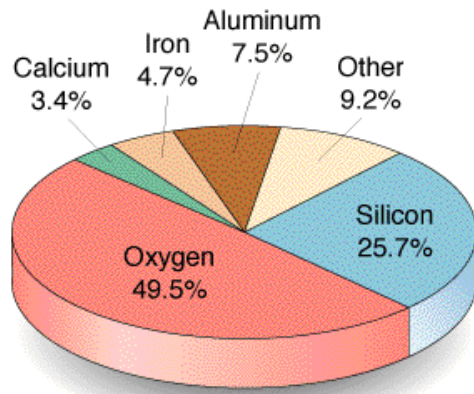
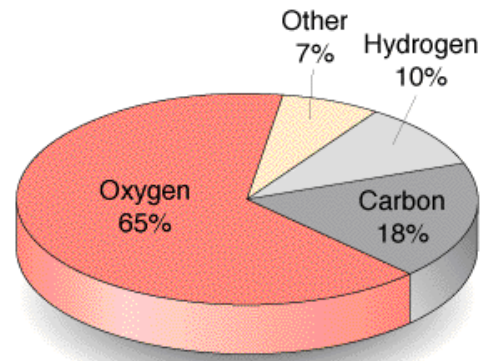


# Chapter 2: The Chemistry of Life



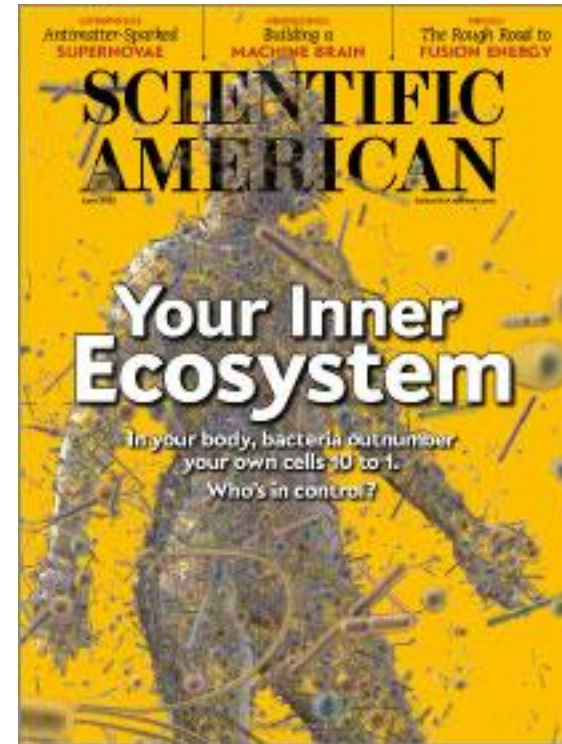
Earth's crust

(a)



Human body

(b)



# Nature of Matter

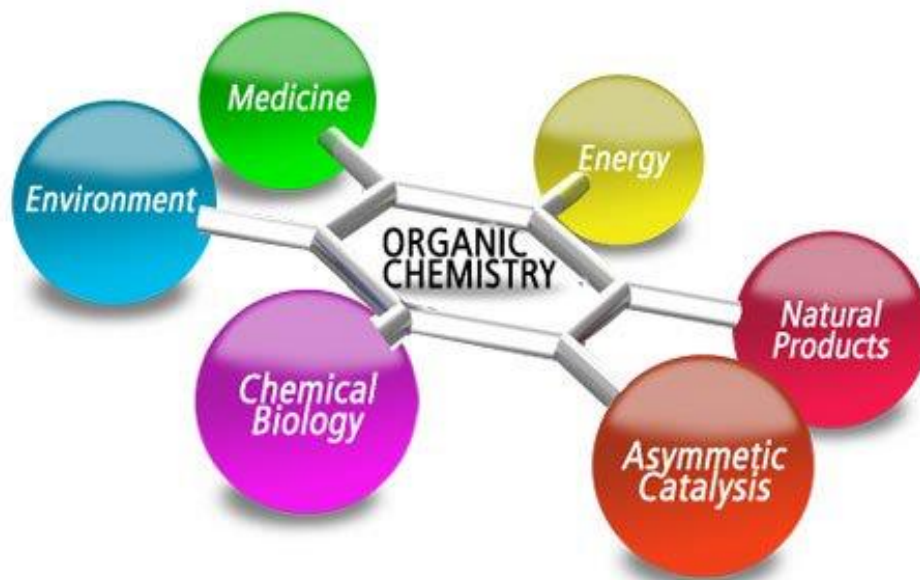
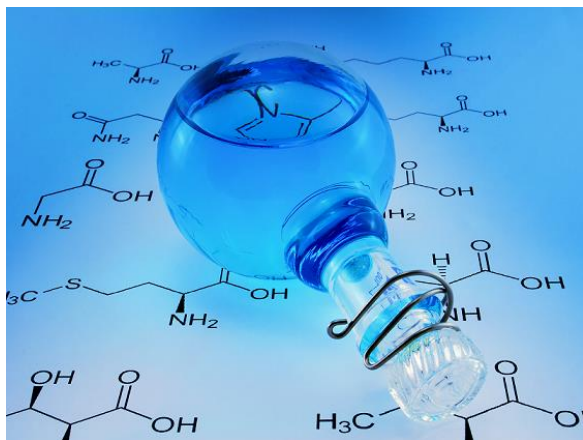
## Objectives:

