Metals and Non-Metals

- Introduction
- Physical properties of metals and non-metals


LOOK AT THE PICTURES
This is a foil made up of…
ALUMINIUM
Mom, what you are using to wrap my burger???

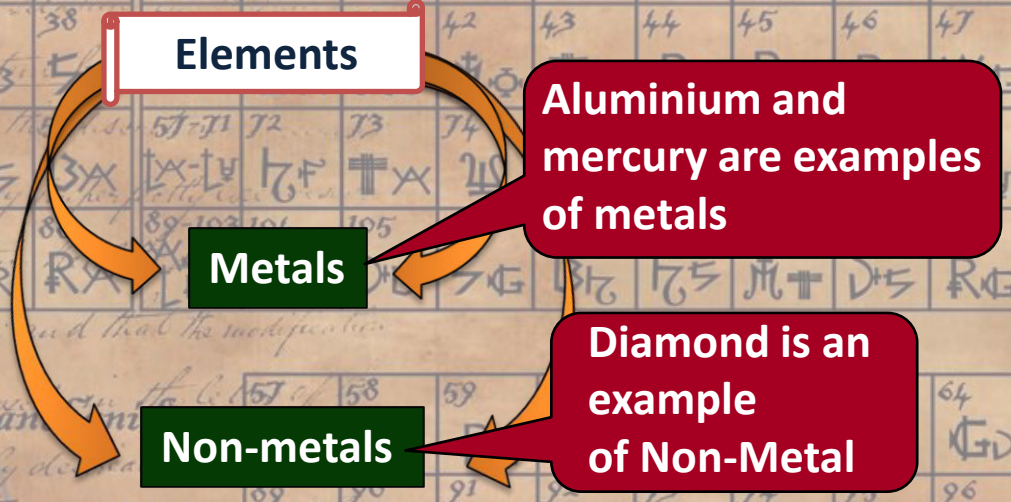

The liquid inside the thermometer is …
MERCURY
Doctor, what is this liquid inside the thermometer??


The ring is shining so much as it is made of .....
Mom, why is your ring shining so much ???
DIAMOND

INTRODUCTION

Elements can be classified into two categories

In the previous slide we studied substances such as Aluminium, Mercury and Diamond.



PHYSICAL PROPERTIES OF METALS AND NON-METALS

Metals and Non-metals

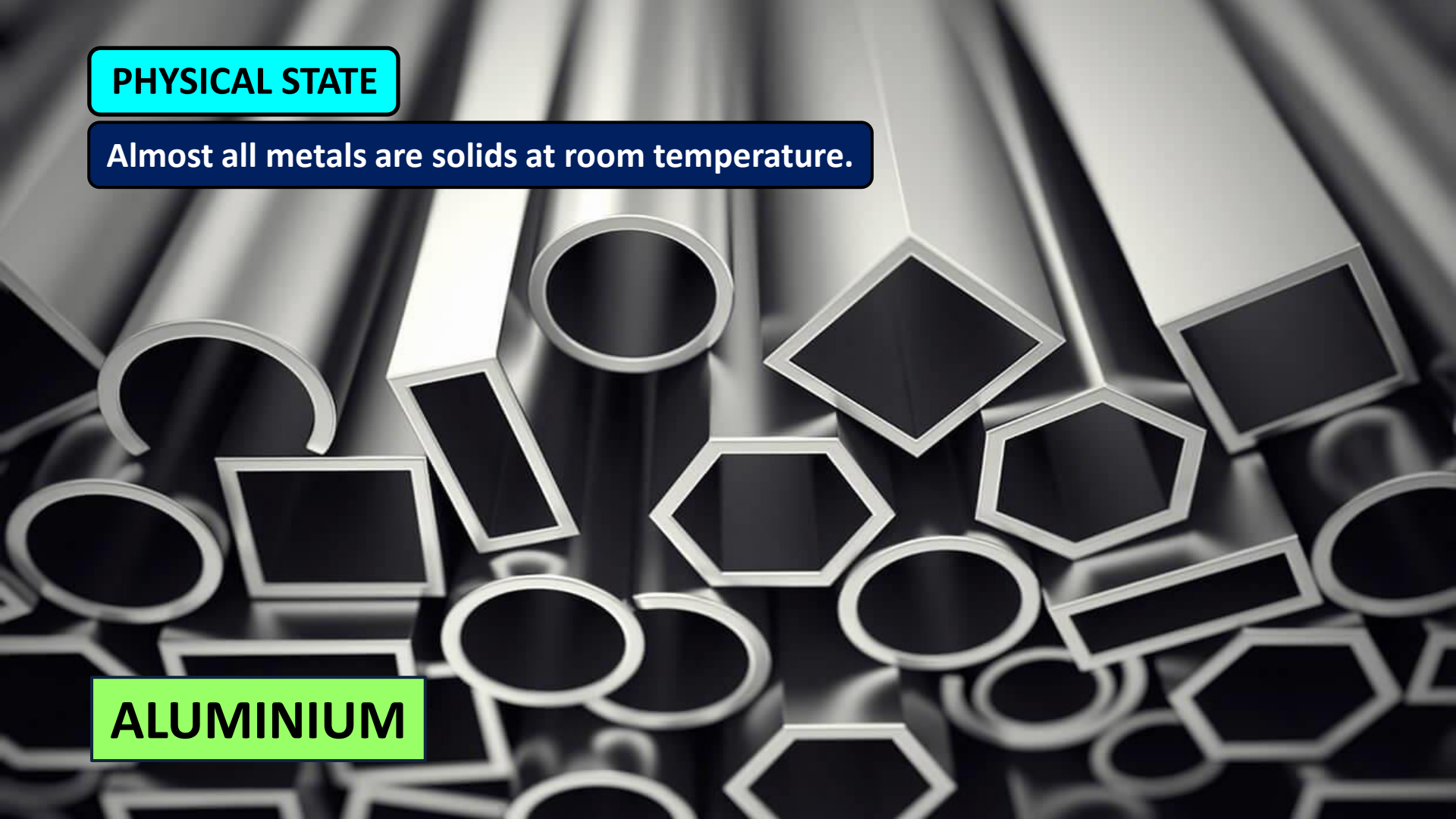
- ✓ Physical state
- ✓ Lustre
- ✓ Malleability & Ductility
- ✓ Hardness
- ✓ Colour
- ✓ Thermal conductivity
- ✓ Electrical conductivity
- ✓ Sonority

Questions

1. How elements are classified ?
2. Give two examples of metals and non metals each.
3. You are given following materials. Classify them into metals and non metals.
   Iron, coal, sulphur, aluminium and copper

Metals and Non-Metals

- Physical state
- Lustre



PHYSICAL STATE

Almost all metals are solids at room temperature.

ALUMINIUM

PHYSICAL STATE

Some of the metals to occur in a liquid state at room temperature are :

37

85.468

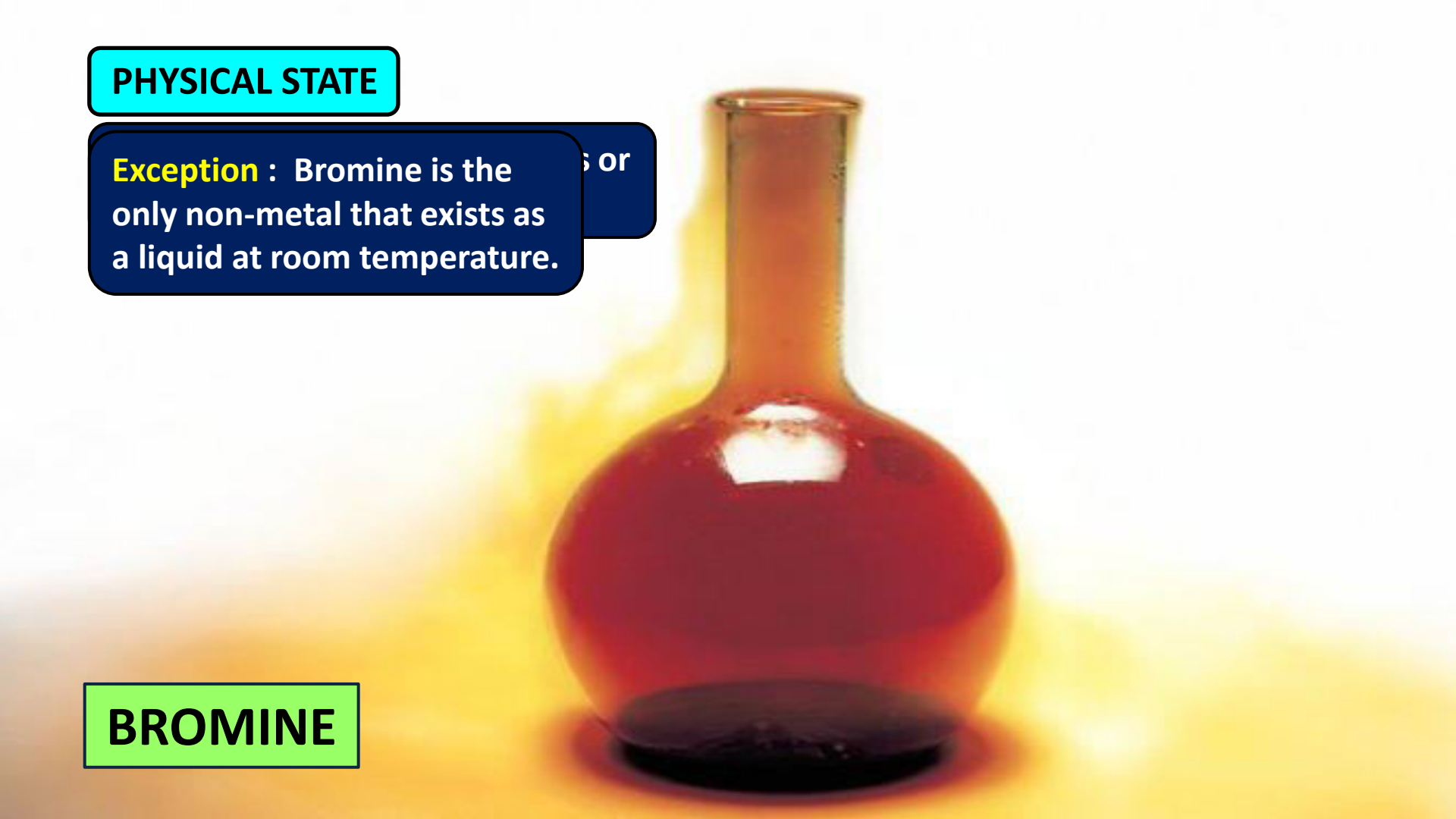
Are the only metals known to occur in a liquid state at room temperature.

