SCIENCE

Notes Project

FORM 5

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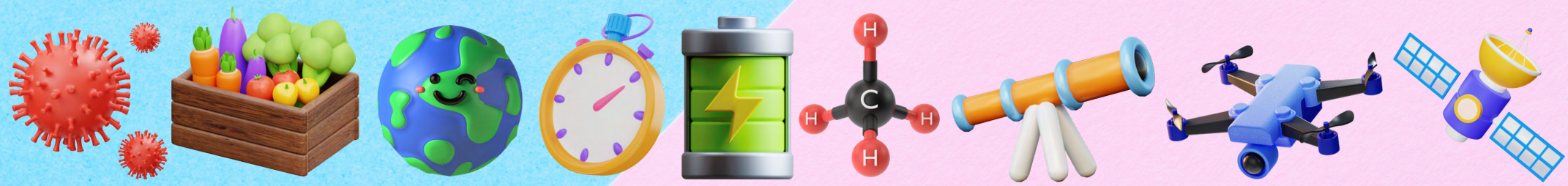

Chapter 1
Microorganisms

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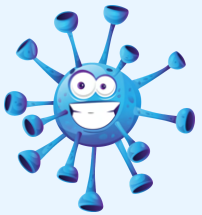
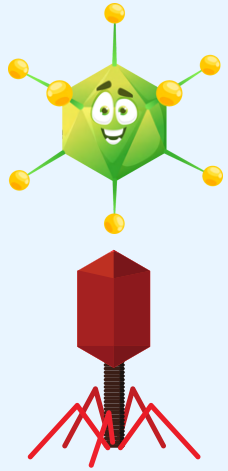
What is Microorganisms?

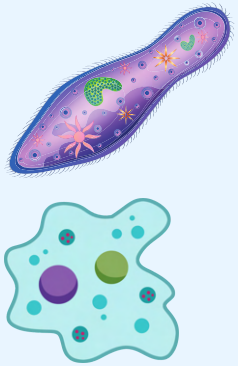


Microorganisms are minute organisms that cannot be seen with the naked eye. Microoganisms can only be seen with the help oa **microscope.**

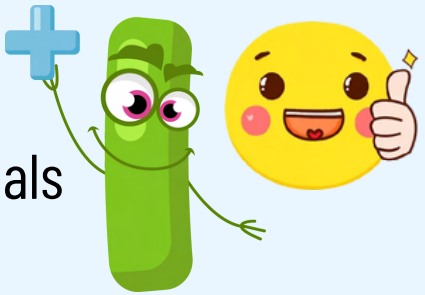
Classification of Microorganisms

- Fungi
- Viruses
- Bacteria
- Protozoa
- Algae





Normal Flora



Microorganisms that found in organisms such as humans and animals and **do not cause any disease.**

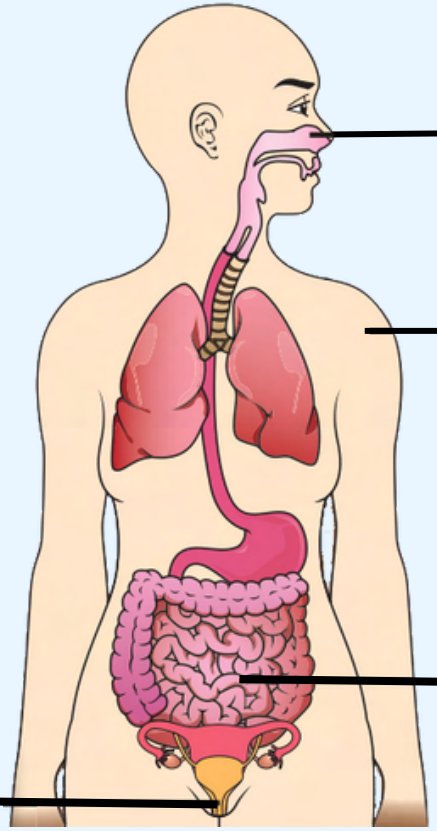

Staphylococcus sp.


Corynebacterium sp.


Escherichia coli


Lactobacillus sp.


Streptococcus sp.



UPPER PART OF RESPIRATORY TRACT
- *Staphylococcus sp.*
- *Streptococcus sp.*

SKIN
- *Staphylococcus sp.*
- *Corynebacterium sp.*

SMALL INTESTINE
- *Escherichia coli*
- *Lactobacillus sp.*
- *Streptococcus sp.*

URETHRA
- *Staphylococcus sp.*
- *Corynebacterium sp.*

Importance of Normal Flora

- **Compete with pathogens** for nutrients and prevent the formation of pathogen colony.
- Consists of bacteria that **synthesize vitamin B_{12} and vitamin K.**
- **Stimulates the growth of body tissues** such as colon tissue and digestive tract tissue.
- **Stimulates the formation of antibodies** that fight pathogens and diseases.

FUNGI

Size

Macroscopic fungi

Mushrooms can be seen by naked eye.

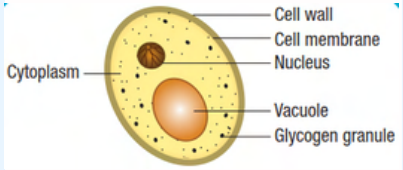
Microscopic fungi 10 µm – 100 µm.

Yeast

Mucor

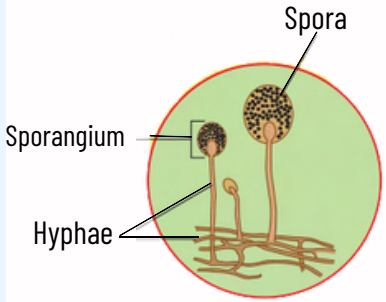
Shape

Unicellular fungi



Yeast –small sphere

Multicellular fungi



Mucor
Sporangium –Hyphae - threads

Nutrition

Parasite

Absorb nutrition from the host

Saprophyte

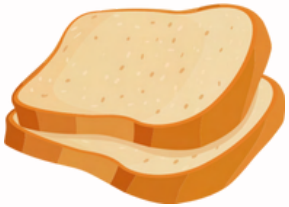
Absorb nutrition from the dead organism

Habitat

A **dark and moist place**, close to its main source of nutrition

Excrement

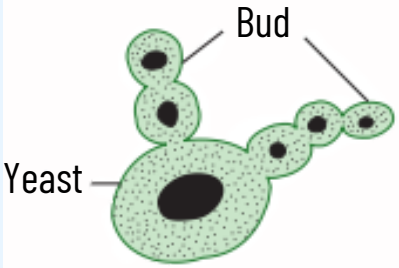
Skin



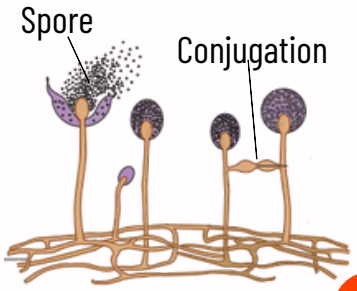
Bread

Reproduction

Yeast reproduces by budding (asexual reproduction)



