**NaCl**

A picture containing shaker, tableware, indoor, table

Description automatically generated

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

1. Which particle diagram best represents the compound NaCl?

A picture containing icon

Description automatically generated

*Put a tick (✓) in the box next to the best answer.*

|  |  |  |
| --- | --- | --- |
| **A** | diagram A |  |
|  |  |  |
| **B** | diagram B |  |
|  |  |  |
| **C** | diagram C |  |
|  |  |  |

**b.** Explain you answer to part a.

*Put a tick (✓) in the boxes next to the statements that best support your answer to part a.*

|  |  |  |
| --- | --- | --- |
| **A** | Sodium chloride is in the solid state. |  |
|  |  |  |
| **B** | The diagram shows one Na+ ion and one Cl- ion which is what the formula shows. |  |
|  |  |  |
| **C** | Sodium chloride is made of molecules. |  |
|  |  |  |
| **D** | The diagram shows that for every Na+ ion there is one Cl- ion which is what the formula shows. |  |

*Chemistry > Big idea CPS: Particles and structure > Topic CPS8: Ionic bonding > Key concept CPS8.1: Ionic lattice*

|  |
| --- |
| **Diagnostic question** |
| **NaCl** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Ionic bonding occurs due to the electrostatic attraction between oppositely charged ions in an ionic lattice. |
| Observable learning outcome: | Interpret an ionic formula as representing the ratio of ions. |
| Question type: | Two-tier multiple choice |
| Key words: | Ion, molecule, formula |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 11-14, to aid transition from earlier stages of learning. |

**What does the research say?**

One paper on student conceptions of ionic bonding (Taber, Tsaparlis and Nakiboğlu, 2012) comments that within a few years of being introduced to a basic particle theory, students are often expected to learn about ions and molecules and understand their role as components of substances, even though other research (Johnson, 1998) suggests that understanding of the basic particle model may only develop over an extended period of time.

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 to 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 questions 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. The follow-on question will give you insights into how they are thinking and highlight specific misconceptions that some may hold.

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**

Diagram B best represents NaCl. Suitable explanations include A and D.

**How to respond - what next?**

A student who initially selects diagram A in part A may hold the misconceptions that NaCl is made from molecules (option C in part b) and that the formula indicates that the molecules are each made up of one Na+ ion and one Cl- ion (option B in part b).

A student who think that diagram C is correct or is unable to decide whether diagram B or C is more correct may be limited in their understanding, thinking only in terms of the basic particle model representation of a solid (option A part b)

If students have misunderstandings about what a formula represents it may help to revisit key concept CPS2.2: Symbols and formulae, in particular diagnostic question “Interpreting chemical formulae”.

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

* Molecule or giant structure?

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images:

Salt pot by Dubravko Sorić on Flickr, CC BY 2.0 via Wikimedia Commons

Particle diagrams by Helen Harden (UYSEG)

**References**

Johnson, P. (1998). Progression in children's understanding of the basic particle theory:a longitudinal study. *International Journal of Science Education,* 20(4)**,** 393-492.

Taber, K. S., Tsaparlis, G. and Nakiboğlu, C. (2012). Student conceptions of ionic bonding: Patterns of thinking across three European contexts. *Internationl Journal of Science Education,* 34(18)**,** 2843-2873.

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.