- Identify the three subatomic particles that make up atoms.
- Explain how isotopes of an element are similar and how they are different.
- Explain how compounds are different from their component elements.
- Describe two major types of chemical bonds.

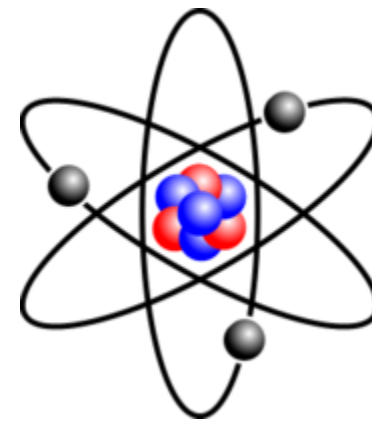
# Organic Chemistry

Why is studying chemistry important in Biology?

All organism are chemical machines



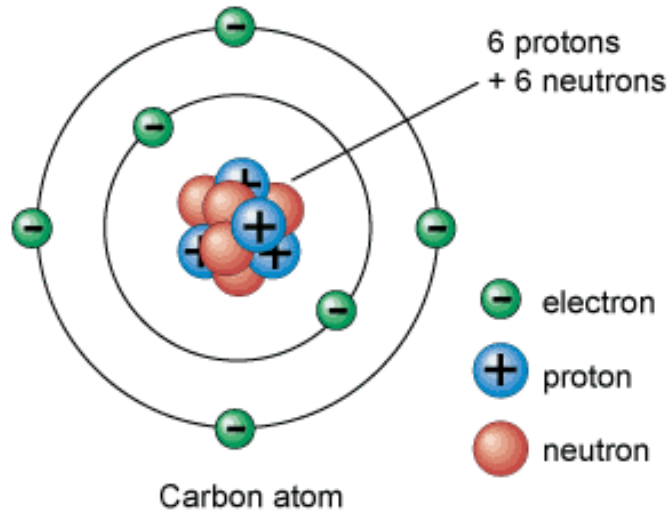
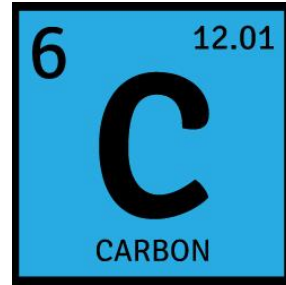
# Atoms



## What does all matter have in common?

- **Atom** - smallest unit of matter that cannot be broken down by chemical means
- Consist of **protons**, **neutrons**, and **electrons**

# Atoms



**Protons** and **Neutrons** make up the atom's **nucleus**

The **electrons** make up the electron **cloud** that orbit the nucleus

Protons (+), Neutrons (no charge), and Electrons are (-)

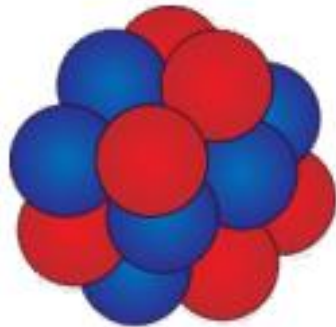
Usually the number of **protons** and electrons are equal, since they are equal the atom has no overall **charge**

# Elements

**Element**- pure substance made of only one kind of atom

Elements differ in the number of protons

Atoms of an element that have a different number of neutrons  
are called **isotopes**