Asexual reproduction (spore formation) and sexual reproduction (conjugation) in mucor



ALGAE

Size

Macroscopic algae

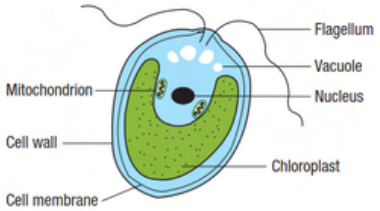
Sea algae can be seen by naked eye

Microscopic algae 1 µm –several hundred µm.

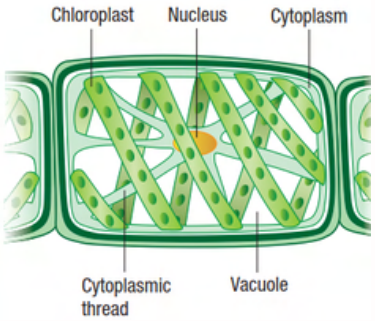
Spirogyra sp.

Chlamydomonas sp.

Shape



Chlamydomonas sp.



Spirogyra sp.

Nutrition

Photosynthesis

Algae have chlorophyll, makes its own food

Habitat

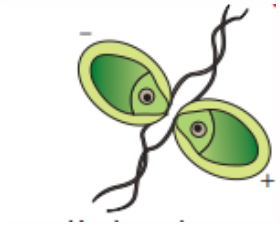
Fresh water

Sea

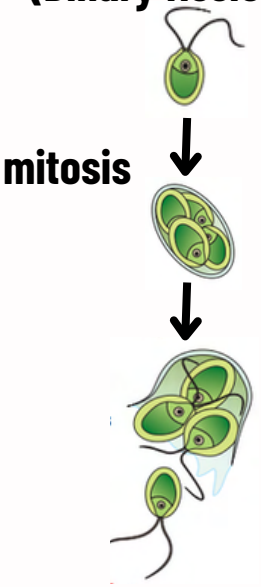
Trunk

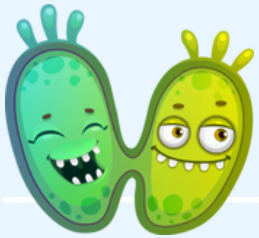
Reproduction

Sexual reproduction (Conjugation)



Asexual reproduction (Binary fission)





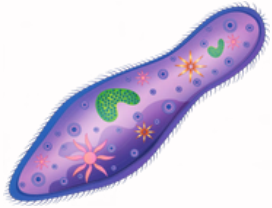
PROTOZOA

Size

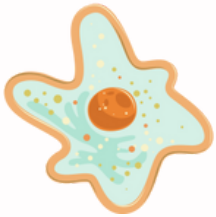
Unicellular microorganism

5 µm – 250 µm

Can be seen through a low power light microscope



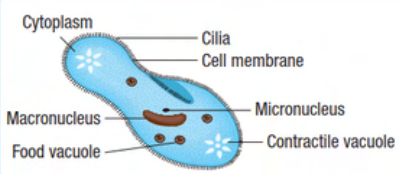
Paramecium sp.



Amoeba sp.

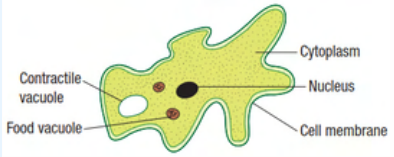
Shape

Slipper



Paramecium sp.

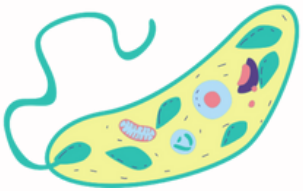
Do not have a fixed shape



Amoeba sp.

Nutrition

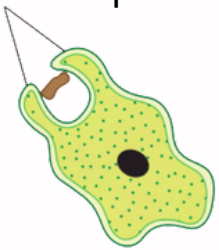
Photosynthesis



Euglena sp.

Phagocytosis

Pseudopodium



Pseudopodium encloses food, forms a food vacuole.

Habitat

Fresh water

Paramecium sp. & Amoeba sp.

Sea

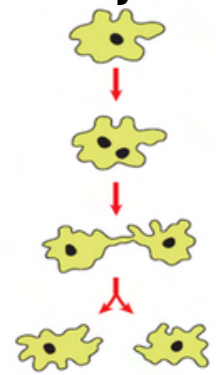
Amoeba sp.

Moist sand/host

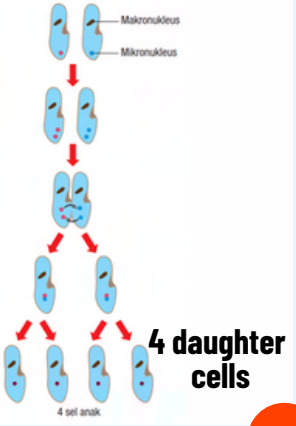
Amoeba sp.

Reproduction

Asexual reproduction (Binary fission)



Sexual reproduction (Conjugation)



BACTERIA

Size

Unicellular microorganism

0.2 µm – 10 µm

Can be seen through a high power light microscope

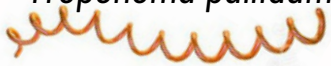
Shape

Cocci

Streptococcus sp.

