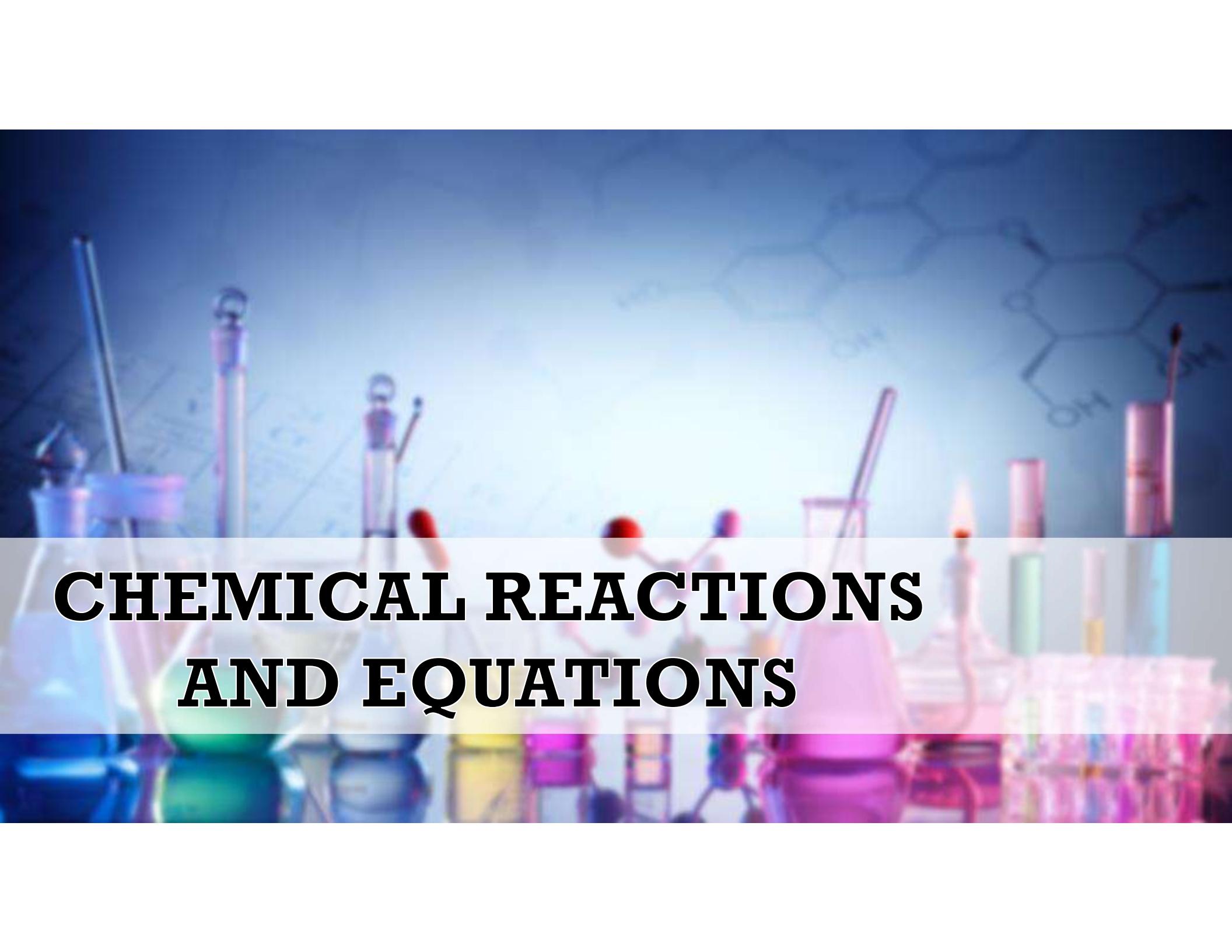




CHEMICAL REACTIONS AND EQUATIONS

- **Module_01**



CHEMICAL REACTIONS AND EQUATIONS

INTRODUCTION



Milk is left at room temperature during summers



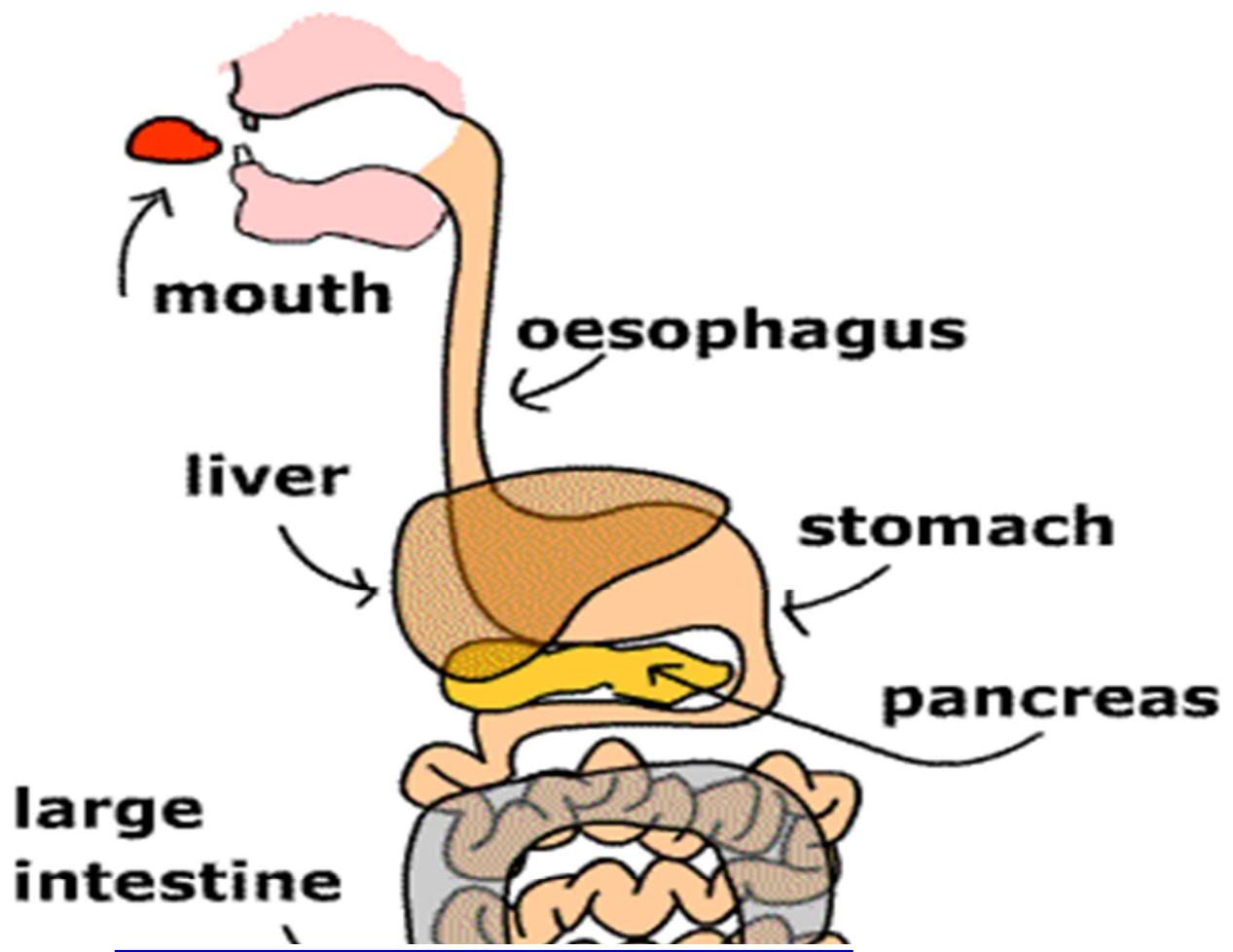
An iron tawa/pan/nail is left exposed to humid atmosphere.



Grapes get fermented

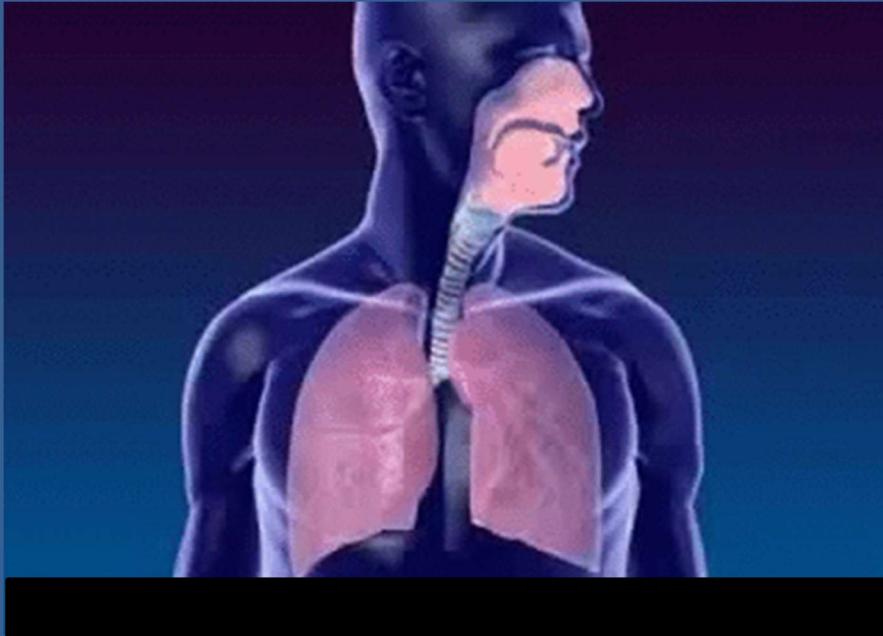


Food is cooked



Food gets digested in
our body.

small
intestine



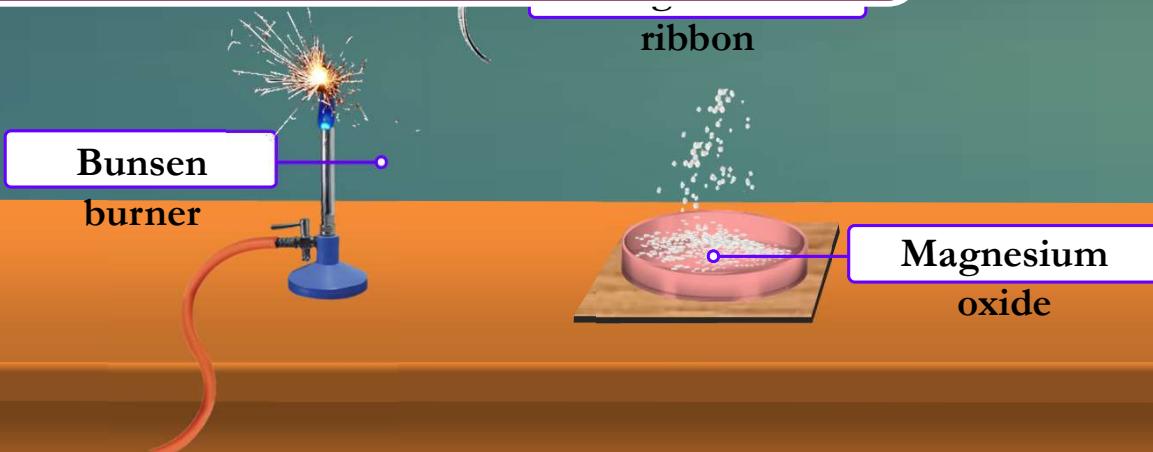
We respire

In all the above situations, the nature and the identity of the initial substance have somewhat changed.

