* Metals
metal + oxygen → metal oxide
metal + water → metal hydroxide + hydrogen
metal + acid → metal salt + hydrogen
Sulfuric... makes sulfates
hydrochloric... makes chlorides
H2SO4...
HCl...
Acid
WATER
AIR - O2
Metals lose electrons
Na+
Al3+
Ca2+
+ve ions
Fe
PHYSICAL PROPERTIES
CHEMICAL PROPERTIES
USES
Some magnetic
good conductors
shiny
hard
malleable
ductile
heat
electricity

13 **Al** *Aluminium metal*

Atomic number 13

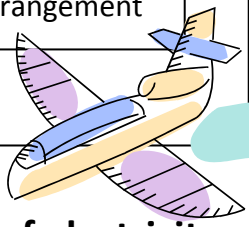
Electron configuration 2,8,3

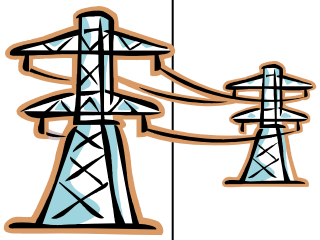
Loses 3 electrons to achieve a full valence shell, which is a **stable** arrangement

Forms an Al^{3+} cation

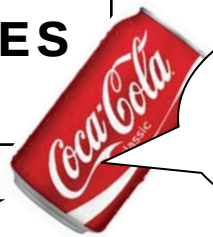
PHYSICAL PROPERTIES

- **Low density**
- **Good conductor of electricity**
- **Good conductor of heat**
- **Ductile**
- **Malleable**
- **Fairly shiny**
- **Not very strong (unless as an Al alloy)**





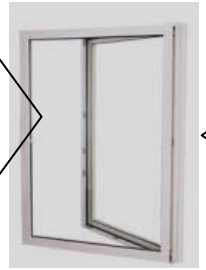
CHEMICAL PROPERTIES



Malleable – can be made "can" shaped; low density – cheaper to transport. Unreactive to O_2, water, acidic contents

- Place in reactivity series Na > Ca > Mg > **Al** > Zn…. But it often appears less reactive than it really is
- Al has ALREADY reacted with oxygen in the air to form a tough, thin oxide layer – Al_2O_3 – which protects the aluminium metal underneath from further reaction with {**named**} substances
  - Oxygen in the air
  - Water as rain
  - Dilute acids eg acid rain / fruit juices / cola drink etc

Oxide layer means the frame is unreactive to O_2 in the air and water (rain & washing), even slightly acidic (polluted) rain



The malleability of Al means that it can be rolled in sheets and extruded. Its low density means that the frames will be quite light, yet still strong.

COPPER

Cu

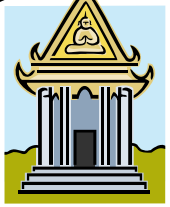
METAL

PINKY - ORANGE

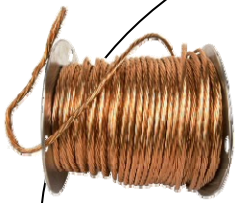
Chemical properties

Very unreactive metal
- No reaction with water
- No reaction with dilute acids

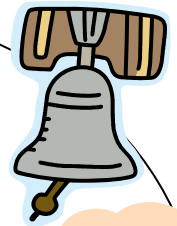
USES mainly related to lack of reactivity include
- Water pipes
- Roofing material
- Statues
- Coins

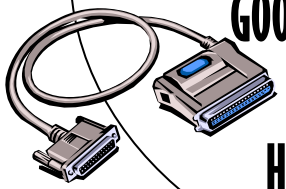


PHYSICAL PROPERTIES

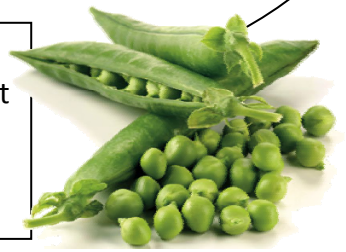


QUITE HEAVY MALLEABLE
DUCTILE SONOROUS
GOOD CONDUCTOR OF HEAT
GOOD CONDUCTOR OF ELECTRICITY
HARD STRONG
HIGH MELTING POINT SHINY





A saucepan needs to be a good conductor of heat – but the fact it also conducts electricity well is irrelevant here – we do not cook peas by electrocution!