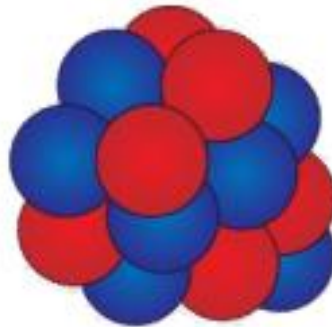


**Carbon-12**

98.9%

6 protons

6 neutrons

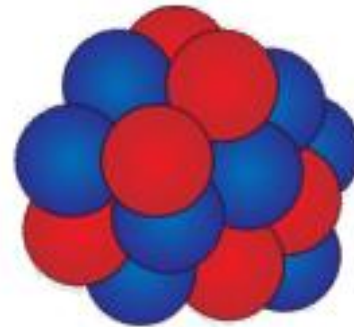


**Carbon-13**

1.1%

6 protons

7 neutrons



**Carbon-14**

<0.1%

6 protons

8 neutrons

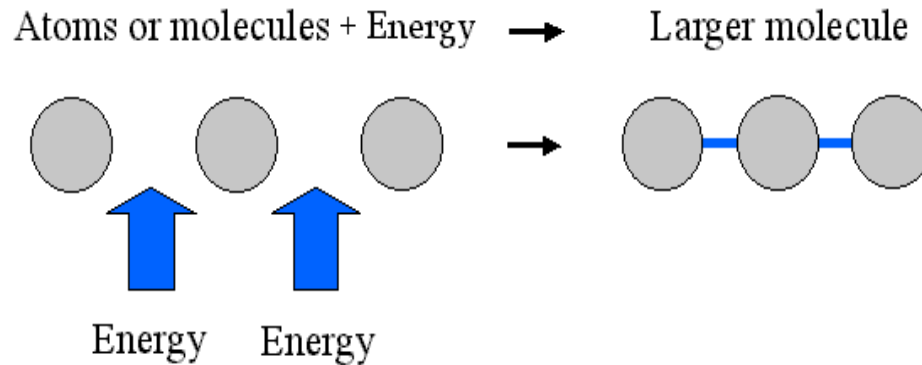
# Chemical Bonds

- A **chemical bond** is an attractive force existing between two atoms when their **electrons interact**
- Atoms can **join** with other atoms to form stable substances
- A force that joins the 2 is called a **chemical bond**
- **Compound**- a substance made of joined atoms of 2 or more different elements
- Example:
- $\text{Na} + \text{Cl} = \text{NaCl}$  “Table Salt”



# Chemical Bonding

## 1. Making of chemical bonds Stores Energy.



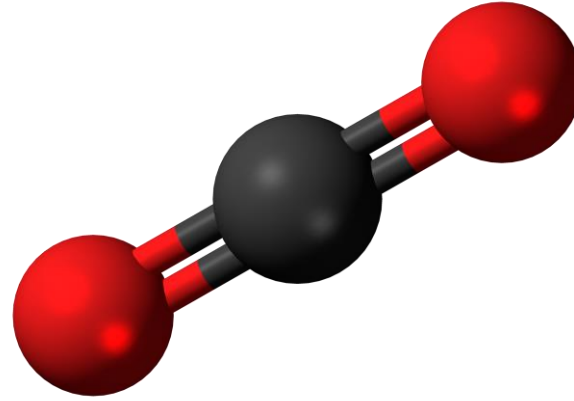
## 2. The breaking of chemical bonds Releases Energy



**Mitochondria** (powerhouse of the Eukaryotic cell)



# Chemical Bonding



**Covalent bonding**- when 2 or more atoms share electrons to form a molecule

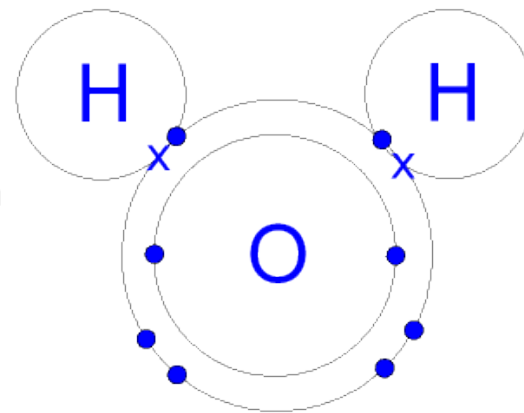
- **Molecule**- is a group of atoms held together by covalent bonds
- Because the number of protons = the number of electrons the molecule has no net **electrical** charge
- EX: CO<sub>2</sub>

