

# The Periodic Table

Big idea: Structure Determines Properties

## Key Vocabulary

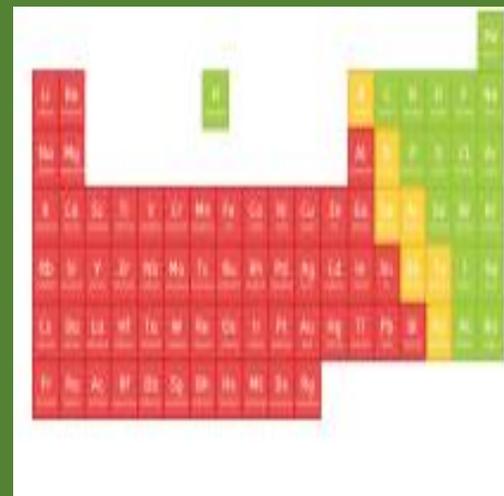
Mendeleev	Mendeleev's periodic table left gaps for the unknown elements which when discovered matched his predictions
Noble Gases	The noble gases in Group 0 are unreactive because of their very stable electron arrangements.
Alkali Metals	These are elements in group 1 of the periodic table and they all have 1 electron in their outermost shell.
Halogens	These are group 7 elements which have 7 electrons in their outermost shell.
Displace	A more reactive halogen will displace a least reactive halogen from an aqueous solution containing its salt.

## The development of the Periodic Table

In the early 1800s, elements were arranged by **atomic mass**. The periodic table was not complete because some of the elements had not been found. Some elements were put in the wrong group.

Dimitri Mendeleev (1869) left **gaps** in the periodic table. He put them in order of **atomic mass**. The gaps show that he believed there was some undiscovered elements. He was right! Once found, they fitted in the pattern.

## The Modern Periodic Table



Elements are in order of atomic mass/proton number. It shows where the **metals and non-metals** are. Metals are on the left and non-metals on the right.

The columns show the groups. The group number of electrons in the outer shell. The rows are periods—each period shows another full shell of electrons.

## The Noble Gases

The atoms of noble gases have **eight electrons** in their **outermost shell**, making the atoms very **stable**. The exception is the first of the noble gases, helium, which has just two electrons but this complete its first shell is also a very stable electronic structure.

## Alkali Metals

The alkali metals (group 1 elements) are soft and **very reactive** metals. They all have **one electron** on their **outer shell**, making them very reactive. They are low density. As you go down the group, they become more reactive

- They get bigger and it is easier to **lose** an electron that is further away from the nucleus.
- They form ionic compounds with non-metals.
- They react with water to produce hydrogen.

## Reactions of Alkali Metals

With oxygen	Forms a metal oxide	Metal + oxygen → metal oxide	e.g. $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$
With water	Forms a metal hydroxide and hydrogen	Metal + water → metal hydroxide + hydrogen	e.g. $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$
With chlorine	Forms a metal chloride	Metal + chlorine → metal chloride	e.g. $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$

## Explaining Trends

Li  
Na  
K  
Rb  
Cs

Getting more reactive

F  
Cl  
Br  
I  
At

Getting less reactive

Trends in reactivity as you go down the group can be explained in terms of the **attraction** between electrons in the **outermost shell** and the **nucleus**.

In deciding how easy it is for **atoms to lose or gain electrons** from their outermost shell depends on three factors:

- The size of the atom
- The shielding effect of inner electrons, and
- The nuclear charge

## Halogens

Consist of molecules made of a pair of atoms

Melting and boiling point increases down the group (gas → liquid → solid)

Reactivity decreases down the group

Have seven electrons in their outer shell. Form -1 ions.

Increasing atomic mass number.

Increasing proton number means an electron is more easily gained

### With metals

Forms a metal halide

Metal + halogen → metal halide  
e.g. Sodium + chlorine → sodium chloride

e.g. NaCl  
metal atom loses outer shell electrons and halogen gains an outer shell electron

### With hydrogen

Forms a hydrogen halide

Hydrogen + halogen → hydrogen halide  
e.g. Hydrogen + bromine → hydrogen bromide

e.g.  $\text{Cl}_2 + \text{H}_2 \rightarrow 2\text{HCl}$

### With solution of a halide salt

A more reactive halogen will displace the less reactive halogen from a salt

Chlorine + potassium bromide → potassium chloride + bromine

e.g.  $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$