**Carbon dioxide possibility**

1. All the substances listed below react with acids.

magnesium (Mg) copper carbonate (CuCO­3) copper oxide (CuO)

* 1. Which substance (or substances) do not produce carbon dioxide when reacted with acid? Explain your answer.
  2. If carbon dioxide is not produced, would another substance in the gas state be made?

*Chemistry > Big idea CCR: Chemical reactions >* *Topic CCR4: Acids and alkalis > Key concept CCR4.1: Neutralisation*

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| **Response activity** |
| **Carbon dioxide possibility** |

**Overview**

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| Learning objective: | A salt is formed form a neutralisation reaction between an acid and a base. |
| Observable learning outcome: | Explain the appearance of bubbles when bicarbonate of soda reacts with vinegar. |
| Activity type: | Application and practice |
| Key words: | substance, gas state |

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

* Vinegar fizz

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| **P** | **PRIOR UNDERSTANDING**  This activity explores ideas from a previous key concept (CCR1.1) to aid transition from earlier stages of learning. |

**What does the research say?**

An article in the Journal of Chemical Education (de Vos and Verdonk, 1985) discusses how 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 reaction of bicarbonate of soda with vinegar is a popular ‘kitchen chemistry’ experiment that some students may be familiar with. The chemical reaction is popular due to the spectacle of watching it bubble up. However, students may be focused on this rather than the understanding that the bubbles are actually formed from a product of the reaction (carbon dioxide) which is in the gas state at this temperature.

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. It may therefore be inferred that students may hold alternative conceptions regarding the source of the bubbles, for example that the bubbles have been released from the bicarbonate of soda, or the vinegar.

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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 activity**

This activity gives students the opportunity to practise applying their understanding and to clarify their thinking through discussion. To support this, students should answer the question in pairs or small groups.

Listening to individual groups as they work often highlights any difficulties they might have. These can often be overcome, through a whole class clarification or redirection part way through the activity.

Asking students to share their answer is a useful check. After a group has fed back, it might be helpful to model an even better answer. You could do this, for example, by asking another group to add to, or clarify, the first observation. Then ask another group to sum up the important part of the observation, and so on.

*Differentiation*

If some students are working with a teaching assistant, then a list of prompt questions for the teaching assistant could help to make this activity more purposeful.

**Expected answers**

1 a Magnesium and copper oxide do not produce carbon dioxide because they do not contain any carbon atoms.

B The reaction of copper oxide with acid does not produce a product in the gas state but the reaction with magnesium produces hydrogen.

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images: None

**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.