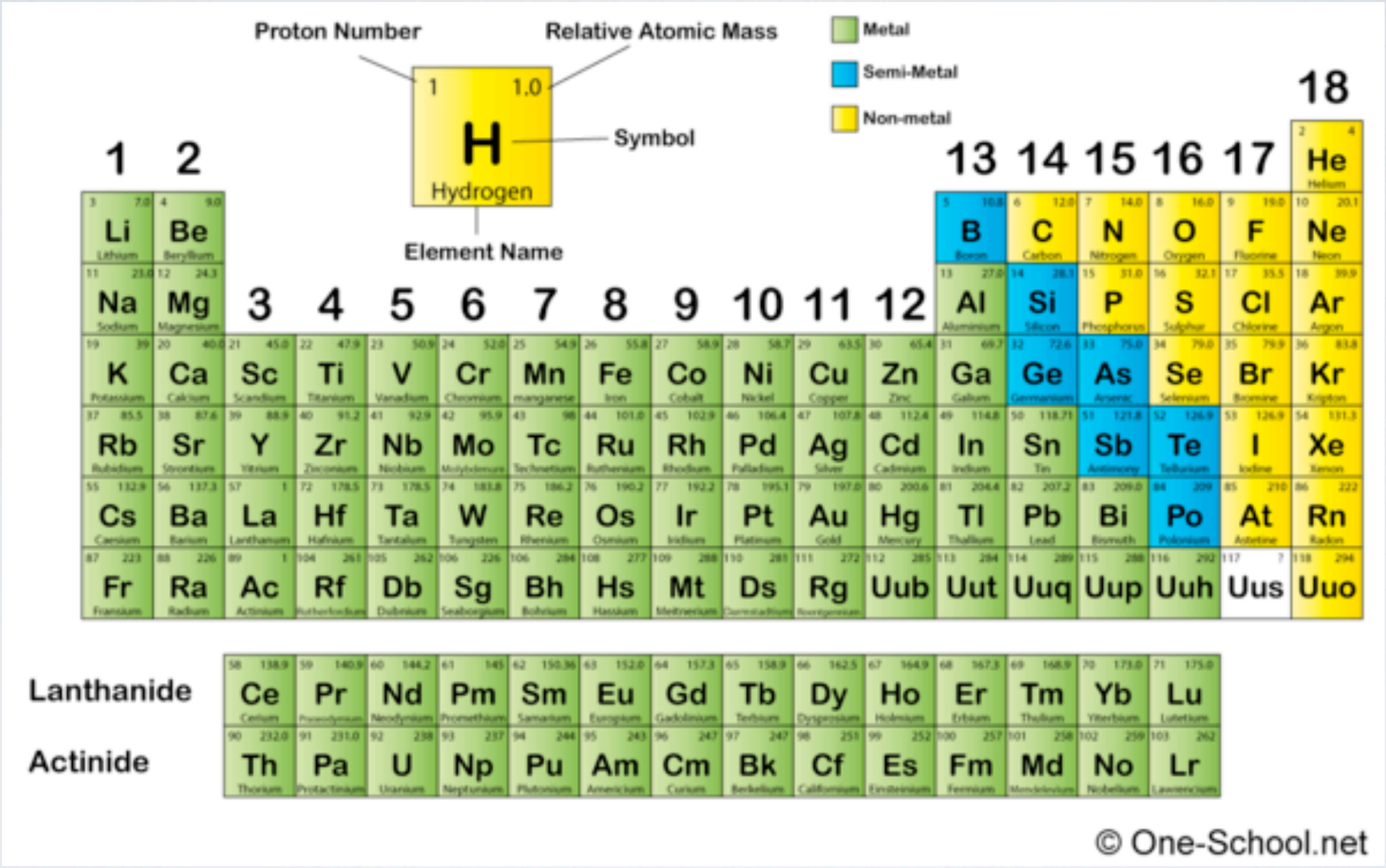
METALS

IGCSE 12.1 Metals and Nonmetals


Proton Number
Relative Atomic Mass
1
1.0
H
Hydrogen
Symbol
Element Name
Metal
Semi-Metal
Non-metal
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Li Be B C N O F He
Na Mg Al Si P S Cl Ne Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
