




# > 8 The metallic model

## Teaching plan

Sub-chapter	Approximate number of learning hours	Learning content	Resources
8.1 Classifying elements as metals	1–2	Describe and explain the characteristic properties of metals.  Understand the connection between the properties of a metal and its uses.	<b>Coursebook</b> Section 8.1 Test your understanding questions <b>Workbook</b> Exercise 8.1 <b>Teacher's resource</b>
8.2 Metallic bonding 8.3 Properties of metals and their uses	1–2	Describe and explain the characteristic properties of metals.  Understand the connection between the properties of a metal and its uses.	<b>Coursebook</b> Sections 8.2 and 8.3 <b>Workbook</b> Exercises 8.2–8.3 <b>Teacher's resource</b>  PowerPoint 8, slides 2–6  Worksheet 8.1
8.4 Transition metals	1–2	Understand that transition metals have delocalised d electrons.  Explain the melting points and electrical conductivity of transition metals.	<b>Coursebook</b> Section 8.4 Figure 8.5 <b>Workbook</b> Exercise 8.4 <b>Teacher's resource</b>  End of Chapter 8 test

### BACKGROUND KNOWLEDGE

- Students should have some knowledge of metals from previous learning. Students will need to know about ions from the atomic theory section to understand the bonding

in metals. They will also need to understand the electronic configurations from the atomic theory topic as well.

## Syllabus overview

- Students will understand what the bonding in metals looks like. They will be able to link the properties of metals to the bonding in metals and be able to explain this. They will also be able to link the properties of metals to their common uses.
- At Higher Level, they will have an understanding of transition metals and be able to explain the trends in properties of the transition metals.

## 8.1 Classifying elements as metals

LEARNING PLAN	
Learning objectives	Success criteria
Explain metallic bonding	Student can describe and explain metallic bonding.
Explain the variation in the melting point of main group metals down a group and across a period	Students can explain the trend in melting points for different metals.
Explain the factors that affect the strength of metallic bonding	Students understand the different factors that affect the bond strengths in metals.

### Common misconceptions

Misconceptions	How to identify	How to overcome
Students get confused between the different types of bonding – ionic structure vs metallic structure.	Questioning in class.	Reinforce the differences between the two, looking at where the elements are on the periodic table.
Students don't understand where the metals are on a periodic table.	Through previous questioning on covalent and ionic bonding.	Give students a periodic table and get them to colour code metals and non-metals, so they can see it visually.

### Starter ideas

#### 1 Different objects (15 minutes)

**Resources:** Different objects (wooden / metallic / plastic).

**Description and purpose:** Discussion of the different properties these objects have and why.

**What to do next:** Students try to link the properties to chemical bonding.

#### 2 What makes something a metal? (20 minutes)

**Resources:** Whiteboard

**Description and purpose:** Put this question on the board and ask students to think about this for 5 minutes and come up with an answer. Students' previous learning of this topic can be assessed.

**What to do next:** Do all metals behave the same way? Ask students this question and see if they can come up with examples of metals not fitting into their description of a metal.

## Main teaching ideas

### 1 Metallic bonding (30 minutes)

**Resources:** Metallic bonding diagram and simulation. Graph of melting points for Group 1 metals and across Period 2.

**Description and purpose:** Describe metallic bonding using diagrams and simulations. Explain these trends using the charge of the metal ions, distance between the electrons and the nucleus of the positive ion, and the charge density of the metal ion.

> **Differentiation ideas:**

**Support:** Use more simplified models to help students understand the concepts.

**Stretch and challenge:** Students are given data for transition metals, and they can try to explain the melting points of these versus Group 1 and 2 metals.

### 2 Metallic bonding across the period (30 minutes)

**Description and purpose:** Students are given examples of sodium, magnesium and aluminium and asked to discuss which metal will have the strongest bonding.

> **Differentiation ideas:**

**Support:** Students are given hints, so they think about the structure of a metal and the charges on the ion.

**Stretch and challenge:** Students could expand this to discuss the bonding across the whole of Period 3 and try to explain what happens.

## Plenary ideas

### 1 Correct the statements (10 minutes)

**Resources:** Quiz listing different statements (some correct some incorrect) on the board about metallic bonding.

**Description and purpose:** Students should be able to identify the correct statements from the board; this will help to remove some of the misconceptions that the students may have with this topic.

> **Language focus:** Reading and understanding statements.

## 8.2 Metallic bonding and 8.3 Properties of metals and their uses

### LEARNING PLAN

#### Learning objectives

Describe and explain the characteristic properties of metals

Understand the connection between the properties of a metal and its uses

#### Success criteria

Students should be able to understand, and explain, how the bonding in metals affects their properties.

Students can explain why metals are used in different ways linking it to their properties.

## Common misconceptions

Misconceptions	How to identify	How to overcome
Students think that the ions flow in metals, not electrons, to produce electricity.	When discussing this, ask students to explain why metals conduct electricity.	Show them the model of metallic bonding and focus on the delocalised electrons moving.
Students get confused between being light and having low density.	Ask students to explain why aluminium is used in the manufacture of planes.	Highlight misconceptions and spend time making sure all students understand the difference between being light and having low density.

