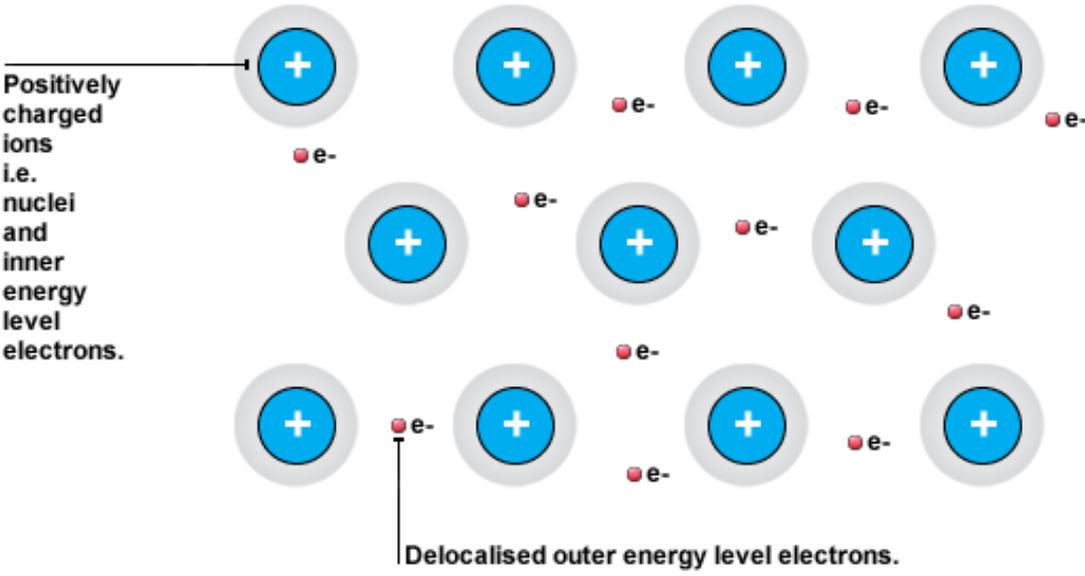




## Key Area: Metals

Learning Statement		😊	😐	☹️
Metals are found on the left side of the zig-zag line on the Periodic Table.				
Metallic bonding holds metal atoms together.				
<p>Metallic bonds are the electrostatic attraction between negatively charged delocalised electrons and the positively charged metal ion lattice.</p> 				
Delocalised electrons are electrons that are not 'attached' to a particular atom. They are free to move.				
<b>Physical Properties of Metals</b>				
Strong	Conduct electricity			
Are <b>malleable</b> (can be shaped)	Conduct heat			
Are <b>ductile</b> (can be drawn into wires)	High melting and boiling points			
Are shiny	Are mostly solid, except mercury.			
Unreactive metals such as gold and silver are found uncombined in the Earth's crust. Other metals are found in the ground in the form of metal ores. Metal ores are naturally occurring metal compounds.				
Metals can be extracted from their ores by: <b>heating, heating with Carbon or Carbon monoxide, or by electrolysis.</b>				
<b>Method</b>	Electrolysis	Heat With Carbon	Heat Alone	
<b>Metals Made This Way</b>	Potassium Sodium Lithium	Zinc Iron Copper	Mercury Silver	
	Calcium Magnesium Aluminium	Tin Lead	Gold Platinum	
<b>Reason</b>	most reactive metals	medium reactive metals	least reactive metals	
The extraction of a metal from an ore is an example of a <b>reduction</b> reaction.				
The percentage of a metal in a metal ore can be calculated using the formula:				

$$\text{Percentage Mass} = \frac{\text{Mass of Element in Formula}}{\text{Gram Formula Mass}} \times 100\%$$

Calculate mass of 1 mole	Find mass of element	Percentage Fe in Fe <sub>2</sub> O <sub>3</sub> calculation
$\text{Fe}_2\text{O}_3 = (2 \times 56) + (3 \times 16)$ $= 112 + 48$ $= 160\text{g}$	$2 \times \text{Fe} = (2 \times 56)$ $= 112\text{g}$	$\frac{112\text{g}}{160\text{g}} \times 100 = 70\%$

Metals can be placed in a reactivity series. The most reactive metals are placed at the top and the least reactive are at the bottom.

