

ACIDS, BASES AND SALTS

- **Introduction of acids, bases and Indicators**



ACIDS, BASES AND SALTS

ACIDS

Substances which are sour to taste have acidic ingredients and their solutions are Acids.



Citric acid



Acetic acid



Lemon



Vinegar



Tartaric acid



Tamarind



Oxalic acid

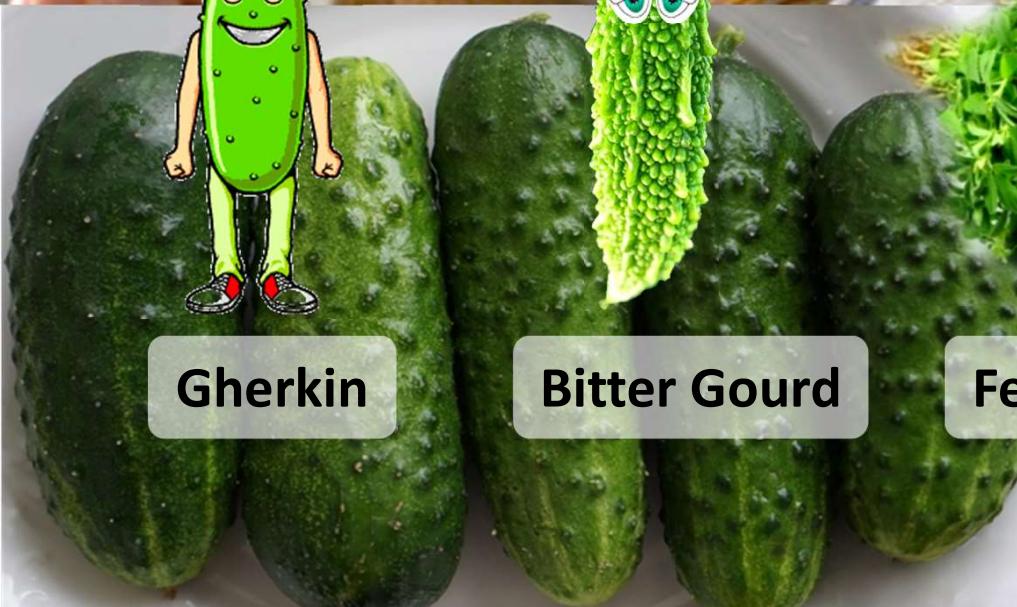


Tomato



BASES

Substances which are bitter to taste are bases.



Gherkin

Bitter Gourd

Fenugreek

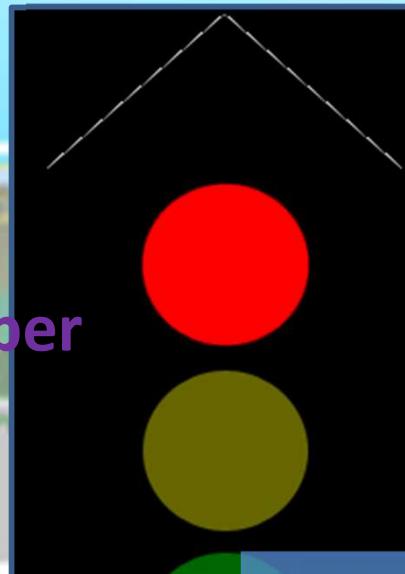


INDICATORS

COMMON E.g – Litmus paper



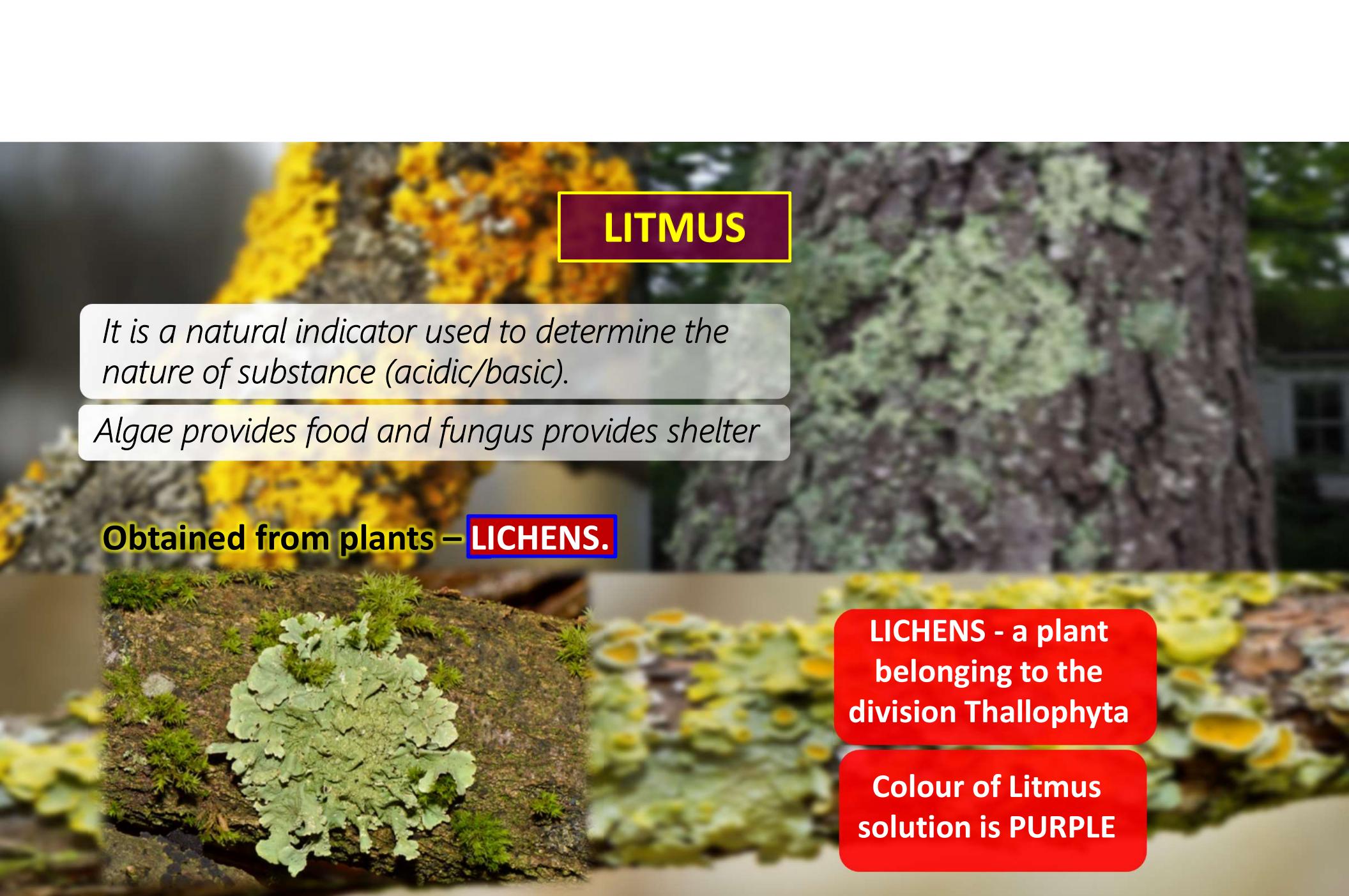
As re
IND
sign
bases are INDICATED by...



The acidic and basic nature of the compound by some substances are indicated by some substances known as indicators. Each of three colours of the signal indicates the activity expected from the people, i.e. to stop, to be ready and to go.

ACIDS, BASES AND SALTS

- **Natural indicators**



LITMUS

It is a natural indicator used to determine the nature of substance (acidic/basic).

Algae provides food and fungus provides shelter

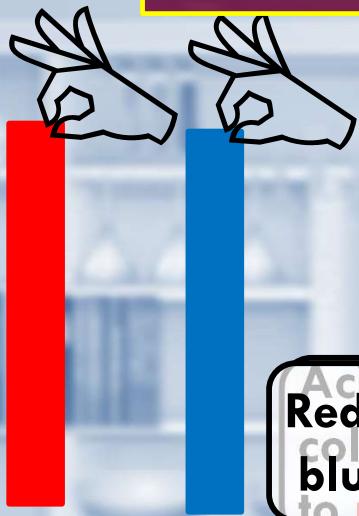
Obtained from plants – LICHENS.

