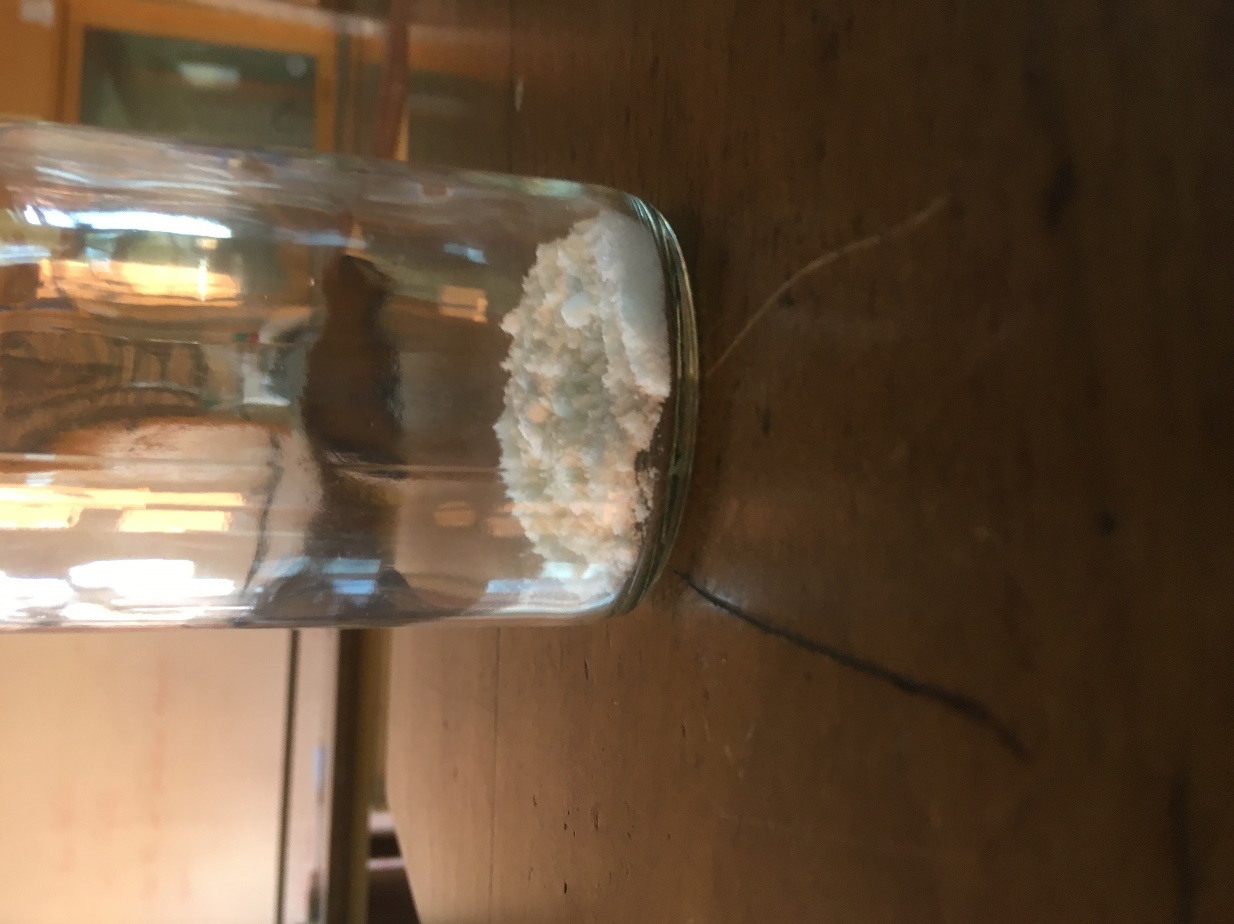
**Colour change**

1. Compound A and compound B are added to a small glass jar.

The lid is placed onto the jar.

The jar is shaken.

A yellow colour appears.

