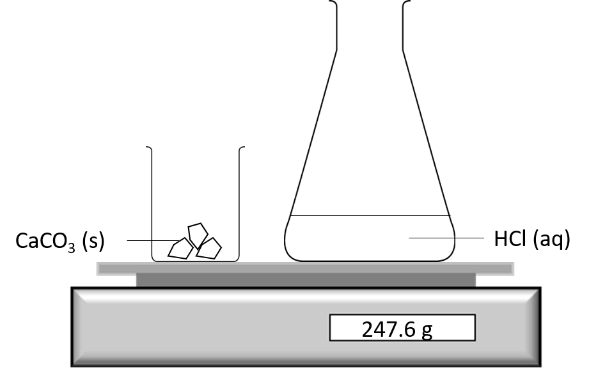
**Mass prediction**

1. The reactants are placed on a balance.



The total mass is 247.6g.

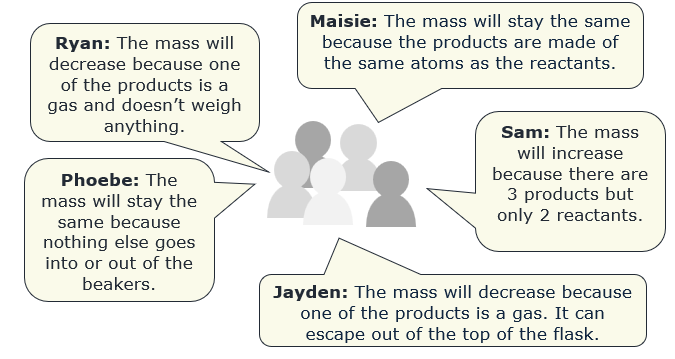
The chemical equation for the reaction is:

CaCO3 (aq) + 2HCl (aq) → CaCl2 (aq) + CO2 (g) + H2O (l)

The reactants are mixed. A chemical reaction takes place.

Some students predict how the mass of the reaction will change.

Who do you agree with, and why?



|  |
| --- |
| **Maisie**  The mass will stay the same because the products are made of the same atoms as the reactants. |
| **Sam**  The mass will increase because there are 3 products but only 2 reactants. |
| **Jayden**  The mass will decrease because one of the products is a gas. It can escape out of the top of he flask. |
| **Phoebe**  The mass will stay the same because nothing else goes into or out of the beakers. |
| **Ryan**  The mass will decrease because one of the products is a gas and doesn’t weight anything. |

*Chemistry > Big idea CPS: Particles and structure > Topic CPS4: Understanding reactions > Key concept CPS4.2: Conservation of mass*

|  |
| --- |
| **Response activity** |
| **Mass prediction** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | During a chemical reaction no atoms are created or destroyed. Mass is conserved. |
| Observable learning outcome: | Use a symbolic chemical equation to predict and explain an apparent change of mass in an open system where a product is in the gas state. |
| Activity type: | talking heads |
| Key words: | chemical reaction, mass |

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

* Mass prediction

**What does the research say?**

The questions devised for research by Barker and Millar (1999) consider student understanding of conservation of mass both in closed systems (such as a precipitation reaction) and open systems (such as the combustion of fuels). For a combustion reaction, students need to understand that the measured starting mass does not include both reactants. Therefore, the final measured mass will be greater than the starting mass. If the mass of oxygen were included, mass would still be conserved.

In this example one of the products is in the gas state. Johnson (2012) describes student difficulties in recognising that a gas is substance. He suggests that an understanding of the arrangement of particles can help students to understand that a gas is a substance. Only then can a student appreciate that the escape of a product in the gas state, in an open system, will result in a decrease in measured mass.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. The statements are also provided as cut-out cards for students to physically organise.

If there is disagreement when you take feedback, a good way to progress might be 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*

The quality of the discussions may be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as a scribe. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

Jayden correctly predicts that the mass will decrease and provides a scientifically correct explanation.

Ryan also correctly predicts that the mass will decrease but for a scientifically incorrect reason.

Maisie and Phoebe correctly explain conservation of mass. This would be correct in a closed system however this experiment is an open system and the product in the gas state is able to escape.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden and Alistair Moore

**References**

Barker, V. and Millar, R. (1999). Students' reasoning about chemical reactions: what changes occur during a context-based post-16 chemistry course? *International Journal of Science Education,* 21(6)**,** 645-665.

Johnson, P. (2012). Introducing particle theory. In Taber, K. (ed.) *ASE Science Practice: Teaching Secondary Chemistry.* New edition ed. London, UK: Hodder Education.