RUBIDIUM

Rubidium

PHYSICAL STATE

Exception : Bromine is the only non-metal that exists as a liquid at room temperature.



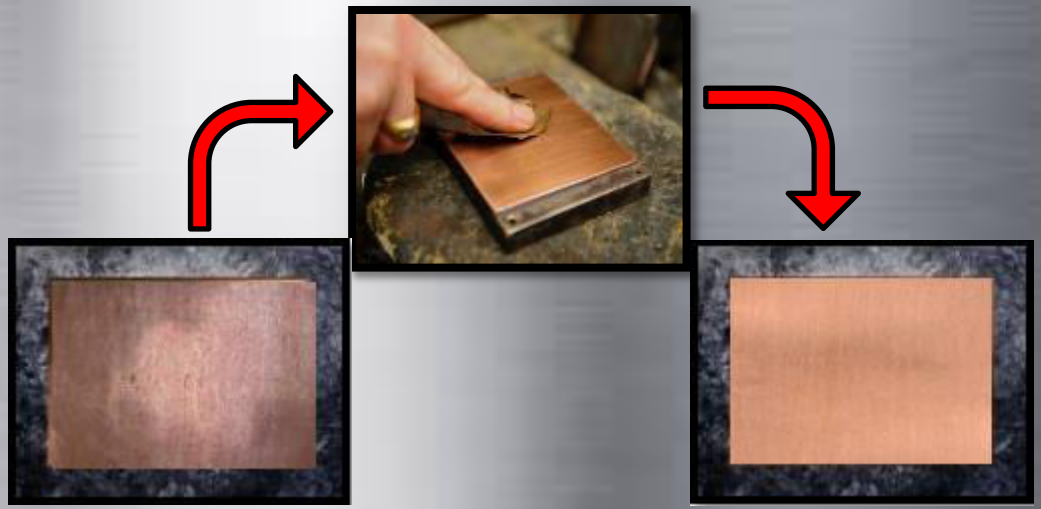
BROMINE

LUSTRE

Glitter or shiny surface is a property of most metals.

This is because metals can be polished.

This property is called lustre.



LUSTRE

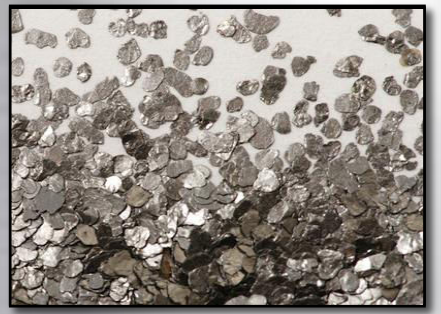
Because of their ability to shine and reflect light, metals like gold, silver and platinum are used for making jewellery and other decorative articles.

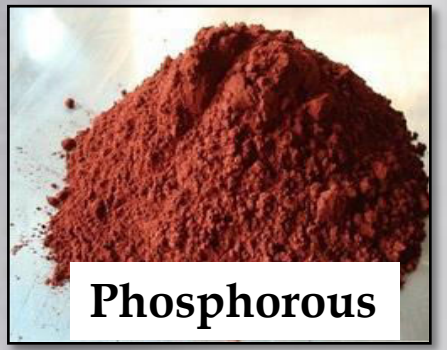





LUSTRE

Almost all non-metals have a dull surface.





Exception: Graphite and iodine do show some lustre.

Questions

1. Name one non metal that occurs in liquid state.
2. Name one non metal which has lustre.
3. Name one metal that occurs in liquid state.

Metals and Non-Metals

- Colour
- Malleability

COLOUR

Exceptions are gold is yellow and copper is reddish brown.

MALLEABILITY

Other metals that can be beaten into sheets include aluminium, iron, copper, and tin.

MALLEABILITY

Activity 1:

are brittle and cannot be beaten
or foils.

Beat the iron nail with a hammer

eable and
non-metals are brittle.

MALLEABILITY

Activity 2:

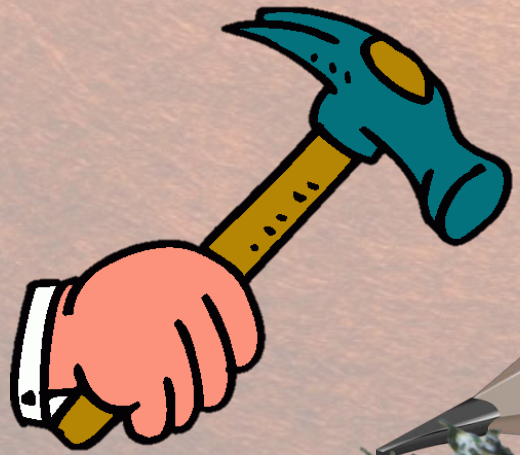
Beat the aluminium sheet with a hammer

Aluminium sheet flattened upon beating hard.

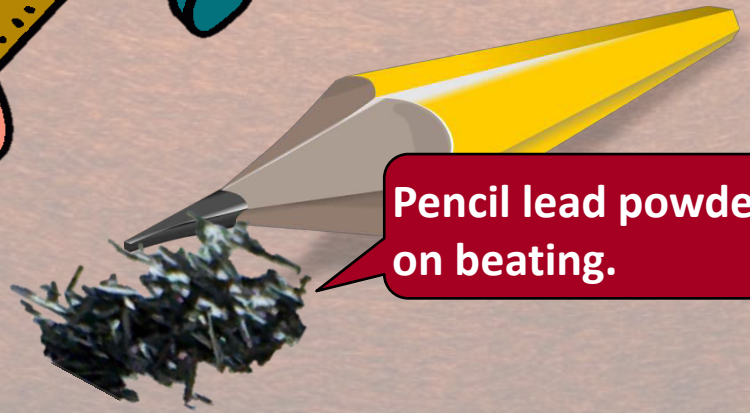
MALLEABILITY

Activity 3:

Beat the pencil lead with a hammer



Conclusion: Metals are malleable whereas non-metals are brittle.



Pencil lead powders on beating.

Questions

1. What is malleability ? Name the most malleable metals.
2. Have you ever seen a black smith beating the iron piece? Do you find a change in the shape of these pieces on beating? Would you expect a similar change in wood log on beating?

Metals and Non-Metals

- Colour
- Hardness
- Ductility

COLOUR

Some non-metals are colourless while some are coloured.

Nitrogen is a colourless gas.

HARDNESS

Non metals are generally soft.

Diamond is an exception. It is the hardest substance known.

Metals like sodium and potassium are so soft that they can be cut with a knife.

DUCTILITY

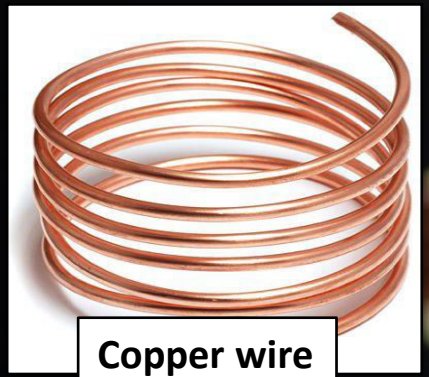
Most metals can easily be drawn into thin wires, which have a wide range of applications.

The property by virtue of which metals can be drawn into thin wires is called ductility.

Gold and silver are two of the most ductile metals known.

DUCTILITY

Other metals that can be drawn into wires include copper, aluminium, and tungsten.



Copper wire

Aluminium wire

Tungsten wire


Definitely not!
Definitely not! Iron is brittle and cannot be drawn into wires.

Questions

1. **Name the property of the metals by virtue of which it can be drawn into wires.**
2. **Name the two metals which can be cut with a knife.**

Metals and Non-Metals

- Thermal conductivity
- Electrical conductivity
- Sonority
- Comparison between metals and non-metals

THERMAL CONDUCTIVITY

Can you hold a hot

Non metals are generally or poor conductors of heat. er.

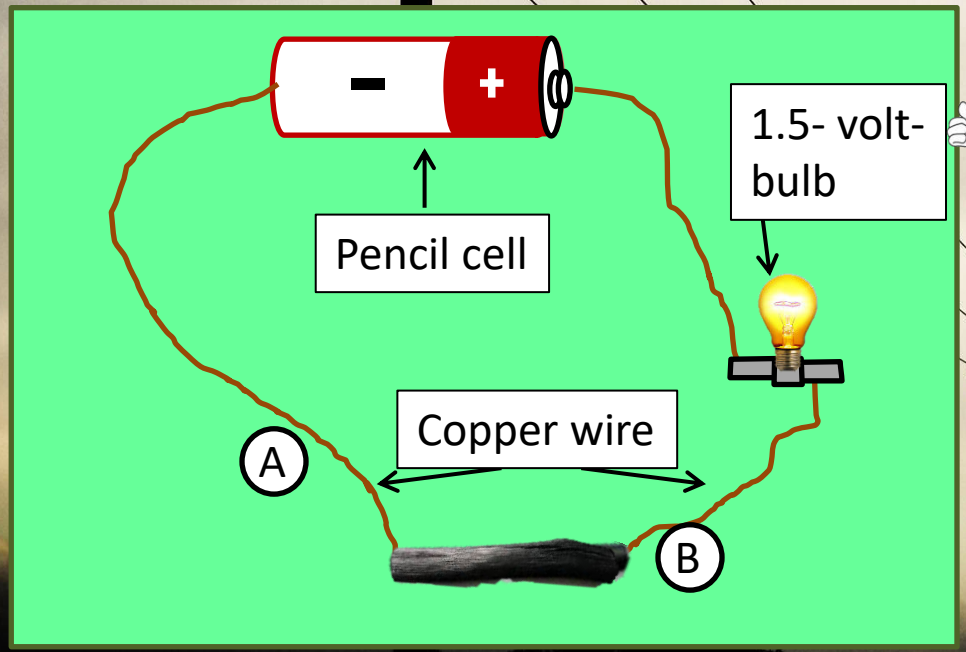
ELECTRICAL CONDUCTIVITY

Activity :

Aim : To show that meta
good conductors of elec
metals are poor conductors.

Connect
copper

Observation: The bulb glows when metals and graphite are connected to the free ends



Conclusion: Metals and graphite are good conductors of electricity whereas non metals are poor conductors.

SONORITY

Objects like wind chimes and bells make use of this property of metals.

Non-metals produce a dull sound when struck with a hard object.

with a hard object is called sonority.

