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What are metals?

Metals are raw materials that we mine from rocks in the Earth called ore. We get iron from iron ore and copper from copper ore.

General properties of metals:

Metals are mined from the Earth.
Metals are **shiny**.
Most metals are **hard** and they feel **heavy**.
Metals **conduct** electricity very well.
Metals are **malleable** (they can be shaped into flat sheets)
Metals can be **heated to high temperatures without melting or changing** their shape, which is one of the reasons why pots and pans are made of metal.
Metals can be drawn into thin wires. We say they are **ductile**.

<table>
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<tr>
<th>Properties of specific metals</th>
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**Iron** is a very useful metal. It is used to make objects such as nails, wire fences, weapons, fence posts and tools. This is because it is strong and hard.
The main problem with iron is that it **rusts**.

![Image of rusted car]

**Gold** is a valuable and expensive metal. It is very **malleable** which means is can easily be hammered into a shape. It is used in the manufacture of jewellery as it shines and never goes dull.

![Image of gold bangles]

**Silver** is also an old metal that shines brightly and used to make jewellery. It has been in use for about 8000 years.

![Image of silver bracelet]
Since 6000 BCE (Before Common Era\textsuperscript{1}) copper has been used in the production of ornaments and weapons. Today it is used in electric wires because it conducts electricity very well.

Aluminium is another strong metal. It is used in aircraft construction because it is weighs much less than other strong metals. There is more aluminium in the Earth than any other metal.

\textbf{Activity}

Read the following extract on Iron Age \textit{smelting}\textsuperscript{2} in South Africa and answer the questions that follow:

In 1932, a farmer in the Messina district discovered evidence of gold and iron smelting on Mapungubwe Hill. The African Iron Age is a period in African history that started about 1800 years ago. During this period, people learned how to make weapons and tools from iron. Using iron to make tools had many advantages. Iron is a strong, hard metal that can be hammered into different shapes. It can be used to make tools for chopping trees, cutting stone and for hunting. Iron is separated contains from rock that contains iron, by heating and melting iron ore.

\textsuperscript{1} BCE is an abbreviation for Before Common Era. The first year of the Common Era (CE) is usually considered to be the year that Jesus Christ, from the Christian Religion, was born.

\textsuperscript{2} Smelting is a process involving heating and melting that removes metal from metal ore. In other words, smelting removes a metal such as iron from rock (ore) that contains bits of iron.
1. Use your dictionary to help you explain the following, in your own words:
   a. Smelting
   b. Iron Age

2. When did the Iron Age occur in Africa?

3. Describe how the iron was separated from the ore.

4. What was the iron used for?
   a. Explain the importance of discovering iron for the Iron-Age people.
   b. What properties of iron make it useful for tool making?

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**Unit 2: Properties of non-metals**

**Key Words**

- **Brittle:** easily breaks into pieces when it falls
- **Synthetic polymers:** plastics, rubber and fabrics
- **Ceramic:** objects made from clay or sand

**What are non-metals?**

Non-metals are all materials that are not metal. If a material does not have any of the properties of a metal, then it is a non-metal.

**Properties of non-metals**

- They are **dull**.
- Some are **brittle** and break easily.
- Some are **flexible** and **bendable**.
- Some are easy to shape.
- They are usually easy to colour.
Examples of non-metals

Ceramics is pottery and articles made by firing materials extracted from the Earth.

Glass is made from liquid sand. Glass is made by heating ordinary sand until it melts and turns into a liquid. Sand melts at the incredibly high temperature of 1700 degrees Celsius.

Plastics are springy, waterproof, easily-shaped and lightweight. They are used to make thing that need these properties.