*Think about following statements. Then tick the box to show how confident you are that each statement is right or wrong.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | I am **sure** this is right | I think this is right. | I think this is wrong. | I am **sure** this is wrong. |
| **A** A yellow substance has been released from the white powder. |  |  |  |  |
| **B** The white powder has changed colour. |  |  |  |  |
| **C** One of the white substances has changed into a yellow substance. |  |  |  |  |
| **D** A new yellow substance has been formed. |  |  |  |  |

*Chemistry > Big idea CCR: Chemical reactions > Topic CCR1: Chemical change > Key concept CCR1.1: Formation of new substances*

|  |
| --- |
| **Diagnostic question** |
| **Colour change** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | During a chemical reaction a new substance (or substances) are formed with different properties. |
| Observable learning outcome: | Explain observations of a chemical reaction in terms of the formation of a new substance or substances with different properties. |
| Question type: | confidence grid |
| Key words: | substance |

**What does the research say?**

This activity was inspired by an article from the Journal of Chemical Education (de Vos and Verdonk, 1985). The spectacular nature of some chemical reactions (for example burning magnesium) were thought to ‘distract’ students from observations relating to the formation of a new substance. The solid-solid reaction between lead nitrate and potassium iodide was chosen because it results in the appearance of a yellow colour and does not display any other ‘distracting’ phenomena. The research found that students were often very reluctant to attribute the colour change to the formation of a new substance. Instead they created other explanations to account for this observation.

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. Many of the explanations provided by students attempting to explain the appearance of the yellow colour fall into one of these categories.

|  |  |  |
| --- | --- | --- |
| **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**

Whilst the demonstration could be shown to the whole class, for diagnostic purposes it is important that students respond independently.

*Differentiation*

You may wish to repeat (or video and replay) the reaction to allow students the opportunity to observe it more than once.

**Equipment**

For the class:

* test tube and stopper (or lidded glass jar)
* lead nitrate
* potassium iodide

**Technician notes**

Particular care should be taken with the use of lead nitrate powder which is harmful if swallowed and if inhaled. Eye protection should be worn. Avoid raising dust when powdered. Care should be taken to avoid skin contact and hands should be washed after use.

**Health and safety**

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

Particular care should be taken with the use of lead nitrate powder which is harmful if swallowed and if inhaled. Eye protection should be worn. Avoid raising dust when powdered. Care should be taken to avoid skin contact and hands should be washed after use.

Full safety guidance may be found on the appropriate CLEAPSS Hazcard.

**Expected answers**

Without any information on the name of the two compounds it would be expected that students would predict the observation ‘no change’.

Having observed the yellow colour students should deduce that a new substance has been formed.

**How to respond - what next?**

The key part of this activity is students’ explanation of the appearance of the yellow colour. If students do not recognise that this indicates the formation of a new substance it is worth exploring what their alternative explanations are. These can be categorised using the groupings described earlier.

A student who is confident that the yellow colour comes from the white powder is explaining the observation using the idea of displacement (movement). They may think that the yellow colour has moved from inside the white powder.

Thinking that the white substances have changed colour is using the idea of modification. The student may think that the identity of the substances remains the same but that their properties (colour) have changed.

The third suggestion (C) is based on the idea of transmutation. Just one substance has changed form to become a yellow substance. This fails to recognise the need for the interaction between the two substances. One substance alone cannot transform into another.

It should be noted that, in the case of thermal decomposition (see diagnostic question: heating a compound), a chemical change is possible with one starting substance, however in this case two products are formed. A single substance cannot transform into another single substance.

If students have misunderstandings about the reason for the formation of the yellow colour their alternative explanations could be challenged. For example, if a student thinks that the yellow colour appears from inside the white powder then samples of the white compound could be shaken separately or even crushed with a pestle and mortar to show that no yellow colour appears.

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

* Counter arguments

**Acknowledgments**

Developed by Helen Harden (UYSEG), from an idea by de Vos and Verdonk (Utrecht University, Netherlands)

Images: Sarah Longshaw

**References**

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

de Vos, W. and Verdonk, A. H. (1985). A new road to reactions (part 1). *Journal of Chemical Education,* 62(3)**,** 238-240.