DISTINGUISH BETWEEN METALS AND NON-METALS

Metals	Non-metals
Metals have a lustre.	Non metals do not have lustre.
Metals are malleable.	Non metals are not malleable.
Metals are ductile.	Non metals are not ductile.
Metals are good conductors of heat and electricity.	Non metals are poor conductors of heat and electricity.
At normal temperature, metals are in the solid state. Exception : Mercury	At normal temperature, non metals are in the solid or gaseous state. Exception : Bromine
Ordinarily, metals have high densities.	Ordinarily, non metals have low densities.
Metals are sonorous.	Non metals are non sonorous.

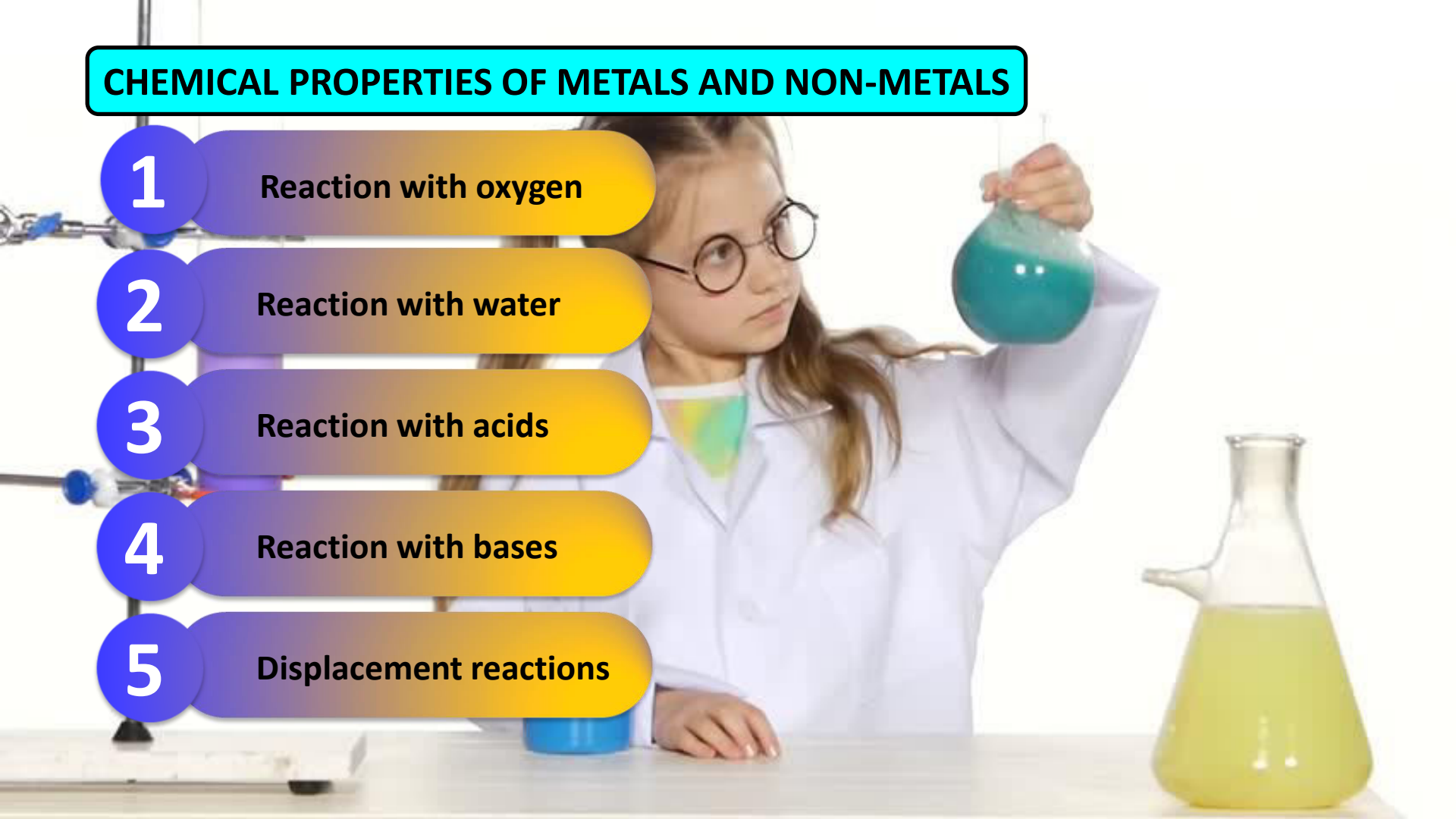
Questions

1. Write the differences between metals and non-metals on the basis of their physical properties.
2. Why cannot you have wooden bells?
3. Non-metals do not conduct heat or electricity except one. Name of the non-metal.

Metals and Non-Metals

- Chemical properties of metals and non-metals
- Reaction with oxygen

CHEMICAL PROPERTIES OF METALS AND NON-METALS



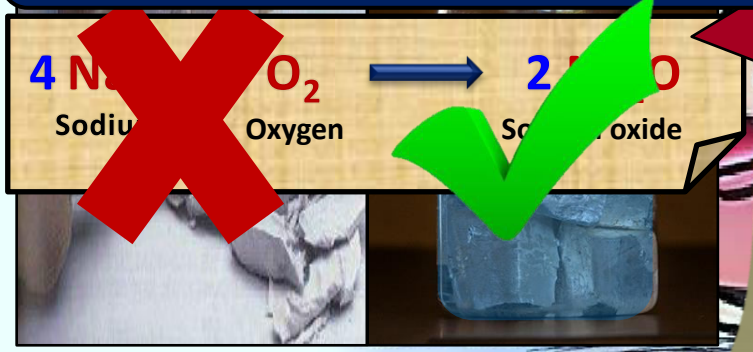
1. Reaction with oxygen
2. Reaction with water
3. Reaction with acids
4. Reaction with bases
5. Displacement reactions

REACTION WITH OXYGEN

Most metals combine with oxygen to form metal oxides.

METAL + OXYGEN ⟶ METAL OXIDE

Sodium reacts vigorously with the oxygen present in air to form sodium oxide.



m catches fire if
open. It is,
ore, kept
immersed in kerosene.

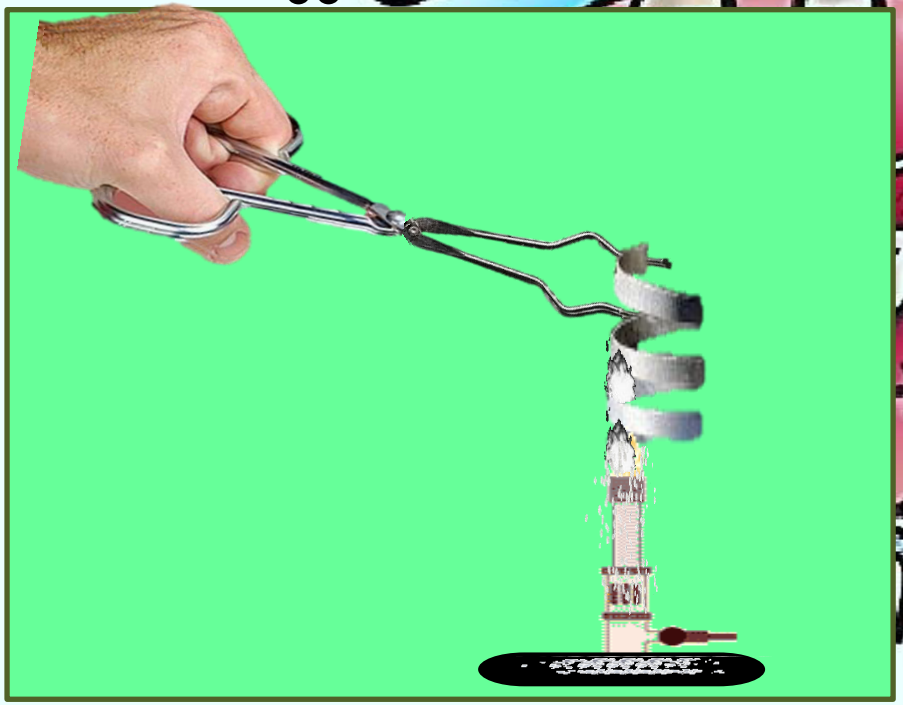
1 2

Na_2O

REACTION WITH OXYGEN

Activity :

Aim: To synthesize a metallic oxide and test its solution using litmus paper.



REACTION WITH OXYGEN

Magnesium, on heating, burns in air (oxygen) with a dazzling white light to form magnesium oxide.

$$2\,Mg + O_2 \longrightarrow 2\,MgO$$

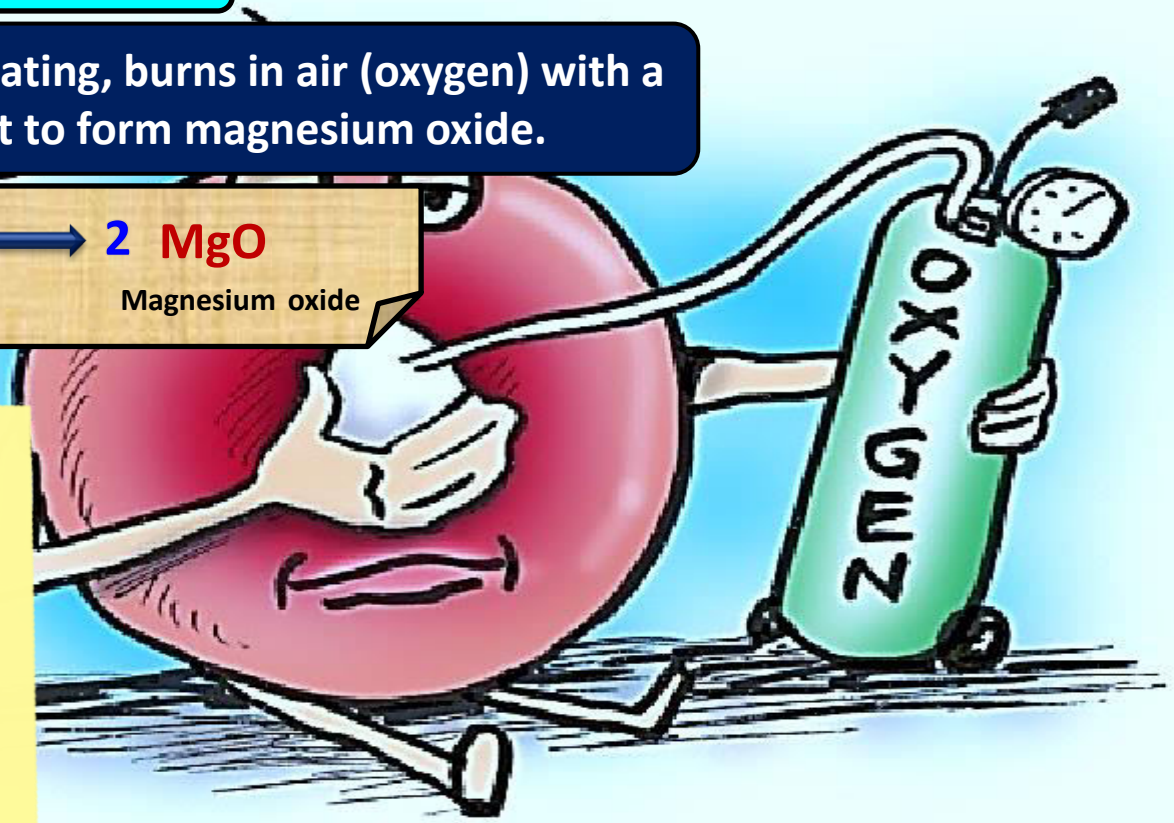
Magnesium + Oxygen → Magnesium oxide

Mg O

2 2

$Mg_2 O_2$

MgO



REACTION WITH OXYGEN

Activity :

…ns because magnesium oxide dissolves …form magnesium hydroxide, which is an alkali and turns red litmus blue.