Spirilla

Treponema pallidum



Bacilli

Bacillus anthracis

Vibrio

Vibrio cholerae

Nutrition

Photosynthesis

Bacteria have chlorophyll, makes its own food

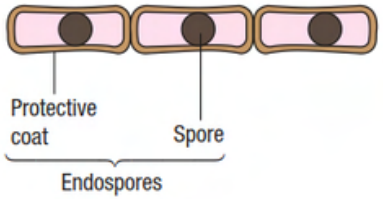
Saprophytes

Absorb nutrition from the dead organism

Parasite

Absorb nutrition from the host

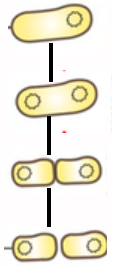
Special Characteristics



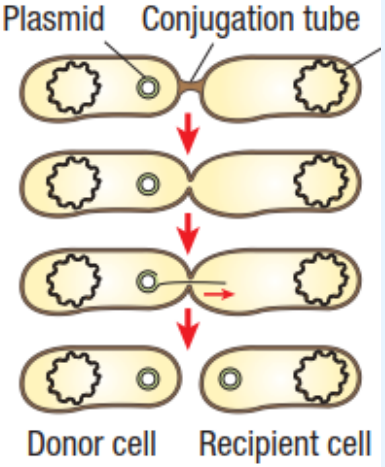
Bacteria such as *Bacillus anthracis* form **endospores** so that they can **survive** in **extreme environments** such as overheat areas or cold, drought and lack of food.

Reproduction

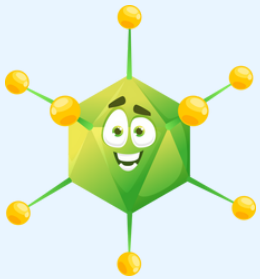
Asexual reproduction (Binary fission)



Sexual reproduction (Conjugation)



VIRUS



Size

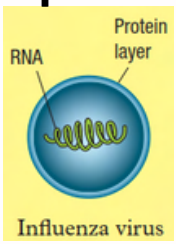
The most small organism.

Size less than 0.5 μm

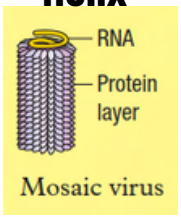
Can be seen through an electron microscope

Shape

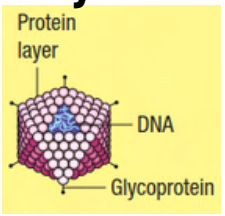
Spheres



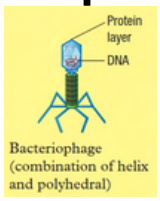
Helix



Polyhedral



Complex



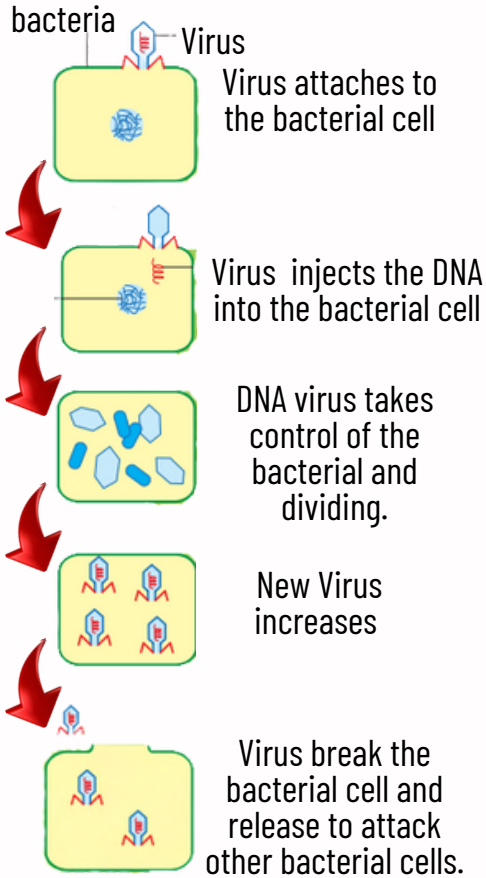
Special Characteristic

Virus do not have characteristics of living outside of the host because they do **not** carry out:

- **respiration,**
- **excretion,**
- **growth and**
- **does not respond to the stimuli.**

Reproduction

Infecting host cells

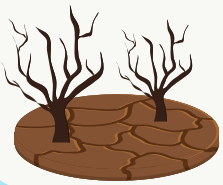


Factors Affecting the Growth of Microorganisms

HUMIDITY

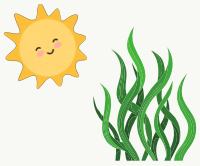
- Moist environment is the most suitable for the growth of and reproduction of microorganisms

- Dry environment causes the microorganisms to be less active and retard the growth.



LIGHT

- Algae have chlorophyll and needs light for photosynthesis.



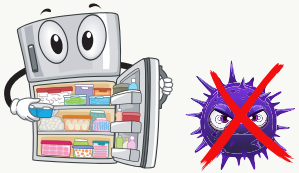
- Fungi and bacteria grow better in dark environment.
- Ultraviolet light can kill microorganisms.

TEMPERATURE

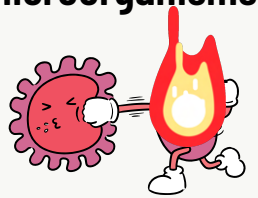
40'c

35'c

- Optimum temperature for the growth of microorganisms is 35°C- 40°C
- Low temperature (refrigerator) retard their growth of microorganisms.



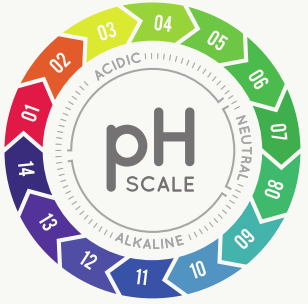
- Too high temperature can kill microorganisms



PH VALUE

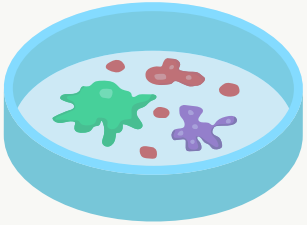
1 2 3 4 5 6 7 8 9 10 11 12 13 14

- The pH value of 7 (neutral pH) is the optimum pH value for the growth of microorganisms.
- There are some microorganisms that can live in a slightly acidic and alkaline environment.



NUTRITION

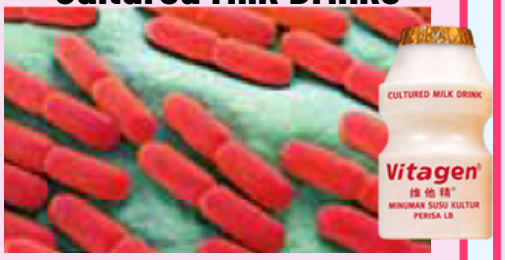
- The growth rate of microorganisms increases with the presence of sufficient nutrients.
- The growth rate will be slow even with the presence of nutrients if other factors such as humidity, light, temperature and pH value are limited.