Cs Ba La Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
Fr Ra Ac Rf Db Sg Bh Hs Mt Ds Rg Uub Uut Uuq Uup Uuh Uus Uuo
Lanthanide
Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Actinide
Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr
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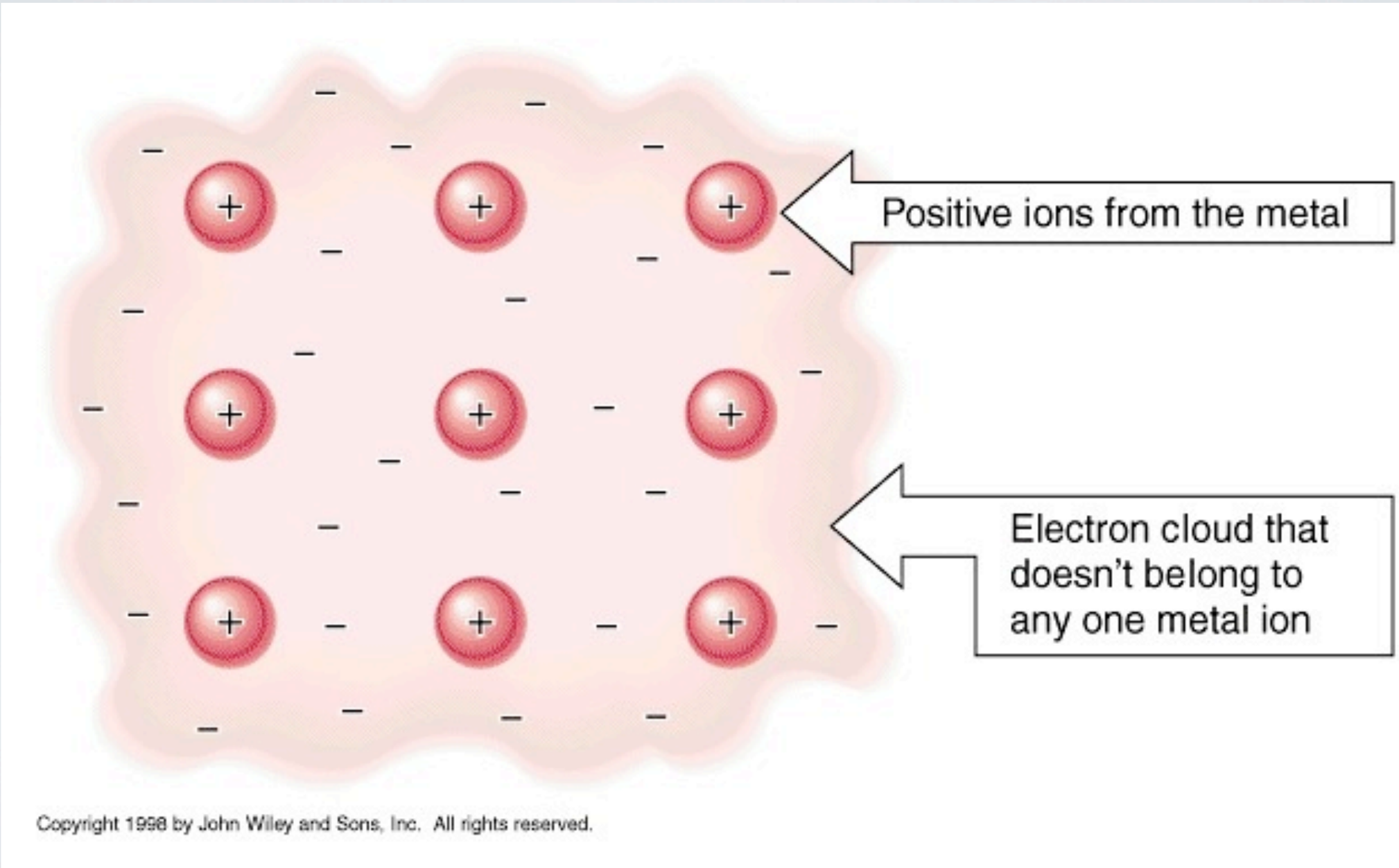
PHYSICAL PROPERTIES OF METALS