LICHENS - a plant belonging to the division Thallophyta

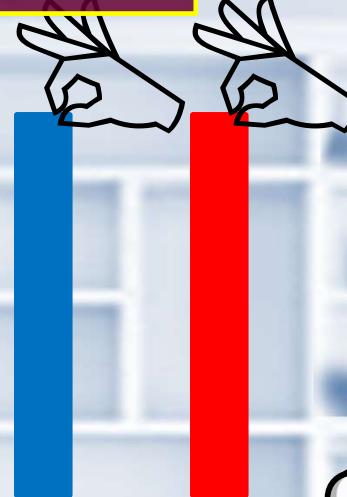
Colour of Litmus solution is PURPLE

NATURAL

INDICATORS



Blue litmus paper turns red on dipping in acid and red litmus turns blue by alkali.



Acids change the colour of blue litmus to red
Red remains red and blue changes to red

Blue changes the colour of red litmus to blue
Blue remains blue and red changes to blue

Natural substances

Natural indicators can also be prepared from

PETUNIA

TURMERIC

GERANIUM

BEET ROOT

RED CABBAGE EXTRACT





Red cabbage extract remains red in acidic solution but turns blue to green in basic solution.





The flower of hydrangea plant are usually blue in acid which turn pink in the presence of base.



Turmeric + water Lemon juice (acidic) Bleach + water (basic)



Many times we have noticed that yellow stain of curry on a white cloth (which is due to the presence of turmeric in curry) turns reddish-brown when soap is scrubbed on it. This is due to the fact that soap solution is basic in nature which changes the colour of turmeric in the curry stain to red brown.

ACIDS, BASES AND SALTS

- **Synthetic, olfactory and universal indicators**

SYNTHETIC INDICATORS

Some chemical substances such as phenolphthalein, methyl orange, eosin are also indicators. They are synthetic indicators.

PHENOLPHTHALEIN INDICATOR



METHYL ORANGE



PHENOLPHTHALEIN

Phenolphthalein: colourless to pink
No colour for acids, pink for alkalis

| Sample solution | Red litmus solution | Blue litmus solution | Phenolphthalein solution | Methyl orange solution |
|--------------------------|---------------------|----------------------|--------------------------|------------------------|
| HCl | No Change | Turns Blue | Colourless | Turns red |
| H_2SO_4 | No Change | Turns Blue | Colourless | Turns red |
| HNO_3 | No Change | Turns Blue | Colourless | Turns red |
| CH_3COOH | No Change | Turns Blue | Colourless | Turns orange |
| NaOH | Turns Blue | No Change | Turns pink | Turns yellow |
| $\text{Ca}(\text{OH})_2$ | Turns Blue | No Change | Turns pink | Turns yellow |
| KOH | Turns Blue | No Change | Turns pink | Turns yellow |
| $\text{Mg}(\text{OH})_2$ | Turns Blue | No Change | Turns pink | Turns yellow |
| NH_4OH | Turns Blue | No Change | Turns pink | Turns yellow |

OLFACTORY INDICATORS



Onion slice

Since this indicator works
on smell it is called as

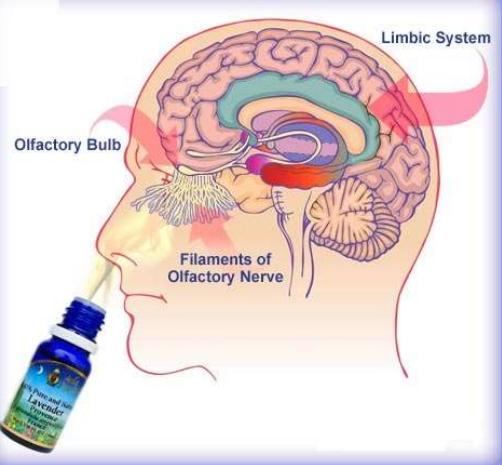
Onion smell
remains as it is

e.g:- onion



Onion smell
goes off

In Acids :- odour remains as it is.
In Bases :- odour goes off.



OLFAC TORY INDICATORS.

Certain substances whose odour change in acidic or basic medium are known as

Onion

Clove

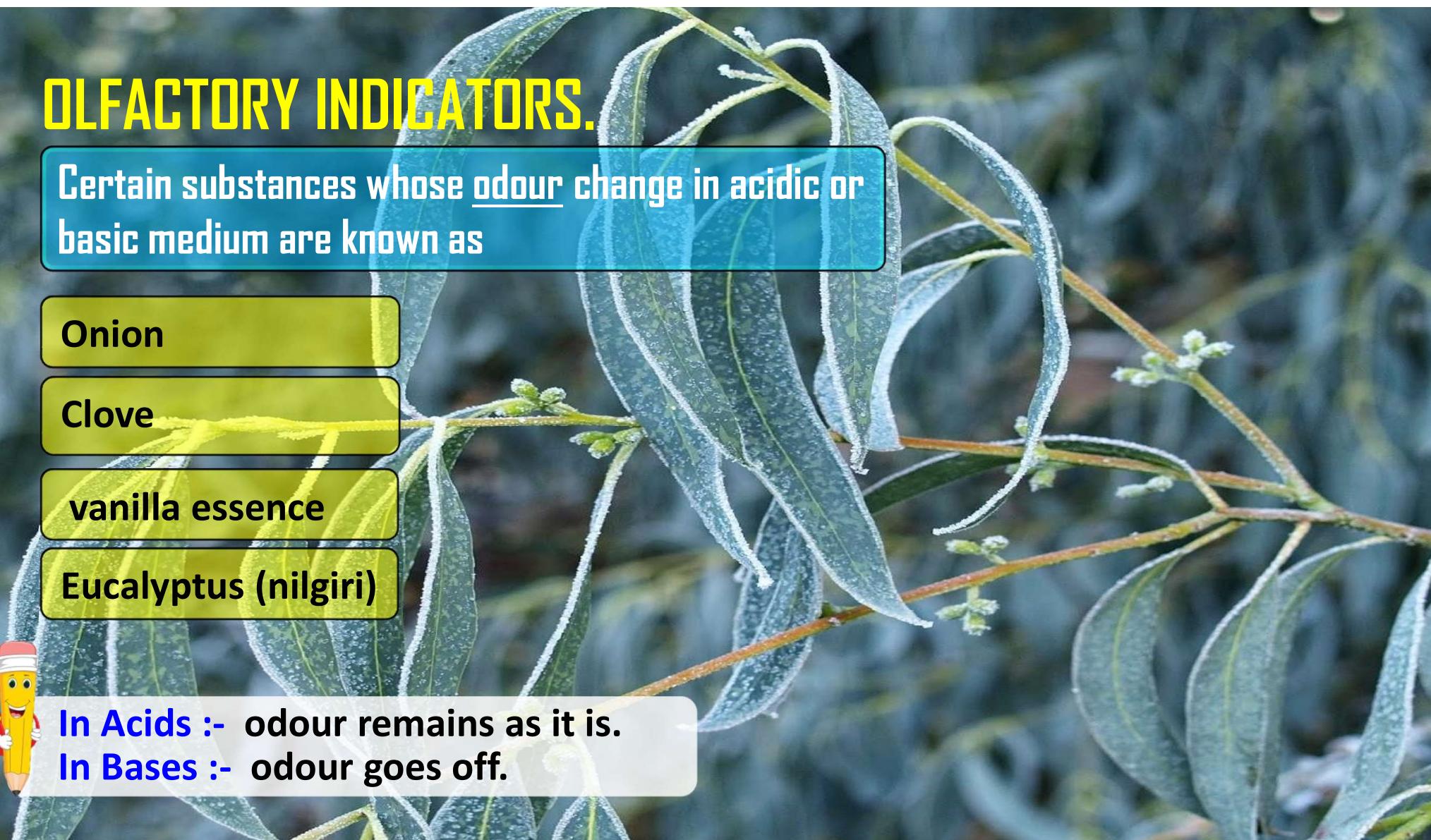
vanilla essence

Eucalyptus (nilgiri)



In Acids :- odour remains as it is.