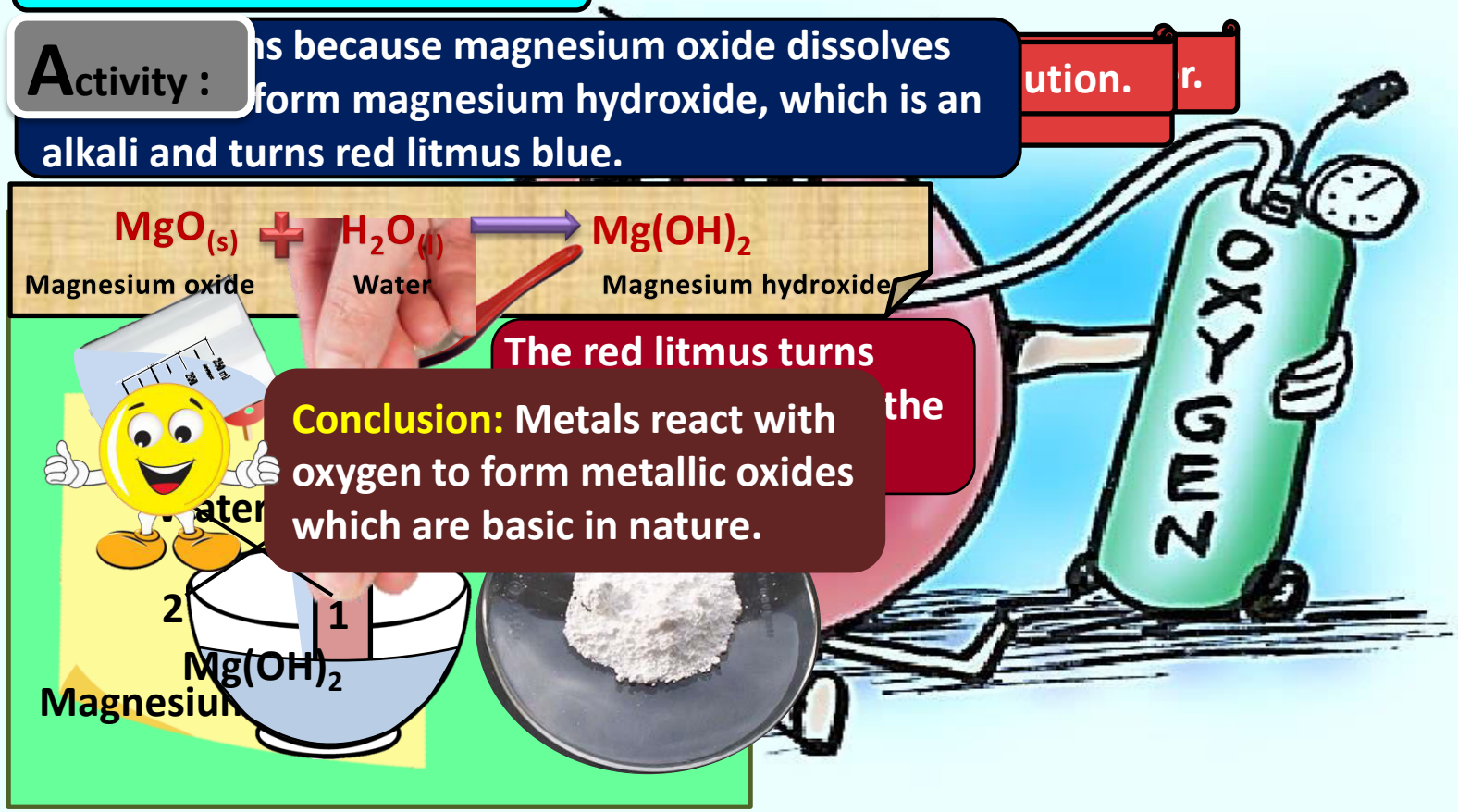
…ution. …r.

$MgO_{(s)}$ + $H_2O_{(l)}$ → $Mg(OH)_2$

Magnesium oxide | Water | Magnesium hydroxide

The red litmus turns … the …

Conclusion: Metals react with oxygen to form metallic oxides which are basic in nature.



REACTION WITH OXYGEN

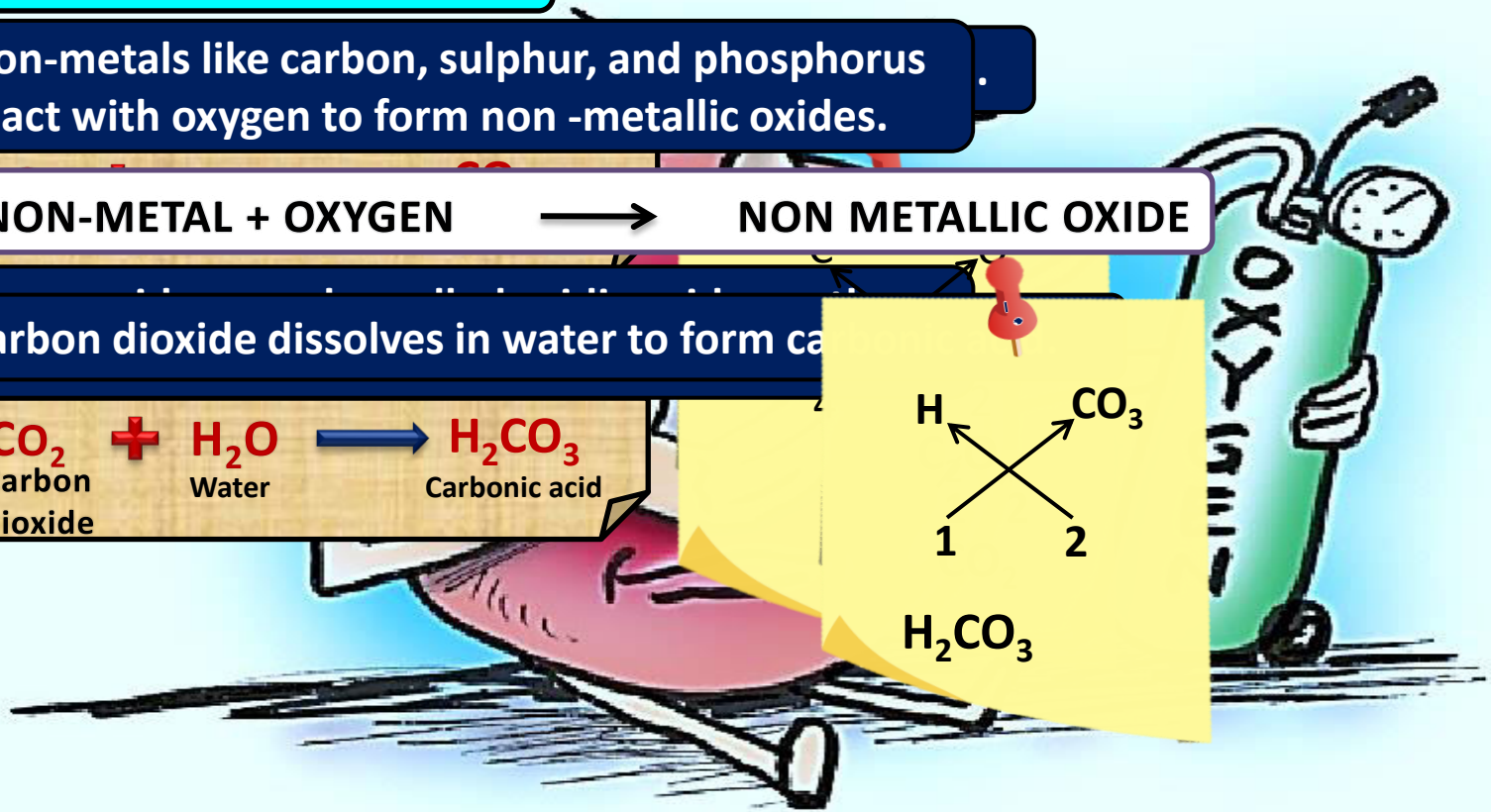
Non-metals like carbon, sulphur, and phosphorus react with oxygen to form non -metallic oxides.

NON-METAL + OXYGEN ⟶ NON METALLIC OXIDE

Carbon dioxide dissolves in water to form ca

CO_2 + H_2O ⟶ H_2CO_3

Carbon dioxide + Water ⟶ Carbonic acid



Questions

1. What happens when a metal reacts with oxygen?
2. Give a balanced chemical equation when magnesium reacts with oxygen.
3. Why is sodium stored in kerosene ?

Metals and Non-Metals

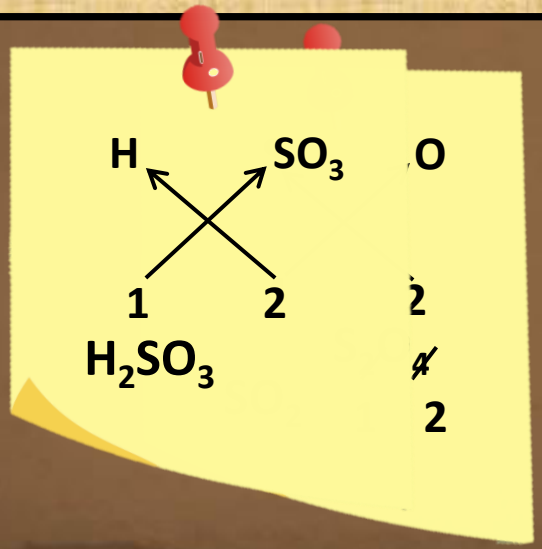
- **Reaction with Oxygen**

REACTION WITH OXYGEN

Sulphur dioxide dissolve in water to form sulphurous acid.