## Starter ideas

### 1 Recap previous learning (15 minutes)

**Resources:** Diagram on the board of metallic bonding. Gap-filling questions on metallic bonding.

**Description and purpose:** Students recap their understanding from previous learning. Fill in questions with gaps. Students will label the key points from the metallic bonding diagram.

➤ **Language focus:** Students can fill in the gaps of the questions.

➤ **Assessment idea:** Teacher can assess the students' understanding of the previous lesson.

## Main teaching ideas

### 1 Properties of metals (40 minutes)

**Resources:** Computer room, tablets and so on.

**Description and purpose:** Students can do a project looking at different metals and their properties, linking them to some of their uses.

➤ **Differentiation ideas:**

**Support:** Give students some common metals that they can research with common uses (copper, aluminium, iron, etc.).

**Stretch and challenge:** Students could find more obscure metals and research these to find out what their properties are and what their uses are. They could look at all the metals in a mobile phone and see what they are used for and which properties make them suitable.

### 2 Crossword design on properties of metals (40 minutes)

**Resources:** Crossword grid. Alternatively, it could be designed on a computer.

**Description and purpose:** Students design a crossword that defines the different properties of a metal. Students could also link the crossword to the uses of metals.

➤ **Language focus:** Students use the definitions for the keywords from this topic to give them a better understanding of the terminology used.

➤ **Differentiation ideas:**

**Support:** Students could be given the definitions of the words they need to include in the crossword.

**Stretch and challenge:** Students could test their crosswords on each other. Students could come up with unusual properties of metals and work out clues for these.

## Plenary ideas

### 1 Mix and match (15 minutes)

**Resources:** Questions and explanations mixed up (either on the board or on paper).

**Description and purpose:** Students link the correct explanation to the correct question. The teacher goes through the correct answers with the students and assesses their understanding of the lesson.

### 2 Student presentation (20 minutes)

**Description and purpose:** Students could research an interesting new smart metal (shape memory alloy) and discuss this with the class.

## 8.4 Transition metals

LEARNING PLAN	
Learning objectives	Success criteria
<ul style="list-style-type: none"> <li>Understand that transition metals have delocalised d electrons</li> <li>Explain the melting points and electrical conductivity of transition metals</li> </ul>	<p>Students can explain the electronic configurations of transition metals and show how d electrons are used in bonding.</p> <p>Students can explain the trends in melting point across the transition metals and the electrical conductivity.</p>

## Common misconceptions

Misconceptions	How to identify	How to overcome
Electronic configurations of transition elements – students forget the two exceptions of chromium and copper.	Use the starter ideas activity.	Lots of practice throughout the course. Highlight these two ions regularly when discussing transition elements.

## Starter ideas

### 1 Transition metal electronic configurations (10 minutes)

**Description and purpose:** Students recap the electronic configurations of transition elements. This is a good opportunity for students to reinforce their knowledge of electronic configurations.

**What to do next:** Students can look at the electronic configurations of the ions of transition elements.

## Main teaching ideas

### 1 Properties of transition elements (25 minutes)

**Resources:** Graphs showing melting points and boiling points of transition elements.

**Description and purpose:** Go through the graphs and explain the trends in data. Students can annotate their graphs to explain the trends.

> **Differentiation ideas:**

**Support:** Give students the structure of metals (positive ions surrounded by sea of delocalised electrons). Give hints about ionic charge and size of ions to help them think about the trends.

**Stretch and challenge:** Why do transition elements have higher melting points than other metals? Students can look at covalent character in transition metal complexes and try to explain their answers.

## 2 Uses of transition elements (25 minutes)

**Resources:** Computers or tablets.

**Description and purpose:** Students research different uses of transition metals in the real world. This will give them an insight into what they are used for and why they are useful.

> **Differentiation ideas:**

**Support:** Students can be given an example to research, such as catalytic converters in cars.

**Stretch and challenge:** Students can be stretched by looking at the chemical reactions that are happening and link this to the electronic configurations of transition metals.

## Plenary ideas

### 1 Transition metal charge bingo (10 minutes)

**Description and purpose:** Students are asked to work out which transition metal it is from the charges given. Set up like bingo.

### 2 Students write exam-style questions (20 minutes)

**Resources:** Post-it notes.

**Description and purpose:** Each student comes up with one exam-style question and answer from the chapter. The student puts the question on a Post-it note and sticks it on the board and then the other students try to answer.

> **Language focus:** Writing exam-style questions.

## Assessment ideas

- Summarise the content from the lessons; the students could present to the class.

## Homework ideas

- Questions from the Coursebook.
- Questions from the Workbook.
- 5-minute mind map – students can have 5 minutes to write as much as they know about this topic. They can then annotate it afterwards to check what is right and add more information in a different colour to show what they have learned and what they need to learn.

## Links to digital resources

- Explanation of the [general properties of transition metals](#)
- Interactive [periodic table](#) of the elements showing their properties

### CROSS-CURRICULAR LINKS

- Physics: Properties of metals.
- Design technology: Use of materials.