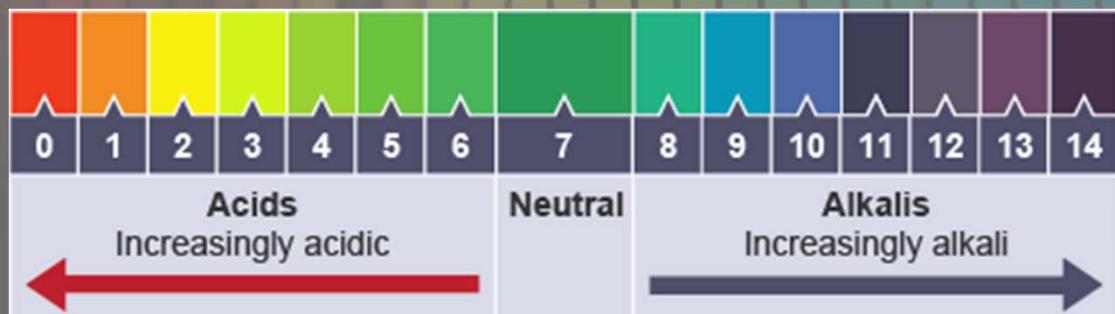
In Bases :- odour goes off.



UNIVERSAL INDICATOR

Mixture of several indicators is known as
UNIVERSAL INDICATOR.

Universal indicator not only tells us whether the given solution is acid or a base but we can also judge how strong an acid or base can be.



ACIDS, BASES AND SALTS

- **Chemical definition of acids**
- **Mineral and organic acids**

CHEMICAL DEFINITION OF ACID AND BASE

Acids



Substances which when dissolved in water give H^+ ions are called as acids.

Bases



Substances which when dissolved in water give OH^- ions are called as Bases.

ORGANIC ACIDS

The acid present in plants and animals are called organic acids.

Some of the organic acids are citric acid, lactic acid, tartaric acid, oxalic acid etc.

Mango

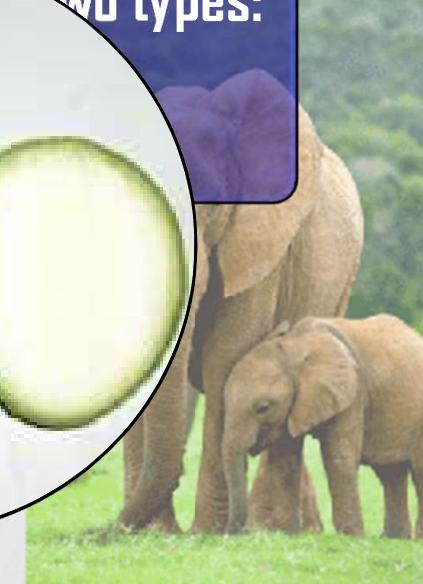
Tamarind

Orange

Grapes

Lemon

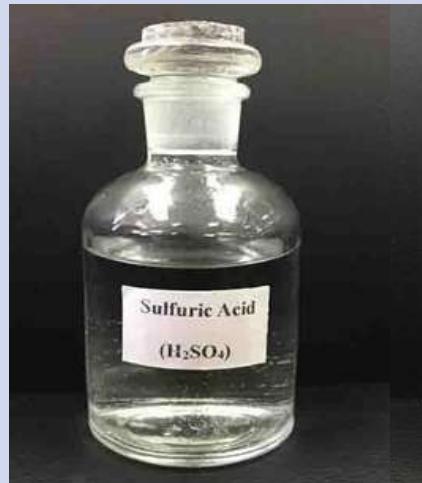
Acids are classified into two types:
Organic acids and inorganic acids.



MINERAL ACIDS

The acid prepared from the minerals of the earth are called mineral acids.

Examples



Sulphuric acid
(H₂SO₄)



Warning sign displayed on containers containing
concentrated acids and bases



Concentrated mineral acids are very dangerous. In laboratory acids are generally mixed with water to dilute them such acids are called dilute acids

Always add acid into water to avoid any accident.

ACIDS, BASES AND SALTS

- **Classification of acids and bases :**
Strong acids,
Weak acids,
Physical properties of acids

Classification of acids and bases depending on the **H⁺** and **OH⁻** ions

STRONG ACIDS:- Eg. HCl, HNO₃, H₂SO₄

The acids which give more number of HYDROGEN ions in aqueous solution are called **STRONG ACIDS.**



WEAK ACIDS All mineral acids are strong except carbonic acid

The acids which gives less number of HYDROGEN IONS in aqueous solution are called **WEAK ACIDS.**



Hence they are used as a food ingredients to drink

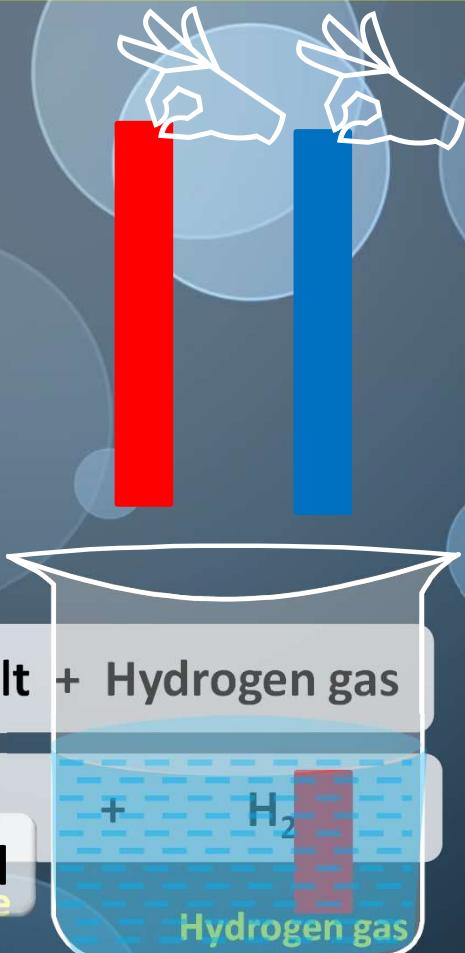
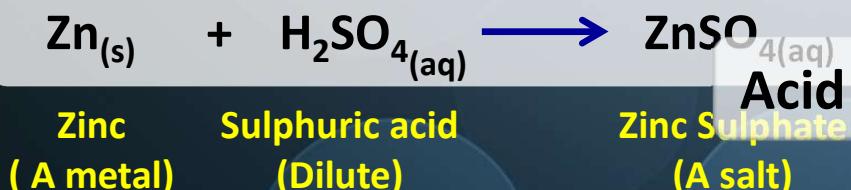
PROPERTIES OF ACIDS

