

Metallic bonding

This resource is part of the **Structure strip** series of resources, designed to support literacy in science teaching. More resources in this series can be found at:

rsc.li/3SVMXjO

Learning objectives

- 1 Describe the metallic bonding model using words and diagrams.
- 2 Explain how the metallic bonding model leads to the common properties of metals.
- 3 Develop your skills extended writing skills.

Introduction

Your learners can probably list many of the properties of metals from their prior learning in 11–14. In this activity, they will use a structure strip to describe the metallic bonding model and explain how this leads to particular properties. You can use this activity as an introduction to the concept or as revision.

How to use structure strips

Structure strips are a type of scaffolding you can use to support learners to retrieve information independently. Use them to take an overview at the start of the topic, to activate prior knowledge, or to summarise learning at the end of a teaching topic.

Structure strips have sections containing prompts which are sized to suggest the amount that learners must write. Learners glue the strips into the margin of an exercise book and write their answers next to the sections, in full sentences. When learners have finished using the structure strip, they should have an A4 page set of notes and examples.

Scaffolding

To further support learners to answer the questions you can include a list of keywords or add prompts to the structure strip.

As learners grow in confidence, they may be able to answer the question without the structure strip or attempt the question first and then use the structure strip to improve or self-assess their answer.

Metacognition

This activity supports learners to develop their metacognitive skills in three key areas.

TEACHER NOTES

- **Planning:** the strips provide scaffolding to plan the written response. Learners will decide where to gather information from (textbooks, own notes, revision websites). Ask learners: is the source of information you are using reliable?
- **Monitoring:** learners are prompted by the questions in the structure strip and can check their answer against the prompts. Ask learners: have you covered all of the questions in the space provided? Do you need to change anything to complete the task?
- **Evaluation:** learners can self-assess or ask a peer to check their work against the answers. Ask learners: did you achieve what you meant to achieve? What might you do differently another time?

Follow-up question

Learners should answer this question after they have attempted the structure strip. The structure strip activates the required knowledge which learners can then apply to the question.

Copper is used to make saucepans. Use your understanding of the metallic bonding model and general knowledge to explain this use of copper.

4 marks

Keywords

Metallic, ion, electrostatic, malleable, conductor, delocalised.

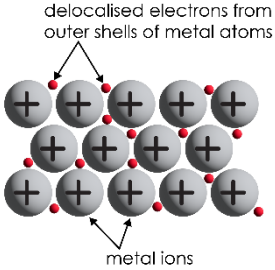
Answers

Suggested answers for the structure strip activity are given in the frame on the next page of this document.

Follow-up question

Indicative content for the answer:

- A saucepan must be a good thermal conductor, allowing the heat from the cooker to reach the contents. (1)
- Copper is a metal.
- Metals have metallic bonding which is a regular arrangement of layers of positive metal ions (1) surrounded by a sea of delocalised electrons (1).
- Metals conduct heat as the delocalised electrons are able to move through the lattice (1) and transfer heat energy.

Structure strip Metallic bonding	Suggested answer
<p>Draw a labelled diagram of the metallic bonding model and write a short description.</p>	<p>The metallic bonding model is a regular arrangement (lattice) of positive metal ions. The ions are arranged in layers. The electrons that are lost from the atoms to make the ions then form a 'sea' of delocalised electrons. The metal ions are held in place by the electrostatic attraction between the positive ions and the delocalised electrons.</p> 
<p>Explain how the charge on a metal ion can be found from its electronic structure and therefore the periodic table.</p> <p>Describe how this influences the metallic model.</p>	<ul style="list-style-type: none"> • The number of electrons in the outer shell indicates the charge on the ion (for main group metals). • Group 1 metals form 1+ ions so each atom gives one electron to the sea of delocalised electrons. • Group 2 metals form 2+ ions so each atom gives two electrons to the sea of delocalised electrons. • Group 3 metals form 3+ ions so each atom gives one electron to the sea of delocalised electrons. • The higher the charge on the ion and the greater the number of electrons in the sea of delocalised electrons, the stronger the electrostatic attraction.
<p>Metals generally have a high melting point. How does the metallic bonding model explain this property?</p>	<p>There is a strong electrostatic attraction between the positive metal ions and the sea of delocalised electrons. This takes a lot of energy to overcome and means metals have a high melting point.</p>
<p>Metals can conduct electricity. How does the metallic bonding model explain this property?</p>	<p>The electrons are able to move through the metallic lattice because they are delocalised. This carries the current throughout the metal.</p>
<p>Metals are malleable. Define the term malleable.</p> <p>How does metallic bonding explain this property?</p>	<p>Malleable means that a metal can be hammered into different shapes.</p> <p>In the metallic bonding model, the ions are arranged in layers with the sea of delocalised electrons surrounding them. This allows the ions to slide over each other when a force is applied (like a hammer).</p>
<p>Metals are thermal conductors. How does metallic bonding explain this property?</p>	<p>The delocalised electrons are able to move throughout the lattice and transfer heat energy.</p>