SO_2 + H_2O ⟶ H_2SO_3

Sulphur dioxide + Water ⟶ Sulphurous acid

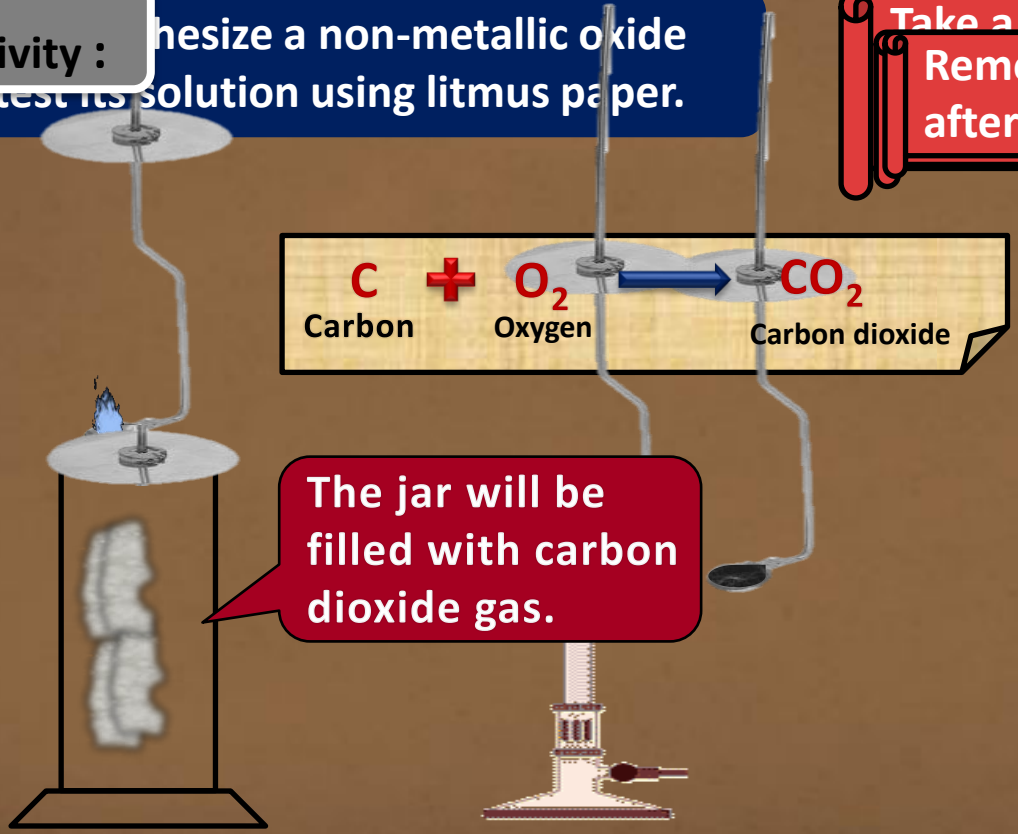


REACTION WITH OXYGEN

Activity : hesize a non-metallic oxide and test its solution using litmus paper.

Take a small piece of charcoal (a

Remove the spoon from the jar after sometime.



$C + O_2 \rightarrow CO_2$

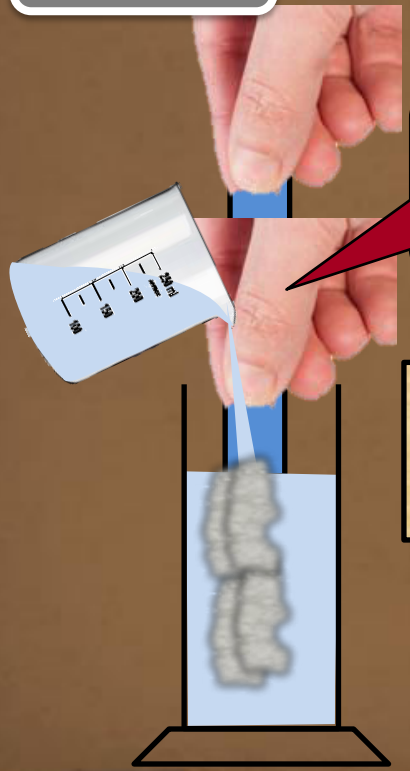
Carbon + Oxygen → Carbon dioxide

The jar will be filled with carbon dioxide gas.

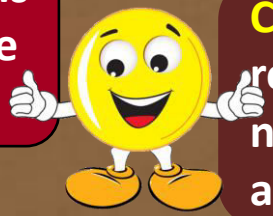
REACTION WITH OXYGEN

Activity :

Test the solution with blue litmus paper. ain.



Blue litmus paper turns red, indicating that the solution is acidic.



Conclusion: The non-metals react with oxygen to form non-metallic oxides which are acidic in nature.

CO_2 + H_2O → H_2CO_3

Carbon dioxide + Water → Carbonic acid

Questions

1. Write a balanced chemical equation when sulphur dioxide is dissolved in water.
2. What is the effect of sulphurous acid on blue litmus ?
3. Explain the reaction of non-metals with oxygen with the help of an activity.

Metals and Non-Metals

- Reactivity series
- Reaction with water

REACTIVITY SERIES

The arrangement of m de order of their reactivity in the form of series is called the reactivity series of the metal.

K is most reactive

K	Potassium
Na	Sodium
Ca	Calcium
Mg	Magnesium
Al	Aluminium
Zn	Zinc
Fe	Iron
Pb	Lead
Cu	Copper
Hg	Mercury
Ag	Silver
Au	Gold

As we move down, reactivity decreases

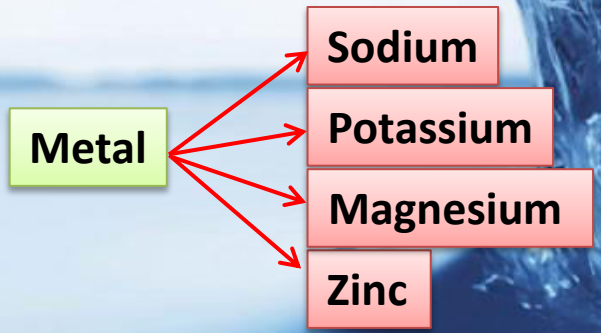
Gold is least reactive

REACTION WITH WATER

Most metals react with water to produce a metal hydroxide or metal oxide and hydrogen gas.

METAL + WATER ⟶ METAL HYDROXIDE + HYDROGEN GAS

METAL + WATER (Steam) ⟶ METAL OXIDE + HYDROGEN GAS



REACTION WITH WATER

$2\,Na + 2\,H_2O \rightarrow \ldots + H_2$

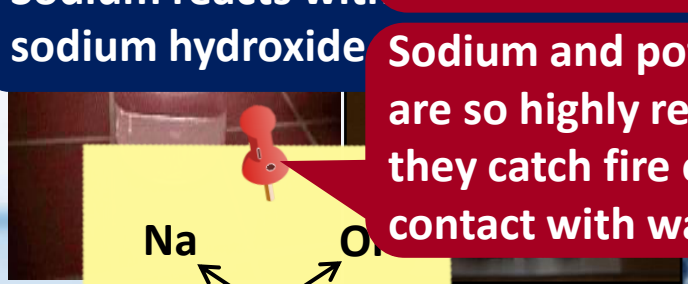
Sodium — Water — ydrogen

Reaction of metals with water depends reactivity seri

Therefore, they are stored under kerosene.

Sodium reacts wit
sodium hydroxide

Sodium and potassium metals are so highly reactive that they catch fire on coming in contact with water.



Na O

1 1

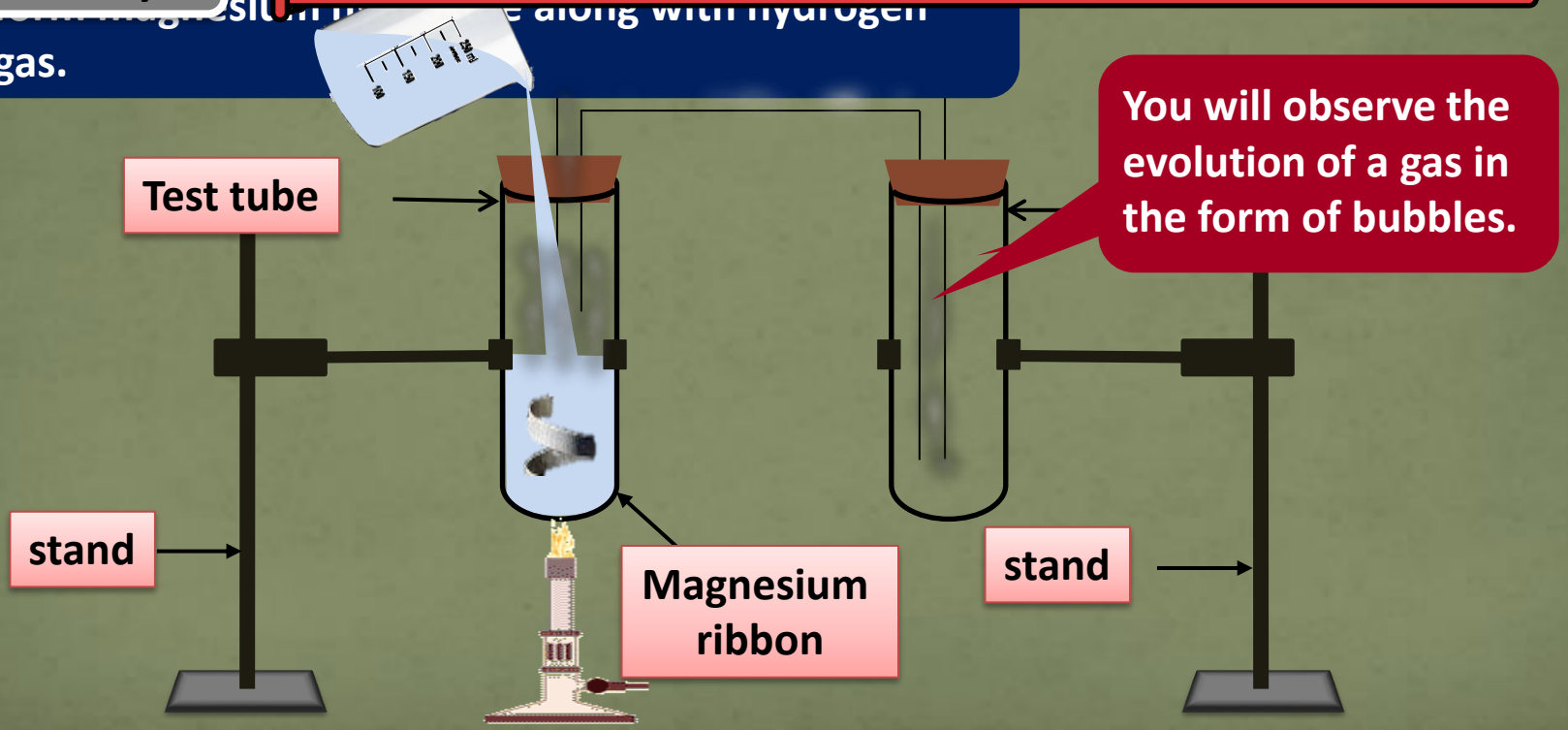
NaOH

REACTION WITH WATER

Activity :

gas.