1. Acids have a sour taste.

2. Acids turn blue litmus to red.

3. Acid solutions conduct electricity
(They are electrolytes).

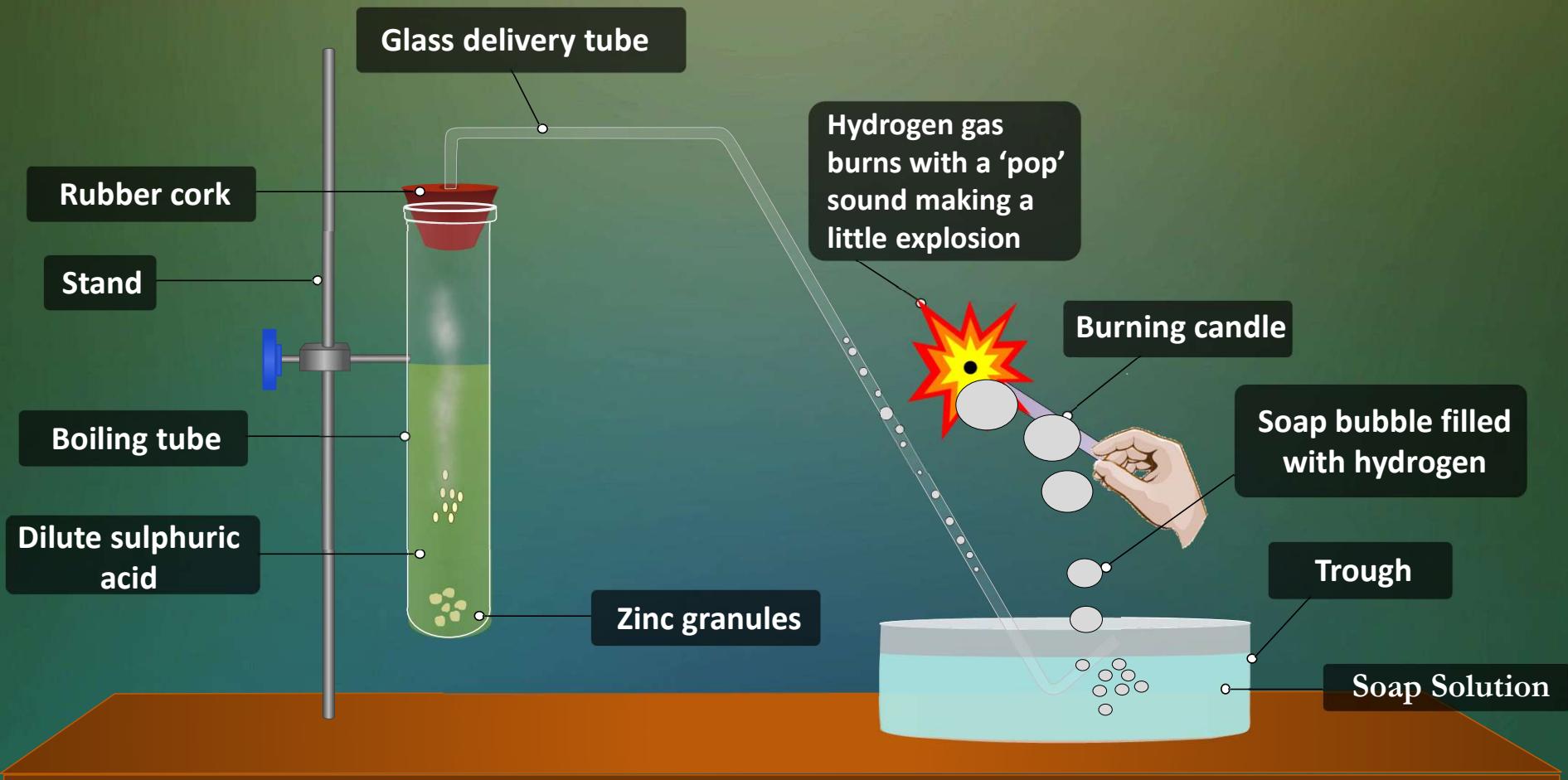
4. Acids react with metals to form hydrogen



ACIDS, BASES AND SALTS

- **Chemical properties of acid with metals**

REACTION OF DILUTE SULPHURIC ACID WITH ZINC METAL

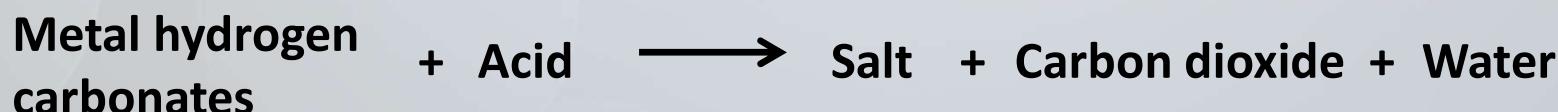
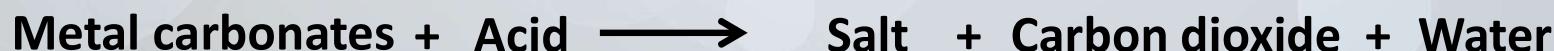


ACIDS, BASES AND SALTS

- **Chemical properties of acids**

PROPERTIES OF ACIDS

5. Acids react with metal carbonates (and metal hydrogen - carbonates) to form carbon dioxide gas.



The carbon dioxide gas is formed in the form of brisk effervescence
(the rapid escape of small bubbles of gas from the liquid)

PROPERTIES OF ACIDS

If excess of carbon dioxide gas is passed through lime water then the white precipitate formed first dissolves due to the formation of a soluble salt calcium hydrogencarbonate, and the solution becomes clear again.



Clear lime water



When carbon dioxide is passed through lime water, it turns milky



If carbon dioxide is passed for longer time, the milkiness disappear

ACIDS, BASES AND SALTS

- **Chemical properties of acids**

PROPERTIES OF ACIDS

6. Acids react with bases (or alkalis) to form salt and water. It is known as neutralisation reaction.



Sodium
hydroxide

Hydrochloric
acid

Sodium
chloride

Water

7. Acids react with metal oxide to form salt and water.
Hence metallic oxides are said to be basic oxides



Copper(II)
oxide

Hydrochloric
acid

Copper (II)
chloride

Water

PROPERTIES OF ACIDS

8. *Acids have corrosive nature.*

The mineral acids cause severe burns on the skin and attack and eat up material like cloth, wood, metal structures and stone work, so they are said to be corrosive.

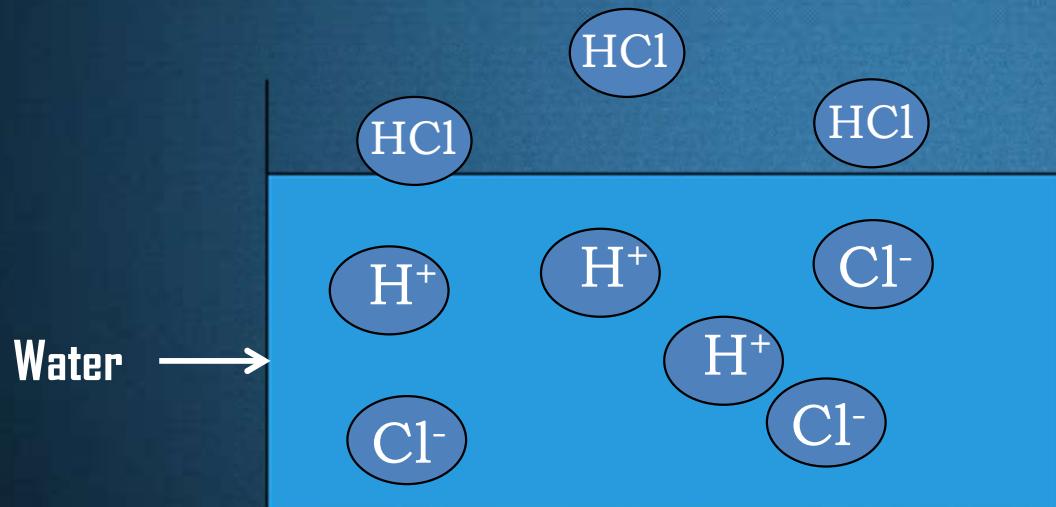
PROPERTIES OF ACIDS

1. Acids have a sour taste.
2. Acids turn blue litmus to red.
3. Acid solutions conduct electricity (They are electrolytes).
4. Acids react with metals to form hydrogen gas.
5. Acids react with metal carbonates (and metal hydrogen - carbonates) to form carbon dioxide gas.
6. Acids react with bases (or alkalis) to form salt and water.
7. Acids react with metal oxide to form salt and water.
8. Acids have corrosive nature.

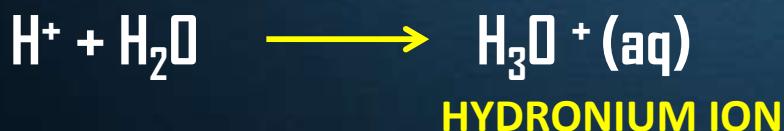
ACIDS, BASES AND SALTS

- **Hydronium ion**

What do all acids have in common



Separation of HCl into H⁺ and Cl⁻ ions will be possible in presence of water. The process is termed as ionization.



This happens because H⁺ ions are not stable..