- Strong under tension and compression
- Malleable (can be hammered and bent)
- Ductile (they can be drawn into wires)
- Shiny (when clean and uncorroded)
- Good conductors of electricity and heat
- They have high melting and boiling points (all are solids except Hg)
- They have high densities (feel heavy)

WHY DUCTILE OR MALLEABLE




Au


Al

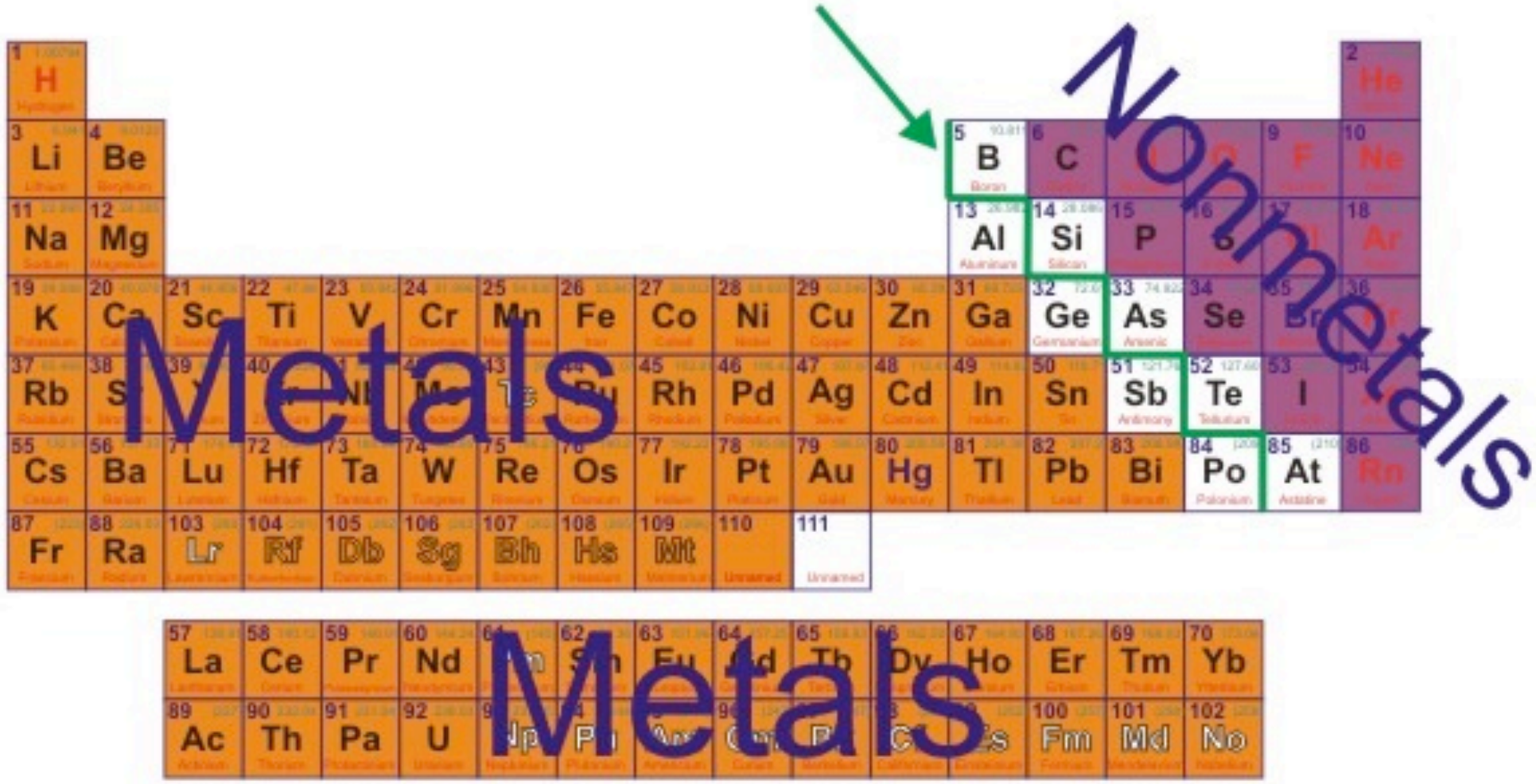

Na


Mg

CHEMICAL PROPERTIES

- Tend to lose electrons to form positive ions (Na^{+}, Fe^{+2}, etc.)
- React with oxygen to form basic oxides.
- Most react with air and water (oxidize/rust)
- Most react with acids to form hydrogen and a salt

