Science Lesson Plan – Dr Dee and alchemy

Subject content from the National Curriculum 2014

Pupils should be taught to:

♣ distinguish between an object and the material from which it is made

♣ identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock

♣ describe the simple physical properties of a variety of everyday materials

♣ compare and group together a variety of everyday materials on the basis of their simple physical properties

Pupils should be taught to:

♣ identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses

♣ find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching

Aims of the National Curriculum 2014

The national curriculum for science aims to ensure that all pupils:

♣ develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics

♣ develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them

♣ are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future

Cross-Curricular Links	**SMSC (from Ofsted Guidance April 2014)**
History A local history study Examples (non-statutory) ♣ a depth study linked to one of the British areas of study listed above ♣ a study over time tracing how several aspects of national history are reflected in the locality (this can go beyond 1066) ♣ a study of an aspect of history or a site dating from a period beyond 1066 that is significant in the locality. ♣ a study of an aspect or theme in British history that extends pupils' chronological knowledge beyond 1066 Examples (non-statutory) ♣ the changing power of monarchs	**Spiritual** • Experience enjoyment and fascination in learning about others and the world around them. • Use imagination and creativity in learning. **Moral** • Investigate, and offer reasoned views about, moral and ethical issues. **Social** • Show interest in, and understanding of, the way communities and societies function at a variety of levels. **Cultural** • Show understanding and appreciation of the wide range of cultural influences that have shaped their own heritage • Be willing to participate in, and respond to artistic, technological, scientific and cultural opportunities.

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1527-1608.

Dr Dee was an astronomer, mathematician, navigator, alchemist, spy and celestial necromancer.

His name means ‘black’.

He was tutor and advisor to Elizabeth I.

Dee was a larger-than-life figure. He was probably the inspiration for Christopher Marlowe's character Doctor Faustus, Ben Jonson's The Alchemist, Shakespeare's Prospero and Harry Potter’s Dumbledore.

Before Chemistry was a science, there was Alchemy. One of the supreme quests of alchemy was to transmute lead into gold. This was one among many of the experiments of Dr Dee – to find the Philosophers’ Stone, a mythical symbol and substance that would turn base metal into gold.

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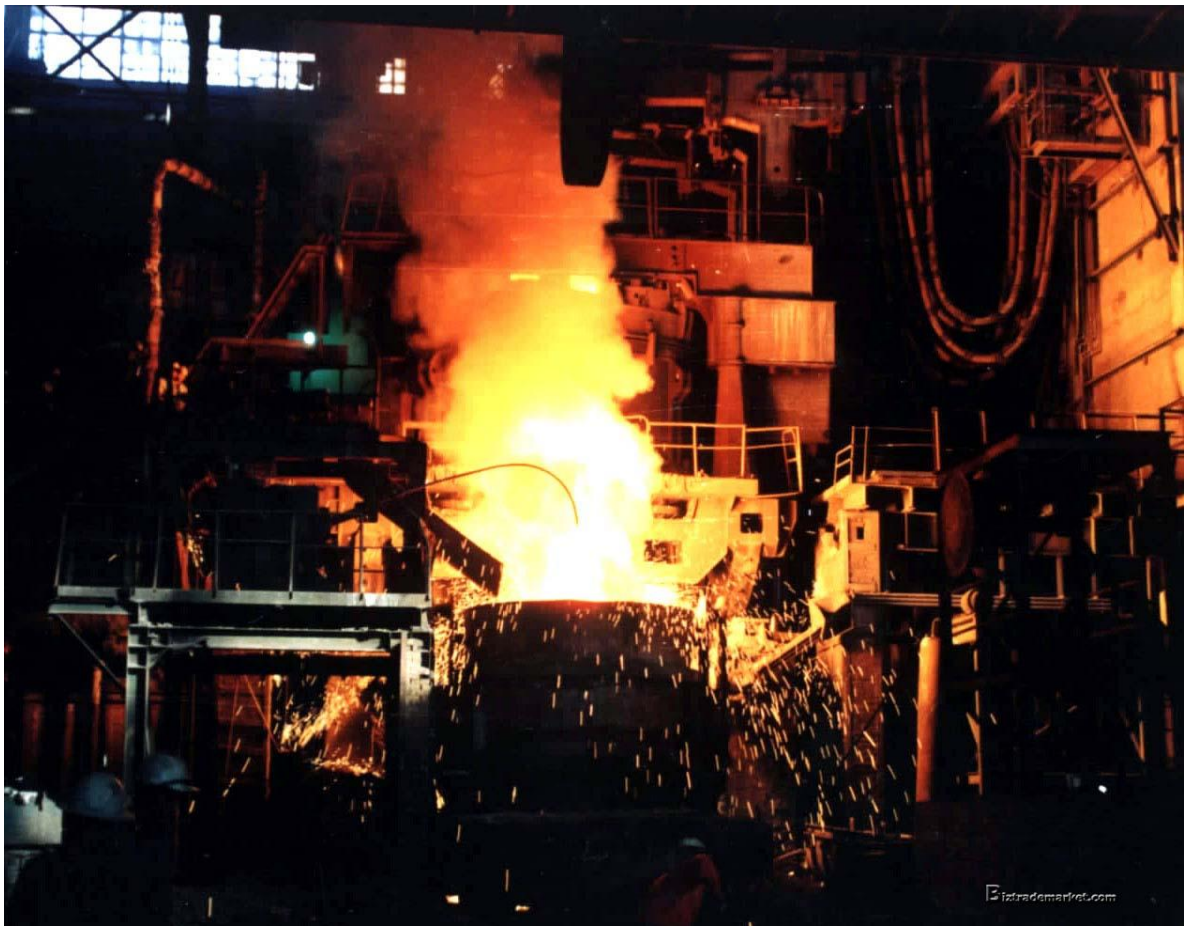
In modern times, it has been discovered that lead can in fact be turned into gold, but not through alchemy, and only in insignificant amounts. However, there are other ways of transmuting or extracting various metals.

