscopic understanding of an observed property is the use of an additive rather than an emergent framework. The research study included a question to investigate this. Students were shown a particle diagram for a blue substance and a yellow substance, each made of one type of atom. The students were then asked to predict the colour of a third substance made up of a combination of the two types of atom. Many responses took an additive approach and predicted that the colour of the compound would be green. In fact, properties emerge from the arrangement of atoms.

**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.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

**Expected answers**

A

**How to respond - what next?**

A student who concludes from the observations that copper is sometimes soluble may think that the element copper is still present in the compound. This indicates that the student may be using an additive framework to think about compounds.

If students have misunderstandings about the difference in properties between an element and a related compound, they may need to revisit the idea that the properties of a substance emerge from the arrangement of atoms. A single atom does not have the properties of a substance.

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

* Explaining differences

**Acknowledgments**

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Images: Peter Fairhurst and Helen Harden

**References**

Talanquer, V. (2007). Students' predictions about the sensory properties of chemical compounds: Additive versus emergent frameworks. *Science Education,* 92(1)**,** 96-114.