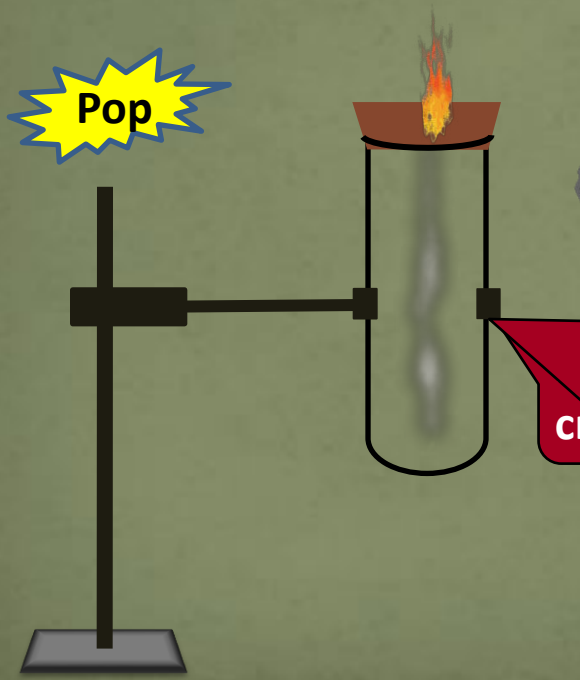
Gently warm the test tube over the flame of a bunsen burner.

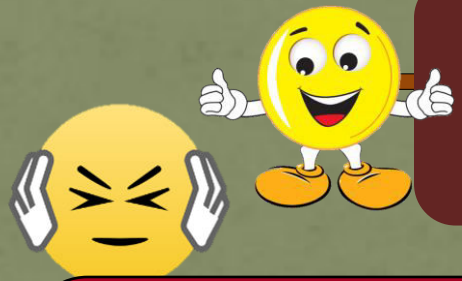


REACTION WITH WATER

Activity :

Now bring a burning splinter near the mouth of the test tube.





Conclusion: Magnesium reacts with water to form magnesium hydroxide along with hydrogen gas.

This happens because magnesium reacts with water on heating and liberates hydrogen gas which burns with a popping sound.

Questions

1. Copper cannot displace zinc from its salt solution. Give reason.
2. Arrange the following metals in the order of their decreasing chemical activity : Magnesium, potassium, iron, gold.

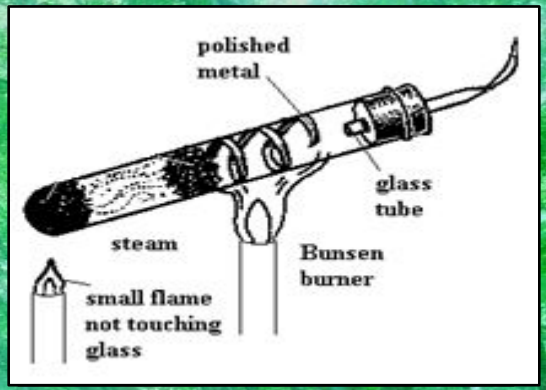
Metals and Non-Metals

- Reaction of metal with water
- Reaction of non-metal with water
- Reaction with acid

REACTION OF METALS WITH WATER

Metals differ in the reactivity towards water.

Metal	Reaction condition
Copper Mercury Silver Gold Platinum	No reaction
Zinc Iron Lead	Steam



REACTION OF METALS WITH WATER

Non metals do not react with water.

Therefore, some reactive Non-metals are stored in water to prevent their reaction with air.

For example phosphorus is kept in water to prevent its contact with air.

REACTION WITH ACID

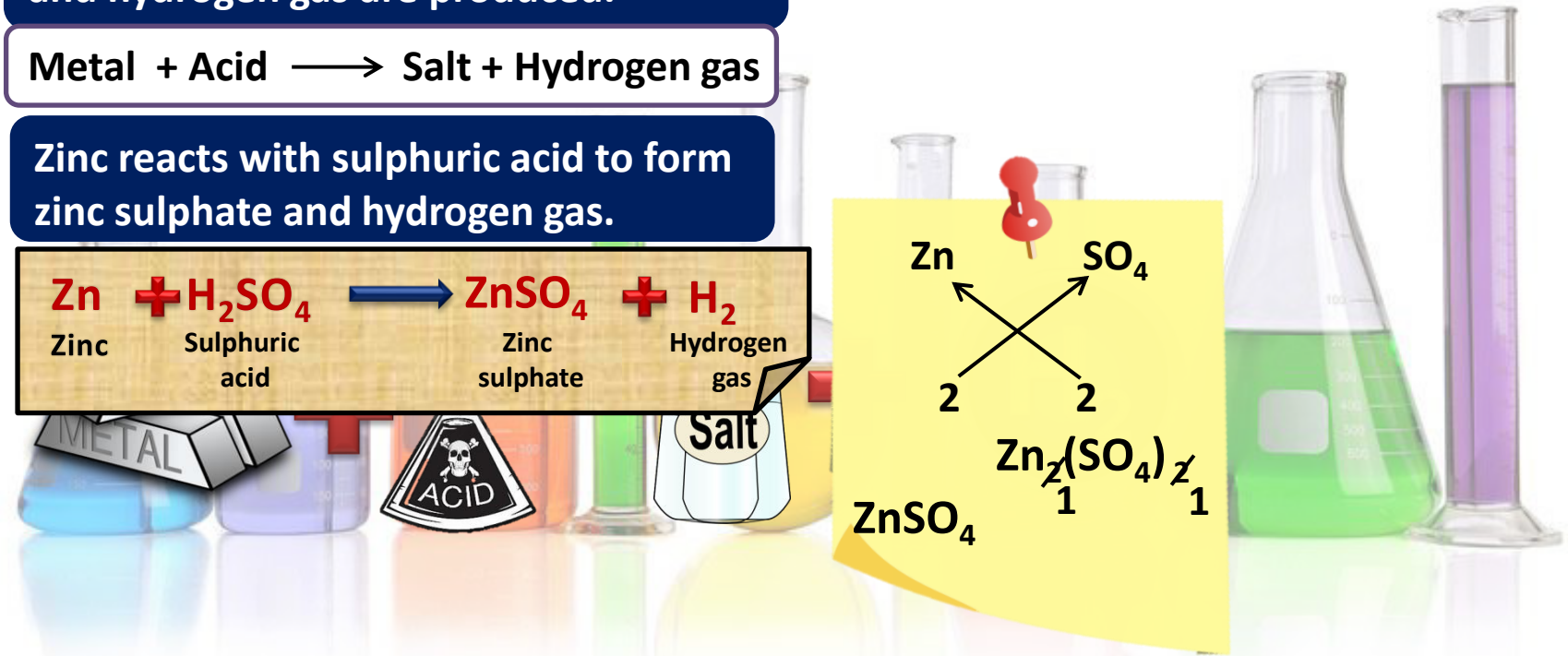
When a metal reacts with an acid, a salt and hydrogen gas are produced.

Metal + Acid ⟶ Salt + Hydrogen gas

Zinc reacts with sulphuric acid to form zinc sulphate and hydrogen gas.

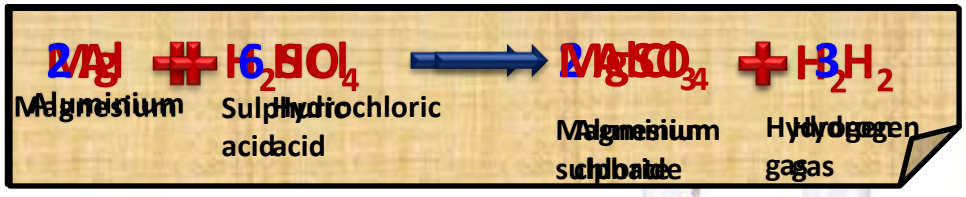
$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

Zinc — Sulphuric acid — Zinc sulphate — Hydrogen gas



REACTION WITH ACID

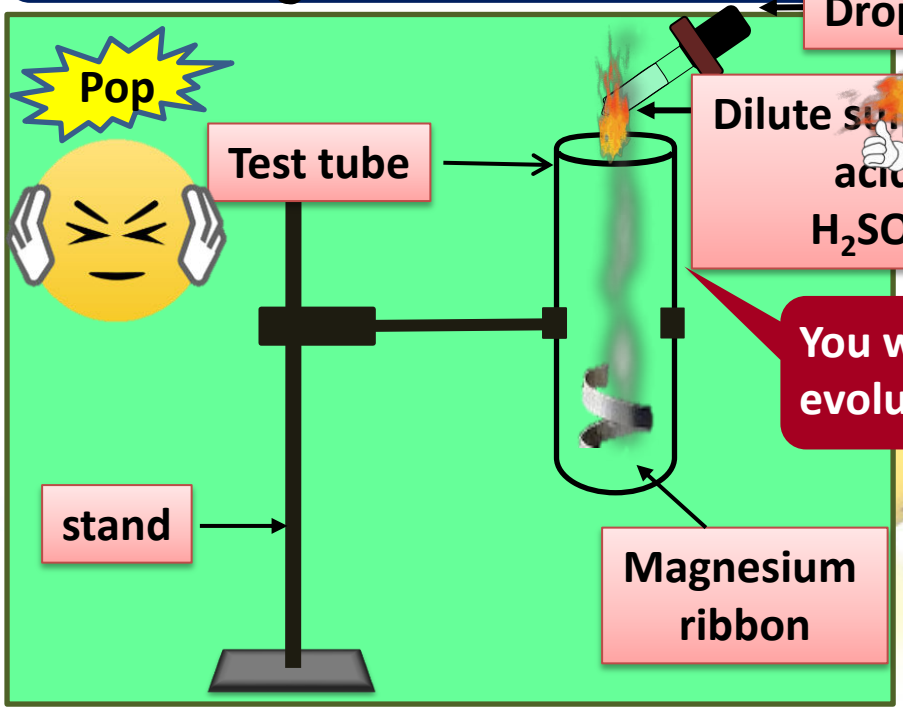
Aluminium reacts with hydrochloric acid to form aluminium chloride and hydrogen gas.