To investigate whether all the compounds containing hydrogen are acids.

The aqueous solution of an acid conducts electricity due to the presence of charged particles called ions in it.

Bulb is glowing

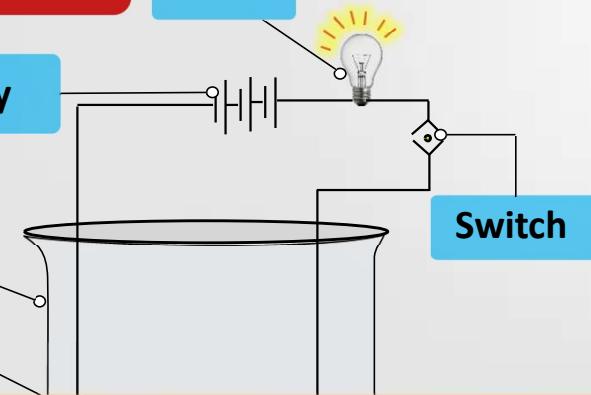
Bulb

Battery

Beaker

Nail

Switch



Battery

Bulb

Bulb does not glow

Switch

Beaker

From this experiment we conclude that the hydrogen containing compounds such as glucose and alcohol are not acid because they do not dissociate in water to produce H^+ ions.

Rubber cork

Glucose Solⁿ

Rubber cork

Acids do not show acidic behavior in the absence of water

In absence of water, a substance will not form hydrogen ions and hence will not show its acidic behavior



Moist litmus paper

No Change
HCl gas

Concentrated
 H_2SO_4

Bent tube

one hole
stop cork

Test – tube

Copper
chloride

Hydrogen ions cannot exist alone.
Separation of HCl into H^+ and Cl^- ions will be possible in the presence of water. The process is termed as ionization.
 $\text{H}^+ + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+$

ACIDS, BASES AND SALTS

- **Bases and properties of bases**

BASES

Base which is soluble in water is also called an alkali.

Sodium hydroxide (NaOH)

Calcium hydroxide [Ca(OH)₂]

Potassium hydroxide (KOH)

Ammonium hydroxide (NH₄OH)

Magnesium hydroxide [Mg(OH)₂]



Classification of acids and bases depending on the **number of H⁺ and OH⁻ ions**

STRONG BASES:- NaOH, KOH, NH₃.

The bases which give more number of HYDROXIDE IONS in aqueous solution are called **STRONG BASES**.



WEAK BASES:- Eg. NH₄OH

The bases which gives less number of HYDROXIDE IONS in aqueous solution are called **WEAK BASES**.

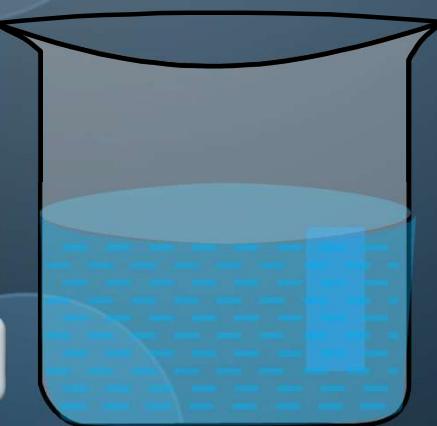


PROPERTIES OF BASES

1. Bases have bitter taste.

2

3



PROPERTIES OF BASES

4. Base conduct in solution electricity
(They are electrolytes).

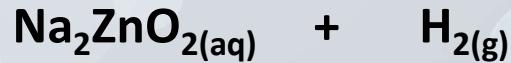
5. Bases
form hy-



Sodium hydroxide
(base)

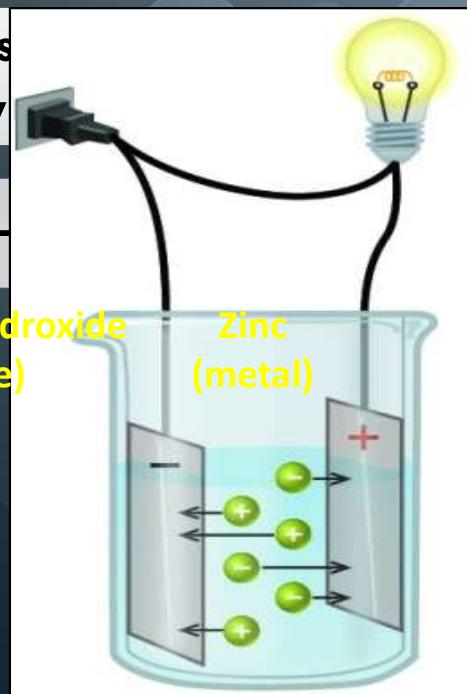
Zinc
(metal)

als to
and Zn)



Sodium zincate
(salt)

Hydrogen
gas



ACIDS, BASES AND SALTS

- **Chemical properties and uses of bases**

PROPERTIES OF BASES

6. Bases react with acids to form salt and water



Sodium Sulphuric Sodium Water
hydroxide(base) acid sulphate(salt)

7. Bases react with non-metal oxides to form salt and water. Hence, non-metallic oxides are acidic in nature.

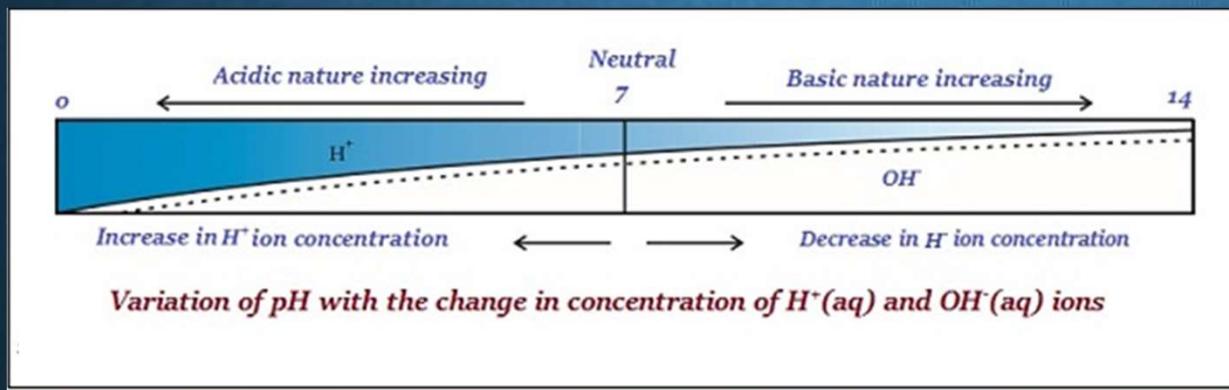


Calcium Carbon dioxide Calcium Water
hydroxide(base) (non-metal oxide) carbonate(salt)