Heated in air
- Gains an oxide layer – black – when heated in air
- copper + oxygen → copper oxide

Corrodes VERY slowly in moist air (reacts with both O_2 & CO_2); layer of basic copper carbonate makes it greenish

MANY USES RELY ON BOTH PHYSICAL AND CHEMICAL PROPERTIES…… a bracelet has to be malleable (to shape it), the Cu colour is attractive, it stays quite shiny, it is hard, it doesn't react with water, sweat, or chemicals it might come into contact with……

Copper oxide is a base
- Reacts with acid to give a salt and water eg
- $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
- $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

evaporate

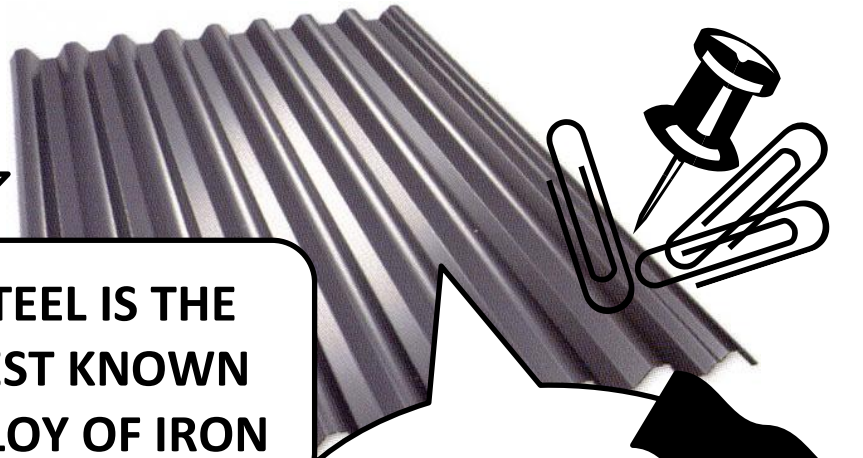
Blue colour due to the Cu^{2+} ion

IRON

Fe

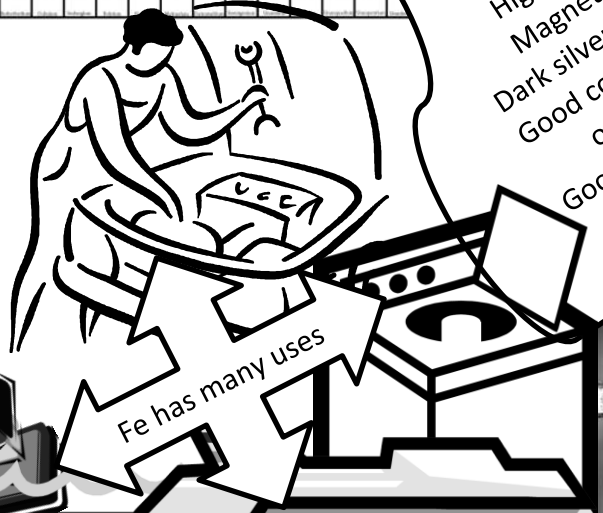
Ductile
Hard
Strong
High M pt
High B pt
Magnetic
Dark silvery grey
Good conductor of heat
Good conductor of electricity

STEEL IS THE BEST KNOWN ALLOY OF IRON

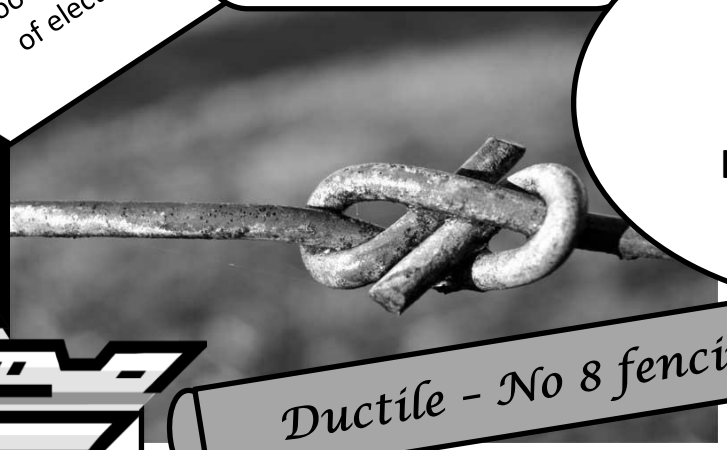


Most used of all the metals due to low cost & high strength

Fe has many uses



Malleable
Is coated in zinc (galvanised) or painted to stop it from rusting



Ductile – No 8 fencing wire!!

Iron – corrodes in the presence of water AND oxygen.

This corrosion of iron is called **RUST**

Rust weakens the metal

Fe is the only metal that rusts – rust is hydrated iron(III) oxide

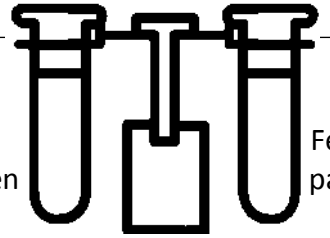
Iron is a fairly reactive metal

Na Ca Mg Al Zn **Fe** Pb Cu

Metal + oxygen → metal oxide

Metal + acid → salt + hydrogen

Can form iron(II) and iron(III) compounds because of Fe^{2+} & Fe^{3+} ions



Fe^{2+}(aq) pale green

Fe^{3+}(aq) pale orange