Whenever a chemical change occurs, we can say that a chemical reaction has taken place.

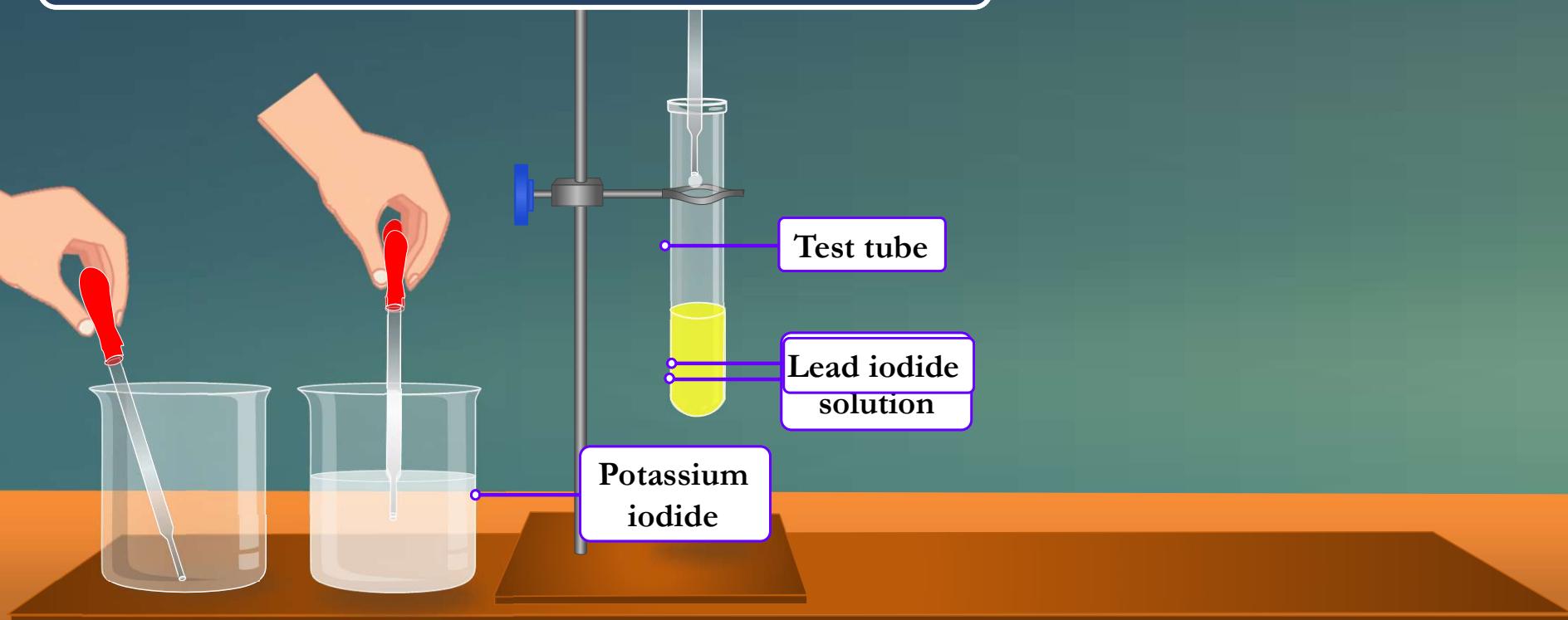
Reaction

- As we have observed that magnesium ribbon burns with a dazzling white flame.
- It changes into a white powder.
- This powder is magnesium oxide.
- It is formed due to the reaction between magnesium and oxygen.



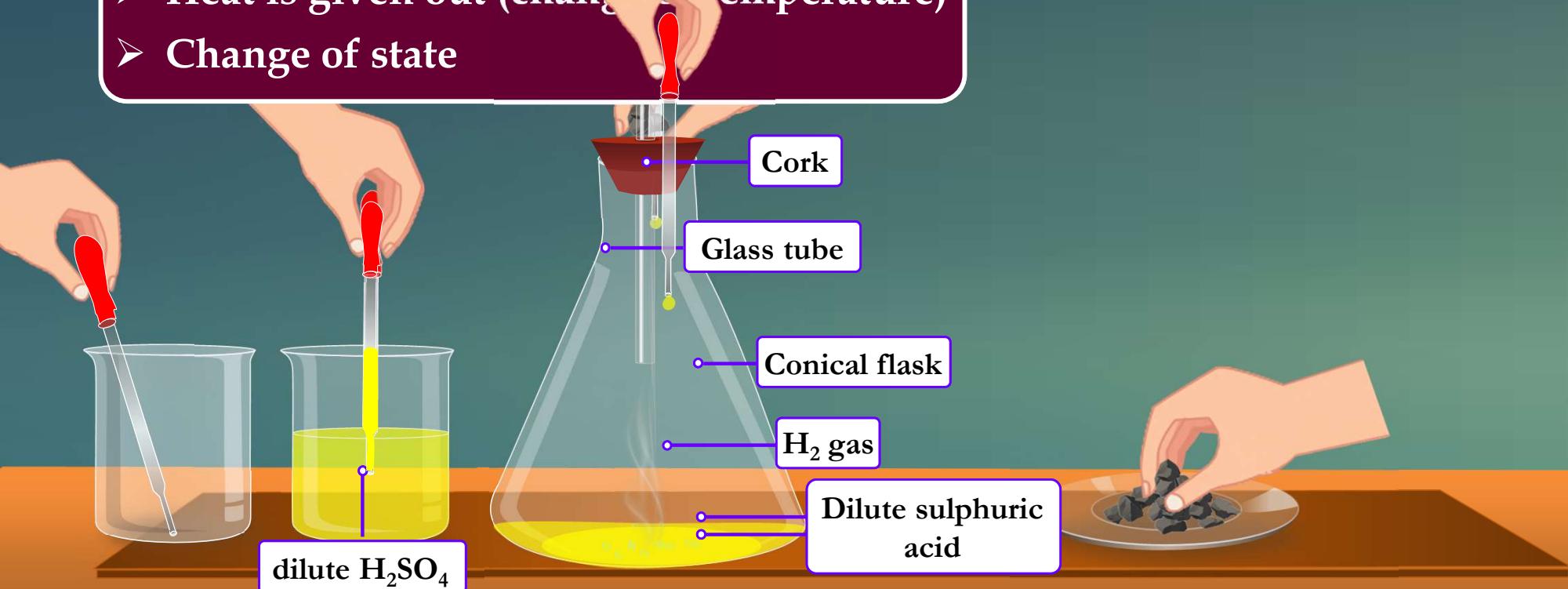
Activity

- Yellow coloured precipitate of lead iodide is formed.



Reactions

- Formation of bubbles (solution of gas)
- Heat is given out (change in temperature)
- Change of state



1

From the above three activities, we can say that any of the following observations helps us to determine whether a chemical reaction is taking place.

2 Change in colour

3

Evolution of a gas

4

Change in temperature

5

Formation of precipitate

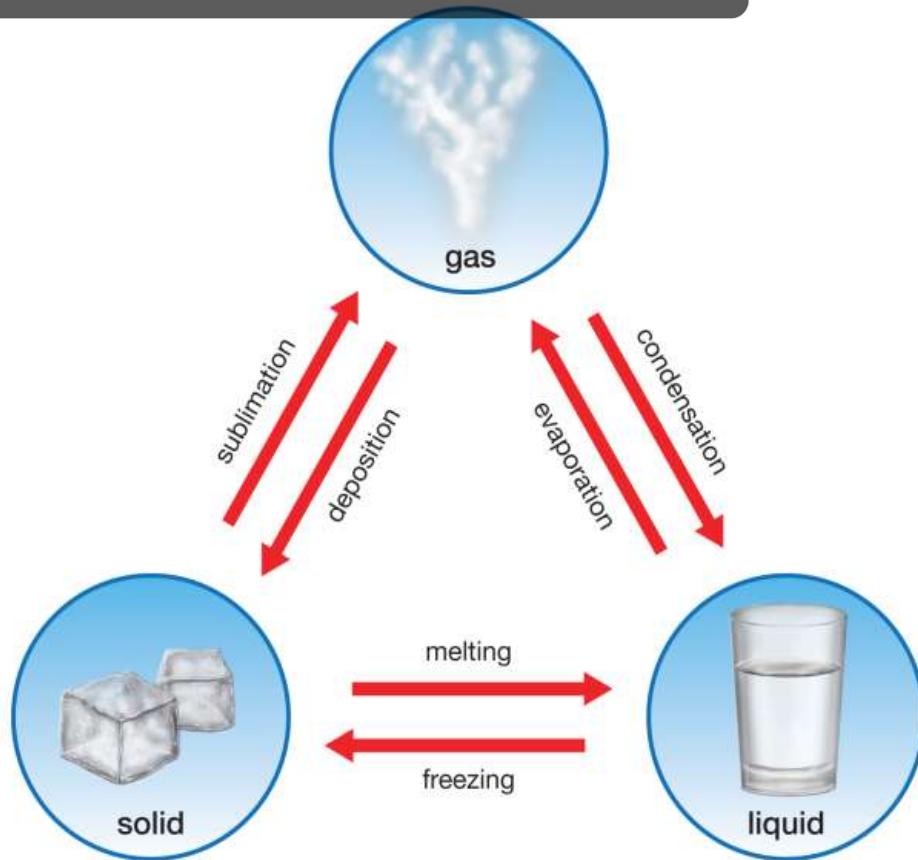


CHEMICAL REACTIONS AND EQUATIONS

- **Module_02**

CHEMICAL REACTIONS AND EQUATIONS

Change in state



Change in colour



Evolution of a gas



Change in temperature



Formation of a precipitate



VALENCY CHART

OH^-	- Hydroxide
Cl^-	- Chloride
Br^-	- Bromide
I^-	- Iodide
NO_3^-	- Nitrate
HCO_3^-	- Bicarbonate
AlO_2^-	- Aluminate
Ag^+	- Silver
Na^+	- Sodium
H^+	- Hydrogen
K^+	- Potassium

sab ki
valency
hai 1

Cd^{2+}	- Cadmium
Ca^{2+}	- Calcium
Mg^{2+}	- Magnesium
Hg^{2+}	- Mercury
Zn^{2+}	- Zinc
Ba^{2+}	- Barium
O^{2-}	- Oxide
S^{2-}	- Sulphide
CrO_4^{2-}	- Chromate
CO_3^{2-}	- Carbonate
SO_4^{2-}	- Sulphate
ZnO_2^{2-}	- Zincate

sab ki
valency
hai 2

Copper (Cu) and Iron (Fe) both of them have variable valency

Copper - 1, 2 Iron - 2, 3 but

but Aluminium (Al) ki valency hai fixed 3

NH_4^+ - Ammonium 1, Pb^{2+} - Lead - 2

CHEMICAL EQUATIONS

A simple representation of a chemical reaction in words is called a word equation.

Arrow indicates

- to yield
- shows the direction



Left Hand Side (L.H.S)

Reactants

Right Hand Side (R.H.S)

Products

A chemical equation is a short-hand form for a chemical change.

