PENANG SANGAM HIGH SCHOOL
P.O.BOX 44, RAKIRAKI

LESSON NOTES

Year/Level: 11 C/D week 19 **Subject:** Chemistry

Strand	4 Materials
Sub Strand	4.1 metals and non-metals
Content Learning Outcome	Explain the physical and chemical properties and uses of selected metals Describe the production of iron and define alloys and identify the different types of alloys.

Metals

Properties of Metal

These elements are generally shiny/lustrous, good conductors of electricity, malleable (can be beaten into sheets), ductile (can be pulled into wires), and some are magnetic

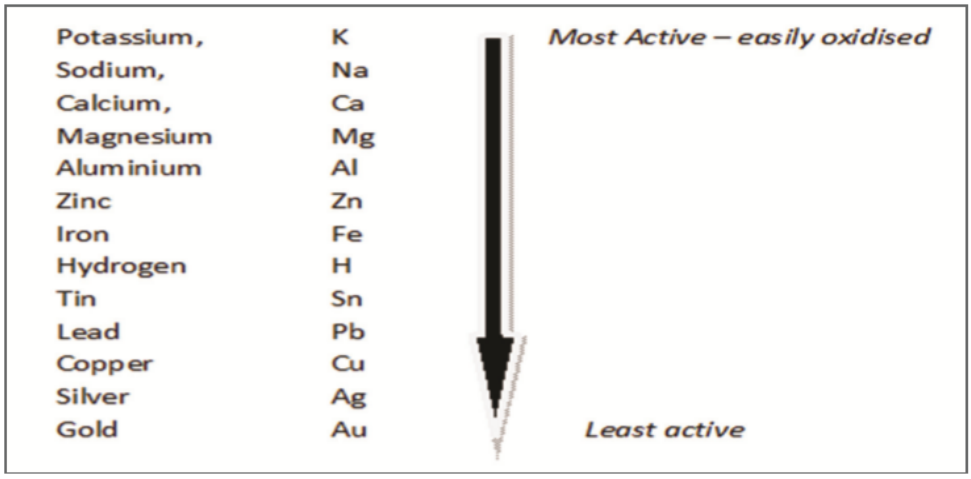
Metals are commonly found in the earth's crust as metal deposits or ores

Differences between each metal depends on its property such as density and strength

Metal	**Color**	**Melting pt (^oC)**	**Boiling pt (^oC)**	**Density (g/cm^3)**	**Uses**
Sodium	Silver-grey	98	900	0.97	Plant micronutrient, needed for neuron function and osmoregulation in cells
Calcium	Silver-grey	840	1490	1.53	White wash, cleaning powder, toothpaste, and antacid.
Magnesium	Silver-grey	650	1100	1.74	Alloy is used in aerospace industry
Aluminium	Silver	660	2350	2.70	Cooking foil, electric wire for power lines
Zinc	Silver	420	913	7.14	Galvanise iron, zinc alloy, brass is used widely
Iron	Grey	1540	2760	7.87	Most commonly used metal. Its available cheaply and has a lot of strength so it is used in the building industries, make tools and body of ships.
Lead	Grey	328	1760	11.3	scuba diving weight belts, lead – acid car batteries
Copper	Brown	1085	2580	8.93	used in electrical wiring for appliances, home, and Telecom lines, Cooking pot

Reactivity of Metals

It is the order of oxidation of metals from the most easily oxidised to the least



Chemical Properties of Metals

Reaction with Air

Exposed metal react with oxygen in air to form metal oxides

Some of these metal oxides may combine with water to form hydroxides

The hydroxides are basic in nature

Metal	Reaction with Air	Observation
Sodium	$2Na + O_2 \longrightarrow Na_2O$	Forms a sodium oxide layer, white in color
Calcium	$2Ca + O_2 \longrightarrow 2CaO$	Develops a greyish white layer of calcium oxide
Magnesium	$2Mg + O_2 \longrightarrow 2MgO$	A layer of greyish white magnesium oxide will form Burns in air to form a brilliant white flame
Aluminium	$2Al + 3/2\ O_2 \longrightarrow Al_2O_3$	White oxide layer prevents the corrosion of Al
Zinc	$2Zn + O_2 \longrightarrow 2ZnO$	Burns with a green flame to form a white powder
Iron	$2Fe + 3/2O_2 \longrightarrow Fe_2O_3$	**Electroplating** – The surface of the metal is electroplated with Tin, a less reactive metal. The iron surface is protected as tin does not corrode. **Galvanising** – The surface of the metal is coated with zinc, a more reactive metal. The iron surface is protected as the zinc will corrode first **Greasing/Painting** – The layer of grease or paint are water and air proof so the iron surface is dry and not exposed to air. Rusting will not take place **Bluing** – When strongly heated a blue iron oxide forms, it forms a layer on the surface of the iron preventing it from corrosion
Lead	$2Pb + O_2 \longrightarrow 2PbO$	Forms a yellow coat
Copper	$2Cu + O_2 \longrightarrow 2CuO$	Black coat

Reaction with Water

- Metals that react with water will release **hydrogen gas** and the **hydroxide of the metal** will form.
- The hydroxide is **basic** in nature.

Metal	Reaction with Water	Observation

Sodium	$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + 2H_{2(g)}$	Very reactive hence, kept under oil in labs Reacts explosively with water
Calcium	$Ca_{(s)} + H_2O \longrightarrow Ca(OH)_{2(aq)} + H_{2(g)}$	reacts vigorously
Magnesium	$Mg_{(s)} + H_2O_{(l)} \longrightarrow Mg(OH)_{2(aq)} + H_{2(g)}$	Forms hydrogen gas and metal hydroxide
Zinc	$Zn_{(s)} + H2O_{(l)} \longrightarrow ZnO_{(s)} + H_{2(g)}$	It does not react with cold water, but red hot zinc will react with steam to form zinc oxide and hydrogen gas.
Iron	$3Fe_{(s)} + 4H_2O_{(g)} \longrightarrow Fe_3O_{4(s)} + 4H_{2(g)}$	It does not react with cold water, but steam passed over heated iron will blue black magnetic oxide of iron.
Lead, Aluminium, Copper	Does not reacts with water	

Test for Hydrogen gas

Bring a glowing splint near the mouth of the test tube containing hydrogen gas. It burns with a **"pop"** sound.

Reaction of Metal with Dilute Acids

- The reaction of dilute acid with metals produces metal chloride and hydrogen gas
- Potassium, Sodium and calcium react explosively with dilute acids and magnesium show vigorous reaction.
- Iron and Zinc react slowly with dilute acids
- Aluminum may show no reaction due to the presence of oxide coat which will first react with the acid.

Example

$Mg_{(s)} + HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$

$Zn_{(s)} + HCl_{(aq)} \longrightarrow Zn\,Cl_{2(aq)} + H_{2(g)}$

Activity

1. Out of the four metals given below, the most reactive metal is _____.
A. Fe B. Zn C. Al D. K

2,Aluminium is a more reactive metal than iron, however it does not rust or corrode.
Provide an explanation for the above statement.

_____

3.Which of the following is a correct use of zinc metal?

A. Strengthening of teeth.
B. Galvanisation of iron nails.
C. Weight belts for scuba diving.
D. Electrical wire for power line