Elements that border on the amphoteric line (shown in green) are metalloids. They have characteristics of both metals and nonmetals. Aluminum (Al), however, definitely has mostly metallic characteristics, and boron (B) is mostly nonmetallic.



Metals

1. Have luster
2. Are malleable and ductile
3. Conduct heat and electricity
4. Tend to lose electrons

Nonmetals

1. Are dull
2. Are brittle
3. Do not conduct heat or electricity very well
4. Tend to gain electrons

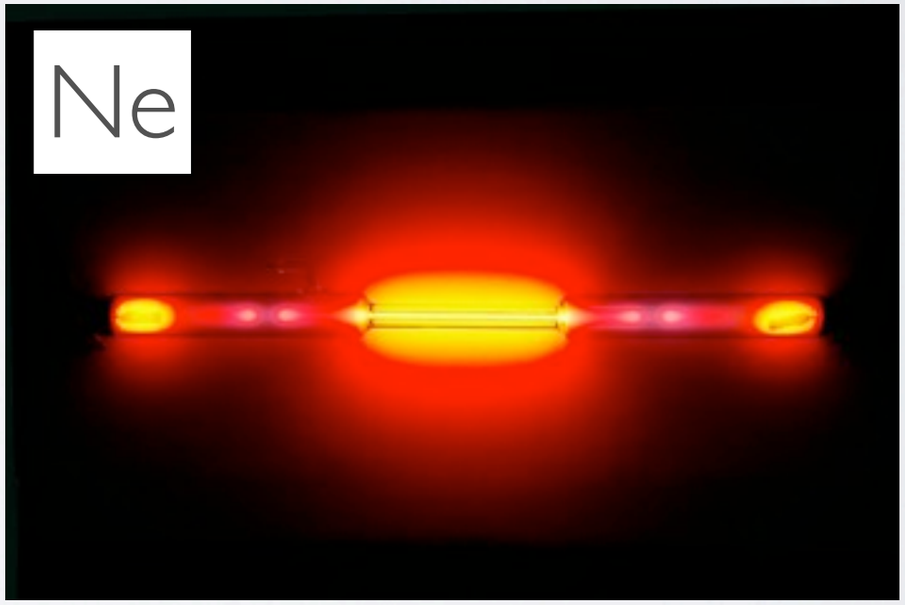
PHYSICAL PROPERTIES OF NON-METALS

- They are brittle (do not bend or form)
- They have low melting and boiling points
- They are poor conductors of heat and electricity
- They have low densities