Arrow indicates

- to yield
- shows the direction



Left Hand Side (L.H.S)

Reactants

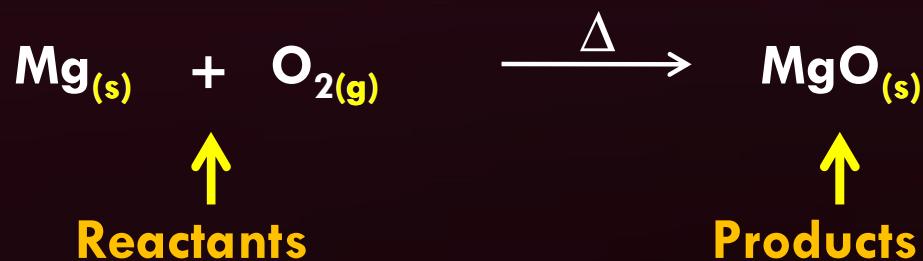
Right Hand Side (R.H.S)

Products

If the number of atoms of each element on the both sides is same then it is balanced
So above reaction is example of skeletal chemical equation.
equation else equation is unbalanced or skeletal chemical equation.

STEPS INVOLVED IN WRITING CHEMICAL EQUATION

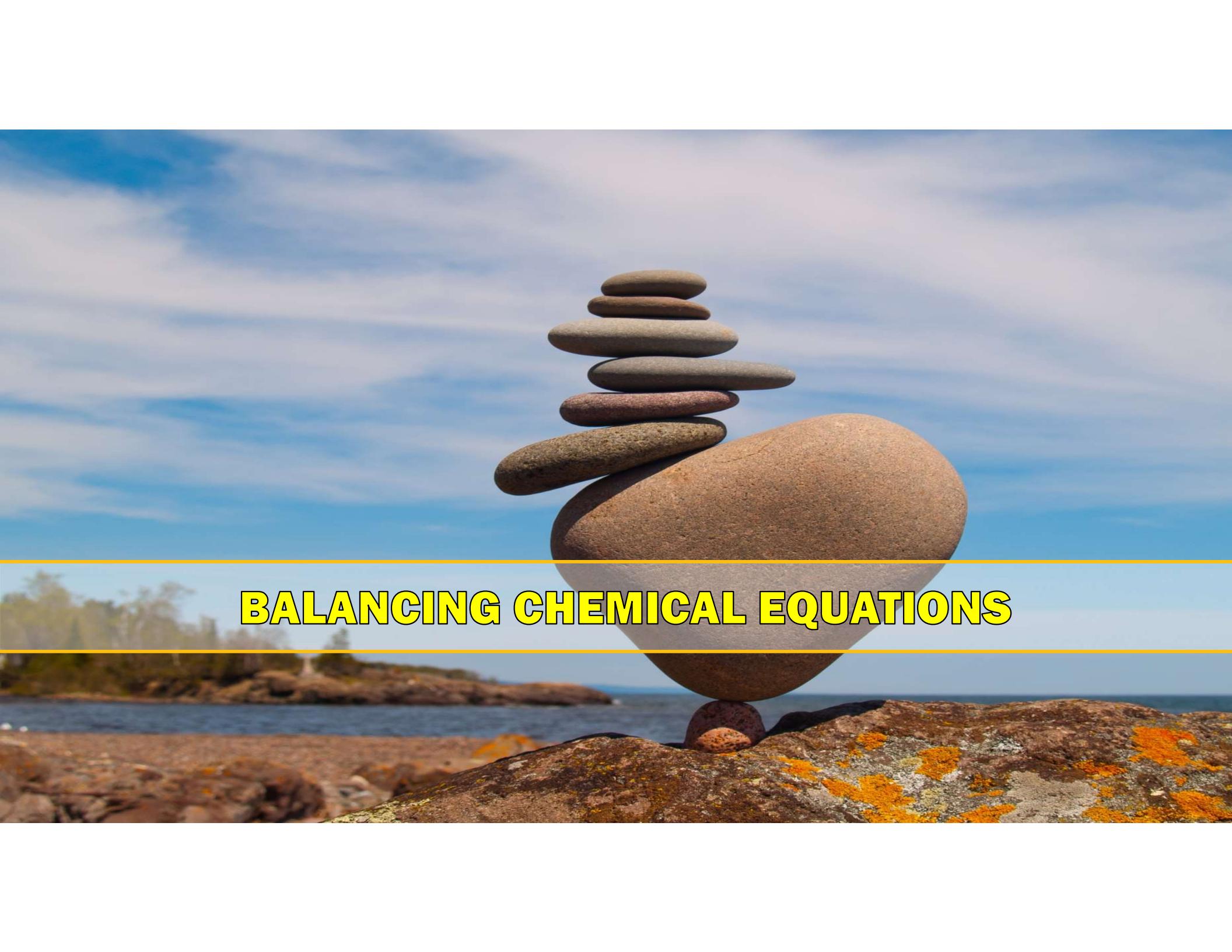
- 1) Reactants: LHS and Products: RHS
 - 2) Reactants and Products: separated by an ARROW
 - 3) 2 or more reactants /products: separated by
PLUS(+)SIGN
 - 4) Conditions: mentioned ON ARROW
 - 5) PHYSICAL STATES of reactants and product:
to make reaction more informative





CHEMICAL REACTIONS AND EQUATIONS

- **Module_03**



BALANCING CHEMICAL EQUATIONS

LAW OF CONSERVATION OF MASS :

Mass can neither be created nor destroyed in a chemical reaction. That is, the total mass of the elements present in the products of a chemical reaction has to be equal to the total mass of the elements present in the reactants.



Total mass of elements in the reactants = Total mass of elements in the products

- As the number of atoms of each element is the same on both sides of the arrow.
- Hence it is a **balanced** chemical equation.



	Reactants (LHS)	Products (RHS)
Element	Number of atoms	Number of atoms
Zn	1	1
H	2	2
S	1	1
O	4	4

Step I

- Draw boxes around each formula

Step II

- List the number of atoms of different elements



	Reactants (LHS)	Products (RHS)
Element	Number of atoms	Number of atoms
Fe	1	3
H	2	2
O	1	4

Step III

- For example to balance oxygen atoms we can put coefficient 4 as $4 \text{ H}_2\text{O}$ and not H_2O_4 or $(\text{H}_2\text{O})_4$ atoms.
- Fe₃O₄**



Atoms of oxygen	In reactants	In products
(i) initial	1 in H_2O	4 in (Fe_3O_4)
(ii) To balance	1×4	4

Step IV

- Let us balance hydrogen atoms in the partly balanced equation.



Atoms of hydrogen	In reactants	In products
(i) initial	8 (in 4 H ₂ O)	2 (in H ₂)
(ii) To balance	8	2x4

Step V

- Let us balance Iron atoms in the partly balanced equation.



Atoms of Iron	In reactants	In products
(i) initial	1 (in Fe)	3 (in Fe_3O_4)
(ii) To balance	1×3	3

Step VI

- Check the correctness of the balanced equation.
- This method of balancing chemical equations is called hit -and-trial method.



Step VII

- The physical states of the reactants and products are mentioned along with their chemical formulae.
- The gaseous, liquid, aqueous and solid states of reactants and products are represented by the notations (g), (l), (aq) and (s).

So the balanced equation becomes



Step VIII

- Sometimes the reaction conditions, such as temperature, pressure, catalyst, etc., for the reaction are indicated above and/or below the arrow in the equation.

For example





CHEMICAL REACTIONS AND EQUATIONS

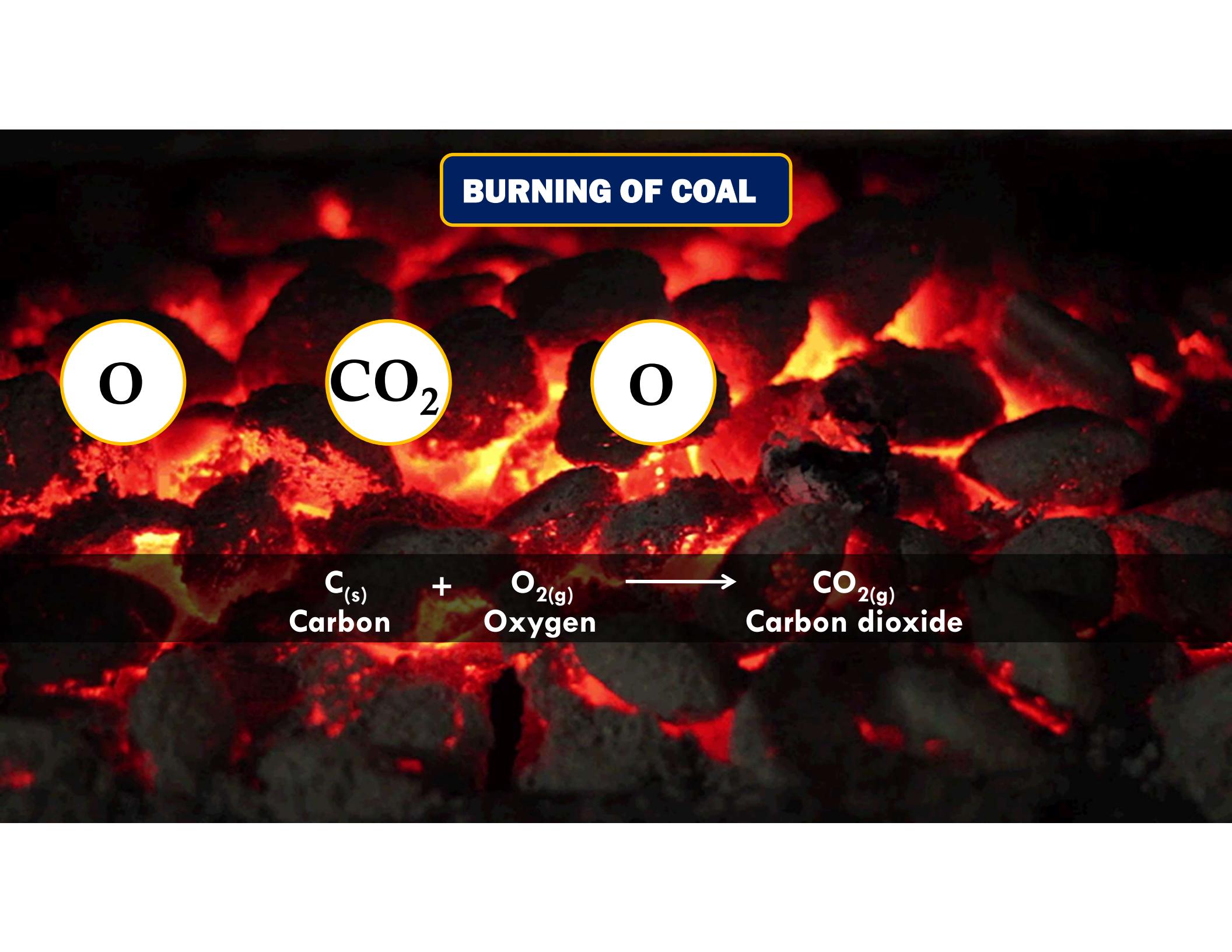
- **Module_04**

TYPES OF CHEMICAL REACTIONS

We have learnt that during a chemical reaction atoms of one element do not change into those of another element.

Nor do atoms disappear from the mixture or appear from elsewhere.

Actually, chemical reactions involve the breaking and making of bonds between atoms to produce new substances.



