

Science

Coins in the Classroom

Know Your Metal

Those who work in The Royal Mint have always had to be very familiar with the properties of metals. During the early 1600s the mint was located at the Tower of London and its coins were made of silver or gold. At that time there were no fewer than 16 processes to make the metal right for striking coins, and working metal by hand was a job for a skilled craftsman. Today we use mechanical processes to produce the metal for our coins.

Scientific Progress and the Mint

In 1810 The Royal Mint moved to a new site at Tower Hill, just opposite the Tower. This housed eight large coin presses that were powered by steam, the most up-to-date technology of the age. The presses could produce 60 coins a minute but the noise was deafening! Later on, in the 1880s, these were replaced by quieter machines, and at the turn of the century, steam was replaced by electricity as their source of power. Today The Royal Mint uses electric presses that can strike up to 850 coins a minute.



Pouring molten metal into the casting furnace

Making Alloys

To make alloys for coins, different metals are placed into a furnace and heated to between 1300°C and 1500°C. The amounts of the different metals used have to be measured accurately before they are put in. Once the metals have melted together the mix is tested again to make sure the composition is right. It is then poured out through water-cooled rollers to make strips that weigh over two tonnes.

Modern Metal Preparation

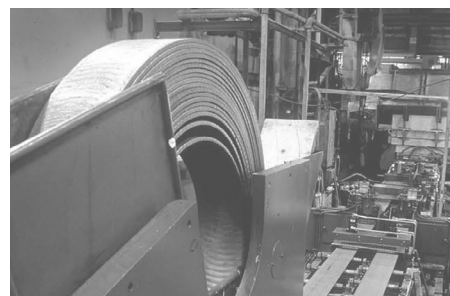
1. Melting

The metal is melted in an electric furnace. Recycled metal (waste from the coining process) is used as well as pure metal.



2. Rolling

When it is ready, the metal is poured out of the furnace into one continuous strip. This is rolled up into a coil that weighs 2.8 tonnes. At this stage, the metal is too thick for coins so it is passed through a rolling mill which reduces it to the required thickness.



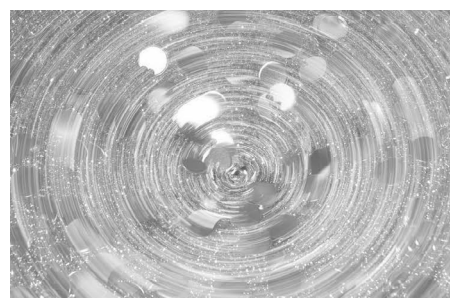
3. Blanking

The long coil of metal is then fed into a blanking press which punches out blank discs of metal. Any leftover strip is sent back to be recycled in the furnace.



4. Annealing and Pickling

The blanks have to be softened in a second furnace at around 500°C, before being cleaned and polished using chemicals and ball bearings.



5. Striking

The blanks are then fed into a coining press, where they are struck between a pair of dies, which have been engraved with the designs that will go on the obverse and reverse of the coin. A modern press can strike around 850 coins a minute.

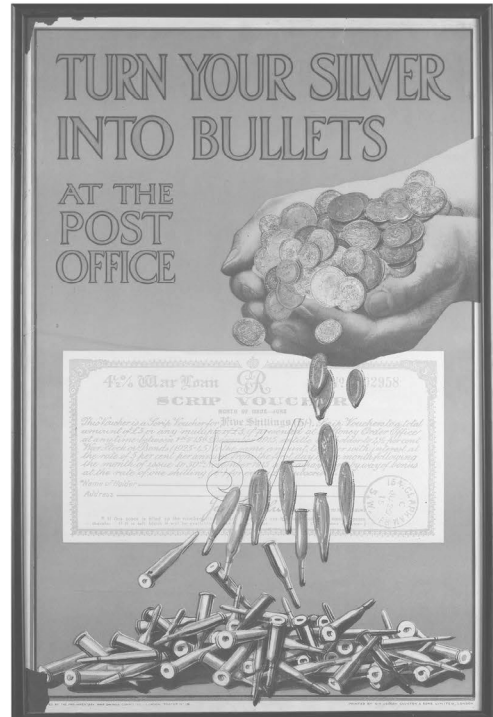


Fact File

Why Not Silver and Gold?

Having used sterling silver for many centuries, in 1920 Britain made sterling silver coins for ordinary circulation for the last time. Sterling silver is a technical name for silver that is composed of 925 parts of silver per 1000 (the other 75 being copper). The price of silver rose sharply after the First World War and it became too expensive to use for coinage.

Silver continued to be used after the war but only in 500 parts per 1000 (so half of a silver coin would have been alloy).
In 1946 Britain stopped making silver coins altogether. The Second World War had taken its toll and Britain needed silver to pay back loans it had received from the USA.
During the war, the Americans had loaned Britain silver for our industries and our coins on the condition that the amount would be returned in full. The government realised that the only source of silver big enough to meet this debt was to be found in Britain's silver coins. Silver coins were therefore taken out of circulation and replaced by coins made of cupro-nickel alloy, though we still refer to these base metal coins as 'silver'.



