

Metallic Bonding Teaching Ideas

Learning Objective: To understand how a metallic bond is formed.

Success Criteria:

- To identify and list properties of metals.
- To describe the bonding in metallic structures.
- To explain the properties of metallic structures.
- To define an alloy and state why they are used.
- To compare metallic, covalent and ionic bonding.

Context: This is the fifth lesson of the GCSE chemistry AQA 4.2 'Structure, Bonding and The Properties of Matter' topic.

Resources

Lesson Pack

Various metal objects to safely handle. For example, copper wire, steel fork, aluminium foil, iron magnet etc.
simple circuit equipment scales/balances
Bunsen burner or a beaker of hot water.
Optional: periodic tables for the starter activity.

Starter

As students enter the classroom and settle, please show slide 3. This is an 'A to Z of Metals' activity asking students to list a metal starting with each letter of the alphabet. This is best done in pairs. Students are also encouraged to think whether the metal is a pure element or a mixture of metals and indicate this on their alphabet. There is an embedded five-minute timer, but you may find this is too long for higher ability classes. This starter activity allows you to embed core literacy into your lesson, and also for students to apply their knowledge of the periodic table. Periodic tables could be given after the first three minutes. Suggested answers for most of the alphabet are shown on slide 4.

Main Activities

Alloys

Slides 5-8: On slide 5 the notion of 'mixed' metals is further explored, as initiated in the starter activity. Slide 4 introduces the term 'alloy' and the history of first alloy (bronze) is given on slides 4 and 5. This allows for cross-curricular links to be made with history. Slide 7 encourages students to write the definition of an alloy and the two examples stated (bronze and steel). Slide 8 links to the next activity which looks at the properties of some pure metals making them unsuitable for certain purposes and that alloys are often superior in strength.

Properties of Metals Mind Map Activity

Slide 9: Students complete the [Properties of Metals Mind Map Activity Sheet](#) which requires either setting up as a 'circus' activity, or to have resources available for small groups of 3-4 students, or as several teacher demonstrations. On the sheet, students are encouraged to observe and record various properties of metals, but should be instructed to do so safely. Pulling, tapping, looking at, and holding the metal object do not require additional resources. To weigh the metal, scales or balances are required. To heat a suitable metal, a Bunsen burner or beaker of hot water is required. To pass electricity through a suitable metal (aluminium foil or copper wire), a simple circuit with a light bulb should be set up.

Metallic Bonding

Slides 10-14: Slide 10 introduces the basic points behind metallic bonding and the term 'sea of delocalised electrons'. Slide 11 states the electrostatic charges between the positive metal ion and the negative electrons, and on slide 12, how this gives rise to a giant, regularly arranged lattice. The property and explanation of metals being 'ductile' is introduced on slide 12 and also 'malleable' on slide 13. Slide 14 recaps why metals can conduct thermal energy (heat) and electricity.

Metallic Bonding Activity Sheet

Slide 15: Students complete one of the differentiated [Metallic Bonding Activity Sheet](#) where they are asked to label images of metallic bonding, state the principles behind metallic bonding and explain the science behind the properties of metals. The lower ability activity sheet has more guided questions and word banks, with a match-up activity for linking the properties to their explanations. The higher ability activity sheet has no word bank, and requires students to independently recall the scientific explanations for the properties of metals.

Bonding in Alloys

Slides 16–17: Slide 16 shows simplified pictures of the bonding in pure metal atoms and the bonding in alloys. Students are encouraged to 'Pause for Thought' and use the pictures to think why alloys are often stronger than their pure metal components. The explanation is given on slide 17 of the regularly arranged lattice structure being disrupted by the inclusion of other metal or non-metal atoms.

Metallic Bonding Exam Style Question

Slide 18: Students follow the activity sheet to demonstrate their knowledge of metallic bonding by answering exam style questions on Olympic medals. There is also a teacher assessment sheet that could be completed after the lesson where formative feedback can be given.

Plenary

Slide 19: Students should complete the [Comparing Bonding Venn Diagram](#) to consolidate their ideas on metallic, covalent and ionic bonding covered in the last five lessons. Each statement is numbered 1–12 and students should write where they think the statement best fits in the three overlapping circles. Remind the students of today's success criteria on slide 20 of the PowerPoint.

Suggested Homework

Students could research about alloys, the mining of metals or even the Bronze Age for cross-curricular links to history. Alternatively, students could complete the [Metallic Bonding Exam Style Question](#) or [Comparing Bonding Venn Diagram](#) if not completed during class time.