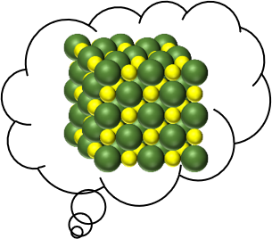
**Thinking about ionic bonding**

Students think about ionic bonding in different ways.



Some students use the idea of **electrostatic forces** for their thinking. Their understanding of ionic bonding is based on the idea of an ionic lattice being held together by the electrostatic attraction between oppositely charged ions. This is the scientifically accepted view.

A picture containing text

Description automatically generatedOther students have some misunderstandings. Their thinking about ionic bonding is based on **small molecules (pairs of ions)**. These students think of an ionic lattice as being made up of lots of smaller molecules that are held together to form the lattice.

Some students are discussing their thinking about ionic bonding.

**Aiden:** A positive ion bonds to all its neighbouring negative ions.

**Rosa:** An ionic lattice is held together by a mixture of ionic bonds and other forces of attraction.

**Will:** A positive ion forms an ionic bond with the negative ion it transferred an electron to.

**Ellie:** An ionic lattice contains no smaller molecules.

1. List which students are thinking about the electrostatic forces and which students are thinking about smaller molecules.
2. Suggest how you could explain the scientifically correct view to students with misunderstandings.

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| --- | --- |
| Cards for  **Thinking about ionic bonding** |  |
| **Rosa:** An ionic lattice held together by a mixture of ionic bonds and other forces of attraction. | **Aiden:** A positive ion bonds to all its neighbouring negative ions. |
| **Ellie:** An ionic lattice contains no smaller molecules. | **Will:** A positive ion forms an ionic bond with the negative ion it transferred an electron to. |

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

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| **Response activity** |
| **Thinking about ionic bonding** |

**Overview**

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| --- | --- |
| Learning focus: | Ionic bonding occurs due to the electrostatic attraction between oppositely charged ions in an ionic lattice. |
| Observable learning outcome: | Recognise that ionic bonding occurs in all directions between oppositely charged ions in an ionic lattice. |
| Activity type: | Talking heads |
| Key words: | ion, lattice, electrostatic attraction |

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

* Lattice model

**What does the research say?**

In their paper on student conceptions of ionic bonding Taber, Tsaparlis and Nakiboğlu (2012) cite earlier research which found that many students held an alternative “molecular framework” about ionic bonding. Some students thought an ionic bond was only formed between ions where electron transfer had occurred. These students thought of ions as being bonded in pairs. This one misconception was found to lead to further misunderstandings which combined to form an alternative way of thinking about ionic bonding.

This alternative “molecular framework” of thinking is thought to arise due to the inferences that are drawn from the initial idea. If students think that an ionic bond is formed by the transfer of electrons, then this implies to them the existence of ionic molecules made up of pairs of ions. This in turn implies that in an ionic lattice each ion can only form an ionic bond with one other ion leading students to conclude that the interaction with other ions is not ionic bonding but rather some other “force of attraction”. Some students think that an ionic lattice is made up of a combination of ion pairs.

The paper recommends that the focus of teaching (and curricula) should be on the idea of an ionic lattice held together by mutual attraction between oppositely charged ions. This would encourage students to learn about the idea of ionic bonding as a lattice phenomenon from the outset. Learning about the idea of an ionic bond through methods like dot and cross diagrams risks implying to students that ions form ion pairs hence causing some to develop the “molecular framework” instead of the more scientifically appropriate “electrostatic framework”.

**Ways to use this activity**

This task is intended for discussion in pairs or small groups. It can be done as a pencil and paper exercise or projected onto a screen.

Students should read the statements and follow the instructions on either the worksheet or the PowerPoint. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

It may help some students to talk through the introductory part of this activity to ensure understanding of the task.

**Expected answers**

Rosa and Will’s comments suggest that they think of ionic bonding in terms of small molecules.

Aiden and Ellie’s comments suggest that they think of ionic bonding in terms of electrostatic forces.

It may help Rosa and Will to develop a more scientific view of ionic bonding if they understand better that a chemical bond is an electrostatic attraction. Ionic bonding does not depend on a process such as the transfer of an electron. An ion can therefore form ionic bonds with all the oppositely charged ions that surround it forming one single lattice structure.

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images: Helen Harden and Peter Fairhurst (UYSEG)

**References**

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