Gold has always been of high value and therefore expensive to use in coinage. Already considered an indulgence by the Chancellor of the Exchequer in 1869, during the First World War gold coinage quickly became a luxury the country could no longer afford, and gold Sovereigns and Half-Sovereigns disappeared from circulation. After the First World War, gold coins were replaced by paper money.

Token Coinage

Token coinage is the term used to describe coins where the metal from which they are made is worth less than the face value on the coin. It is important in preserving the coinage, as it makes it more valuable to use coins as money rather than melt them down. The silver coinage of the UK has been token since 1816 and the need to maintain the token nature of the coinage was one of the factors that influenced the decision to start using base metals in place of silver. This continues to be an important consideration for the UK and countries across the world today.

What Are Coins Made From?

For centuries in the United Kingdom, we have used metal to make coins, but this wasn't always the case.

In the past, people did not have coins at all.

Instead, they would use things like **shells, beads or feathers** to pay for their goods.

This still happens in some parts of the world today.



Do you think using metal is better?

Magnetism Experiment

Using a magnet, sort 1p, 2p, 5p and 10p coins into piles of magnetic and non-magnetic coins.

Create a tally chart like the one below to record your results.

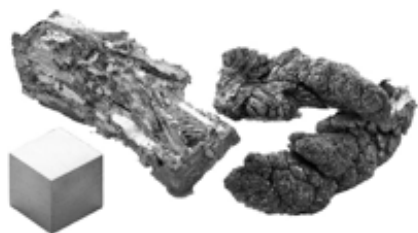
Coin	Magnetic	Non-Magnetic
1p		
2p		
5p		
10p		

What Are the Properties of Coins?

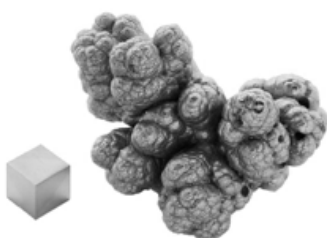
Coins have certain characteristics.
For example, they are strong.
What others can you think of?



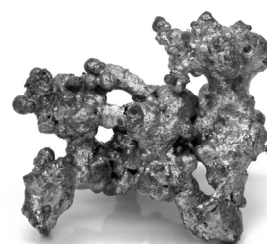
What Metals Are Coins in the United Kingdom Made From?



Zinc



Nickel



Copper

Where else might you find these metals?

Metals Used to Make United Kingdom Coins

Look carefully at Table 1 on your worksheet.

Table 1: Properties of metals

Properties/ Metal	Hardness	Colour	Density	Magnetic?	Resistance to corrosion	Resistance to germs	Recyclable?	Cost (approx per tonne)
Copper	Soft	Reddish- orange	8.9g/cc	No	Corrodes slowly in air – turns green. Will corrode next to other metals	Resistant to and destroys bacteria and fungus	100% recyclable	£5,000
Nickel	Hard	Silvery-white with gold tinge	8.8g/cc	Yes	Resistant to corrosion	In most cases	100% recyclable but can cause an allergic reaction on the skin	£11,100
Zinc	Hard and brittle	Grey or blueish white	7.1g/cc	No	Corrodes but produces a protective layer when it does	Resistant and destroys bacteria	100% recyclable although making zinc produces large amounts of sulphur dioxide	£1,300

1. Which metal do you think would be best to make coins and why?

2. Are there any problems with any of the metals? (i.e. things that would make the metal not good for making coins from)

3. Could these problems be solved? How?

Some coins in the UK are made from a mixture of metals, known as an **alloy**.



Alloy Metals

There are four alloys that The Royal Mint uses to make United Kingdom coins.

Table 2: Properties of metals

Properties/ Metal	Hardness	Colour	Density	Magnetic?	Resistance to corrosion	Resistance to germs	Recyclable?	Cost (approx per tonne)
Nickel-brass 70% Copper 24.5% Zinc 5.5% Nickel	Hard	Yellow	8.4g/cc	No	Yes	Yes	100%	£4,500
Cupro-nickel 75% Copper 25% Nickel	Hard	Silver	8.9g/cc	No	Yes	Yes	100%	£6,600
Cupro-nickel 20p only 84% Copper 16% Nickel	Hard	Silver	8.9g/cc	No	Yes	Yes	100%	£6,000
Bronze 97% Copper 2.5% Zinc 0.5% Tin	Hard	Bronze	8.8g/cc	No	Yes	Yes	100%	£5,000