Application of Useful Microorganisms

Industry

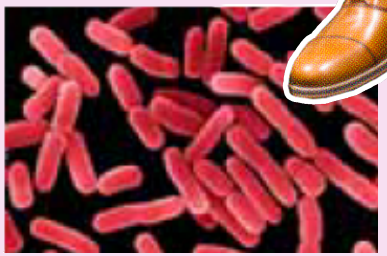
Cultured Milk Drinks



Lactobacillus bulgaricus

Leather Goods

Bifidobacteria sp.



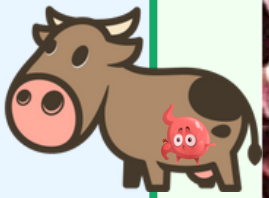
Lactobacillus subtilis

Food

Yeast

Agriculture

Animal Digestion



Bifidobacteria sp.

Denitrifying Bacteria

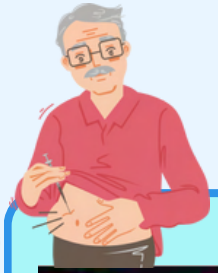
Nitrobacter sp.

Nitrosomonas sp.

Medical

Antibiotic such as Penicillin

Penicillium chrysogenum



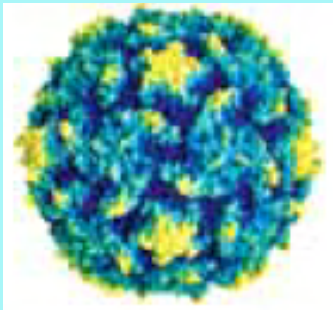
Insulin

Rekombinant DNA of *E. coli*

Vaccine

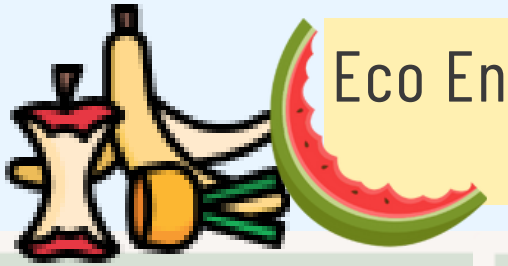
Rotavirus

Salmonella sp.



Poliovirus

Eco Enzyme Cleaning Solution



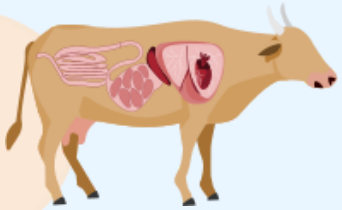
Eco Enzyme – agricultural waste such as **fruits/vegetables** that processed through **fermentation process.**

ASPECT	ECO ENZYME CLEANING SOLUTION	CHEMICAL CLEANING SUBSTANCE
Production process	**Agricultural waste fermentation**	Use of chemicals
Action on fat and grease	Enzymes in eco-enzymes **break down** fats and grease into smaller molecules	Surfactants in chemical detergents emulsify fats and grease into foam
Ease to use	**Fat and grease will remove easily**	Need to scour hard
Clog drainage	Small molecules that produced by enzymes do **not clog drain**	The foam produced by the surfactants clog the drain
Cost	Low	High
Waste production	Low	High
Environment	**Environmentaly friendly**	Polluted the environment

USAGE

Lactobacillus sp. Bacterial Serum

Helps the digestion of animal



Making of compost

Eliminates unpleasant smell

Improves the fishing industry

Production of enzymes

Treats sewage waste and sludge in drainage system

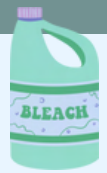
Aseptic Technique

Health procedures to prevent pathogen infection or get rid of existing pathogen.

Aseptic Technique

Disinfectant

Chemicals- use on **non-living things** such as sheets, toilets & swimming pools to kill microorganisms (Pathogens).



Bleaching agent

Chlorine

Hydrogen peroxide

Radiation

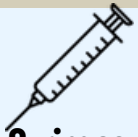
Ionising radiation such as ultraviolet rays, X-rays, gamma rays are used to kill microorganisms.

Ultraviolet radiation used in operation room

Boiling

- **Boiling water** (temperature **100℃)**
- Killing microorganisms on objects of daily use such as

Milk bottles



Syringes

Dental equipment

Antiseptic

Chemicals – applied to human skin to prevent pathogen infection

Acriflavine

Providone

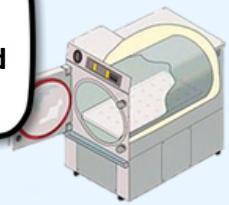
70% isopropyl alcohol

Sterilisation

The process of killing/removing microorganisms from an object/environment.

Heat (Autoclave)

Temperature above 130°C can kill microorganisms and their spores



Chemicals (Soap)

Radiation (Ultraviolet)

High pressure (Pressure cooker)

Filter (Micron filter)

Filters particles and microorganisms (0.1μm-10μm) than water or liquid

Antibiotic

1 What is antibiotic?

Medicine that used to treat infections that caused by bacteria.

2 What is antibiotic resistance?

Occurs when the antibiotic lose their ability to kill bacteria. Therefore, antibiotic are no longer effective in treating bacterial infections.

3 Causes of antibiotic resistance.

- Overuse of antibiotic
- Improper use of antibiotic, example treating infections caused by viruses such as sore throats, fevers, cold and common coughs with antibiotic.
- Do not take antibiotic for the prescribed period.

4 Is antibiotic resistance dangerous?

Dangerous, it making us vulnerable to more disease.

