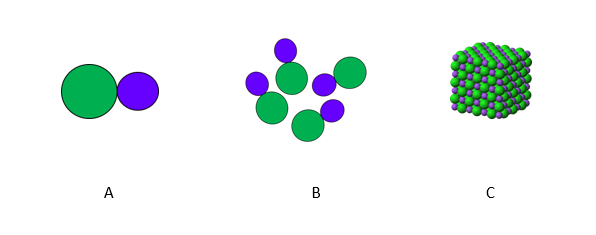
**Interpreting chemical formulae**

1. A jar containing white crystals is labelled NaCl.

NaCl is the chemical formula for sodium chloride (common salt).

Select the diagram that best represents this formula.

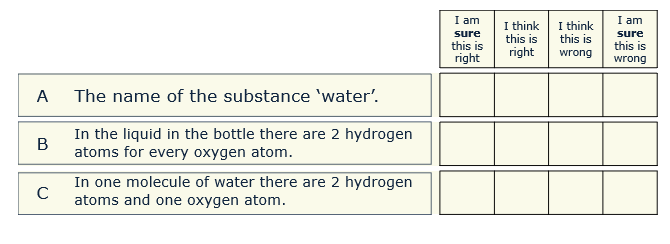


**Interpreting chemical formulae**

1. A bottle containing a colourless liquid is labelled H2O.

What does the chemical formula H2O represent?

Tick a box to show how confident you are that each statement is right or wrong.



*Chemistry > Big idea CPS: Particle and structure > Topic CPS2: Elements and compounds> Key concept CPS2.2.: Symbols and formulae*

|  |
| --- |
| **Diagnostic question** |
| **Interpreting chemical formulae** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | A chemical formula provides information on the composition of a substance. |
| Observable learning outcome: | Interpret the meaning of a chemical formula in terms of the ratio of atoms in a macroscopic sample of the substance. |
| Question type: | simple multiple choice / confidence grid |
| Key words: | chemical formula, atom, molecule |

**What does the research say?**

As part of a review of the empirical research (Taskin and Bernholt, 2012) on student understanding of chemical formulae, the authors cite their own project in which students were asked to match diagrams with different chemical formulae. The majority of students were found to be able to choose the correct diagram when the chemical formula represented as substance made up of individual molecules. However, when presented with the chemical formula of a substance with a giant structure (such as an ionic compound) most students still selected a diagram representing a molecular compound.

**Ways to use this question**

Students should complete the multiple- choice question and 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.

This is a challenging idea which may give rise to a range of answers, so 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.

**Expected answers**

1 The chemical formula NaCl is best represented by diagram C.

2 All three descriptions of the formula H2O are correct.

**How to respond - what next?**

A student selecting option A on the first question is likely to be directly translating the symbols making up the formula into a diagrammatic form. A student selecting option B may be additionally inferring that sodium chloride is made up of separate molecules.

The concept of ratio in chemical formulae is challenging. At this stage the risk is that by keeping ideas simpler by linking chemical formulae to molecules, additional misunderstandings may be introduced. Students should not be expected to understand the detailed structure of sodium chloride as this requires an understanding of ions. However, they could be encouraged make links with their understanding of the existence of single giant structures (see key concept: Atoms and molecules). This should allow students to realise that a chemical formula cannot always represent a separate molecule or molecules. This important idea could be repeatedly reinforced during subsequent teaching.

If students have not yet met the concept of ratio in mathematics simple word expressions could be used such as ‘For every carbon atom there are two oxygen atoms.’ Use of giant covalent structures as examples could help to avoid difficulties with terminology met with the use of giant ionic structures which consist of ions rather than atoms.

The confidence grid question has been included to address any misunderstanding that ratios only apply to the chemical formulae of a substances with a giant structure.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Diagram of sodium chloride lattice by Benjah-bmm27 - Own work, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=702423>

**References**

Taskin, V. and Bernholt, S. (2012). Students' understanding of chemical formulae: A review of empirical research. *International Journal of Science Education,* 36(1)**,** 157-185.