ACIDS, BASES AND SALTS

- **Introduction of pH scale**

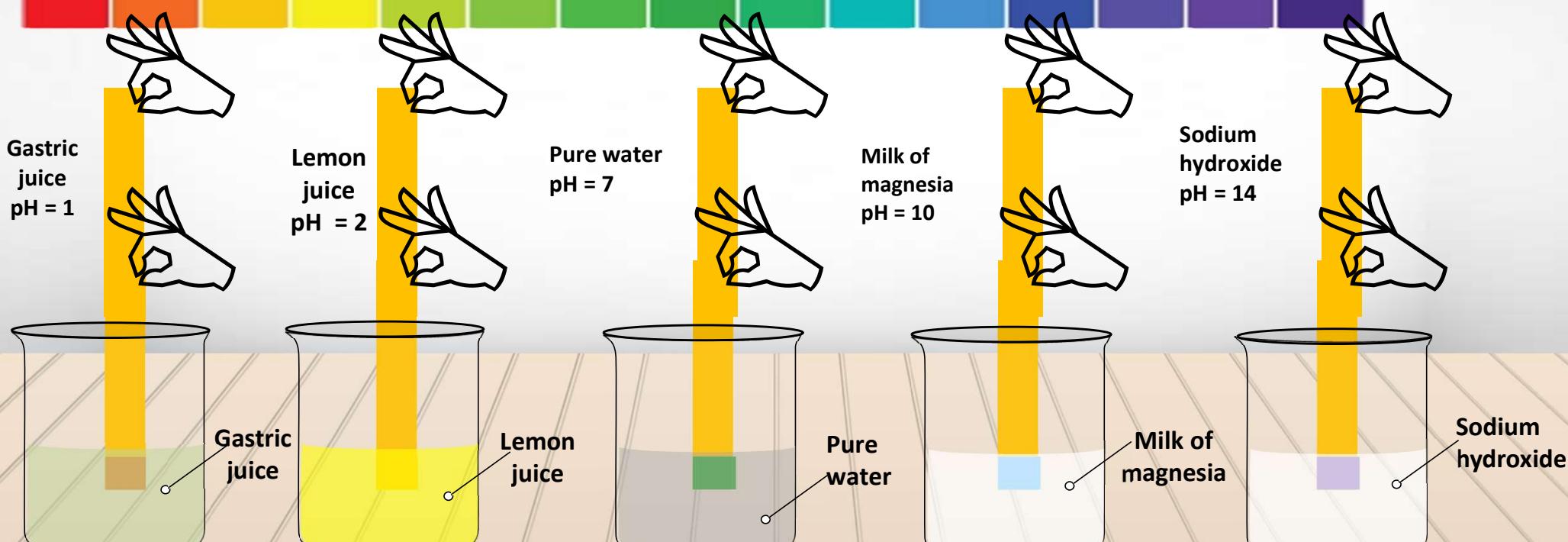
STRENGTH OF ACIDS AND BASES



**Strength of acids and bases is measured by a pH scale.
In pH, p stands for potenz (strength in German)**

Universal indicator with different pH values

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14



| Sr. No. | Solution | Colour of pH paper | Approximate pH value | Nature of substance |
|---------|--------------------------|--------------------|----------------------|---------------------|
| 1. | Saliva (before meal) | Green | 7.4 | Basic |
| 2. | Saliva (after meal) | Yellow | 5.8 | Acidic |
| 3. | Lemon juice | Orange | 2.5 | Acidic |
| 4. | Colourless aerated drink | Green | 6 | Acidic |
| 5. | Carrot juice | Yellow | 5.6 | Acidic |
| 6. | Coffee | Yellow | 5 | Acidic |
| 7. | Tomato juice | Orange | 4.1 | Acidic |
| 8. | Tap water | Green | 6.9 | Acidic |
| 9. | 1M NaOH | Blue | 13 | Basic |
| 10. | 1M HCl | Red | 1 | Acidic |

ACIDS, BASES AND SALTS

- **Importance of pH in everyday life**

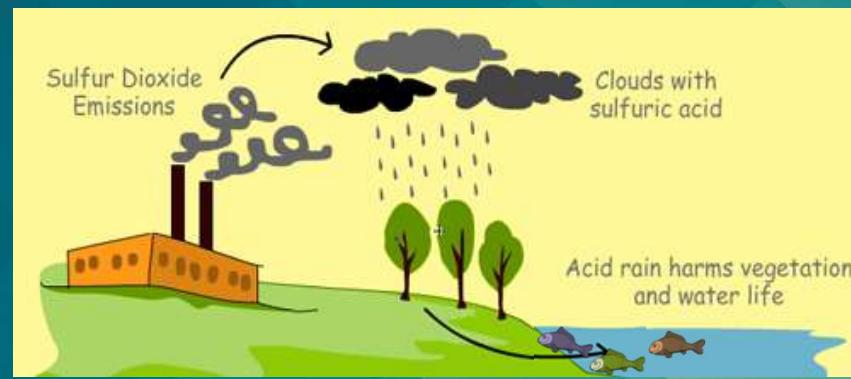
IMPORTANCE OF pH IN EVERYDAY LIFE

Acid rain

pH range of human body is 7.0 to 7.8 .

When the pH of rain water is less than 5.6, the rain water is acidic. When it flows in a river, it lowers the pH of river water.

Aquatic life is drastically affected due to acidic nature. Not only that, when this type of rain water is absorbed by plants, it affects their growth, the flowers and fruits they bear.



➤ Importance of pH in Tooth decay

Tooth decay starts when pH of mouth is lower than 5.5

**Tooth enamel is made up of calcium hydroxyapatite
(a crystalline form of calcium phosphate)**

Bacteria present in the mouth produce acids by degradation of sugar and food particles remaining in the mouth after eating.

Using toothpastes, which are generally basic, for cleaning the teeth can neutralise the excess acid and prevent tooth decay.



STOMACH ACIDITY

- The human body : pH 7.35 to 7.45
- Hydrochloric acid produced in the stomach helps in digestion of food. Due to too much production of acid, causes pain and irritation
- The acidity, indigestion problems can be controlled by adding basic substances called ANTACIDS.
- Example : Magnesium hydroxide (Milk of Magnesia)
Basic substance
neutralizes acid in the stomach.



SOIL pH IN THE BACKYARD

Most of the plants grow best when the pH of soil is close to 7. If the soil is too acidic or too basic (too alkaline), the plants grow badly or do not grow at all.

If the soil is acidic then it is treated with materials like quicklime (CaO)

Before



After



ACIDS, BASES AND SALTS

- **Self defence by animals and plants**

SELF DEFENCE BY ANIMALS AND PLANTS THROUGH CHEMICAL WARFARE

When a honey-bee sting a person, it injects an **acidic** liquid (Methanoic acid) to the skin.

When a wasp stings it injects an **alkaline** liquid into the skin.

Also called formic acid

An ants sting injects **methanoic acid** into the skin of a person causing burning pain

Stinging hair of nettle leaves inject methanoic acid causing burning pain.

like baking soda on the sting

A traditional remedy is rubbing the area with the leaf of the **dock plant**, which often grows beside the nettle in the wild.



SALT

Types of salts: Acidic, Basic and Neutral salts

An acidic salt is formed by the neutralization reaction between a strong acid and a weak base. The pH of the aqueous solution of an acidic salt is less than 7.

A basic salt is formed by a neutralization reaction between a weak acid and a strong base. The pH of an aqueous solution of such a basic salt is greater than 7.

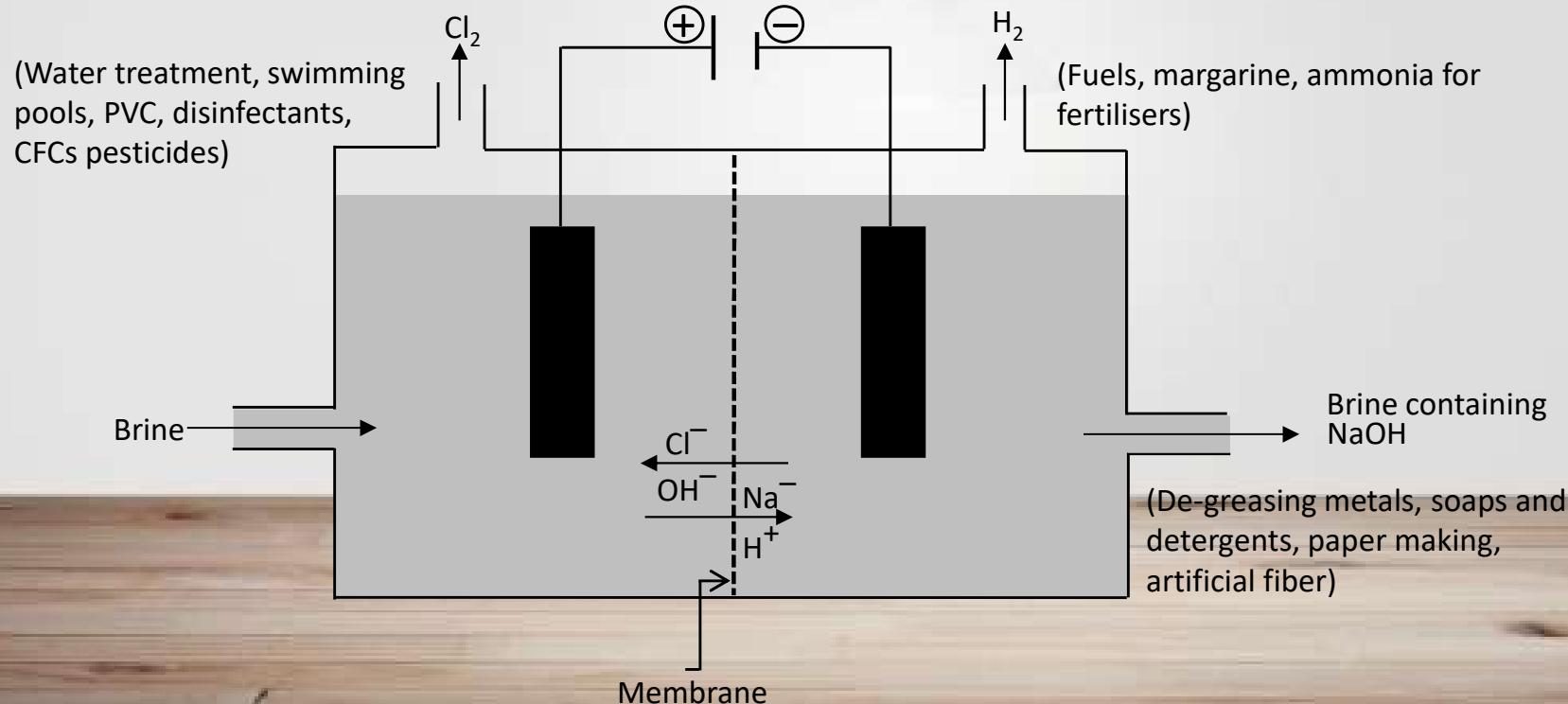
A neutral salt is formed by neutralization of a strong acid by a strong base. The aqueous solution of a neutral salt has pH equal to 7.