Methods of Infectious Disease Treatment

Pneumonia

because of

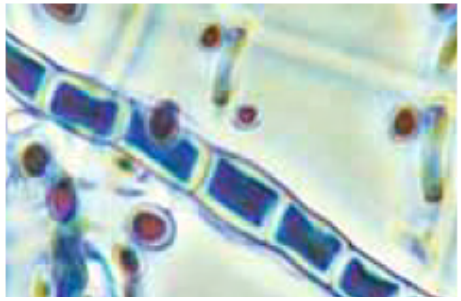
Streptococcus pneumoniae
(bacteria)

treated by

antibiotic
Example: **Penicillin**

Athlete's foot

because of



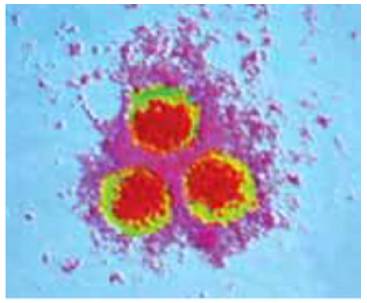
Trichophyton rubrum
(fungus)

treated by

Antifungal
Example: **Clotrimazole**

Shingles

because of



Varicella-zoster
(virus)

treated by

Antiviral
Example: **Acyclovir**

CHAPTER 2: NUTRITION AND FOOD TECHNOLOGY

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BALANCED DIET

Diet that includes **all classes of foods** in the **right quantity** according to the individual's body requirement.

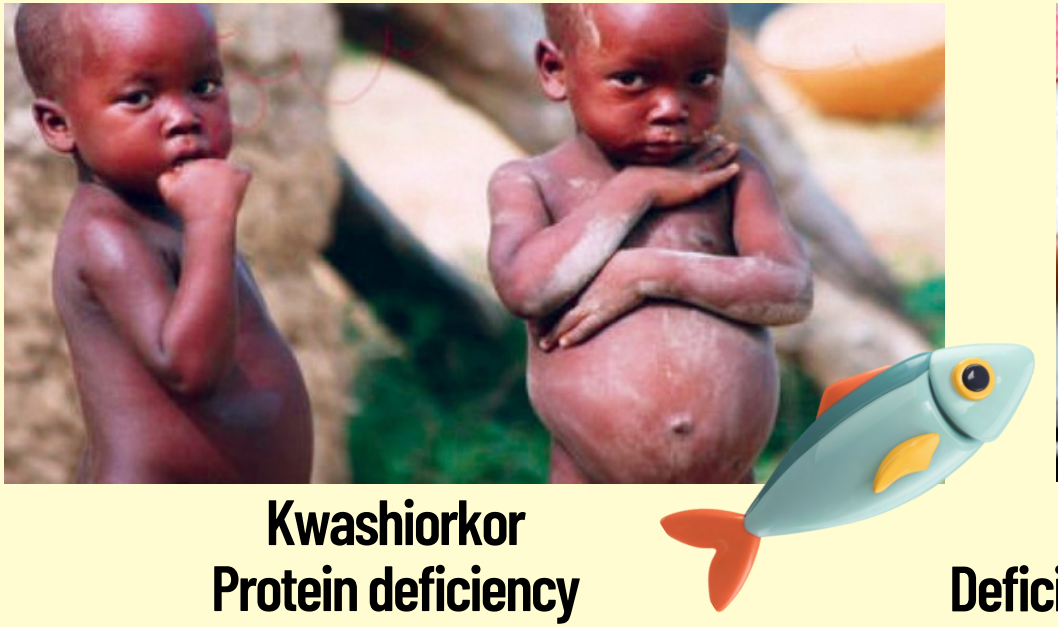
MALNUTRITION

A lack or an excess of any class of food.