CHEMICAL PROPERTIES OF NON-METALS

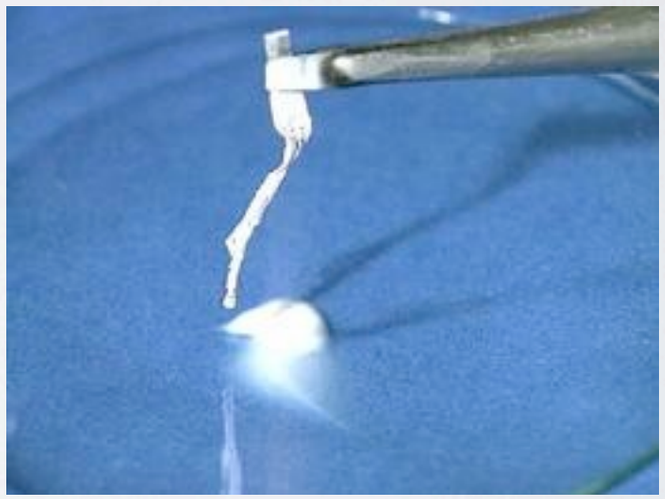
- React with oxygen to form acidic oxides
- Tend to attract electrons to form negative ions (anions)

O (as a liquid)



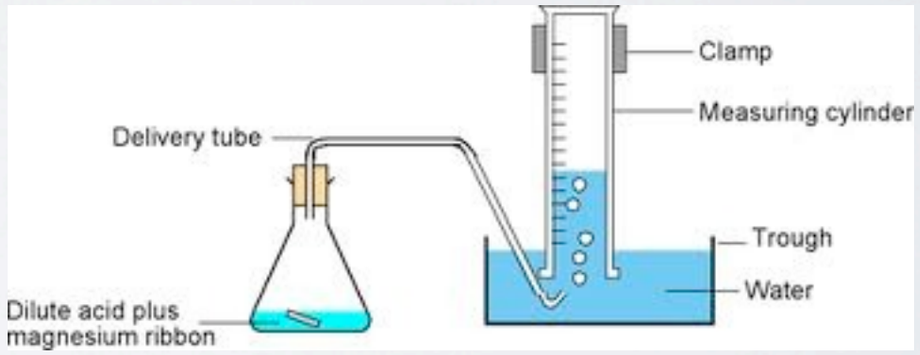
METAL REACTIVITY

- Most metals react with oxygen.
- Metals have varying levels of reactivity.
- Those that do react, from basic oxides.
- $Mg + O_2 \rightarrow MgO$