REACTION WITH ACID

Activity :

Bring a burning matchstick near the mouth of the test tube.



You will observe the evolution of a gas.

Conclusion: The gas produced in the reaction is hydrogen.

Questions

1. Some non-metals like phosphorus are kept in water to protect them from atmospheric oxygen. State the property of the non-metals utilized here.
2. What happens when a metal reacts with acids ?

Metals and Non-Metals

- Reaction with acid
- Reaction with bases
- Displacement reaction
- Comparing reactivity of metals

REACTION WITH ACID

Non-metals generally do not react with acids.

Certain food stuffs like citrus fruits, curd, pickle, tamarind, etc., contain acid.

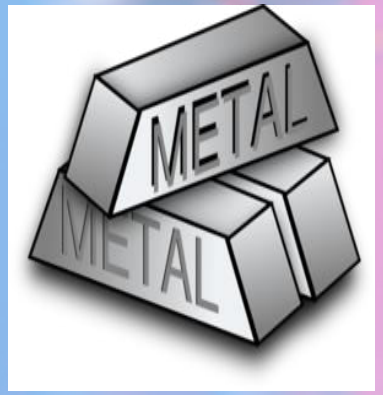
stored

ot ??

Some non-metals like sulphur and phosphorous react with, hot, concentrated sulphuric acid and nitric acid but they do not liberate Hydrogen gas.

REACTION WITH BASES

Most metals do not react with bases.



No reaction

Only a few, like aluminium, zinc and lead react with solution of strong bases like sodium hydroxide to produce a compound of that metal and hydrogen gas.

The reactions of non metals with bases are complex.

DISPLACEMENT REACTION

It is a chemical reaction which take place when an element [or radical] has – replaced another element in a compound.

Representation : $X+YZ \longrightarrow Y + XZ$

$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

A metal will only react with a salt solution if it is placed higher in the activity series than the metal in the salt.

More Electropositive metal	Metals	Displaces →	Less Electropositive metal
	K		
	Na		
	Ca		
	Mg		
	Al		
	Zn		
	Fe		
	Pb		
	[H]		
	Cu		
	Hg		
	Ag		
	Pt		
	Au		

DISPLACEMENT REACTION

Silver does not react with zinc sulphate

$Ag + ZnSO_4 \longrightarrow$ No reaction

Silver does not react with copper sulphate

$Ag + CuSO_4 \longrightarrow$ No reaction

From the above reactions, we can conclude that the order of reactivity of zinc, copper, and silver is: Zn > Cu > Ag (i.e., zinc is the most reactive of the three and silver, the least reactive).

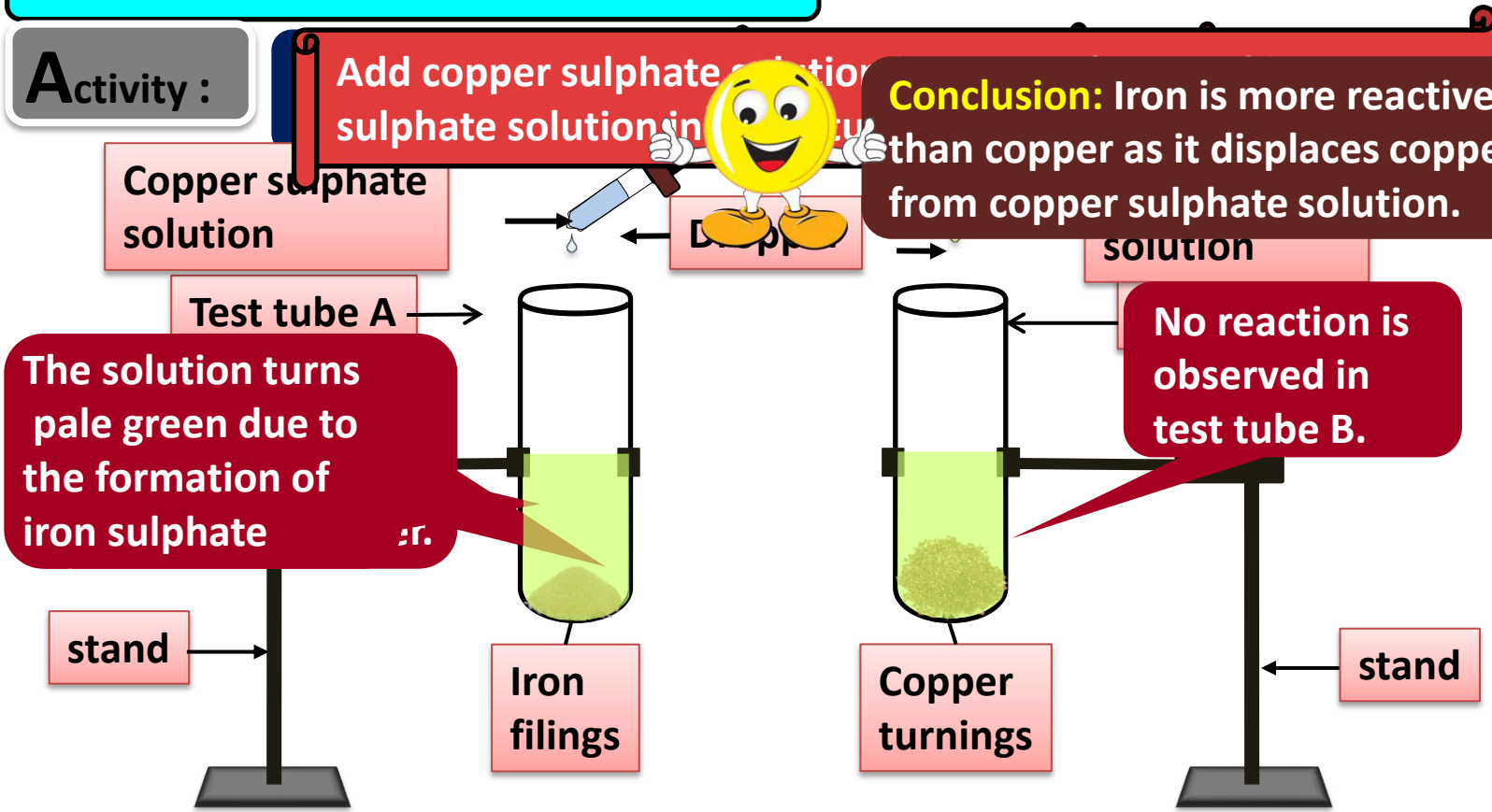
Metals
K
Na
Ca
Mg
Al
Zn
Fe
Pb
[H]
Cu
Hg
Ag
Pt
Au

COMPARING REACTIVITY OF METALS

Activity :

Add copper sulphate solution to iron sulphate solution in test tube A

Conclusion: Iron is more reactive than copper as it displaces copper from copper sulphate solution.



Questions

1. Can you store lemon pickle in an aluminium utensil? Explain.
2. Name the metals which reacts with bases.
3. Give one example of displacement reaction.
4. What happens when iron nails are placed in copper sulphate solution? Write word equation for the reaction.

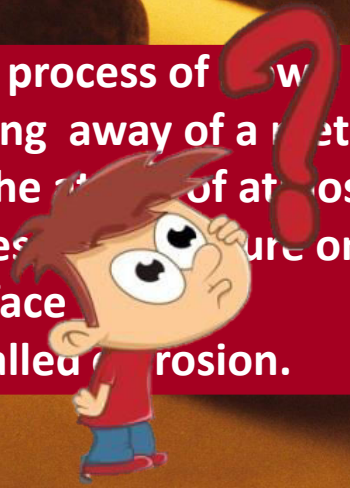
Metals and Non-Metals

- Corrosion

CORROSION

What is the reason behind this???

The process of w
eating away of a etal due
to the of at ospheric
gases ure on it
surface
is called rosion.



CORROSION

Iron reacts with oxygen and moisture present in the atmosphere to form brown, flaky substance called rust.

Iron objects become weak with the passage of time.

layer of rust formed falls off, exposing the metal to a further rusting.

CORROSION

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

CORROSION

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

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

Questions

1. What is corrosion ?
2. What are the conditions for rusting.
3. Silver dose not combine easily with oxygen but silver jewellery tarnishes after some time. Why ?

Metals and Non-Metals

- Noble metals
- Uses of common metals

NOBLE METALS

Metals

K
Na
Ca
Mg
Al
Zn
Fe
Pb
[H]
Cu
Hg
Ag
Pt
Au

Since noble metals are least reactive, they are not chemically affected by the substances around them.

Hence they do not get tarnished and retain their lustre for a longer time.

It does not react
Another metal which shows similar behaviour is gold.

eactivity
the least

NOBLE METALS

The purity of gold is expressed in terms of carats or karats.

rts of gold present
l and other metals.

s 22 parts gold is
old with copper or
4 carats.

USES OF COMMON METALS

Metals have been an integral part of our daily life since ancient times.

They have played an important part in the development of various civilizations.

The most commonly used metals in everyday life are Iron, Copper, Aluminium and Silver.

Questions

1. Name the noble metals.
2. Write the uses of metals.
3. Why copper is added in making gold jewellery ?

Metals and Non-Metals

- Uses of common metals

USES OF COMMON METALS

Iron is used for making

NAILS


USES OF COMMON METALS
It is also used for making cooking utensils.


USES OF COMMON METALS
Silver is used for making
FOOD STUFFS

Questions

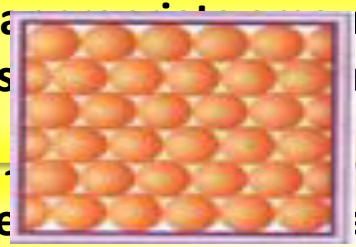
1. Write the uses of iron.
2. Aluminium is used for making aircraft bodies. Give reason ?
3. Write the common uses of copper and silver.