Goitre
Iodine deficiency

Scurvy
Vitamin C deficiency

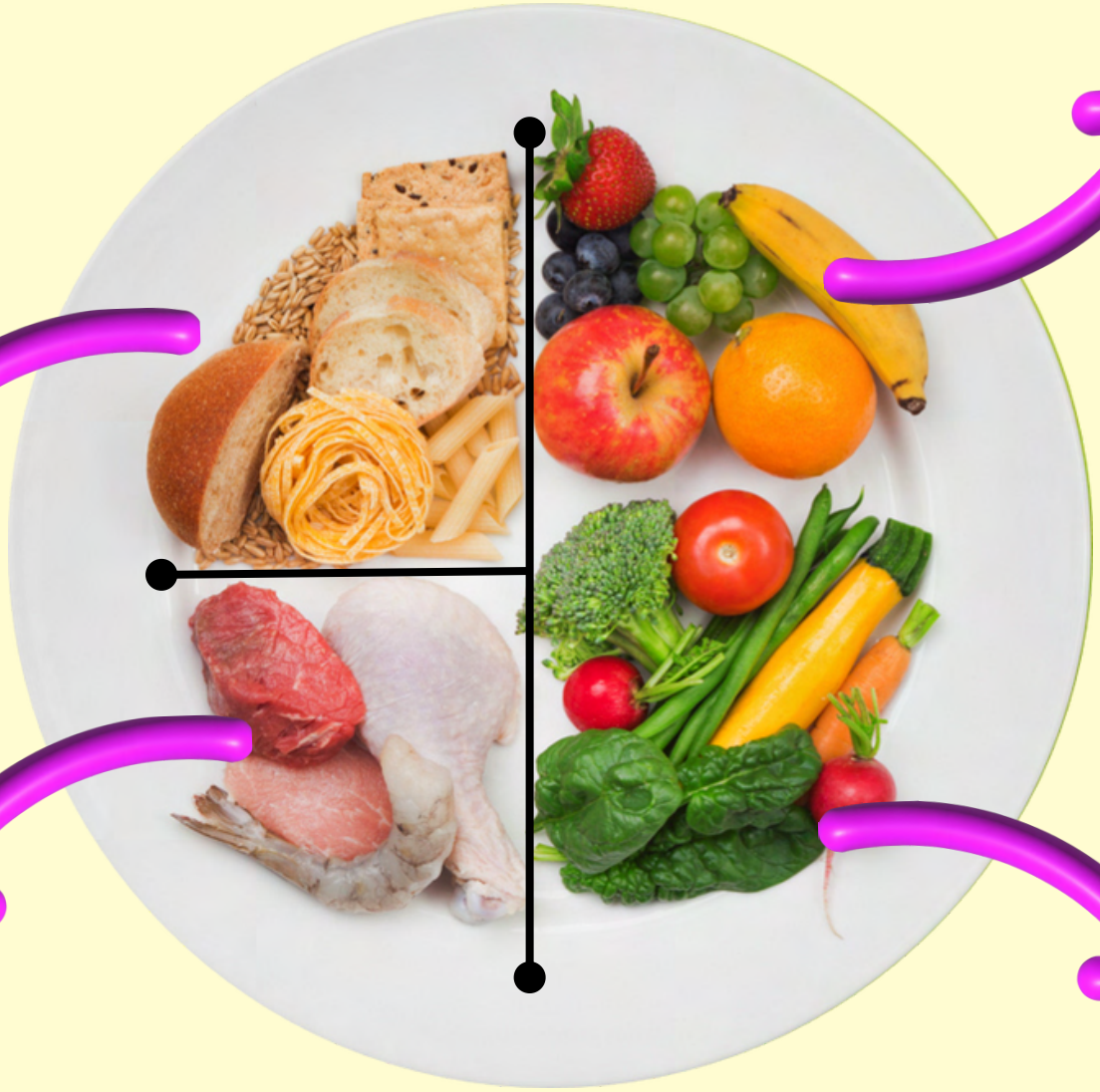
Rickets
Vitamin D deficiency



Kwashiorkor
Protein deficiency

Marasmus
Deficiency of protein, carbohydrates & fats

PINGGAN SIHAT MALAYSIA



Fruits

Carbohydrate

Protein

Vegetables

A QUARTER-A QUARTER & HALF (SUKU-SUKU SEPARUH)

CALORIFIC VALUE OF FOOD

The amount of energy that is released from the complete oxidation or combustion of 1 g of that food.

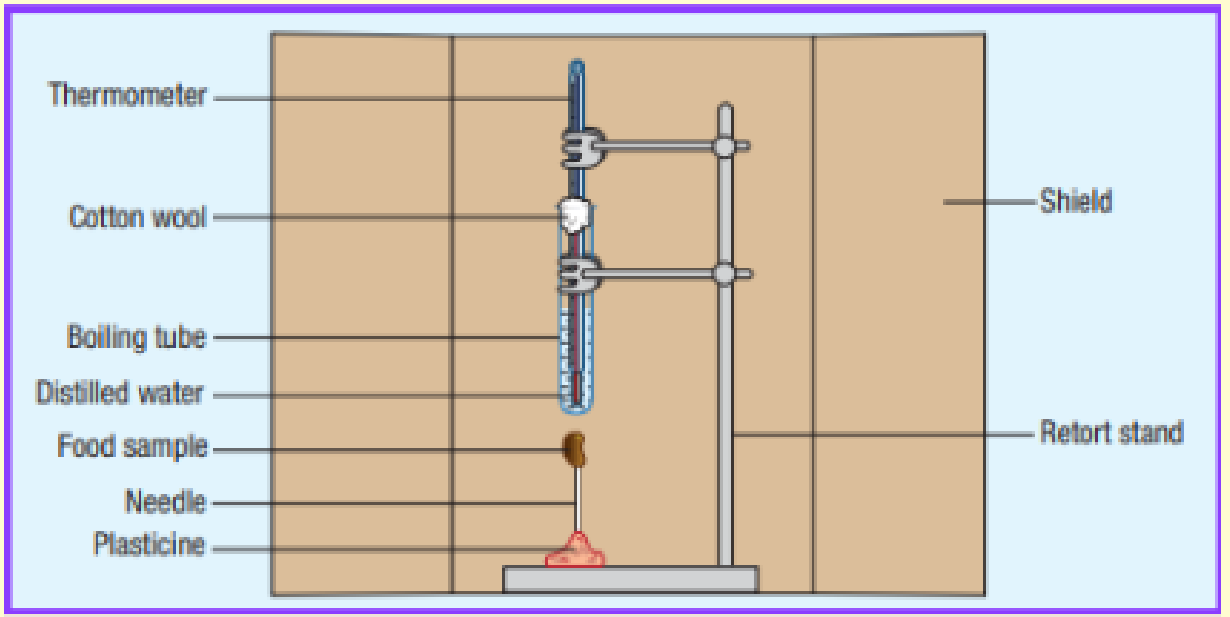
S.I unit : joule per kilogram (J kg)

1 calorie (cal) = 4.2 joules (J)

1 kilocalorie (kcal) = 4.2 kilojoule (kJ)

Bomb calorimeter

A tool to measure the calorific value of food



Simple calorimeter

EFFECTS OF CONSUMING TOTAL CALORIES THAT DO NOT MEET INDIVIDUAL REQUIREMENTS

OBESITY

CAUSE

Consuming food with high calorific value excessively over long periods of time.

EFFECT

A risk of developing diseases :

- Diabetes mellitus
- Arteriosclerosis
- High blood pressure

ANOREXIA NERVOSA

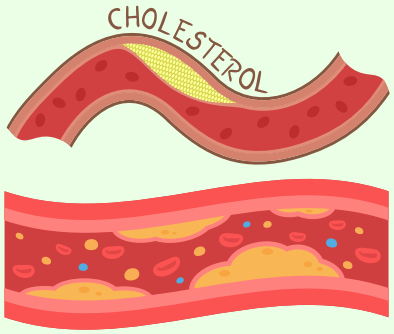
CAUSE

Individual's refusal to eat due to worries of gaining weight.

EFFECT

Cause malnutrition that can be fatal.

ATHEROSCLEROSIS (a type of arteriosclerosis)



CAUSE

Cholesterol deposition on the artery wall.

EFFECT

- Narrowing of the artery lumen causes high blood pressure
- Increased risk of heart diseases and stroke

DIABETES MELLITUS

CAUSE

Consuming food & drinks high in sugar over long periods of time.

EFFECT

- Affects vision, kidney & nervous system
- Slow recovery of wound

HIGH BLOOD PRESSURE

CAUSE

Consuming food with high salt content over long periods of time.

EFFECT

Increased risk of heart diseases and stroke

RESTAURANTS THAT OPERATE 24 HOURS

- Encourages late night eating habits.
- Eat unhealthy food servings and exceeds the need of the body causes the increase in body weight.
- Risk of obesity.
- Disrupts sleep.

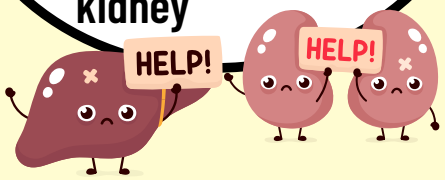
EFFECTS OF FAST FOOD AND JUNK FOOD

Excessive sugar

- Obesity
- Tooth decay
- Diabetes mellitus at an early age

Artificial coloring & sweeteners

- Cancer
- Infertility
- Diabetes mellitus
- Damage to liver & kidney



Absence of beneficial nutrients

- Malnutrition

Caffeine

- Insomnia
- Anxiety
- Addiction

Excessive salt

- High blood pressure
- Heart diseases
- Damage to kidney

NUTRIENT REQUIREMENTS IN PLANTS

Why do plants need nutrients?

