**Vinegar fizz**

Some bicarbonate of soda (“bicarb”) is added to a test tube containing vinegar. It fizzes.

Explain how the bubbles are made.

For each statement, tick (✓) **one** column to show what you think*.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | A gas escapes from the “bicarb”. |  |  |  |  |
| **B** | A gas is released from the vinegar. |  |  |  |  |
| **C** | A new substance in the gas state is made. |  |  |  |  |
| **D** | The vinegar changes into the gas state. |  |  |  |  |

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

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| --- |
| **Diagnostic question** |
| **Vinegar fizz** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | A salt is formed from a neutralisation reaction between an acid and a base. |
| Observable learning outcome: | Explain the appearance of bubbles when bicarbonate of soda reacts with vinegar. |
| Question type: | confidence grid |
| Key words: | substance, gas state |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of 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 fizz. 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.

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

Students should complete the confidence grid 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.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations, it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

The scientifically correct answer is that a new substance is formed which is in the gas state (carbon dioxide) so this is the answer that students should be confident is right.

**How to respond - what next?**

A student who is confident that either a gas escapes from the bicarbonate of soda (A) or is released from the vinegar (B) may be hold the misunderstanding that an observed new product moves from somewhere else where it has previously been unobservable.

It may help these students to revisit ideas from key concept CCR1.1: Formation of new substance. The products of a reaction have different properties to the reactants. So, in this case one of the products is carbon dioxide which is in the gas state at room temperature.

As student who thinks that D is correct may not realise that the properties of a substance remain fixed. Vinegar is not in the gas state at the temperature conditions involved.

If students have misunderstandings about the formation of new substances during a reaction following the rearrangement of atoms, it may help to revisit key concept CPS3.1: Rearrangement of atoms.

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

* Carbon dioxide possibility

**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.