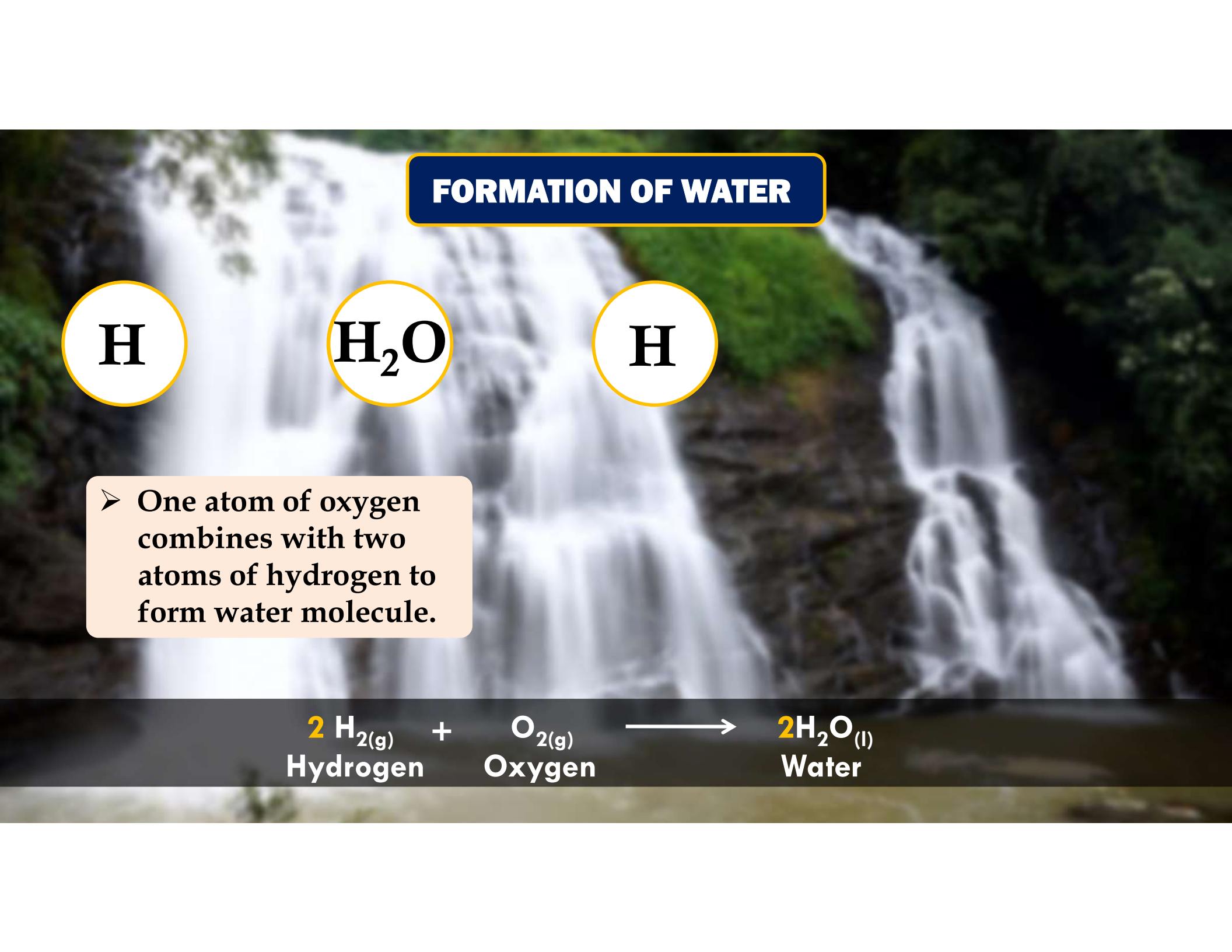
BURNING OF COAL

O

CO₂

O



A blurred background image of a waterfall cascading down a rocky cliff into a pool of water, surrounded by dense green foliage.

FORMATION OF WATER

H

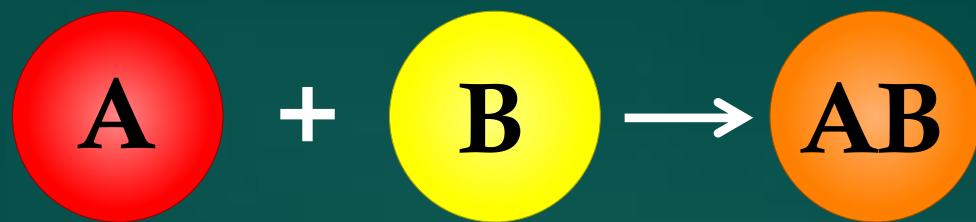
H₂O

H

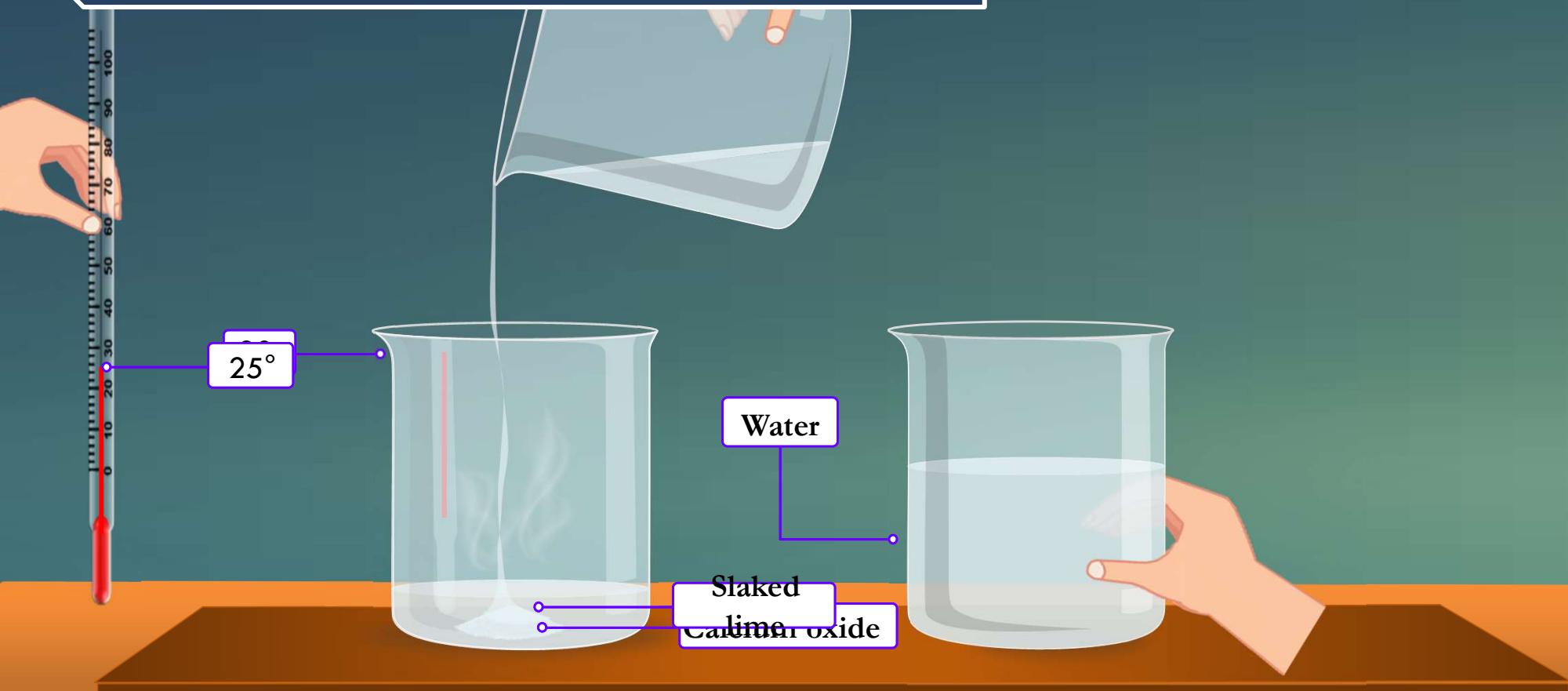
- One atom of oxygen combines with two atoms of hydrogen to form water molecule.



COMBINATION REACTION



A chemical reaction in which two or more reactants combine to form a Single product, is called **COMBINATION REACTION**.



Do You Know?

- A solution of slaked lime produced is used for white washing walls.
- Calcium hydroxide reacts slowly with the carbon dioxide in air to form a thin layer of calcium carbonate on the walls.
- Calcium carbonate is formed after two to three days of white washing and gives a shiny finish to the walls.
- It is interesting to note that the chemical formula for marble is also CaCO_3 .





CHEMICAL REACTIONS AND EQUATIONS

- **Module_05**

EXOTHERMIC REACTION

i. Burning of natural gas :

Reactions in which heat is released along with the formation of products are called exothermic chemical reactions.



i. **Respiration reaction :**

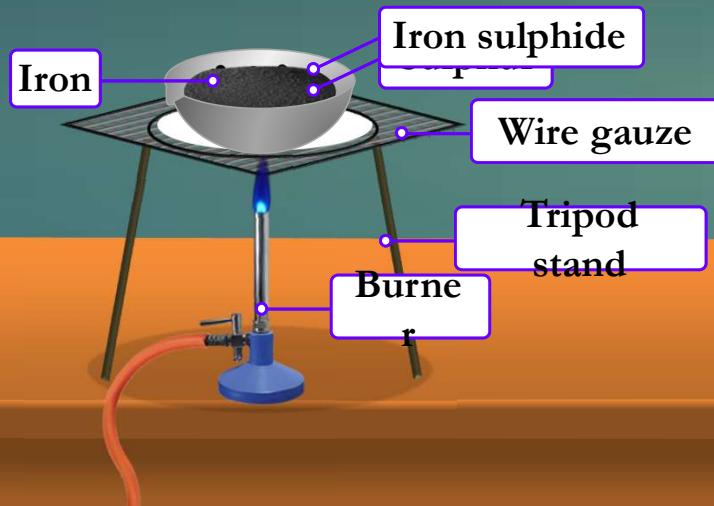


The decomposition of vegetable matter into compost is also an example of an exothermic reaction.

Endothermic reaction



- Reactions in which heat is absorbed are called endothermic chemical reactions.

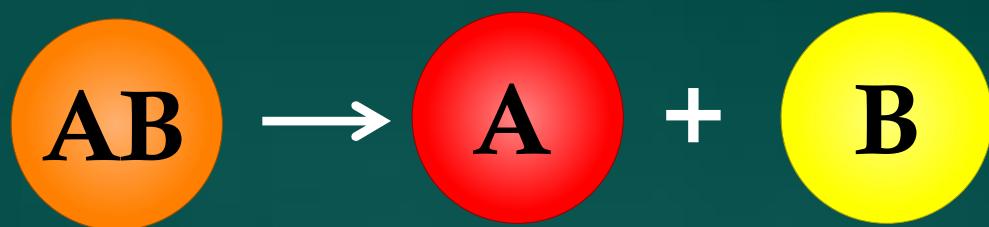




CHEMICAL REACTIONS AND EQUATIONS

- **Module_06**

DECOMPOSITION REACTION



A chemical reaction in which a compound is split into two or more simple substances is called as **DECOMPOSITION REACTION**.