Plants need nutrients for:

- Growth
- Development
- Reproduction

MACRONUTRIENTS

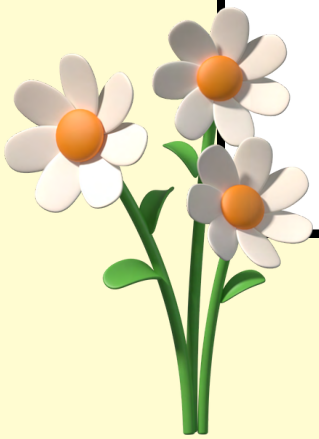
Elements (or minerals) need by plants in **large quantities**

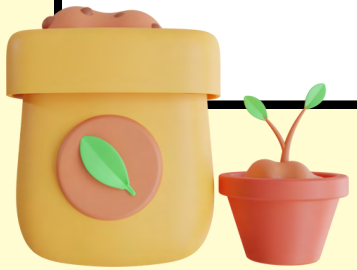
- Nitrogen
- Phosphorus
- Potassium
- Magnesium
- Calcium
- Sulphur
- Oxygen
- Carbon
- Hydrogen

MICRONUTRIENTS

Elements (or minerals) need by plants in **small quantities**

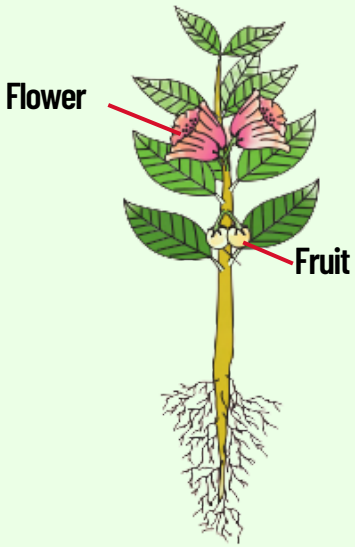
- Boron
- Iron
- Copper
- Molybdenum
- Manganese
- Zinc





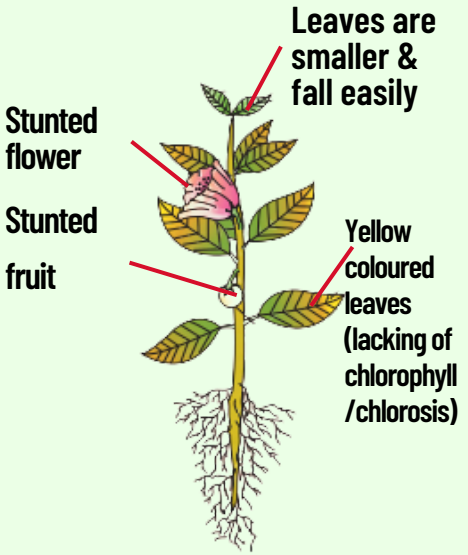
EFFECTS OF NITROGEN, PHOSPHORUS AND POTASSIUM DEFICIENCY ON PLANT GROWTH

HEALTHY PLANT



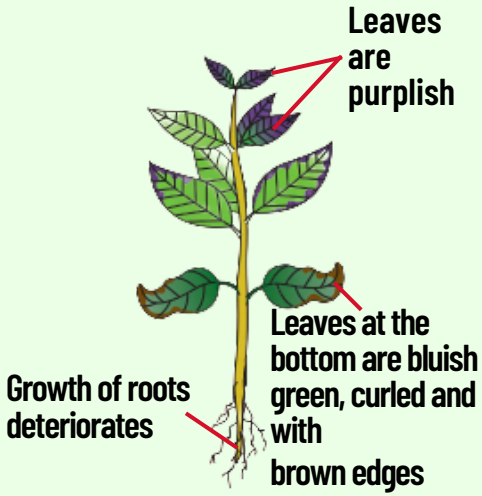
- Normal plant growth.
- Strong stem.
- Leaves at the top are small and light green.
- Leaves at the bottom are bigger and dark green.
- The production of flowers and fruits is normal.

PLANT WITH NITROGEN DEFICIENCY



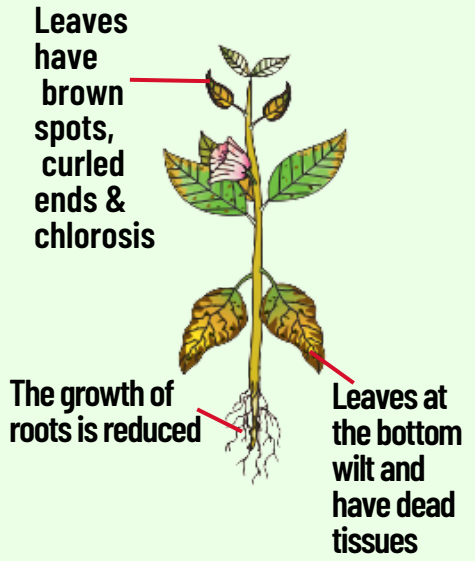
- Stunted plant growth.
- Weak stem.
- Stunted flower and fruit production.
- The growth of roots is normal.

PLANT WITH PHOSPHORUS DEFICIENCY



- Stunted plant growth/slow to growth and mature.
- Weak stem.
- The production of flowers and fruits stops .

PLANT WITH POTASSIUM DEFICIENCY



- Stunted plant growth / dies before reaching maturity.
- Weak stem.
- The production of flowers is reduced and the production of fruits.

NITROGEN CYCLE

IMPORTANCE OF NITROGEN CYCLE

- Maintaning nitrogen content in the air.(78%).
- Maintaining fertility of soil and increasing productivity of crops
- Reducing pollution. (Decomposing organism).
- Maintaining a continuous supply of plant proteins and animal proteins.