Smelting

Smelting is the name given to heating ores in a furnace. This is generally the process used to extract copper from copper-rich ores. The copper can then be purified by electrolysis. However the supply of copper rich ores is limited and the mining and extraction of it has major environmental impacts.



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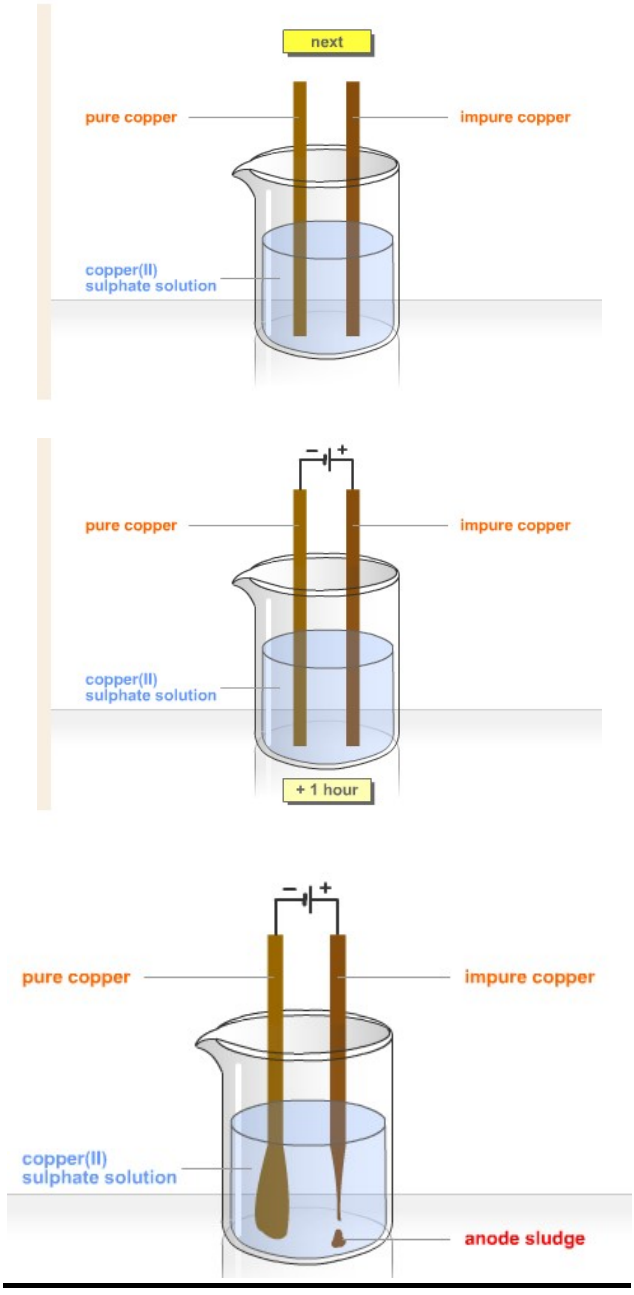
Electrolysis

Electricity is passed through solutions containing copper compounds, such as copper sulphate. During electrolysis, positively charged copper ions move towards the negative electrode and are deposited as copper metal.



This process uses large amounts of energy which makes the extraction process very expensive.