DECOMPOSITION REACTION

Can take place under 3 conditions

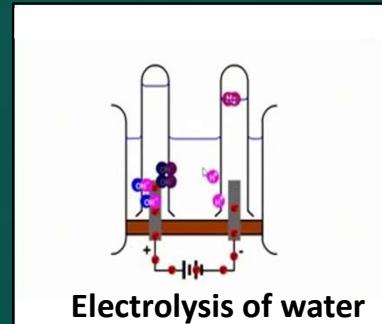
HEAT



LIGHT ENERGY



ELECTRICITY



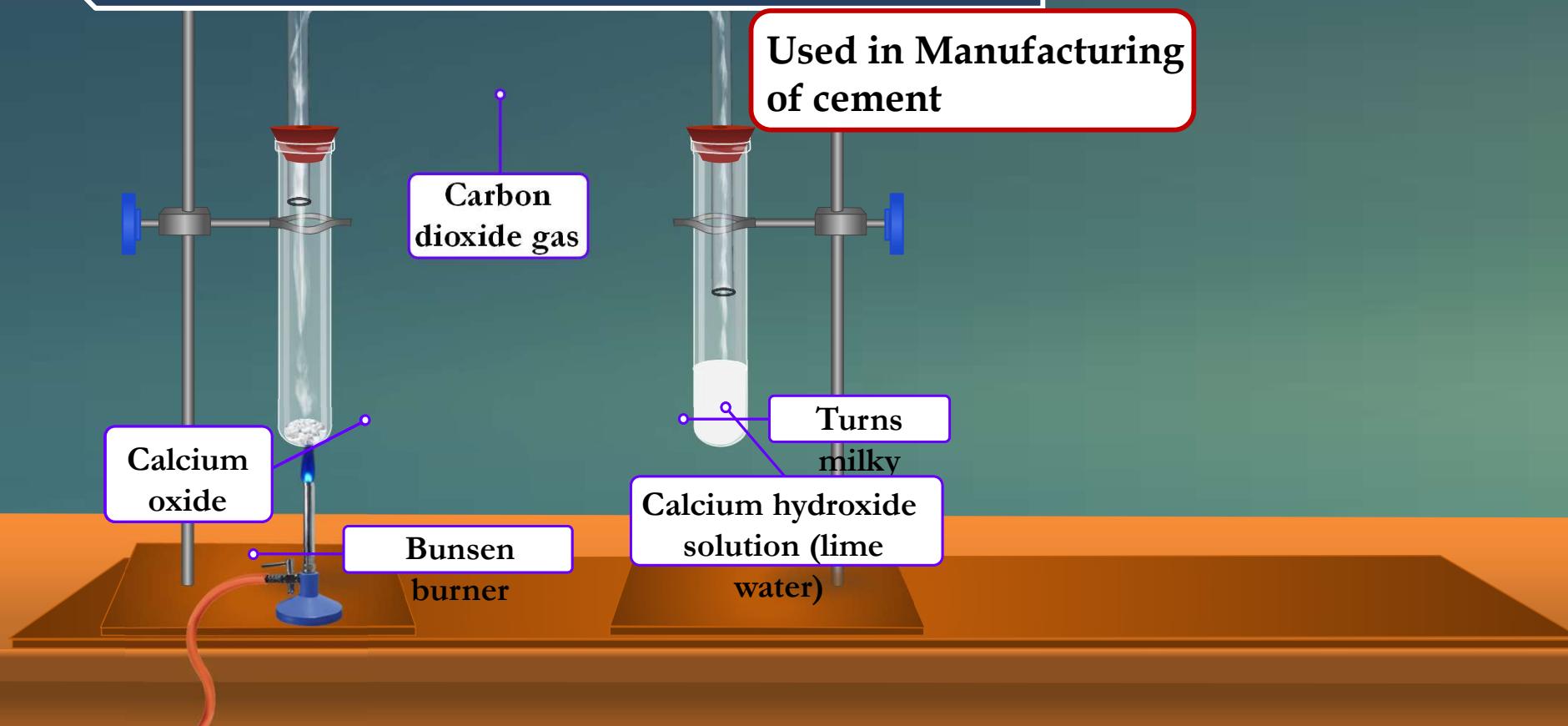
$\text{CaCO}_{3(s)}$
Calcium
carbonate
(Limestone)

Heated

HEATING OF CALCIUM CARBONATE

Calcium
oxide
(Quick lime)

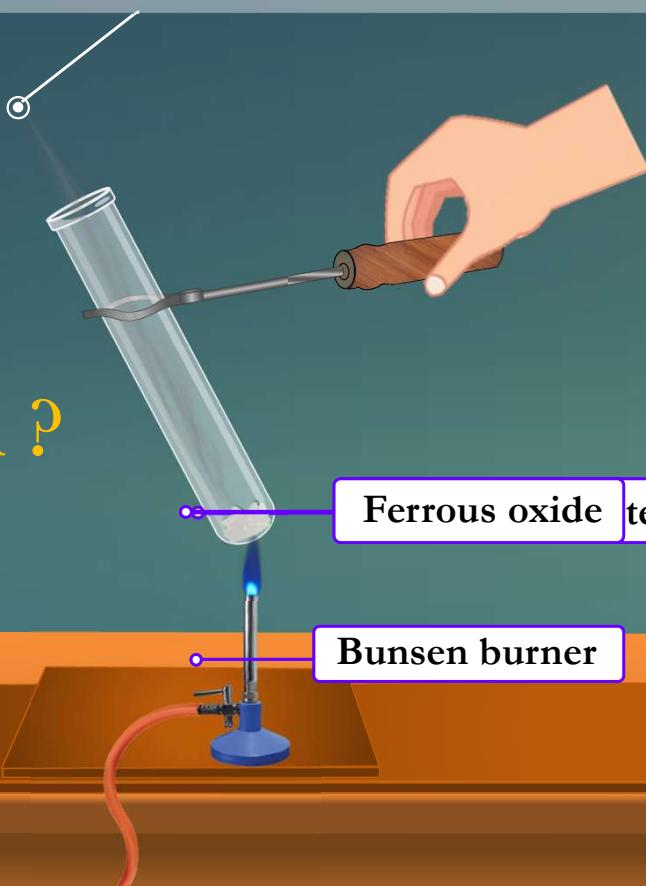
Carbon
dioxide





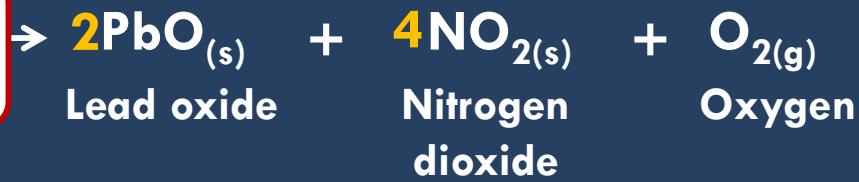
PHATE

yourself.

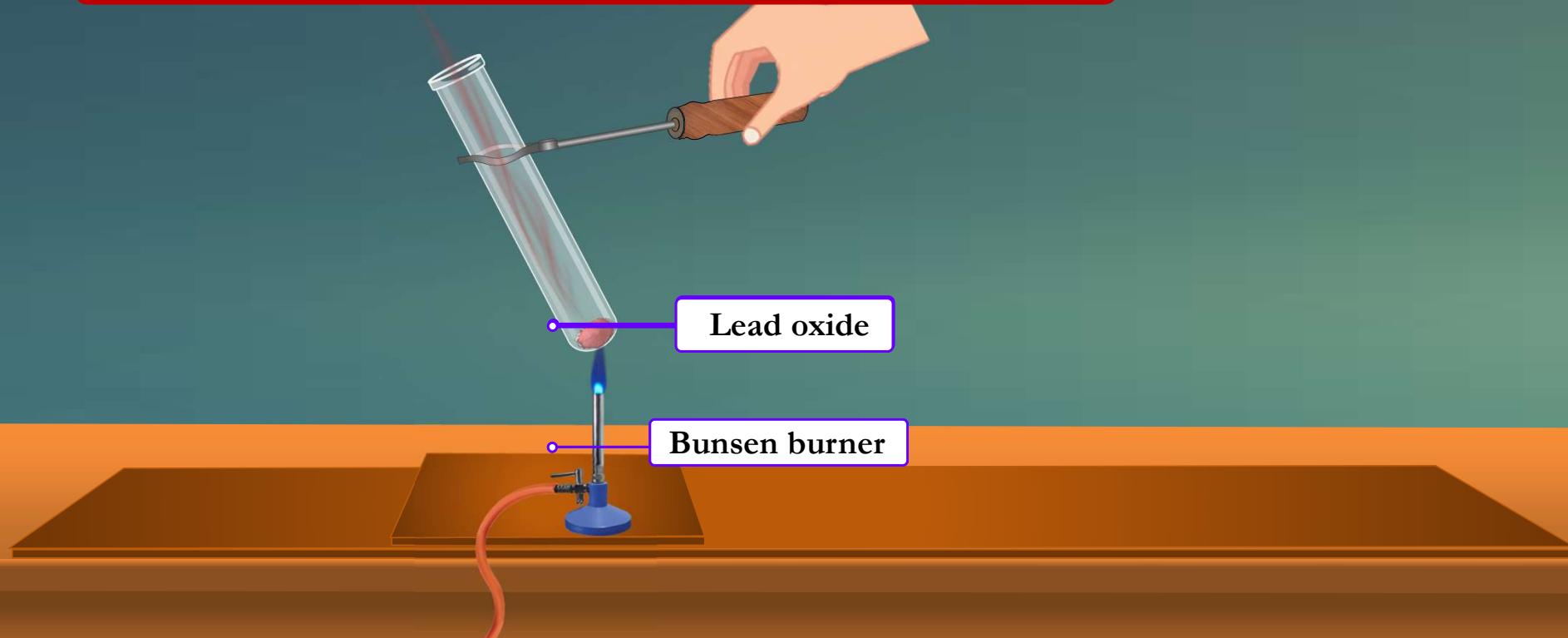


Smell ?

Brown fumes
of nitrogen oxide



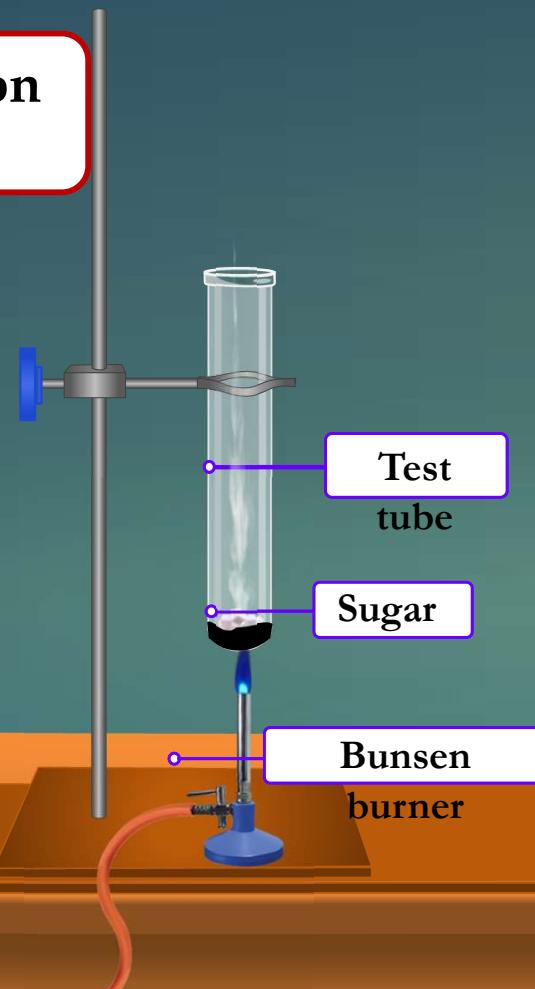
A decomposition reaction carried out by heating is called as, Thermal decomposition reaction.





ON REACTION

↑ indicates evolution
of gas



So we conclude

A decomposition reaction carried out by heating is called as, Thermal decomposition reaction.

