

Chemistry > Big idea CPS: Particles and structure > Topic CPS7: Metallic bonding

Key concept (age 14-16)

CPS7.1: Metallic structure model

Progression toolkit: Metallic structure model

Learning focus	A model of metallic structure, made up of positive metal ions surrounded by 'free' outer electrons, can explain some properties of metals.				
As students' conceptual understanding progresses they can:	<div> <div>CONCEPTUAL PROGRESSION</div> <div></div> </div>				
	Recognise that a diagram of electron arrangement is a model and not a copy of reality.	Describe a model of metallic structure (positive ions and 'free' outer electrons).	Critique representations of metallic structure.	Describe metallic bonding as an all-directional electrostatic interaction.	Evaluate the metallic structure model in terms of its ability to explain physical properties of metals.
Diagnostic questions	Electron diagram	Metallic structure	Metallic structure diagrams	Chemical bonding	Metal properties
Response activities	Electron shells	Atom overlays	Sea of electrons	Metallic bonding diagrams	Explaining metals

Key:

P

Prior understanding from earlier stages of learning

B

Bridge to later stages of learning

<p>Electron diagram</p> <p>BEST STUDENT WORKSHEET</p> <p>Electron diagram</p> <p>Some students look at a page from a textbook.</p> <p>Electron arrangements</p> <p>The diagram below shows the arrangement of electrons in an argon atom. The electrons are arranged in three electron shells with the nucleus in the centre.</p> <p>Some students discuss what this diagram shows.</p> <p>Who do you agree with, and why?</p> <p>Eva: The diagram shows what an atom really looks like.</p> <p>Toby: The circles are the shells.</p> <p>James: The diagram is a tool to help you to work out things about atoms.</p> <p>Libby: The nucleus is protected by the electron shells.</p> <p>Leo: The diagram shows what scientists think is the structure of an atom.</p> <p><small>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.</small></p>	<p>Metallic structure</p> <p>BEST TEACHER NOTES</p> <p>Metallic structure</p> <p>Aluminium is a metal. It has a metallic structure.</p> <p>According to the basic atomic model, an aluminium atom is made up of a central nucleus, inner electrons and outer electrons.</p> <p>1. Complete the following sentences.</p> <p>The structure of aluminium is made up of a regular arrangement of ...</p> <p>Put a tick (✓) in the box next to the best answer.</p> <p>A aluminium nuclei, inner and outer electrons B aluminium nuclei and inner electrons C aluminium nuclei only D outer electrons</p> <p><small>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.</small></p>	<p>Metallic structure diagrams</p> <p>BEST STUDENT WORKSHEET</p> <p>Metallic structure diagrams</p> <p>Some students have drawn diagrams to show how they think about the structure of a metal.</p> <p>1. Which thinking do you most agree with? Explain your answer.</p> <p>2. Which thinking do you disagree with? Explain your answer.</p> <p><small>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.</small></p>	<p>Chemical bonding</p> <p>BEST STUDENT WORKSHEET</p> <p>Chemical bonding</p> <p>Some students are discussing what a chemical bond is. Who do you agree with, and why?</p> <p>Oliver: Chemical bonding is what connects a chemical structure.</p> <p>James: A chemical bond is a physical link between atoms.</p> <p>Kevinder: Chemical bonding is an electrostatic interaction between positive and negative charge.</p> <p>Will: A chemical bond is the sharing or transfer of electrons.</p> <p>Olivia: Chemical bonding is an attraction between atoms.</p> <p><small>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.</small></p>	<p>Metal properties</p> <p>BEST STUDENT WORKSHEET</p> <p>Metal properties.</p> <p>Metals can conduct electricity. Some metals are better electrical conductors than others.</p> <p>Alloys are materials meaning that they can be hammered into shape.</p> <p>A student draws a model of the structure of a metal.</p> <p>Which properties of a metal can this model explain? For each statement, tick (✓) if you believe it shows what you think the metal can explain.</p> <table border="1"> <thead> <tr> <th></th> <th>can explain</th> <th>cannot explain</th> <th>can explain</th> <th>cannot explain</th> </tr> <tr> <th></th> <th>light</th> <th>right</th> <th>strong</th> <th>strong</th> </tr> </thead> <tbody> <tr> <td>A. A metal conducts electricity.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. A metal is malleable.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. Some metals are better electrical conductors than others.</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p><small>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.</small></p>		can explain	cannot explain	can explain	cannot explain		light	right	strong	strong	A. A metal conducts electricity.					B. A metal is malleable.					C. Some metals are better electrical conductors than others.				
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Talking heads	Simple multiple choice	Thinking heads	Talking heads	Confidence grid																									
<p>Electron shells</p> <p>BEST STUDENT WORKSHEET</p> <p>Electron shells</p> <p>Sometimes electrons are said to be arranged in different electron shells.</p> <p>The word shell is used because in some ways an electron shell is like a real shell. Shell is a metaphor.</p> <p>1. Complete the following sentences.</p> <p>An electron shell is like a real shell because...</p> <p>An electron shell is not like a real shell because...</p> <p><small>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.</small></p>	<p>Atom overlays</p> <p>BEST STUDENT WORKSHEET</p> <p>Atom overlays</p> <p>The basic particle model shows a simple arrangement of atoms in a metal. However, it does not show the more detailed structure of an atom.</p> <p>Create an overlay to show the nucleus and electrons of each atom.</p> <p>To do</p> <ol style="list-style-type: none"> Place a piece of tracing paper or clear acetate sheet over the particle model diagram. Draw the first particle, draw a diagram to show the nucleus and inner electron shells of a sodium atom. Repeat for the other particles. Now add the correct number of 'free' electrons. <p><small>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.</small></p>	<p>Sea of electrons</p> <p>BEST STUDENT WORKSHEET</p> <p>Sea of electrons</p> <p>The 'free' outer electrons in a metal structure are often described as a 'sea of electrons'.</p> <p>1. Complete the following sentences.</p> <p>The 'free' outer electrons in this model are like the sea because...</p> <p>The 'free' outer electrons in this model are not like the sea because...</p> <p><small>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.</small></p>	<p>Metallic bonding diagrams</p> <p>BEST STUDENT WORKSHEET</p> <p>Metallic bonding diagrams</p> <p>Three students draw diagrams to show metallic bonding.</p> <p>1. Which do the following represent in the student diagrams?</p> <p>A B C</p> <p>2. Which diagram do you think shows the best representation of metallic bonding? Explain your answer.</p> <p><small>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.</small></p>	<p>Explaining metals</p> <p>BEST STUDENT WORKSHEET</p> <p>Explaining metals</p> <p>Some students have drawn diagrams to show how they think about a metal.</p> <p>1. What do you think will be able to explain the following? Explain your answer.</p> <p>aluminium conducts electricity copper can be hammered into shape copper is a better electrical conductor than aluminium</p> <p><small>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.</small></p>																									
Critiquing language	Clarifying	Critiquing language	Critiquing a representation	Thinking heads																									