ROCK SALT

Deposits of solid salt are also found in several parts of the world. These large crystals are often brown due to impurities. This is called rock salt.

CHLOR-ALKALI PROCESS



ACIDS, BASES AND SALTS

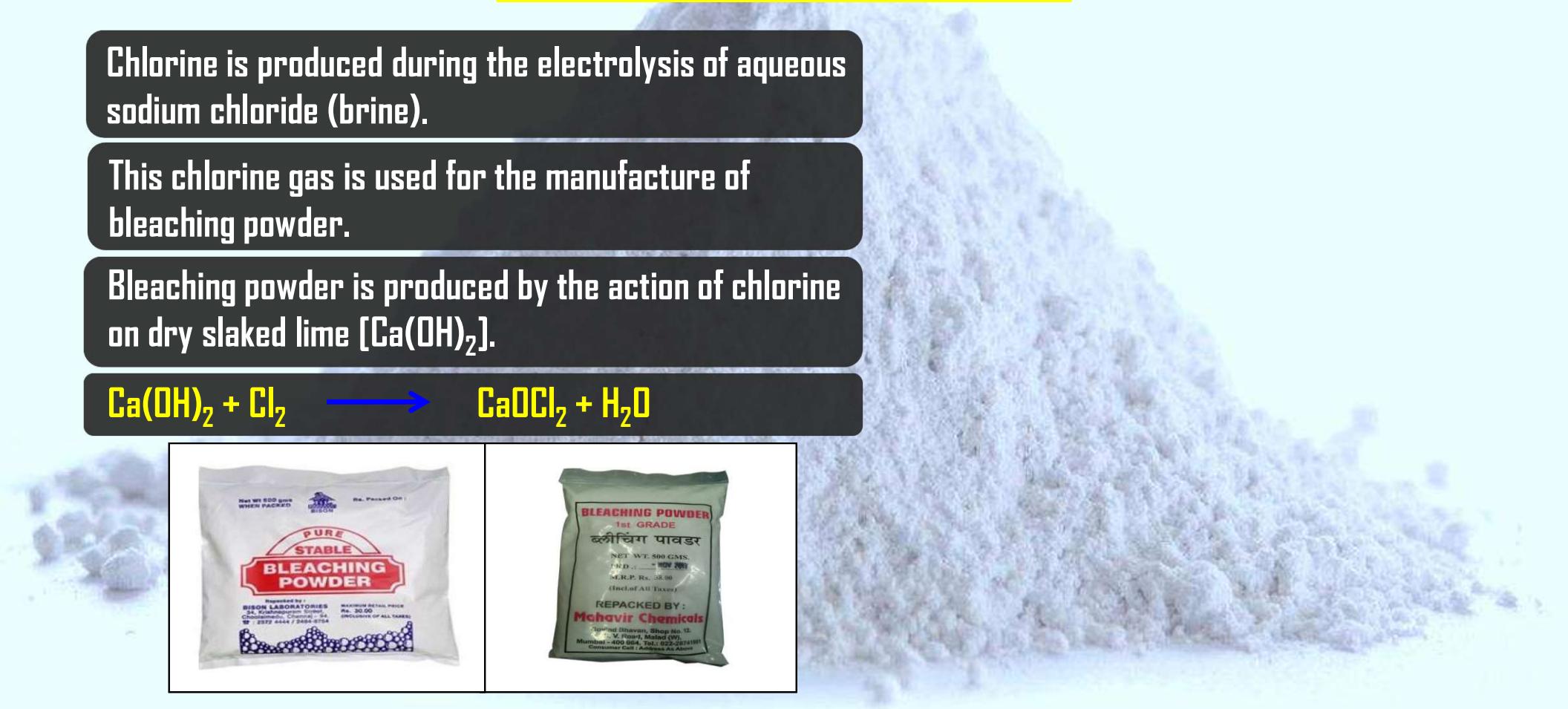
- Bleaching Powder and it's uses
- Baking soda and it's uses

BLEACHING POWDER

Chlorine is produced during the electrolysis of aqueous sodium chloride (brine).

This chlorine gas is used for the manufacture of bleaching powder.

Bleaching powder is produced by the action of chlorine on dry slaked lime $\text{Ca}(\text{OH})_2$.



BLEACHING POWDER

Bleaching powder is used –

i

for bleaching cotton and linen in the textile industry,
for bleaching wood pulp in paper factories and for
bleaching washed clothes in laundry;

ii

as an oxidising agent in many chemical industries;
and

iii

to make drinking water free from germs.



BAKING SODA

The baking soda is commonly used in the kitchen for making tasty crispy pakoras, etc. Sometimes it is added for faster cooking.

The chemical name of the compound is sodium hydrogen carbonate (NaHCO_3). It is produced using sodium chloride as one of the raw materials.



On heating baking soda we get washing soda



ACIDS, BASES AND SALTS

- **Washing soda and it's uses**
- **Water of Crystallisation**
- **Plaster of Paris and it's uses**



WASHING SODA

Chemical formula : $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$.

Chemical name : Sodium carbonate



USES OF WASHING SODA

Sodium carbonate (washing soda) is used in glass, Soap and paper industries.

