Properties of Matter

S1-2-08 Relate the reactivity and stability of different families of elements to their atomic structure. Include: alkali metals, alkaline earths, chalcogens, halogens, noble gases

S1-2-11 Investigate properties of substances and explain the importance of knowing these properties. *Examples: usefulness, durability, safety*

We have been looking at the properties of different types of matter. These properties are classified into two categories:

Physical Properties:

- Are **CHARACTERISTICS** or **DESCRIPTIONS** of a **SUBSTANCE** that may help to **IDENTIFY** it.
- Are usually **EXTERNAL** **OBSERVATIONS** like **TOUCH**, **SIGHT**, **SMELL** etc.
- Do **NOT** involve the substance becoming a **NEW** **SUBSTANCE**.

Examples:

- **SOLID/LIQUID/GAS**
- **MALLEABILITY**
- **MELTING/BOILING POINTS**
- **HARDNESS**
- **DUCTILITY**
- **SOLUBILITY**

Most of the properties we have observed this far have been physical properties.

Chemical Properties:

- Describe the **BEHAVIOUR** of a substance as it **BECOMES** a **NEW SUBSTANCE**.
- Are the **WAYS** in which different substances **REACT** with eachother.

Examples:

- **COMBUSTIBILITY**
- **REACTIVITY**
- **REACTION** with **ACIDS**

Chemical Properties…

We saw earlier that a chemical property describes how one substance **REACTS** with another substance.

This property is known as **CHEMICAL REACTIVITY**, and it depends on the number of **ELECTRONS** that are in the **VALENCE SHELL**.

All **ATOMS** want to become **STRUCTURALLY** and **CHEMICALLY STABLE**.

→This means that they want to be **UNREACTIVE** like the **NOBLE GASES** (have **FULL OUTER SHELLS**).

An atom must obtain a **FULL OUTER SHELL** in order to become **STABLE** and **UNREACTIVE.**

To get a full outer shell an atom can:

1. ***Gain electons***
2. ***Lose electrons***
3. ***Share electrons***

Of these three, an atom will do whatever is **EASIEST**.

(if it has **1 VALENCE ELECTRON**, its easier to **LOSE** the 1 electron than it is to **FIND 7 MORE**)

This explains the **REACTIVITY** of the different **GROUPS** (**FAMILIES**) on the periodic table.

Hydrogen:

- Has only **1 ELECTRON**.
- It can **GAIN** an **ELECTRON** to **FILL** its **OUTER SHELL**.
- It can also **LOSE** an **ELECTRON** to "**FILL**" its **OUTER SHELL**.
- Therefore it is **VERY**, **VERY REACTIVE** and **EXPLOSIVE**.

Bohr Diagram for hydrogen:

Alkali Metals:

- Have only **ONE VALENCE ELECTRON**.
- Will lose the **1 ELECTRON**, rather than **GAIN SEVEN** more to **FILL** the **OUTER SHELL**.
- They are **VERY REACTIVE** because they are **SO CLOSE** to having a **FULL OUTER SHELL**, and they want to **LOSE** the one electron **VERY BADLY**.

Bohr Diagram for lithium:

Alkaline Earth Metals:

- Have **TWO VALENCE ELECTRONS**.
- Would rather **LOSE** the **2 ELECTRONS** than **GAIN 6** more.
- **LESS REACTIVE** than **ALKALI METALS**.
- They are still **VERY REACTIVE** because it is quite **EASY** to **LOSE 2 ELECTRONS**, but not as easy as losing **1**.

Bohr Diagram for magnesium:

Chalcogens:

- Have **6 VALENCE ELECTRONS**.
- Would rather **GAIN 2** electrons than **LOSE ALL 6**.
- Are **QUITE REACTIVE**, since it is **FAIRLY EASY** to **FIND TWO** electrons. They are **NOT** as **REACTIVE** as the **HALOGENS**.

Bohr Diagram for oxygen:

Halogens:

- Have **7 VALENCE ELECTRONS**.
- Will **GAIN 1** more **ELECTRON** to **FILL** their **OUTER SHELL** (easier than **LOSING 7**)
- Are **VERY REACTIVE** because, like **ALKALI METALS**, they are **VERY CLOSE** to being like the noble gases so they react **VERY VIGOROUSLY** to **GAIN** an **ELECTRON**.

Bohr Diagram for chlorine:

Let's make a chart to organize this information:

Family	# Valence Electrons	Gain or Lose?	# Electrons Gained/Lost?	Reactivity
Hydrogen				
Alkali Metals				
Alkaline Earth Metals				
Chalcogens				
Halogens				
Noble Gases				

Questions:

1. Make a rule to determine the reactivity of an element based on the number of valence electrons.

2. Which families do you think would most likely react well with each other?