

Part 1 Pre-16 – The platinum story

Teacher's notes

This section includes information on platinum (which can be used along with the video), questions to test comprehension, a word search and a hidden word puzzle.

Curriculum links

Useful products from metal ores and rocks, periodicity, properties of metals, transition metals.

Level

Pre-16 science/chemistry courses

Timing

60–70 mins

This pack contains:

- ▼ an information sheet, *The platinum story*, on the extraction of platinum;
- ▼ a question sheet, *Platinum question sheet*, relating to the above information and/or to the video;
- ▼ an alternative simpler word completion exercise, *Platinum comprehension*, with straightforward questions relating to some text on the extraction of platinum;
- ▼ a puzzle sheet – *Precious metal puzzle*; and
- ▼ a *Wordsearch* with questions.

All of the above are available as photocopy masters.

Possible lesson plan

To introduce the topic, ask the class to name a metal comparable in price to gold – hopefully someone will suggest platinum and be aware of its use in jewellery. Begin a discussion on the possible reasons for platinum being so expensive. This might encompass useful properties (unreactive and high melting point), difficulty in extraction, scarcity *etc.* This last point could be emphasised by pointing out that a handful of typical platinum ore contains so little platinum that it is worth less than 10p.

Now show the video (and/or give out the information sheet) followed by the question sheet, *Platinum question sheet*. If you use the information sheet, which is much more detailed, it may be useful to demonstrate a precipitation reaction in a test-tube. For example, adding copper(II) sulfate solution to sodium carbonate solution makes clear the idea of separating out by precipitation.

Several of the questions in part B of the question sheet are more open-ended and could be used to stretch the more able students. One or two of these questions could be chosen for students to write up answers in the normal way, or to give a presentation to the class.

The simpler sheet may be used, if more appropriate, to accompany the video. The *Precious metal puzzle* sheet and *Wordsearch* are available for further work.

Answers to the platinum question sheet

Part A

1.
 - a) South Africa.
 - b) It is rare and has many uses.
 - c) Three tonnes.
2. a) The main steps:

Mining – the ore is brought to surface.

Crushing – the ore is first crushed and then a wet slurry is formed in the ball mills.

Froth flotation – a detergent is added and the metal ore particles float on the foam where they are separated off.

Smelting – the ores are melted, driving off some sulfur, to leave metals and metal sulfides.

Separation

- (i) By using a magnetic drum which separates the metals (because nickel is magnetic and is present in the alloy of platinum group metals (PGM)) from the sulfides
 - (ii) Final separation of PGM using solvents or precipitation.
 - b) Sulfur dioxide is converted to sulfuric acid.
3. Cobalt (Co); copper (Cu); gold (Au); iridium (Ir); nickel (Ni); osmium (Os); palladium (Pd); rhodium (Rh); ruthenium (Ru); silver (Ag).

Part B

1.

Jewellery	– stays shiny because it is unreactive
Catalytic converter	– suitable catalytic properties
Electronics	– good conductor and does not corrode
Fuel cells	– chemically inert (catalytically active) electrodes
Chemotherapy	– some platinum compounds are anticancer agents
Glass fibre drawing	– high melting point and does not corrode

2. Factors which might affect the price include:

More expensive	Cheaper
More uses found for platinum Resources used up Mining becomes more difficult as resources dwindle	Alternative cheaper material found, suitable for same use New deposits found Better mining design Recycling made easy

3. Any suitable research answer.
4. Catalytic converters change carbon monoxide, unburnt hydrocarbons and nitrogen oxides into carbon dioxide, water and nitrogen.
 Lead compounds poison the catalyst.
 Despite difficulties in collecting the converters from scrapped cars, an increasing proportion is being recycled, particularly in North America.

Platinum comprehension answers

1. Metals, Periodic, ore, solvent, gold, catalyst.
2. South Africa.
3. Two thousand million (two billion) years ago.
4. It is rare and has many uses.
5. It converts harmful exhaust gases to safer gases.

Precious metal puzzle answers

1. Nickel.
2. Platinum.
3. Smelting.
4. Exhaust.
5. Palladium.
6. Merensky.
7. Corrosion.
8. South Africa.
9. Steel.

Hidden word: catalysts

Wordsearch answers

- a) Iron, cobalt.
- b) Silver.