### Reaction of Metals and Oxygen

When a metal reacts with oxygen, a metal oxide is formed.



### Reaction of Metals with Water

The Alkali Metals (Group 1) and the Alkaline Earth Metals (Group 2) react with water to form a metal hydroxide (an alkali) and hydrogen gas.



### Reaction of Metals with Acid

The MAZINTL metals (all metals above copper) react with acid to form a metal salt and hydrogen gas.



Copper does not react with dilute acid.

Metal	Potassium	Sodium	Lithium	Calcium	Magnesium	Aluminium	Zinc	Iron	Tin	Lead	Copper	Mercury	Silver	Gold	Platinum
Reaction With Oxygen	Burn In Oxygen to Form Metal Oxide								Slowly React With Oxygen		No Reaction With Oxygen				
Reaction With Water	Fast Reaction With Water			Slow Reaction With Water Faster Reaction With Steam					No Reaction with Water or Steam						
Reaction With Acids	Violent Reaction With Acids			React With Acids			Slow Reaction		No Reaction With Acids						

The reactions of metals can be explained by the loss of gain or electrons in the reaction.

A reaction in which electrons are gained is called **REDUCTION**.



Reduction reactions will always have the electrons on the left of the arrow.

A reaction in which electrons are lost is called **OXIDATION**.



Oxidation reactions will always have the electrons on the right of the arrow.

Reactions in which both **reduction** and **oxidation** occur are called **Redox** reactions.

The mnemonic: **OIL RIG** can be used to remember that **Oxidation Is Loss** and **Reduction Is Gain** of electrons.

A list of reduction reactions can be found on page 10 of the data booklet.

### Electrochemical Cells

In a battery, the electricity comes from a chemical reaction.

- Electricity passing along metal wires is a flow of electrons
- Batteries run out when the chemicals in the battery are used up.

Some batteries are rechargeable.

- Nickel-Cadmium batteries can be recharged.
- Lead acid batteries in cars can be recharged.

#### Advantages of Batteries

Easy to transport

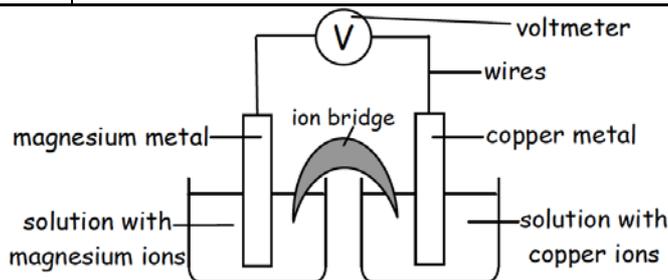
Low voltage, so safer

#### Advantages of Mains Electricity

Costs less than batteries

A cell can produce electricity by connecting different metals together with an electrolyte

- a cell is usually created by connecting two different metals in solutions of their metal ions
- a cell can have half-cells which do not involve metal atoms



The voltage produced in a cell depends on:

- The bigger the difference between the metals on the electrochemical series, the bigger the voltage produced.
- Electrons always flow from the most reactive metal to the least reactive metal.

The purpose of the electrolyte is to complete the circuit.

- An electrolyte is an ionic solution usually stored on an ion bridge.
- Ion bridges are usually pieces of filter paper soaked in an ionic solution.
- Positive ions move towards negative charges due to electrostatic attractions.
- Negative ions move towards positive charges due to electrostatic attractions.

Fuel cells use electrochemistry to generate electricity.

Most fuel cells use hydrogen to generate electricity. The hydrogen reacts with water to form water and oxygen.

- The main advantage of using hydrogen fuel cells is that the products are non-polluting.
- The main disadvantage of using hydrogen fuels cells is that hydrogen gas is difficult to store and is explosive.

**Displacement** reactions are when a metal higher up the electrochemical series pushes one lower down the electrochemical series out of solution.

*Higher Up Metals can displace Lower Down Metal Ions from Solutions*

