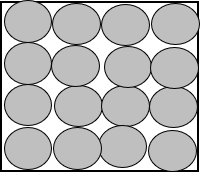
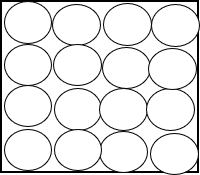
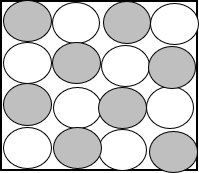
**Which colour?**

1. A compound is made up of a combination of atoms from a blue substance and a yellow substance.

blue substance yellow substance



compound

What colour is the compound?

A blue

B yellow

C green

D other

*Chemistry > Big idea CPS: Particles and structure > Topic CPS2: Elements and compounds > Key concept CPS2.1: Atoms and molecules*

|  |
| --- |
| **Diagnostic question** |
| **Which colour?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The properties of elements and compounds arise from the structural arrangement of their constituent atoms. |
| Observable learning outcome: | Explain that the properties of a compound may not be inferred from the properties of elements made up of its constituent atoms. |
| Question type: | simple multiple choice |
| Key words: | compound, atom |

**What does the research say?**

A study (Talanquer, 2008) was designed to explore the extent to which ‘novice’ learners (university students) used an additive framework to predict the properties of a compound rather than recognising the emergent nature of these properties which result from the interactions of atoms that make up the system as a whole. Multiple choice questions were devised in which students were presented with basic properties (such as smell or colour) of individual substances before being asked to predict the properties of a substance made up of a combination of atoms from the original substances.

The majority of student answers were consistent with the use of an additive framework. Less than 3% of students systematically predicted that the compound would have distinct properties to substances made up of its constituent 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.

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

A class discussion would be useful in order to find out more about student thinking, especially that of students selecting ‘other’ as a response.

**Expected answers**

Other. The colour of the compound is not related to the colour of substances made from its constituent atoms. This information is not sufficient to predict the colour of the compound.

**How to respond - what next?**

Students who are using an additive approach are likely to predict that the compound is green (option). A prediction of blue (option A) may mean that the student thinks that a darker colour may overwhelm the yellow.

If students have misunderstandings about the emergent nature of the properties of compounds the idea could be revisited during introductory work on chemical reactions where two elements react to form a new substance (compound) with different properties.

Prior to study of chemical reactions students could be shown sample of two elements (for example magnesium and oxygen) plus the compound they combine to make, to reinforce that the compound has completely different properties that cannot be predicted from those of the elements. Students could be encouraged to explain this observation in terms of the emergent properties of the different combinations of atoms.

**Acknowledgments**

Developed by Helen Harden (UYSEG), from an idea by Vicente Talanquer (University of Arizona).

Images: Helen Harden

**References**

Talanquer, V. (2008). Students' predictions about the sensory properties of chemical compounds: Additive versus emergent frameworks. *Science Education,* 92(1)**,** 96-114.