It is
succ
Soda
age



in compounds

Cleaning



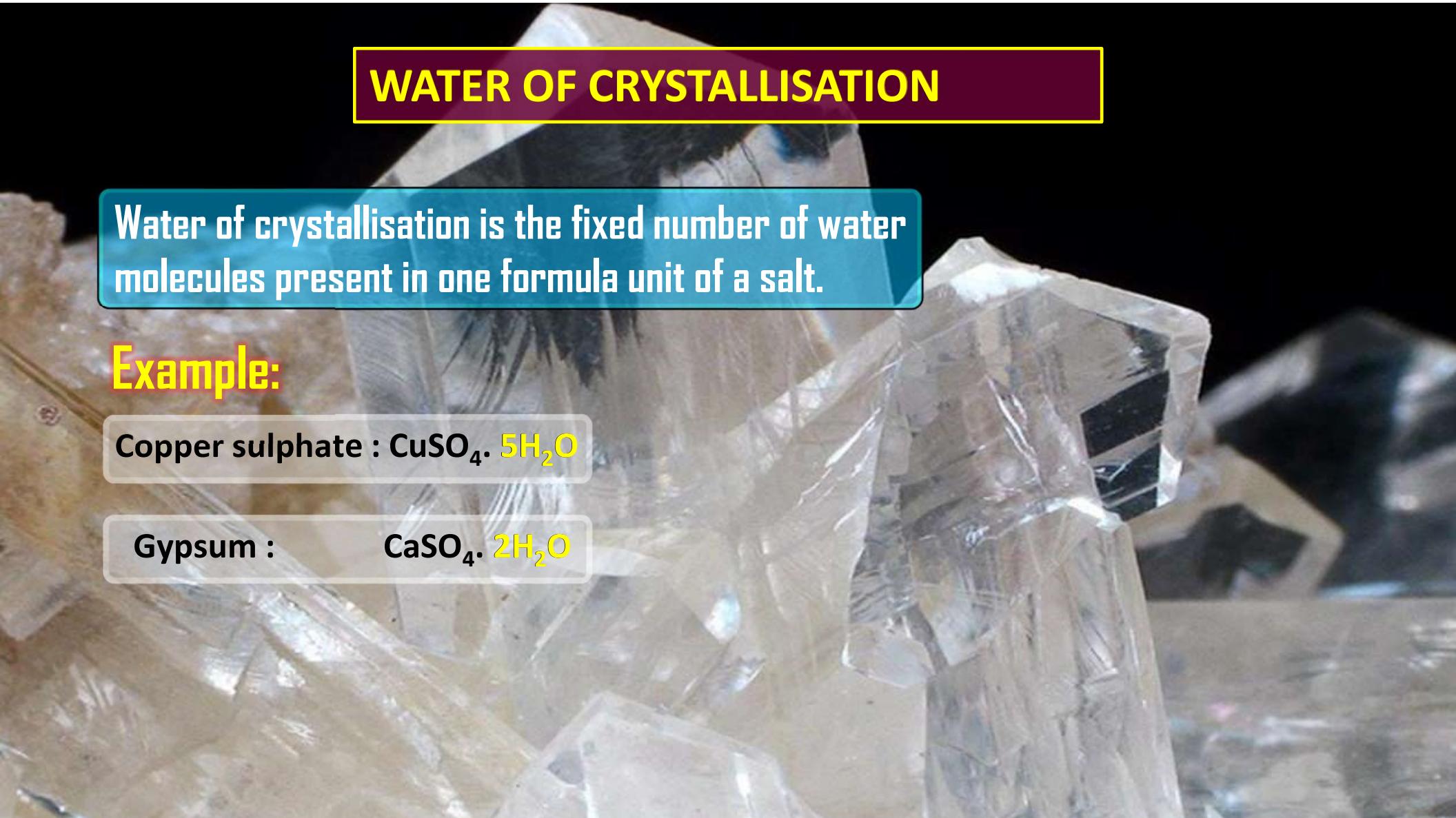
WATER OF CRYSTALLISATION

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt.

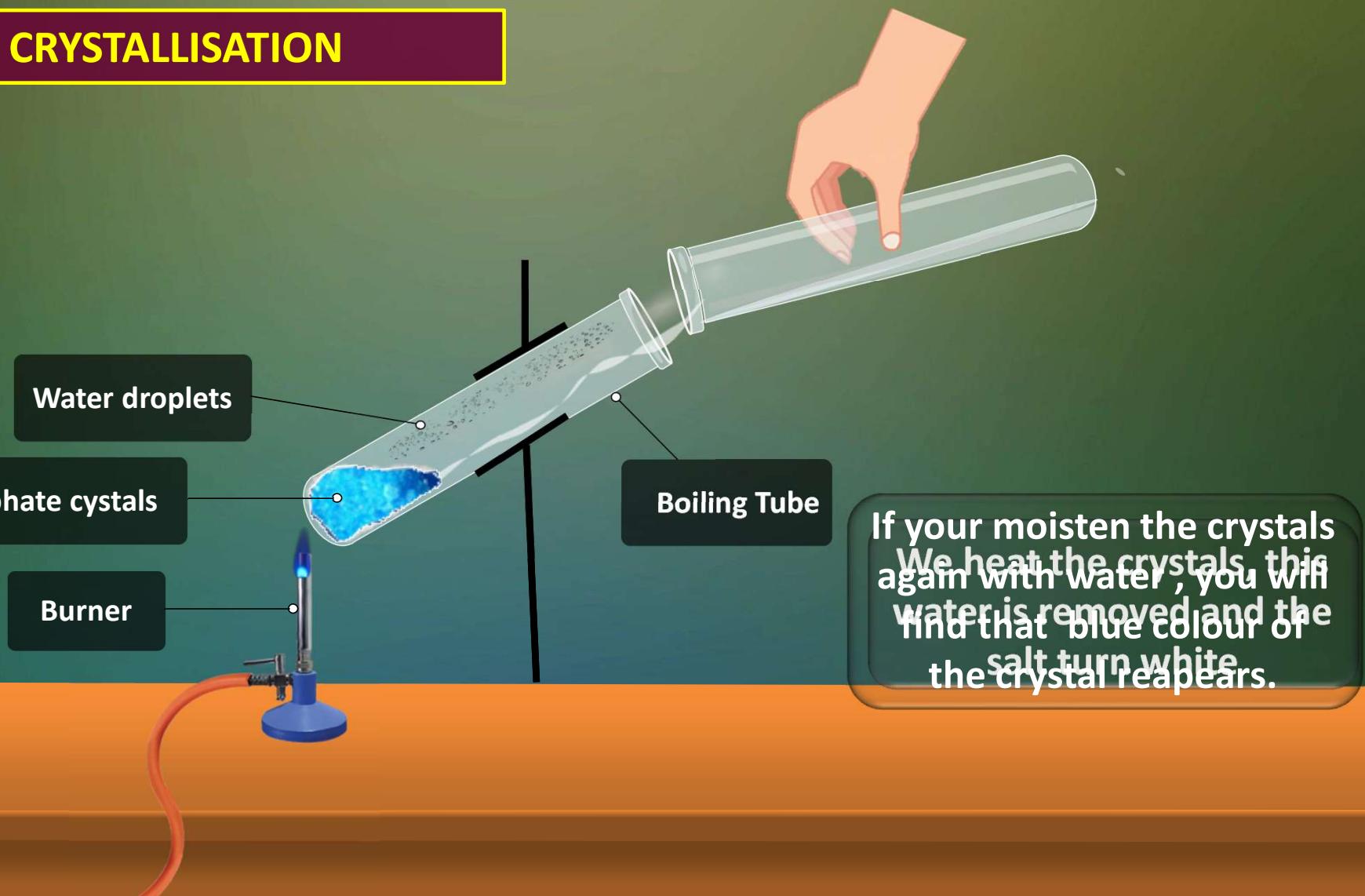
Example:

Copper sulphate : $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

Gypsum : $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$



WATER OF CRYSTALLISATION



PLASTER OF PARIS

On heating gypsum at 373 K, it loses water molecules and becomes calcium sulphate hemihydrate ($\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$).

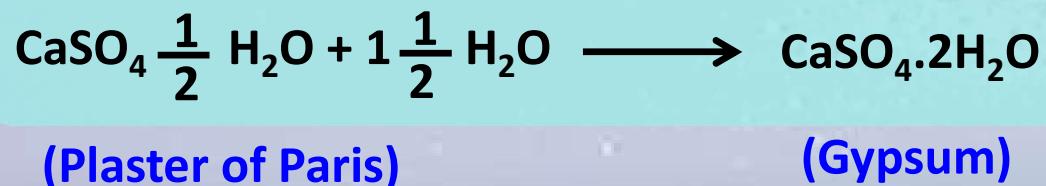
Plaster of Paris is a white powder and on mixing with water, it changes to gypsum once again giving a hard solid mass.



Gypsum

Plaster of Paris

Water



Basically 2CaSO_4 molecules are sharing $1\text{H}_2\text{O}$ molecule hence $\text{CaSO}_4 \cdot 1/2 \text{H}_2\text{O}$.

USES OF PLASTER OF PARIS

It is used as plaster for supporting fractured bones in the right position.

It is used for making toys.

It is

ation

It



Thank You