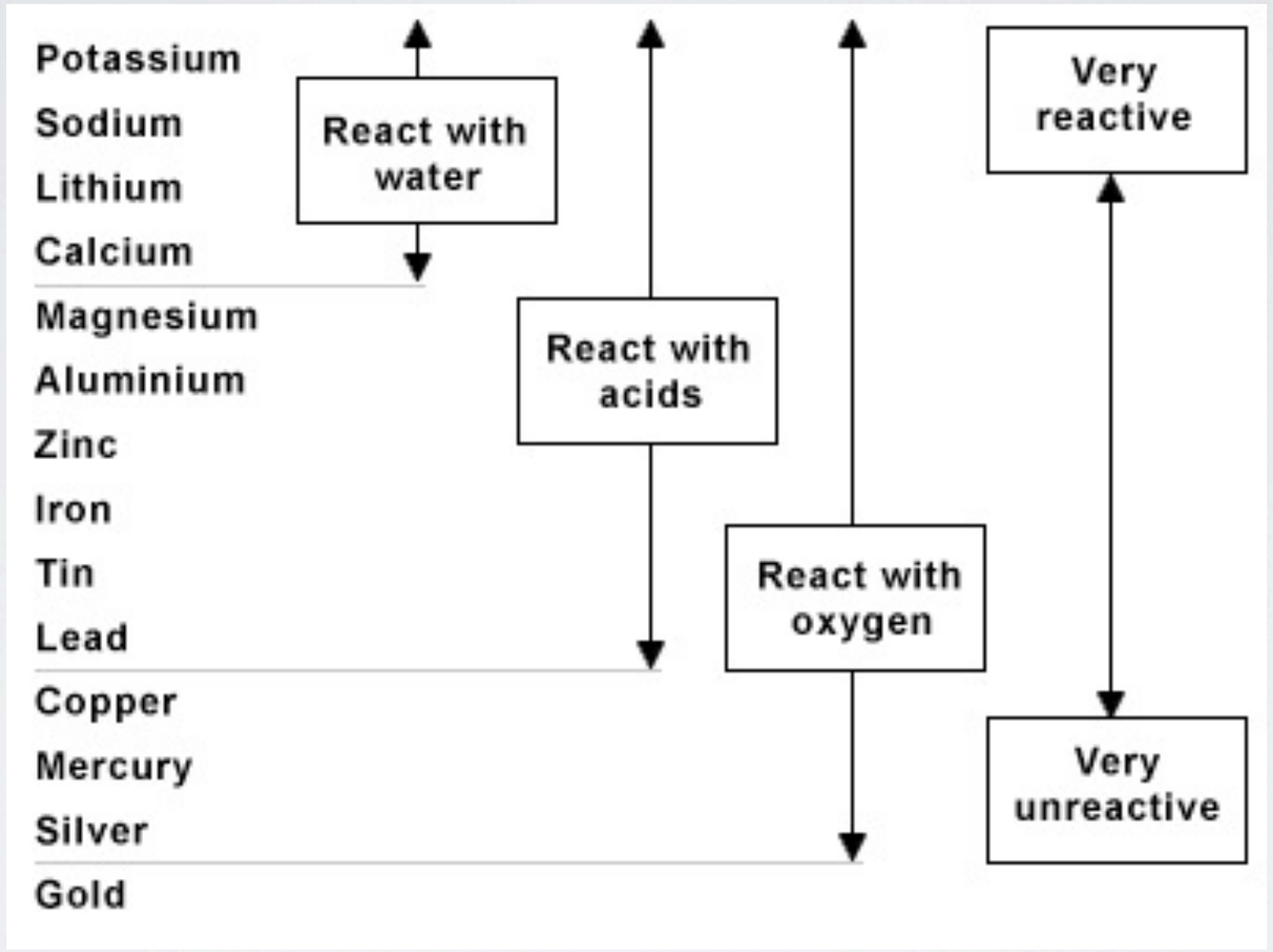
METALS AND ACID

- Many metals will react with acid.
- The level of reaction depends upon the metal.
- When they do react they form H_2 and a salt.
- $Mg + HCl \rightarrow MgCl_2 + H_2$



METALS AND WATER

- Some metals will react with water.
- The level (and rate) of the reaction depends upon the metal.
- When they react they form OH^-.
- $2\ Na + H_2O \rightarrow 2\ NaOH + H_2$


Potassium
Sodium
Lithium
Calcium
Magnesium
Aluminium
Zinc
Iron
Tin
Lead
Copper
Mercury
Silver
Gold
React with water
React with acids
React with oxygen
Very reactive
Very unreactive

METAL DISPLACEMENT

- More react metals will replace others in solution.
- In this reaction copper wire is placed in silver nitrate.
- Since copper is more reactive than silver, the copper dissolves into solution and the silver is forced out.
- $Cu + 2\ AgNO_3 \rightarrow 2\ Ag + Cu(NO_3)_2$
- This reaction will not proceed in the reverse.