HEATING OF CALCIUM CARBONATE

HEATING OF FERROUS SULPHATE

HEATING OF LEAD NITRATE

HEATING OF SUGAR



CHEMICAL REACTIONS AND EQUATIONS

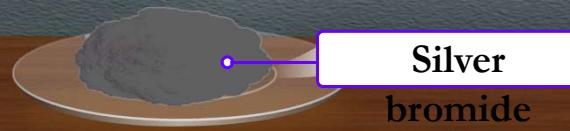
- **Module_07**



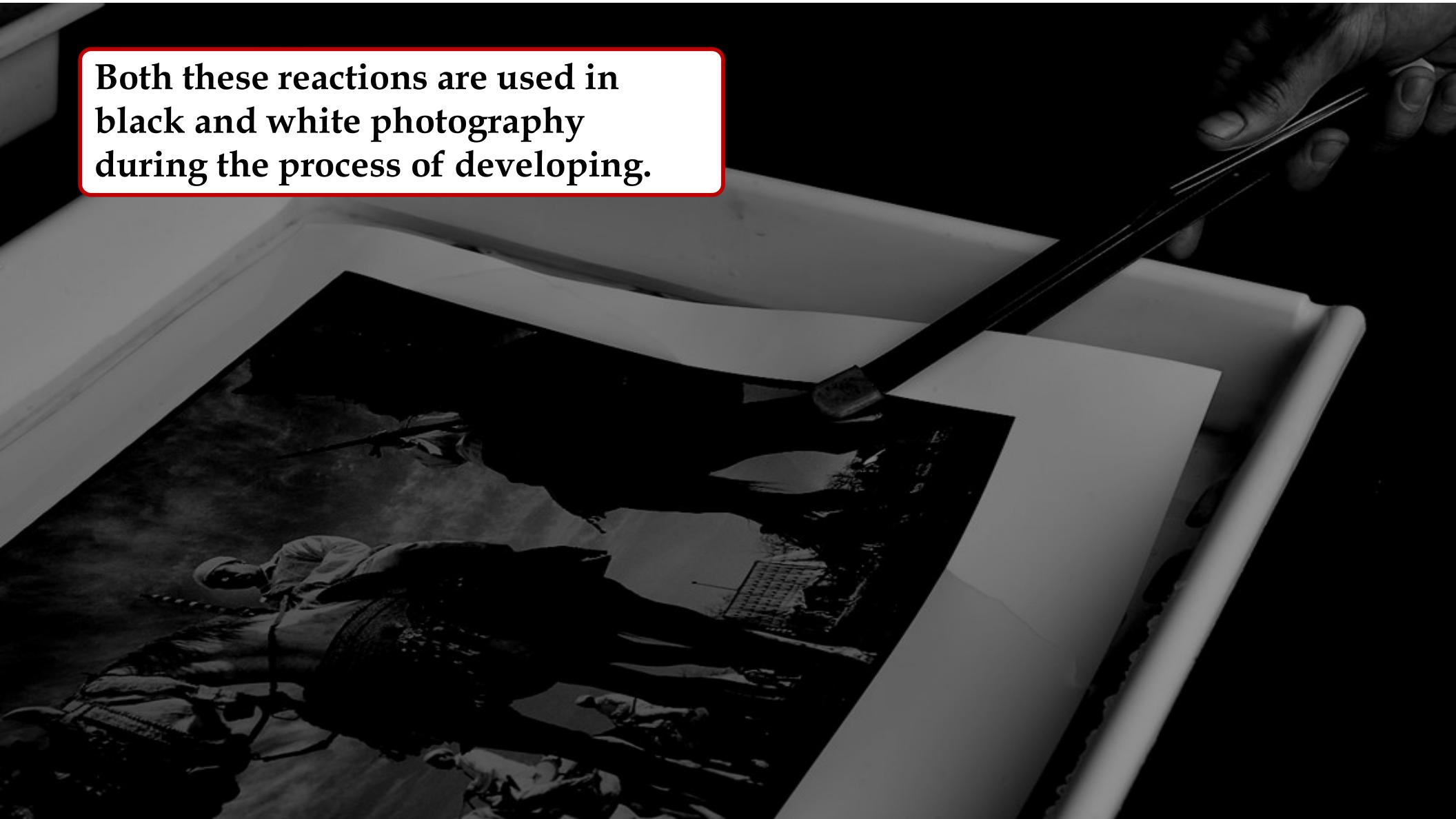
DECOMPOSITION REACTIONS DUE TO LIGHT



Decomposition due to light is called Photolysis.



Both these reactions are used in black and white photography during the process of developing.

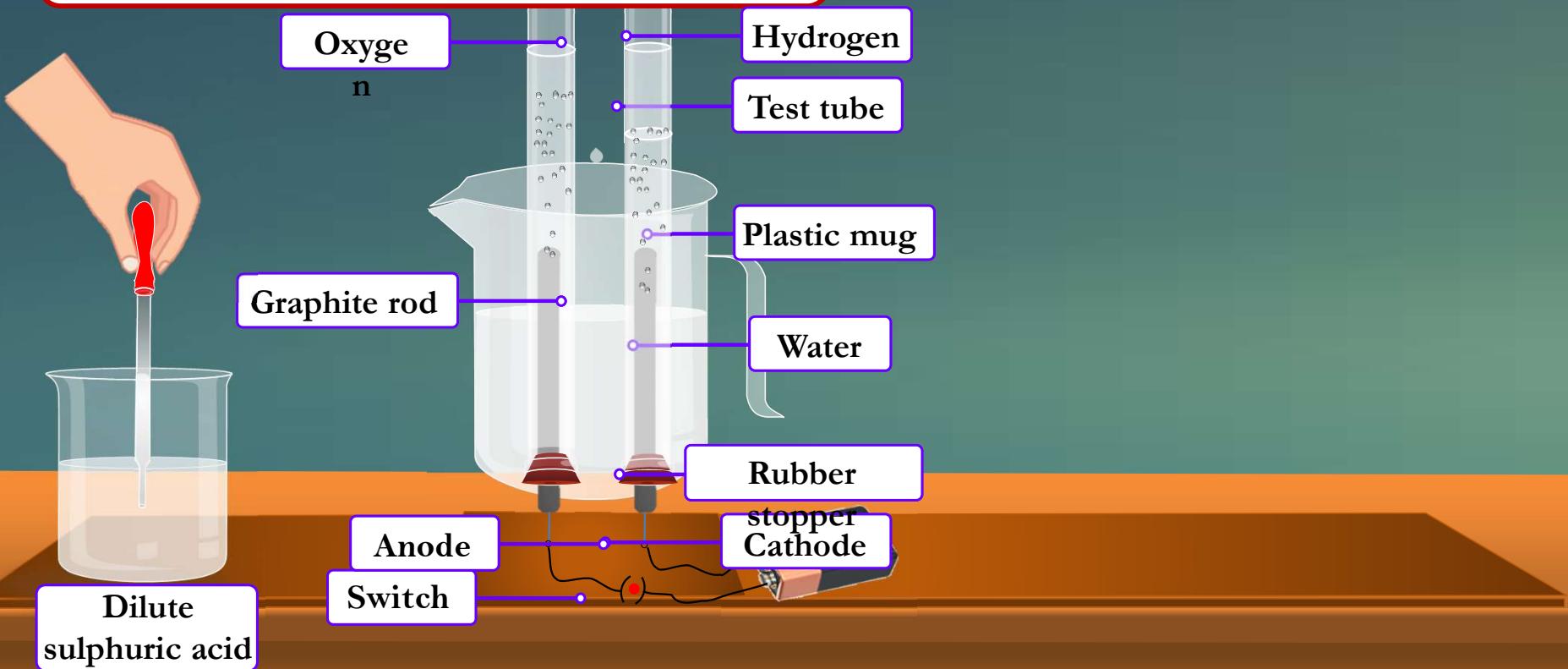




aluminium electroplating

Heated water is used to produce

ions (ionisation)





CHEMICAL REACTIONS AND EQUATIONS

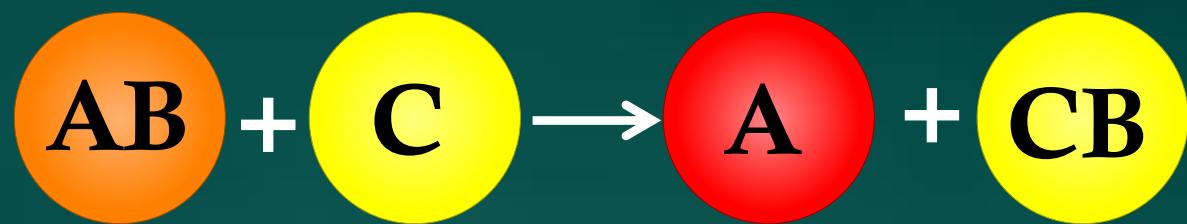
- **Module_08**

REACTIVITY SERIES OF METALS

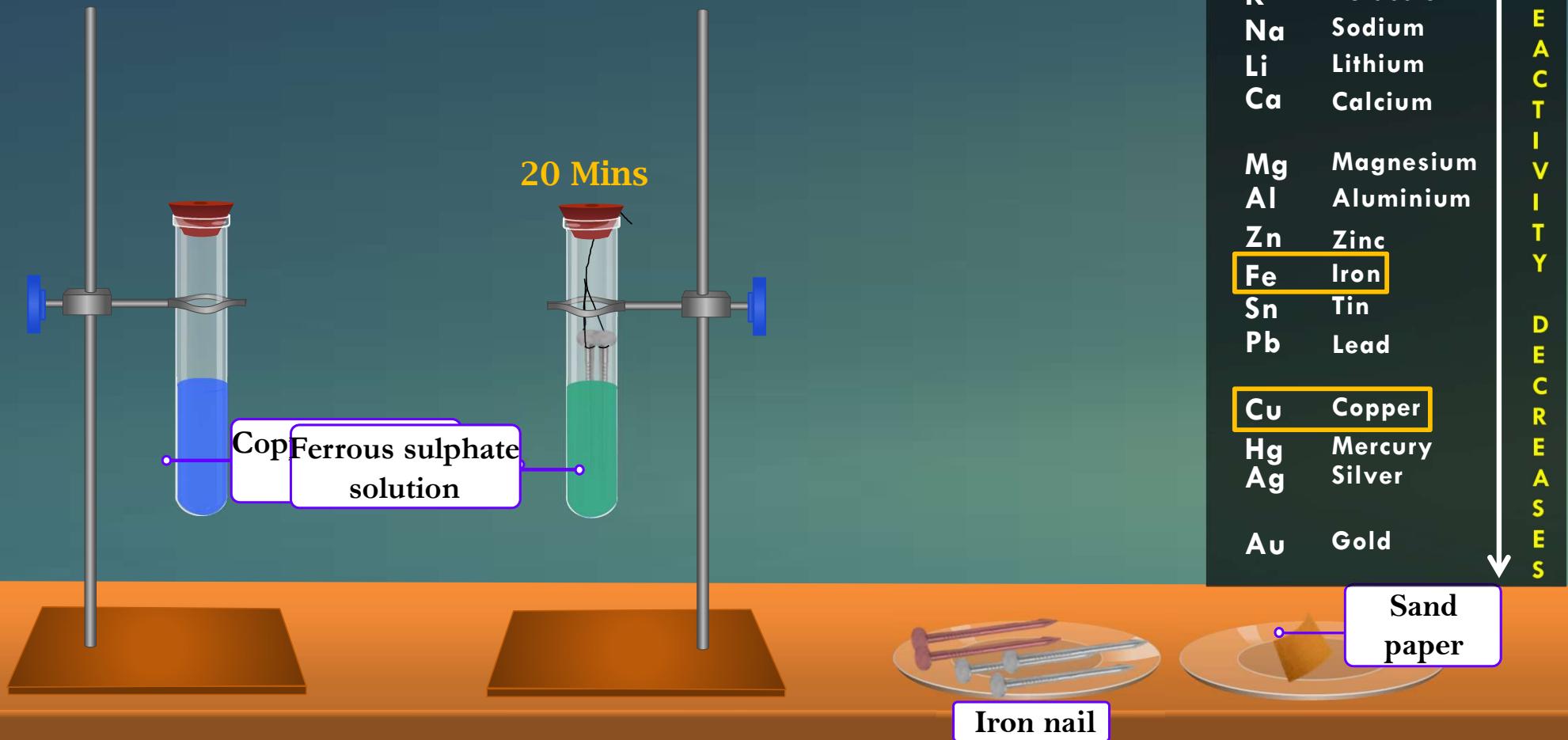
K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	
Fe	Iron	
Pb	Lead	Reactivity decreases
[H]	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

The arrangement of metals in the increasing or decreasing order of reactivity is called the reactivity series of metals.