Fibres can be natural, like cotton, or manufactured, like polyester. They are made of tiny threads so that they are quite strong, flexible and can keep things and people warm.
Key Words

Conductor: materials that allow heat to pass through easily
Magnetic: attracted to a magnet
Non-magnetic: materials that are not magnetic
Attracted: pulled towards
Tarnish: a metal changing and becoming dull
Corrode: a metal breaking down

Metals conduct heat

A metal teaspoon taken from a hot drink is usually hot when touched. This is because heat passes easily from the hot liquid into the metal teaspoon. We say that the teaspoon conducts the heat. Metals are good conductors of heat.
Some metals are magnetic. When you bring certain metals close to a magnet the metals are attracted to the magnet. It would appear that the metal “sticks” to the magnet. Metals that do not have magnetic properties and are not attracted are called non-magnetic.

Iron and steel are the most magnetic metals. Nickel and cobalt are also magnetic. All other metals are non-magnetic.

Metals rust or tarnish

Most metals are affected by air and water. The air makes the metals change. All metals start out bright and shiny but, in the air, they go dull after a few weeks. For many metals, like copper, aluminium and zinc, this dull layer is very thin. We say the metals tarnish or corrode.

Silver gets a blackish layer.
Iron turns reddish brown called rust. Gold does not corrode.

HOW TO STOP THINGS FROM RUSTING

Coat with grease or oil

Coat in plastic
Unit 2: Uses of Metals

Key Words
Structure: framework for support
Ornamental: used as a decoration
Recycle: process of reusing old material to make new objects

Building structures

- Steel is strong and is therefore used for the framework of skyscrapers and large buildings such as warehouses. This framework is its core structure.
- Pylons, that carry electric wires, are also steel structures
- Some buildings use sheets that are mainly made from iron covered with zinc, for walls and roofs.
Transport

- Cars and bikes are usually made of steel, although expensive ones are made of aluminium.
- Steel alloys are used for ships and trains. (An alloy is a man-made metal created by combining two or more metals)
- Aluminium alloys are used in the aircraft industry.

Industry

- Machinery in factories is made of iron and steel.
- The tools that the workers use needs to be strong, so they are usually made of metal.

Decorative Items

- Jewellery and ornamental items are made from gold, silver and copper because these metals shine brightly and do not tarnish.
- Other everyday items such as coins, taps, cutlery, door handles are made of different kinds of metals.
Unit 1: Combining materials

**Key Words**

**Combine**: to mix or join together

**Process**: change in different ways to get new materials or products with new properties.

**Mixture**: something that is made by mixing thing together

**Cement**: a product made from clay and limestone that becomes hard when mixed with water

**Concrete**: a mixture of sand, gravel, cement and water.

**Reinforced**: strengthened with additional material

**Plaster of Paris**: a white powder that quickly becomes a hard solid when mixed with water

**Paste**: a thick mixture of solid and a liquid

**Dissolve**: mixes completely with water

Materials are combined when we put them together in a certain way. Raw materials are processed to make a completely new product.
Mixing and Setting

- Certain materials become hard and set after the mixture is mixed.

- **Cement** is an example, as it becomes hard when mixed with water.

- When sand, gravel, and cement are mixed with water, a very strong material, called **concrete**, is formed.

- Concrete can be **reinforced** with iron bars when dam walls and bridges are built.

- **Plaster of Paris** is a very useful material. It is a white, powdery substance that becomes a soft, malleable paste when mixed with water. When plaster of Paris sets it becomes hard and strong and be used for various purposes such as **ornaments**, **polyfilla** (used to repair cracks in walls) and **as casts** (used to repair broken limbs).

Mixing and cooking

- Raw ingredients are usually combined and cooked to improve the **taste**.

- The cooked product tastes better and it is easier to **digest**.

- Ground maize meal is a typical example of a product that is very hard to digest when it is in its raw state. Combing it with salt and water and cooking it to make porridge, improves taste and digestion.
**Mixing and cooling**

- Sometimes we mix ingredients for a pudding and then put it in a cool place or fridge to set or become a solid.

- A good example is jelly. It is a mixture of sugar, fruit flavours and gelatine (a substance found in animal joints).

- Gelatine **dissolves** in hot water and will set into a solid when it cools.