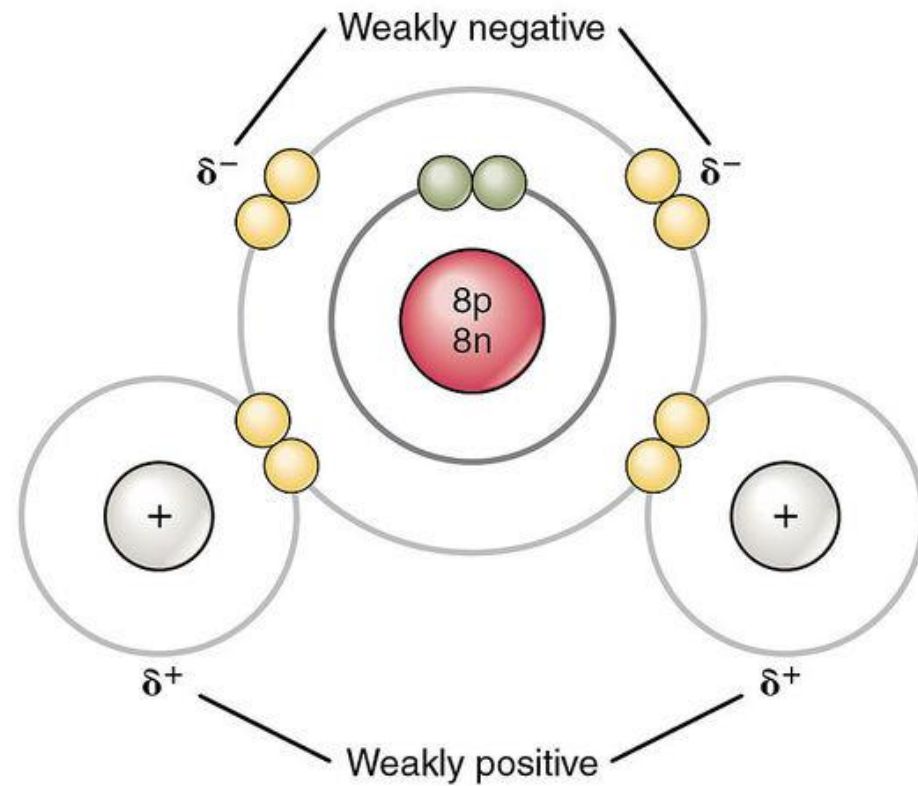
# Chemical Bonding

## Covalent bonding

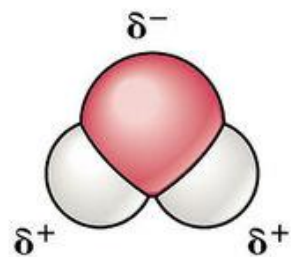
- An atom becomes stable when its outer electron level is **full (8 electrons)**
- If the outer level isn't full, it will **react** with other atoms to **fill** its outer electron shell

Example: **water H<sub>2</sub>O**:  
hydrogen has 1 electron in its outer shell and oxygen has 6  
For a total of 8 shared electrons

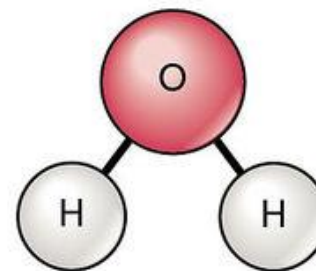




(a) Planetary model of a water molecule



(b) Three-dimensional model of a water molecule



(c) Structural formula for water molecule

# All non-metals form covalent bonds

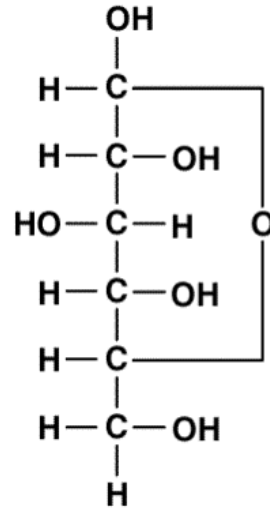
Examples of organic compounds:

glucose

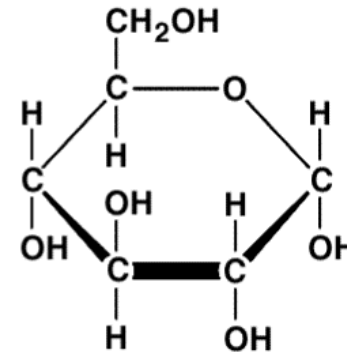
water

carbon dioxide

sucrose



Glucose

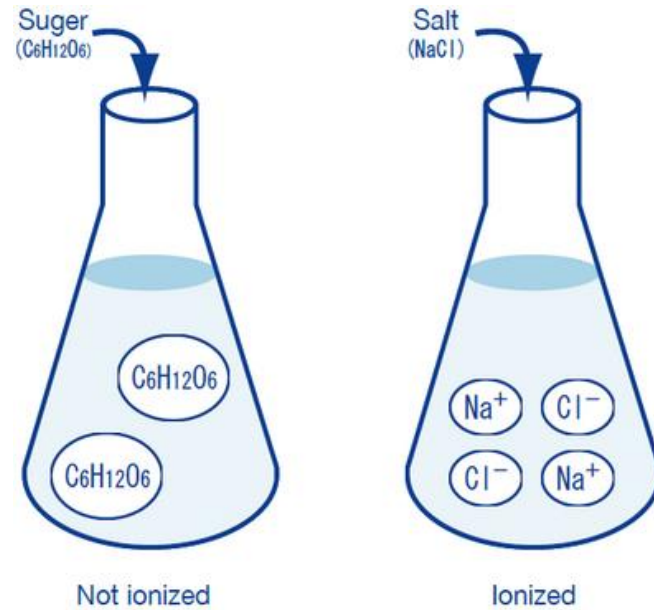
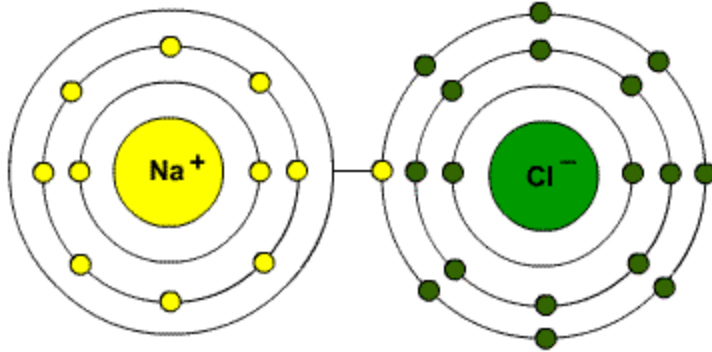


**Recall:**

Making of chemical bonds Stores Energy.

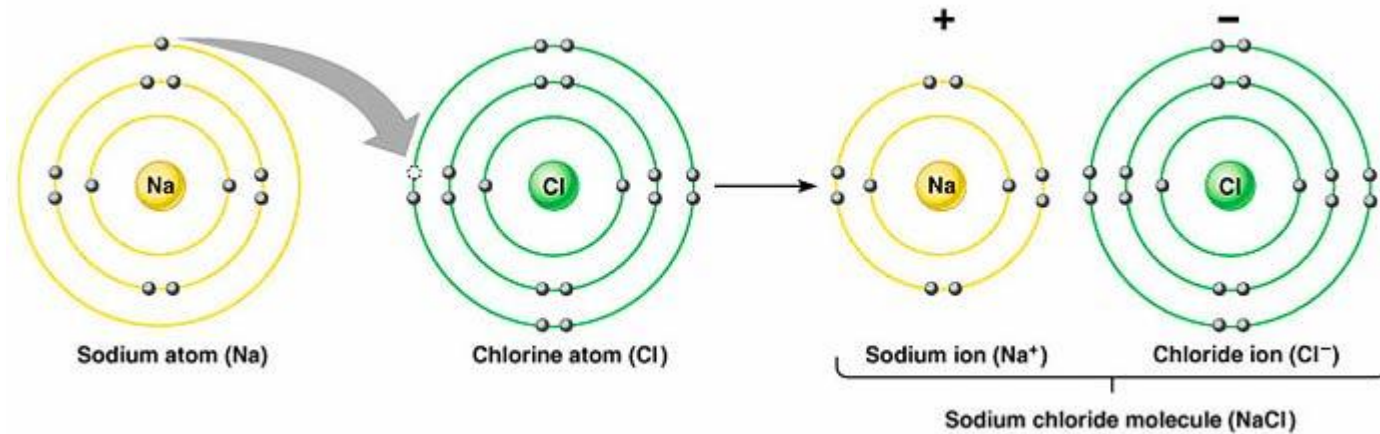
The breaking of chemical bonds Releases Energy