1. Do any of the alloys match what you would have chosen?

2. What do you notice about the **percentage** of metals used in each alloy?

3. What impact does making an alloy have on the **cost**?

4. Is there any **evidence** to explain why some coins are magnetic and some are not?

Properties of Steel

Table 3: Properties of metals

Properties/ Metal	Hardness	Colour	Density	Magnetic?	Resistance to corrosion	Resistance to germs	Recyclable?	Cost (approx per tonne)
Steel (Iron alloyed with Carbon)	Hard	Silver grey	7.9g/cc	Yes	Not good. Often coated to prevent rusting	Yes	100%	£600

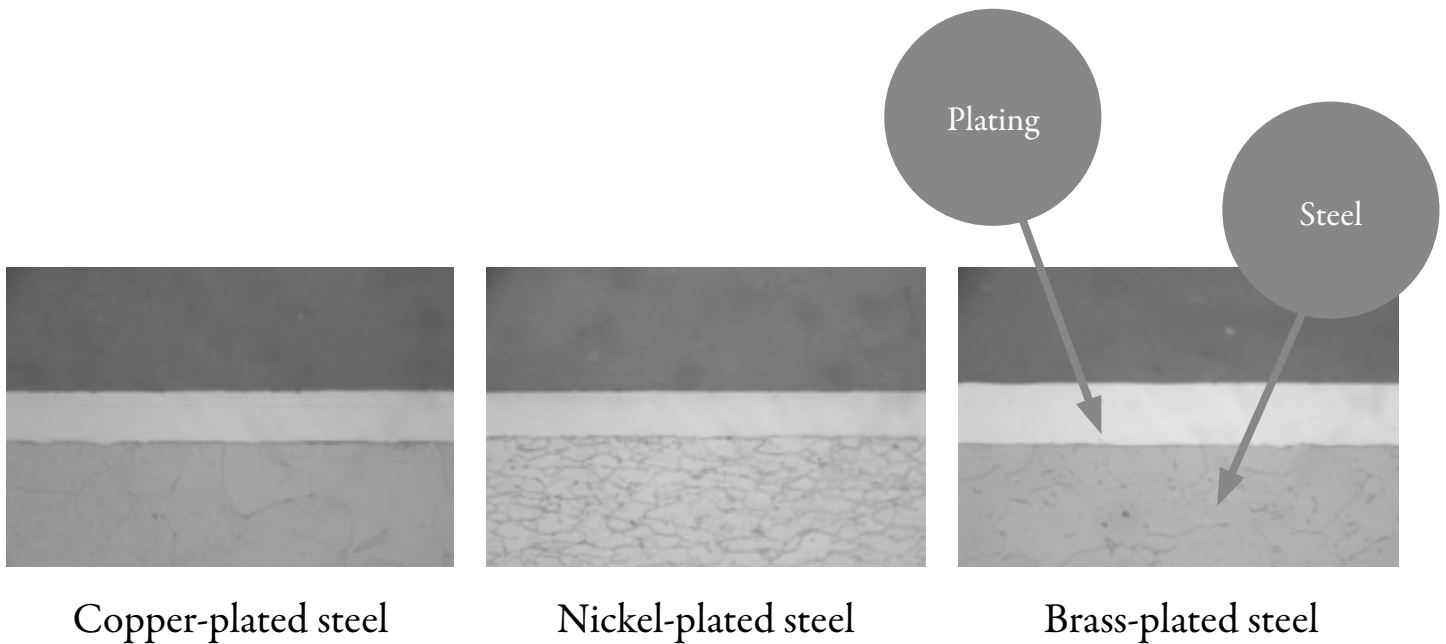
1. What advantages are there to using steel to make coins instead of alloys?

2. What disadvantages are there?

3. How might those disadvantages be overcome?

Plated Steel

The United Kingdom now makes its 1p, 2p, 5p and 10p coins from plated steel.



In order to get the right colour for the coin and **protect the steel** from rusting, 1p and 2p coins are plated with copper and 5p and 10p coins with nickel.

£1 coins are still made of the alloy nickel-brass, but The Royal Mint does make steel coins plated with brass for other countries.

Create a poster explaining the properties of coins and the different ways they are made.

A good poster should:

1. Grab the reader's attention with colours and a catchy title.
2. Tell the reader what the subject of the poster is, in this case **the properties of coins**.
3. Be organised into sections so that the information is quick and easy to read (for example, magnetism, cost, colour).
4. Include interesting facts about the subject.
5. Include the results of your experiment.
6. You might also want to write a conclusion.



Don't forget to talk about your magnetism experiment and your results!

The content in this pack was developed by the team at The Royal Mint Museum. For more information on these resources, including additional teaching materials and in-depth teachers' notes, please visit royalmintmuseum.org.uk/learning

For a more immersive learning experience, online education sessions with The Royal Mint Museum are available upon request. Complete the online form at royalmintmuseum.org.uk/learning to request a booking and we will be in touch to confirm the details.



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