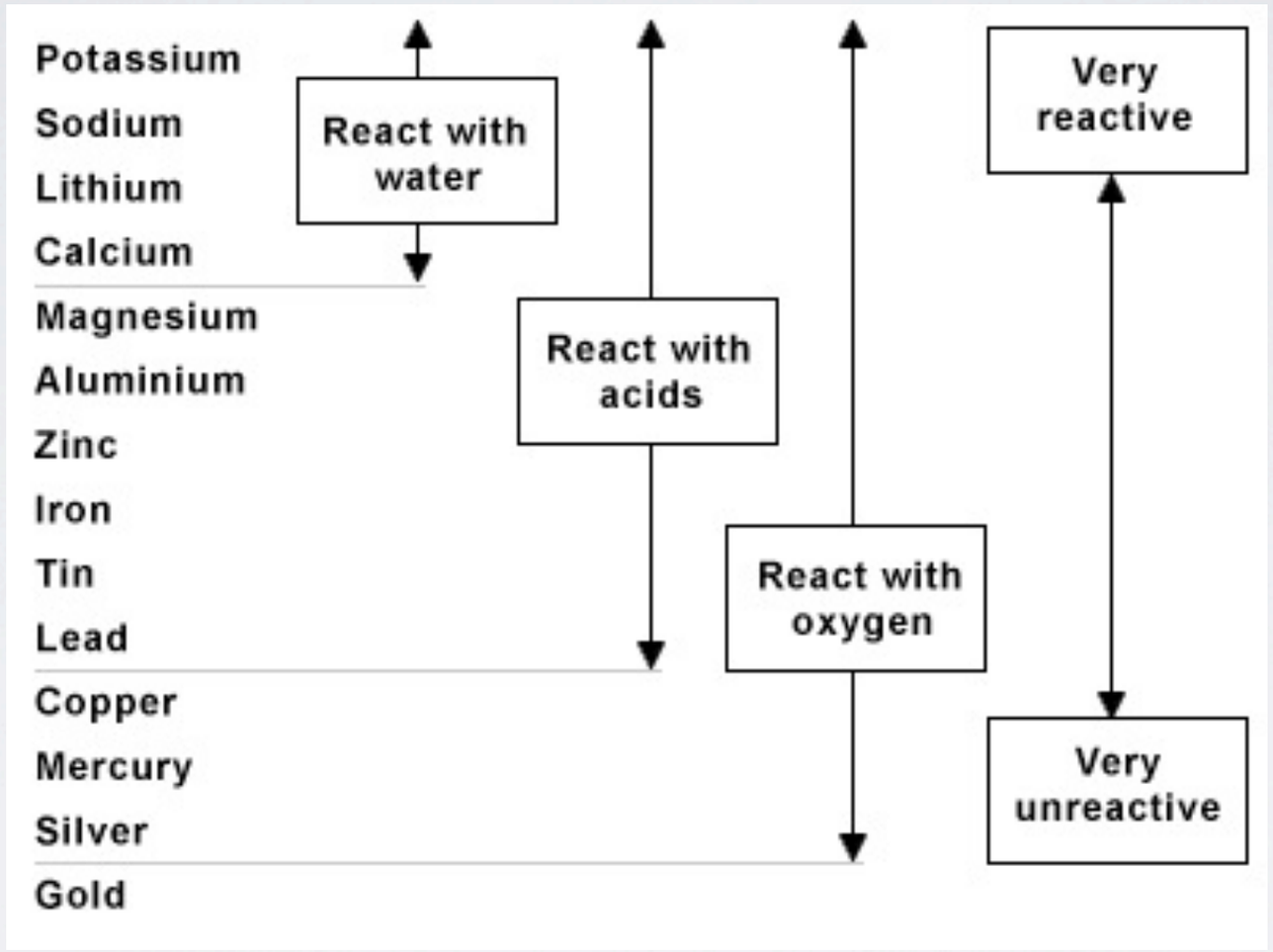
METAL DISPLACEMENT (OXIDES)

- More react metals will also replace less reactive metals in bonds with oxygen.

- When a mixture of iron and copper oxide is heated, the iron bonds with the oxygen and forces out the copper.

- $Fe + CuO \rightarrow FeO + Cu$

- In this reaction Fe is the reducing agent, and Cu is the oxidizing agent.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Very reactive
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