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**Mixing, drying and firing**

- Some products are mixed and then dried or fired.

- In **rural** areas straw, dry grass, or animal dung is mixed with clay to keep the particles together when it dries in the sun.

- In **industrial** brick making, small rock are mixed with coal dust and water then fired and dried in a kiln at 600 to 900 degrees Celsius.

- **Fired bricks**

- **Sun-dried bricks**
Key Words

Processed: materials that have been processed in some way
Fire-resistant: a material that is not easily damaged by fire
Durable: something that will last for a long time
Waterproof: water is unable to pass through
Fabric: material made from yarn or fibres by weaving or knitting
Heat-resistant: material that is not easily damaged by heat
Absorbent: able to take in or soak up liquids
Texture: the way a surface or material feels
Paint: a liquid used to give colour or texture or protect surfaces and objects
Pigment: a dry, coloured powder that is mixed with oil or water to make paint

Processed materials are materials that have been changed in some way. All processed materials have their own special properties.

Uses and special properties of processed materials

Plaster of Paris

1. When mixed with water, it can be malleable and moulded into different shapes.
2. Hardened plaster is water resistant and fire resistant.
3. The soft board used as ceilings in buildings contains sheets of plaster of Paris.
1. Bandages can be soaked in plaster of Paris, mixed with water and wound around a broken arm or leg.
2. It is used to make works of art.
3. It can be used to fill cracks in walls, just like Polyfilla.

Concrete

![Concrete image]

1. Concrete is very strong, hard and durable.
2. When it is dry it is waterproof.
3. Many buildings are made using concrete.
4. Towers of power stations and silos for keeping grain are built of concrete.
5. Concrete pillars, reinforced with iron, are used to uphold parts of roofs.
6. Thick water pipes are made of a hard, strong concrete mixture.

Fabrics

1. Fabrics are fibres that are either man-made or natural. The fibres are spun to make yarn.

**NATURAL FIBRES**

- Silk
- Cotton
- Wool
1. **Cotton** allows air to pass through so that it keeps people cool in hot water.
2. **Silk** is soft and usually used for ladies garments.
3. **Wool** is soft but thick enough to keep people warm in winter.

**MAN-MADE FABRICS**

1. **Nylon** is soft and lightweight, very strong, and durable.
2. **Polyester** is light and blends well with natural fabrics.

Some fabrics have been designed to withstand harsh or unpleasant conditions. For example, fire fighter’s clothes or raincoats.

For thousands of years, people made the things that they needed out of raw materials that they found around them and in the environment. They did not have processed materials like concrete, glass, and plastic. They used indigenous materials from their area, such as grass, clay, and tree stumps. They processed them into useful products such as huts, pots, bricks, and baskets. People still make useful...
objects out of clay and grass today, and they often decorate them to look more interesting and attractive.

Unit 2: Traditional processing

Case Study: Nala pots

Nesta Nala learnt the art of pot making from her mother and grandmother. The knowledge was passed down from one generation to another. The pots are shaped from soft clay. When they are baked, they keep their shape and become hard and waterproof. Nesta makes patterns in the clay to give them an interesting texture and to make them look more attractive. The pots are then baked in an oven called kiln. The baked pots are rubbed with animal fat, to make them waterproof, and polished to give them a smooth, shiny surface. The traditional uses of the pots were storage of water, beer and grain and cooking. Not many people use the clay pots for cooking and storage anymore - They buy pots and containers made from modern materials, such as plastics and metals from shops. The Nala women continue to make beautiful pots, which are often used as ornaments. They are mainly sold to collectors and overseas tourists.

Activity: Work in groups

1. How does Nesta Nala process the clay pots?
2. Identify the properties of the clay pots that she makes.
3. a) How does Nesta waterproof the pots?
   b) Why must the pots be waterproof?
4. How does she change the texture and appearance of the clay pots?
5. Draw a traditional pot and decorate it with vibrant African patterns and colours.

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