# Ionic Bonds



- Sometimes atoms **gain** or **lose** electrons
- An atom or molecule has gained or lost one or more electrons are called **ions**
- Ions have an electrical charge b/c they contain an **unequal** number of **electrons** and **protons**

# Ionic Bonds



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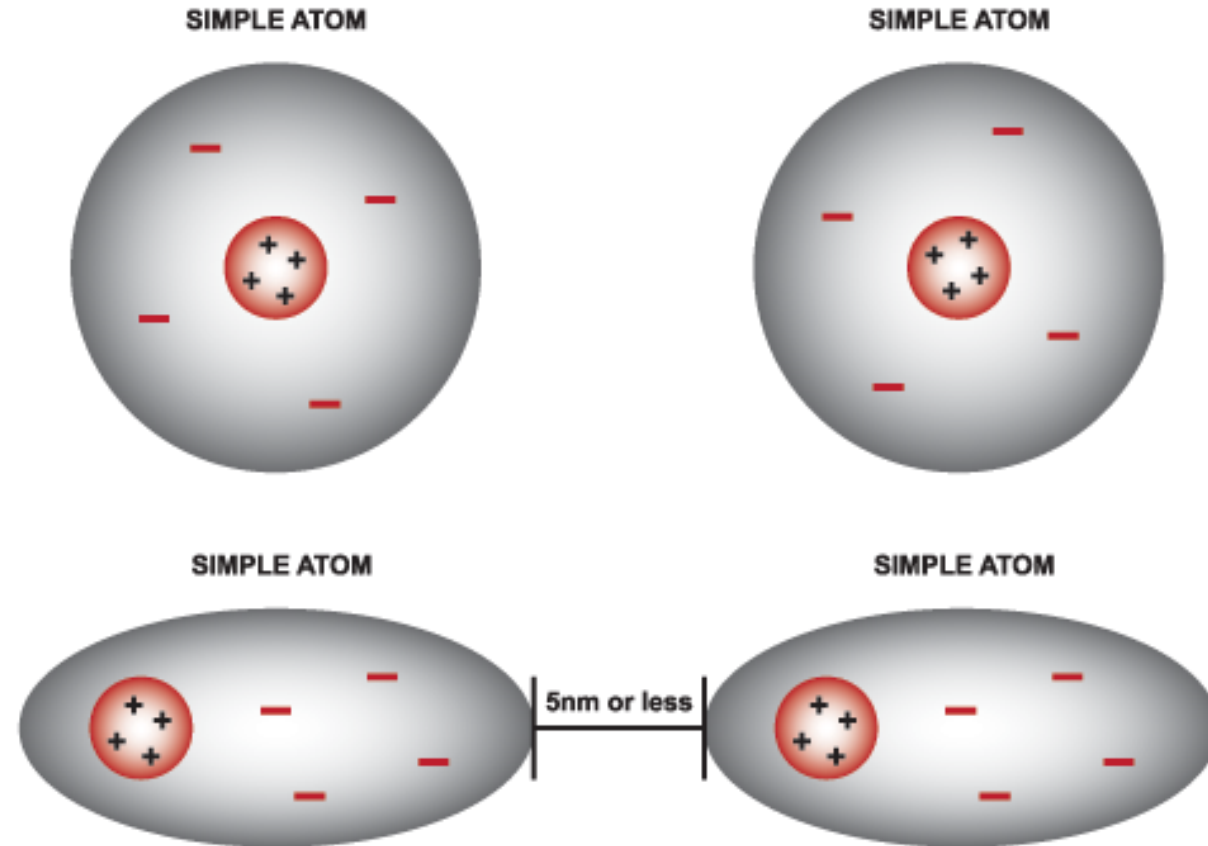
- An atom that has lost electrons are **POSITIVELY CHARGED**
- An atom that has gained electrons are **NEGATIVELY CHARGED**
- Ions of opposite charges can interact to form **Ionic Bonds**

## VAN DER WAALS' FORCES (VDW) DIAGRAM

### KEY

+ POSITIVE NUCLEUS

- NEGATIVE CHARGED ELECTRON CLOUD



When two atoms come within 5 nanometers of each other, there will be a slight interaction between them, thus causing polarity and a slight attraction.

Van der Waals Forces

# The Nature of Matter

## Objectives:

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