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Ores

Copper ore – Cuprite Cu_2O

Aluminium ore - Bauxite $AlOH_3$

Iron ore - Hematite Fe_2O_3

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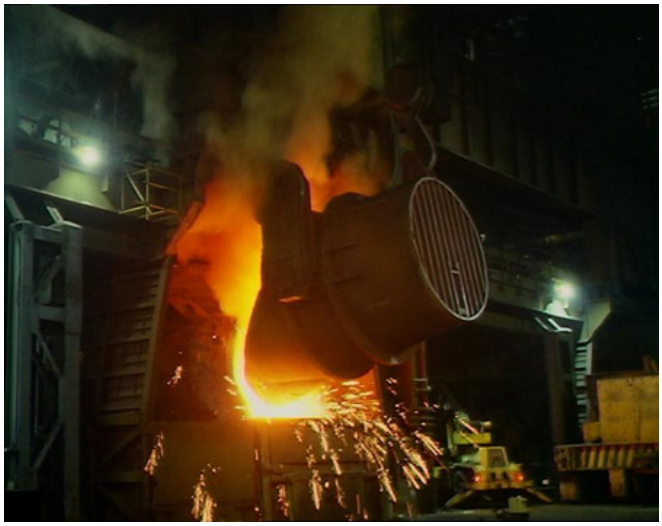
Reduction with Carbon

Iron is extracted from iron ore in a huge container called a blast furnace. Iron ores such as haematite contain iron oxide. The oxygen must be removed from the iron oxide to leave the iron behind. Reactions in which oxygen is removed are called **reduction reactions.**



Carbon is more reactive than iron, so it can push out or displace the iron from iron oxide. Here are the equations for the reaction:

iron oxide + carbon → iron + carbon dioxide

$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$

In this reaction, the iron oxide is reduced to iron, and the carbon is oxidised to carbon dioxide.

In the blast furnace, it is so hot that carbon monoxide will also reduce iron oxide:

iron oxide + carbon monoxide → iron + carbon dioxide

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

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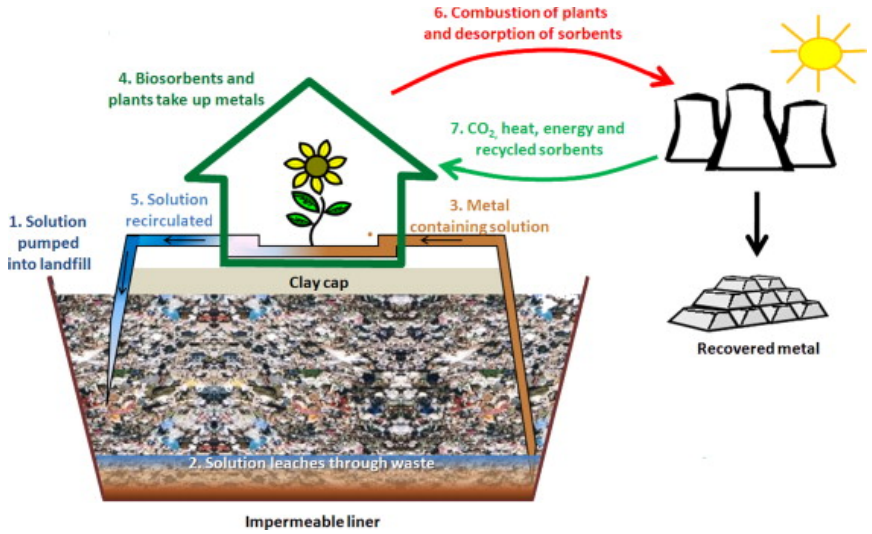
The Future of Copper

We are running out of copper-rich ores. Research is being carried out to find new ways to extract copper from the remaining low-grade ores, without harming the environment too much. This research is very important, as traditional mining involves huge open-cast mines that produce a lot of waste rock



Phytomining, bioleaching and scrap iron

Some plants absorb copper compounds through their roots. They concentrate these compounds as a result of this. The plants can be burned to produce an ash that contains the copper compounds. This method of extraction is called **phytomining**.

Some bacteria absorb copper compounds. They then produce solutions called leachates, which contain copper compounds. This method of extraction is called **bioleaching**.

Copper can also be extracted from solutions of copper salts using scrap iron. Iron is more reactive than copper, so it can displace copper from copper salts. For example:

iron + copper sulfate → iron sulfate + copper

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Extracting Metals

Name three different types of ores stating their chemical formula

-
-
-

Explain the process of reduction by carbon

_____

_____

_____

Complete the equations of reduction with carbon.

$2Fe_2O_3 + 3C \rightarrow$

$Fe_2O_3 + 3CO \rightarrow$

$2ZnO + C \rightarrow$

$2CuO + C \rightarrow$

Why can't we use carbon reduction to extract magnesium?

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Draw a diagram to explain the process of electrolysis and state a disadvantage of this process.

What is smelting?

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Copper-rich ores are running out, what new techniques are being researched to overcome this worldwide issue?