Metals and Non-Metals

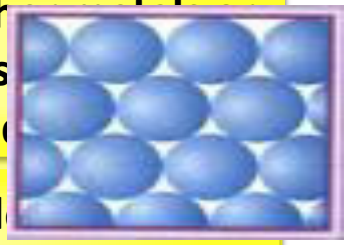
- Uses of alloys
- Composition and uses of alloys

USES OF ALLOYS

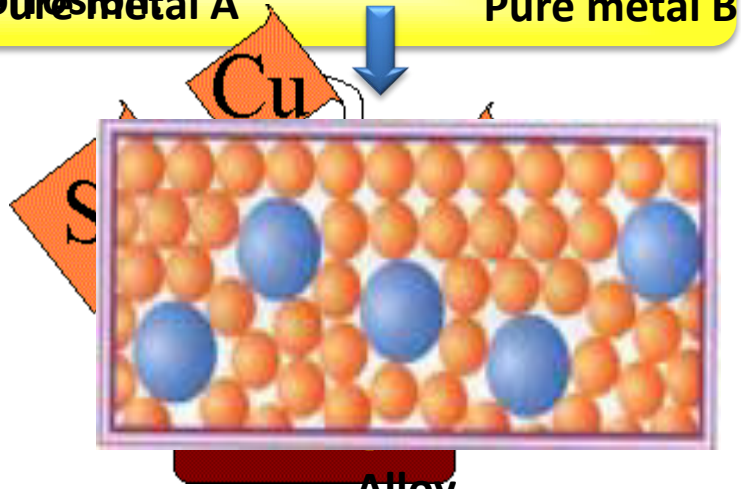
By adding a nt of oth
non metals ng alloys
properties mo ie
An alloy is xture of
Alloy are ge and hard
resistant to corrosion



Pure metal A

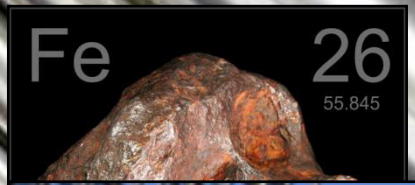


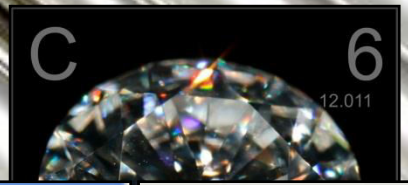
Pure metal B



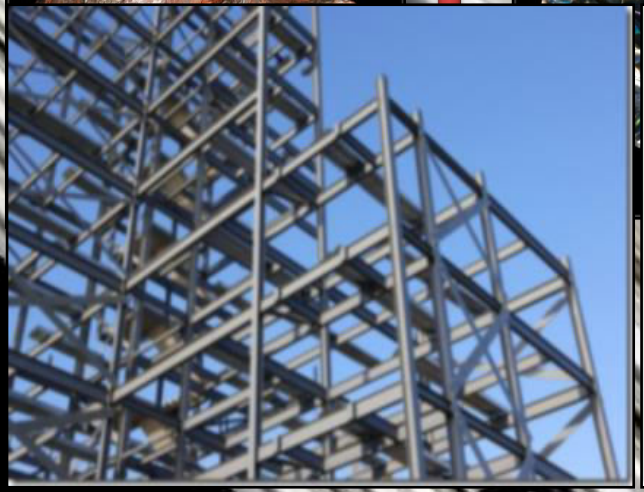
Alloy

COMPOSITION AND USES OF ALLOYS

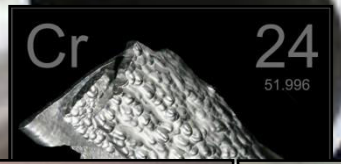




Steel is used in construction material, machine parts.



COMPOSITION AND USES OF ALLOYS



Stainless steel is used for making cooking utensils and surgical implements.

Stainless steel

COMPOSITION AND USES OF ALLOYS

Brass is used in making utensils and decorative statues.

Questions

1. What are alloys ?
2. Write the composition and uses of stainless steel.
3. Name the alloy used in making utensils and statues.

Metals and Non-Metals

- Composition and uses of alloys
- Uses of non-metals

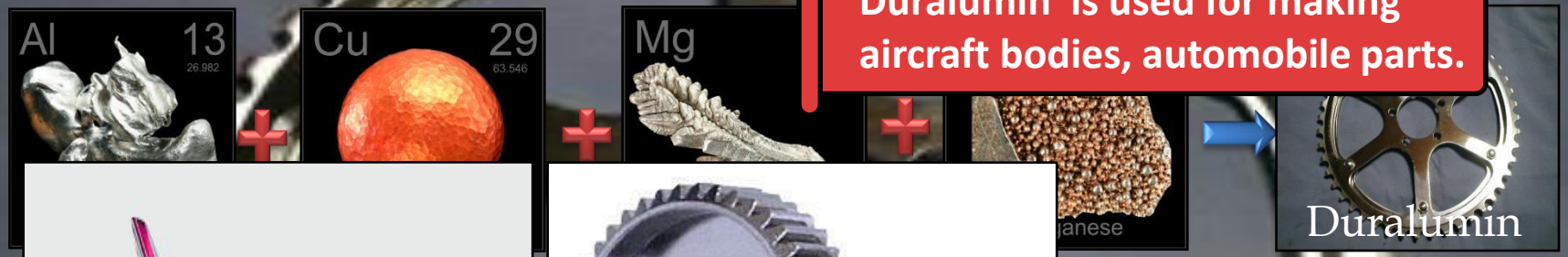
COMPOSITION AND USES OF ALLOYS

Bronze is used for making coins, medals and statues.

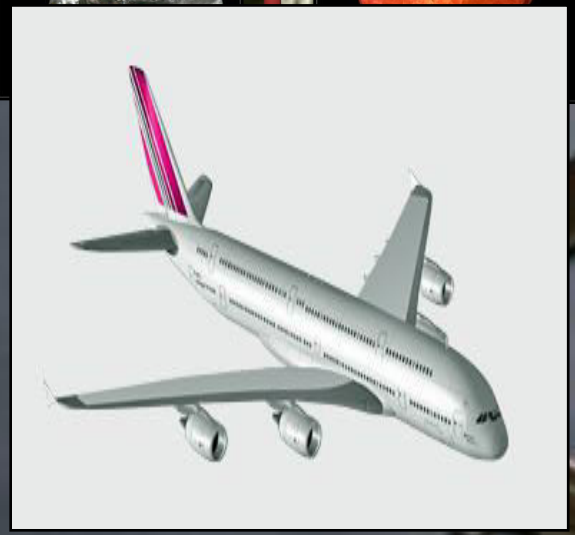
COMPOSITION AND USES OF ALLOYS

German Silver is used for making table ware.

COMPOSITION AND USES OF ALLOYS



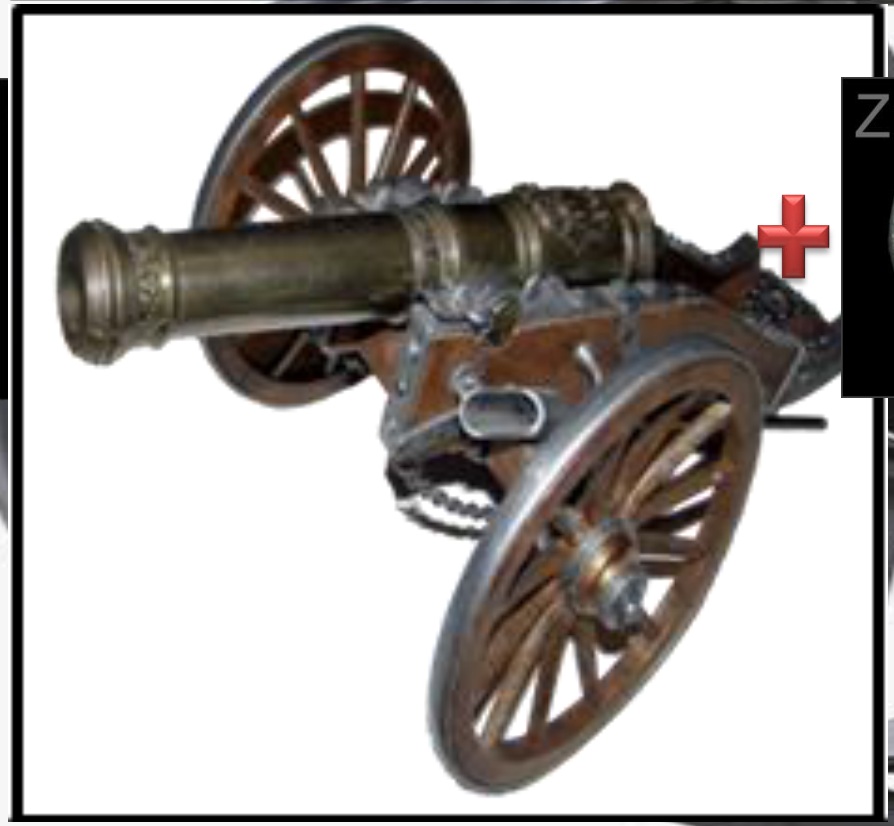
Duralumin is used for making aircraft bodies, automobile parts.



COMPOSITION AND USES OF ALLOYS

Alnico is used for making magnets.

COMPOSITION AND USES OF ALLOYS



Gun metal is used for making gun-barrels.

Gun metal

USES OF NON-METALS

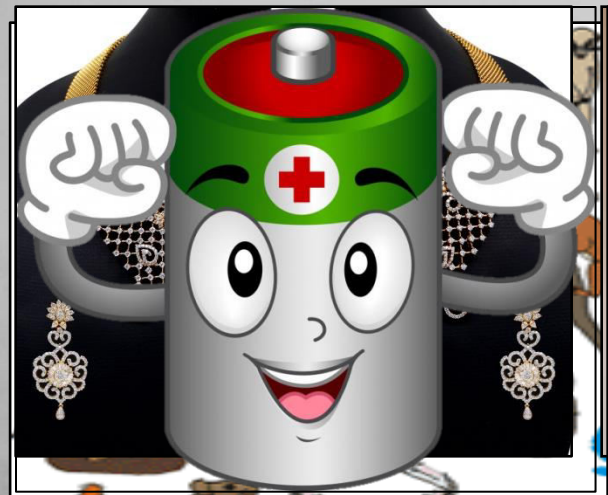
Iodine is used as an antiseptic.

x industry and in ne

fertilizers.

USES OF NON-METALS

Graphite is used in batteries and in pencils.



Questions

1. Write the composition of bronze, German silver, gun metal, Alnico and duralumin.
2. Write the uses of bronze, German silver, gun metal, Alnico and duralumin.
3. Write the uses of non-metals.
4. Name the non-metal used as an antiseptic.