DISPLACEMENT REACTION



When a more reactive element removes another (similar) element, having less reactivity, from its compound, these reactions are termed as **DISPLACEMENT REACTIONS**.





Lead displaces copper

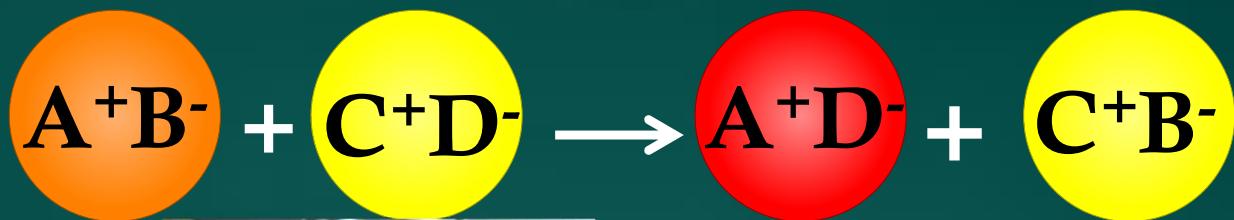
K	Potassium	R
Na	Sodium	E
Li	Lithium	A
Ca	Calcium	C
Mg	Magnesium	T
Al	Aluminium	I
Zn	Zinc	V
Fe	Iron	I
Sn	Tin	D
Pb	Lead	E
Cu	Copper	C
Hg	Mercury	R
Ag	Silver	E
Au	Gold	A



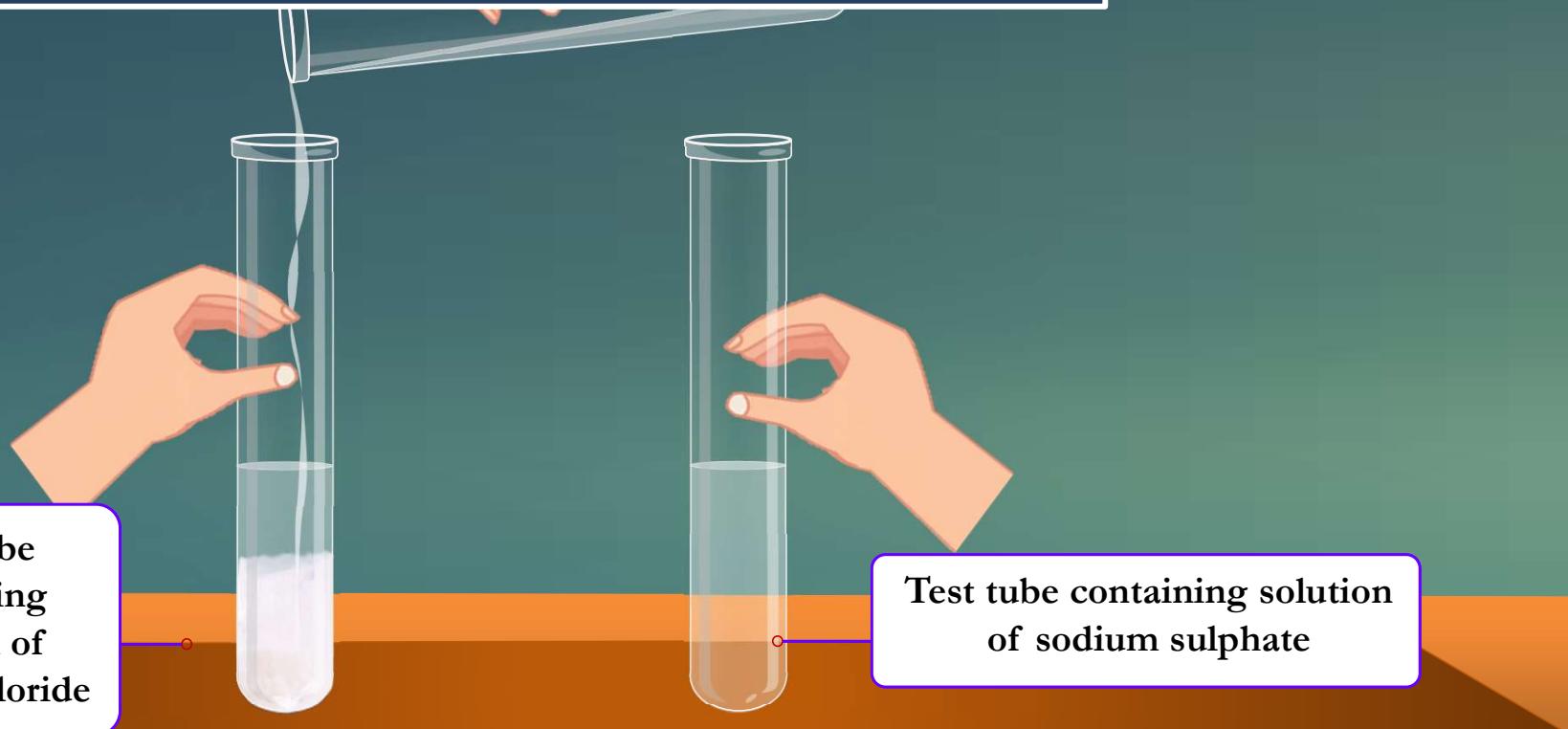
CHEMICAL REACTIONS AND EQUATIONS

- **Module_09**

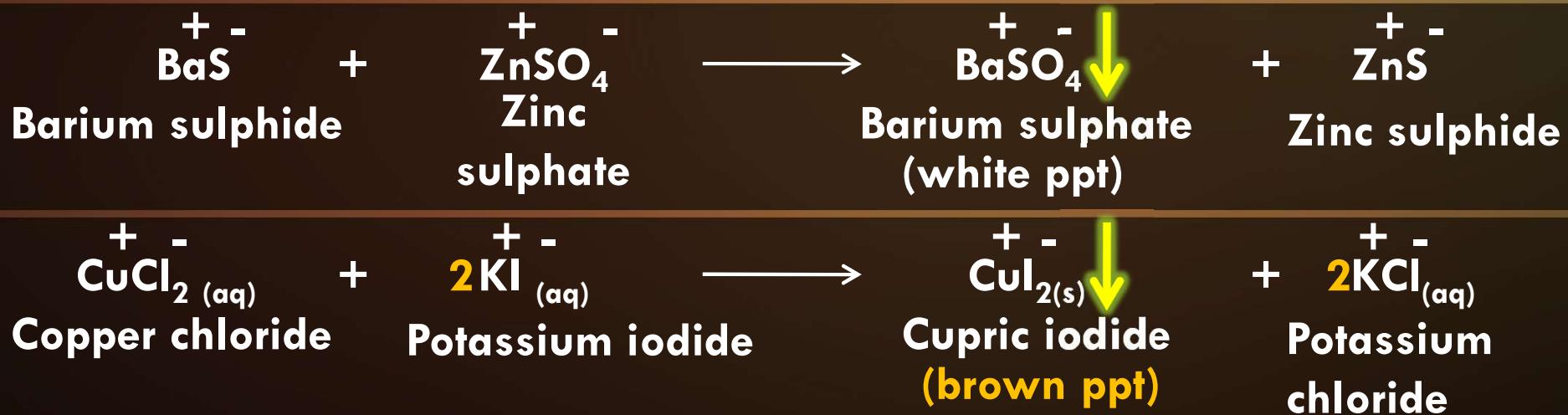
DOUBLE DISPLACEMENT REACTION



The reactions where a precipitate is formed by exchange of ions from between the reactants, are examples of double displacement reactions.



Precipitate is symbolized by an arrow pointing downwards





CHEMICAL REACTIONS AND EQUATIONS

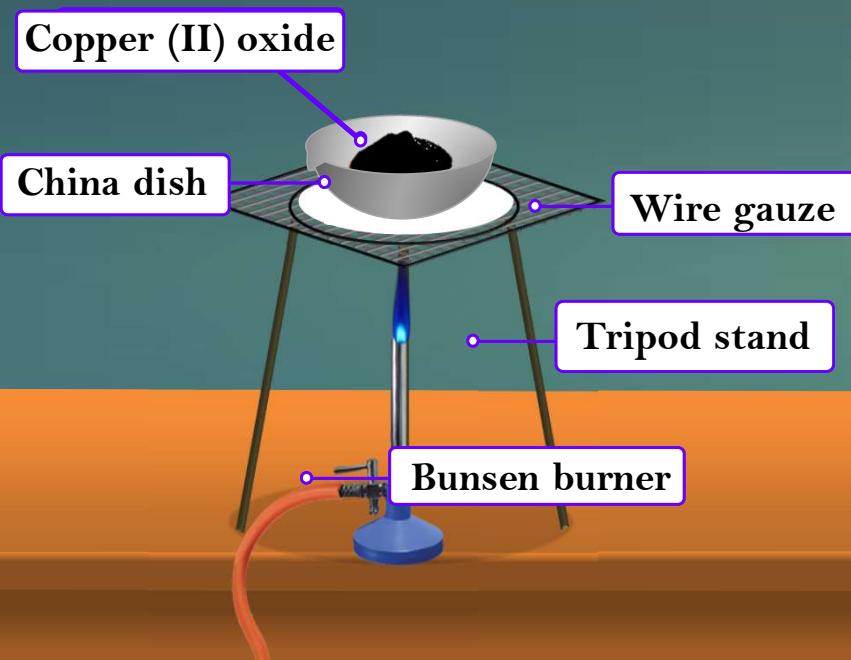
- **Module_10**

OXIDATION AND REDUCTION REACTION

OXIDATION REACTION



Copper is gaining oxygen to form copper oxide.



