

Chemistry > Big idea CPS: Particles and structure > Topic CPS8: Ionic bonding

Key concept (age 14-16)

CPS8.1: Ionic lattice






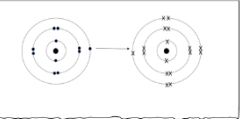





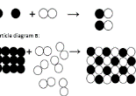
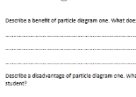
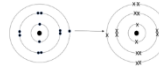


Progression toolkit: Ionic lattice

Learning focus	Ionic bonding occurs due to the electrostatic attraction between oppositely charged ions in an ionic lattice.				
As students' conceptual understanding progresses they can:	<div>CONCEPTUAL PROGRESSION</div>				
	Interpret an ionic formula as representing the ratio of ions. P	Recognise the limitations of what is represented by a dot and cross diagram.	Recognise the uses and limitations of the idea of full outer shells.	Describe ionic bonding as the being the result of electrostatic interactions between oppositely charged ions in a tightly bound lattice.	Recognise that the number of ionic bonds formed by an ion is determined by the arrangement of ions in the lattice. B
Diagnostic questions	NaCl	Dot and cross diagram	Full shells	Lattice model	Comparing ions
Response activities	Molecule or giant structure?	Making sodium chloride	Revision language	Thinking about ionic bonding	Comparing lattices