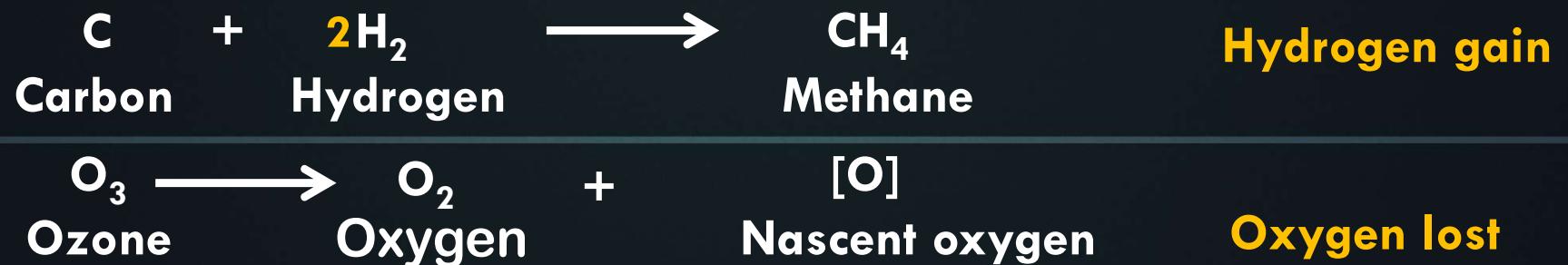
Ethyl alcohol has lost hydrogen

Hence, oxidation is the gain of oxygen or loss of hydrogen.



REDUCTION REACTION

Reduction is the loss of oxygen or gain of hydrogen.





CHEMICAL REACTIONS AND EQUATIONS

- **Module_11**

REDOX REACTION

REDOX REACTION

When oxidation and reduction take place simultaneously in a given chemical reaction, it is known as REDOX REACTION.

CuO is changing to Cu

Oxygen is being removed from CuO

Copper oxide is being reduced to copper

CuO gives oxygen for Oxidation

OXIDISING AGENT

(The substance which gives oxygen for oxidation is called an oxidising agent)

H_2 is changing to H_2O

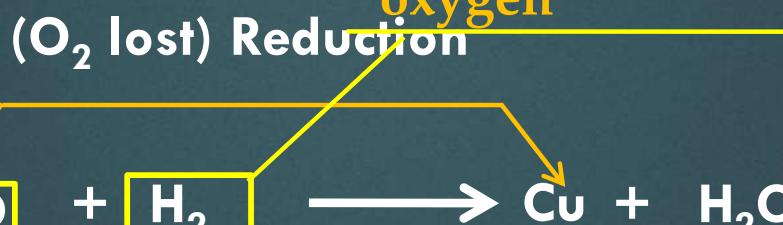
Oxygen is being added to hydrogen

Hydrogen is being oxidised to water

H_2 REMOVES oxygen

REDUCING AGENT

(The substance which removes oxygen is called as reducing agent)



(O_2 lost) Reduction

(O_2 added) Oxidation

H_2

H_2O

CuO

Cu

**OXIDISING
AGENT**

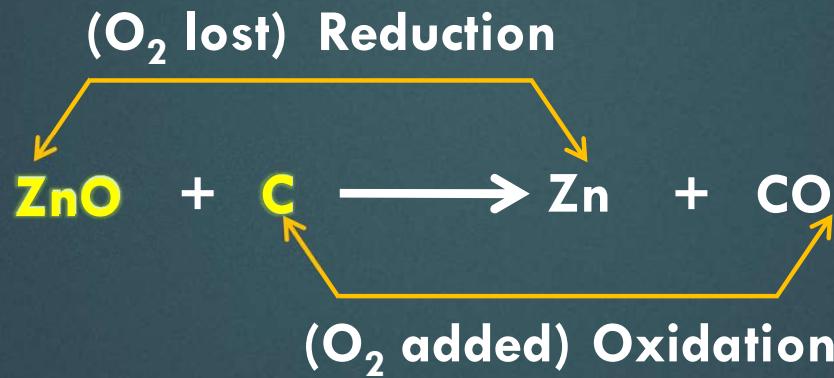
(O₂ lost) Reduction



**REDUCING
AGENT**

(O₂ added) Oxidation

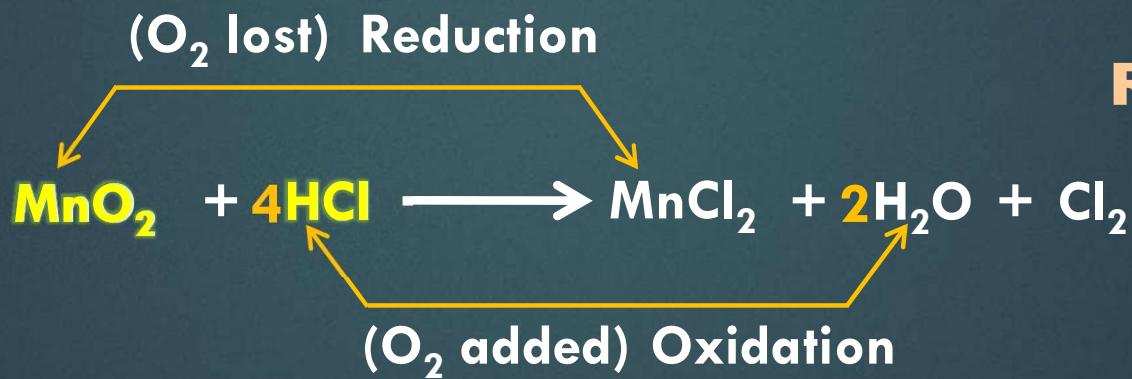
**OXIDISING
AGENT**



**REDUCING
AGENT**

**OXIDISING
AGENT**

**REDUCING
AGENT**





CHEMICAL REACTIONS AND EQUATIONS

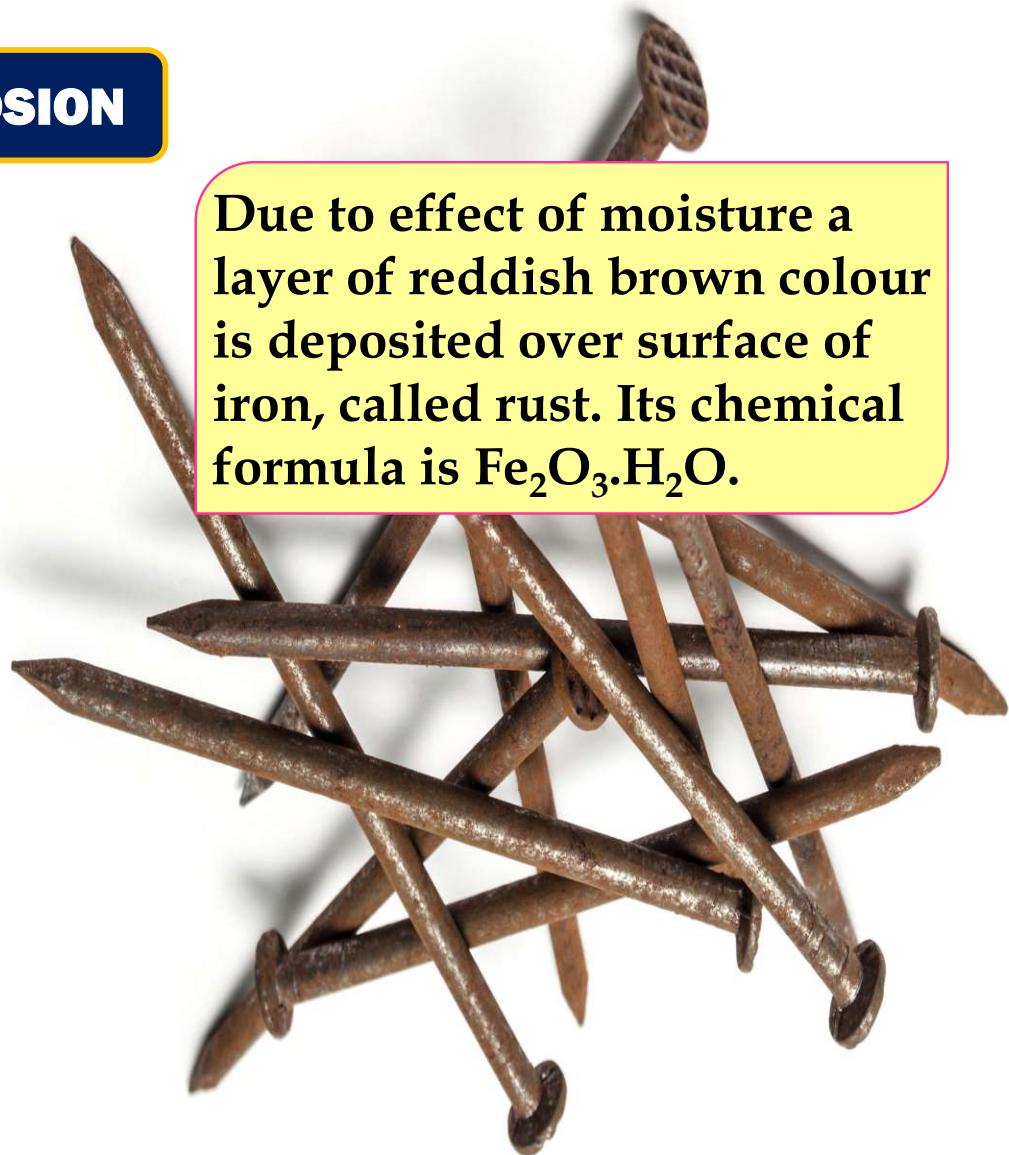
- **Module_12**

CORROSION

The slow process of decay or destruction of metal due to the effect of air, moisture, acids on it is known as CORROSION.



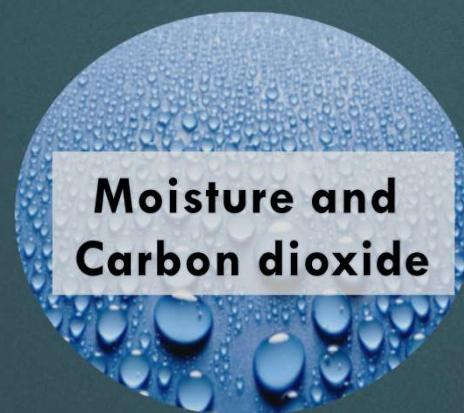
Due to effect of moisture a layer of reddish brown colour is deposited over surface of iron, called rust. Its chemical formula is $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$.



Copper objects get coated with a green substance called copper carbonate with the passage of time.

This green substance is formed due to the reaction of copper with carbon dioxide and moisture present in the atmosphere.

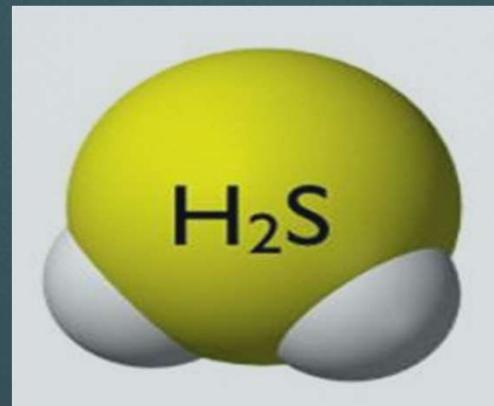
Copper



Silver objects become blackened and lose their shining with the passage of time.

This happens due to the reaction of silver with hydrogen sulphide gas present in the atmosphere.

Silver



A photograph of a woman with long brown hair, wearing a red shirt, standing in a kitchen. She is holding a wooden spoon over a pot on the stove and has her hand near her nose, possibly smelling the food. The background shows a kitchen counter with various items.

RANCIDITY

When oil and fats are oxidized or even allowed to stand for a long time, they become RANCID.

Food smells foul and its taste changes.



TO PREVENT RANCIDITY



Food is placed in air tight container



Chips are stored in nitrogen as nitrogen is least reactive

- ❖ Antioxidants are used to prevention oxidation of food containing fats and oils.
- ❖ Food are also stored in refrigerator as low temperature reduces the rate of reaction
- ❖ It is also advised to store food away from sunlight, as sunlight can increase the rate of reaction

Thank You