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

<p>NaCl</p> <p>STUDENT WORKSHEET</p> <p>NaCl</p> <p>The formula for the compound sodium chloride (common salt) is NaCl.</p>  <p>a. Which particle diagram best represents the compound NaCl?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <p>A.  <input type="checkbox"/></p> <p>B.  <input type="checkbox"/></p> <p>C.  <input type="checkbox"/></p> <p>D.  <input type="checkbox"/></p> <p>b. Decide you answer to part a.</p> <p>Put a tick (✓) in the boxes next to the statements that best support your answer to part a.</p> <p>A. sodium chloride is in the solid state. <input type="checkbox"/></p> <p>B. The diagram shows one Na⁺ ion and one Cl⁻ ion which is what the formula shows. <input type="checkbox"/></p> <p>C. sodium chloride is made of molecules. <input type="checkbox"/></p> <p>D. The diagram shows that for every Na⁺ ion there is one Cl⁻ ion which is what the formula shows. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Dot and cross diagram</p> <p>STUDENT WORKSHEET</p> <p>Dot and cross diagram</p> <p>A textbook shows a dot and cross diagram for sodium chloride.</p>  <p>1. What does the dot and cross diagram show?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <p>A. An ionic bond. <input type="checkbox"/></p> <p>B. The formation of an Na⁺ ion and a Cl⁻ ion. <input type="checkbox"/></p> <p>C. The formation of sodium chloride. <input type="checkbox"/></p> <p>D. The formation of an ionic molecule. <input type="checkbox"/></p> <p>E. The ratio of Na⁺ to Cl⁻ ions. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Full shells</p> <p>STUDENT WORKSHEET</p> <p>Full shells</p> <p>When drawing dot and cross diagrams the outer shell of each ion should be full.</p>  <p>Some students are discussing this full outer shell rule.</p> <p>Who do you agree with, and why?</p> <p>Sharon: The rule explains why atoms react.</p> <p>James: The rule helps to work out the formulae of some compounds.</p> <p>Giles: The rule works because atoms want a full outer shell.</p> <p>Amadeo: The rule helps to work out the charge of different ions.</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Lattice model</p> <p>STUDENT WORKSHEET</p> <p>Lattice model</p>  <p>What do the sticks represent in the model?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <p>A. Ionic bonds only. <input type="checkbox"/></p> <p>B. Forces of attraction (but not bonds) only. <input type="checkbox"/></p> <p>C. Ionic bonds and forces of attraction. <input type="checkbox"/></p> <p>D. Crystal connections. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Comparing ions</p> <p>STUDENT WORKSHEET</p> <p>Comparing ions</p>  <p>a. Look at the following statements about the ions.</p> <p>Put a tick (✓) in the box next to the statement that you think is correct.</p> <p>A. An Na⁺ ion always forms more ionic bonds than an Na⁺ ion. <input type="checkbox"/></p> <p>B. An Na⁺ ion and an Na⁺ ion can form the same number of ionic bonds. <input type="checkbox"/></p> <p>b. Look at the following explanations.</p> <p>Put a tick (✓) in the box next to every explanation that you think helps to explain your answer to part a.</p> <p>A. Ionic bonds only form where an electron is transferred. <input type="checkbox"/></p> <p>B. The number of ionic bonds depends upon the arrangement of ions in the lattice. <input type="checkbox"/></p> <p>C. The magnesium ion has a higher charge than the sodium ion. <input type="checkbox"/></p> <p>D. More electrons are transferred to form an Na⁺ ion than an Na⁺ ion. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>
<p>Two-tier multiple choice</p>	<p>Confidence grid</p>	<p>Talking heads</p>	<p>Simple multiple choice</p>	<p>Two-tier multiple choice</p>
<p>Molecules or giant structure?</p> <p>STUDENT WORKSHEET</p> <p>Molecules or giant structure?</p> <p>Some compounds are made up of separate small molecules.</p>  <p>Other molecules are made up of a giant structure.</p>  <p>1. Look at the list of formulae below.</p> <p>For each formula state whether the compound is made of separate molecules or a giant structure. Explain how you decided each answer.</p> <p>i. CO₂ <input type="checkbox"/></p> <p>ii. H₂O <input type="checkbox"/></p> <p>iii. H₂SO₄ <input type="checkbox"/></p> <p>iv. NaCl <input type="checkbox"/></p> <p>2. If you were unsure about any formulae, explain what extra information would have helped you to answer.</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Making sodium chloride</p> <p>STUDENT WORKSHEET</p> <p>Making sodium chloride</p> <p>Sodium metal reacts with chlorine to form sodium chloride. Two students draw particle diagrams to represent the reaction.</p> <p>The chemical equation for the reaction is</p> $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$ <p>Particle diagram A:</p>  <p>Particle diagram B:</p>  <p>3. Describe a benefit of particle diagram one. What does it help the student to understand?</p> <p>4. Describe a disadvantage of particle diagram one. What misunderstanding could it cause the student?</p> <p>5. Describe how particle diagram two could help to avoid these misunderstandings.</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Revision language</p> <p>STUDENT WORKSHEET</p> <p>Revision language</p> <p>Alan is trying to make how to draw dot and cross diagrams to draw the formation of NaCl.</p>  <p>A revision website says:</p> <p>The sodium atom loses one electron, and the chlorine atom gains one electron because atoms need a full outer shell.</p> <p>1. How might the language used by the revision site help Alan to remember what to draw?</p> <p>2. How might the language best to misunderstandings?</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. 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These students think of an ionic lattice as being made up of lots of smaller molecules that are held together to form the lattice.</p> <p>Some students are discussing their thinking about ionic bonding.</p> <p>Renee: An ionic lattice is held together by a mixture of ionic bonds and other forces of attraction.</p> <p>Adrian: A positive ion bonds to all its neighbouring negative ions.</p> <p>Ellie: An ionic lattice contains no smaller molecules.</p> <p>Wib: A positive ion forms an ionic bond with the negative ion it transferred an electron to.</p> <p>1. Use which students are thinking about the electrostatic forces and which students are thinking about smaller molecules.</p> <p>2. Suggest how you could explain the scientifically correct view to students with misunderstandings.</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>Comparing lattices</p> <p>STUDENT WORKSHEET</p> <p>Comparing lattices</p> <p>Sodium chloride and calcium chloride have different lattice structures.</p>   <p>1. Count the number of chloride ions that surround a central sodium ion.</p> <p>2. Count the number of chloride ions that surround a central calcium ion.</p> <p>3. Explain why you think the two compounds have different arrangements of ions.</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>
<p>Application and practice</p>	<p>Critiquing a representation</p>	<p>Critiquing language</p>	<p>Talking heads</p>	<p>Challenge to thinking</p>