Direction

Process of nitrate ion addition to the soil

Process of nitrate ion extraction from the soil

Nitrogen in the air

1 Lightning

Plant protein

Plants eaten by animals

Animal protein

Legume plants

Nitrogenous fertilisers

Remains of dead animals and plants undergo decomposition (decomposing bacteria and fungi)

Ammonium compounds

Nitrification (nitrifying bacteria)

Nitrite ions

1 Plants absorb nitrate ions through their roots

2 Nitrogen fixation (nitrogen-fixing bacteria)

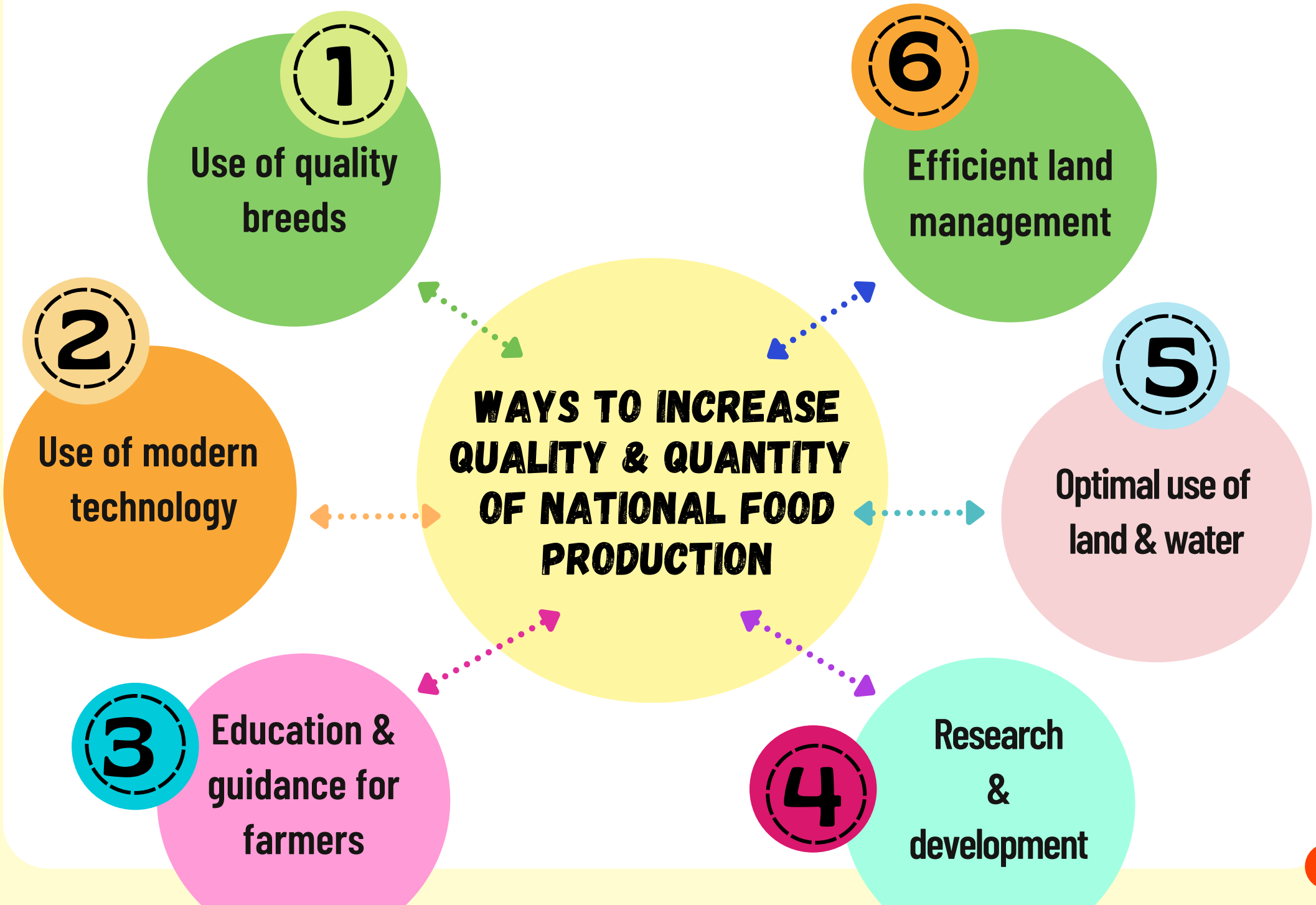
2 Denitrification (denitrifying bacteria)

3 Nitrification (nitrifying bacteria)

Nitrate ion

3 Soluble nitrates (nitrate ions dissolve in groundwater / rivers)

FOOD PRODUCTION TECHNOLOGY



Bintang Mas starfruit
golden yellow, sweet & crunchy

Tenera oil palm
yields more fruits with larger kernel, thicker pulp, thinner shell & higher oil content

Exotica papaya
big in size & sweeter flesh

USE OF QUALITY BREEDS

Mafriwal cow
produces a lot of milk and can adapt to tropical areas

Akar Putra chicken
grows rapidly & has the same meat texture as that of the *kampung* chicken

CHARACTERISTICS OF QUALITY BREEDS

- Meat, milk and fruits of higher quality
- High yields
- Grows and matures rapidly
- Easy and low-cost maintenance
- High resistance to diseases, pests and extreme weather

USE OF MODERN TECHNOLOGY

Grinding machine & liquid filling machine speed up processing & manufacturing food

Machinery such as tractors, bulldozers & harvesters speed up the rate of crop planting & harvesting

The use of drone to spray pesticides can save time and reduce labourcost

Cloning can retain good characteristics in crop & livestock breeds

Biotechnology - embryo transfer, cloning & genetic engineering is used to increase the quality & quantity of food

OPTIMAL USE OF LAND AND WATER RESOURCES

Develop idle land for agricultural & livestock activities

Fertilise barren lands

Build dams and canals for agricultural or livestock land

Develop marshland for marine aquaculture activities

Develop abandoned mining pools for freshwater aquaculture activities

EFFICIENT LAND MANAGEMENT

Crop Rotation

First year

Second year

Third year

Mixed Planting

Terrace Farming

Purpose :

- maintain land fertility
- increase quality of crop yield
- increase quantity of crop yield

USE OF INSECTICIDES

- The process of eliminating crop pests using insecticides
- Important to maintain the quality and quantity of crop yields

Side effects of insecticides :

- polluting the environment
- increasing the pesticide resistance of crop pests
- killing earthworms and useful microorganisms in the soil
- contaminating the land and crop yields

Crop pests

Spraying insecticides on crops

BIOLOGICAL CONTROL

Method which applies the interaction between organisms such as prey-predator & parasitism in order to control crop pests in a habitat.

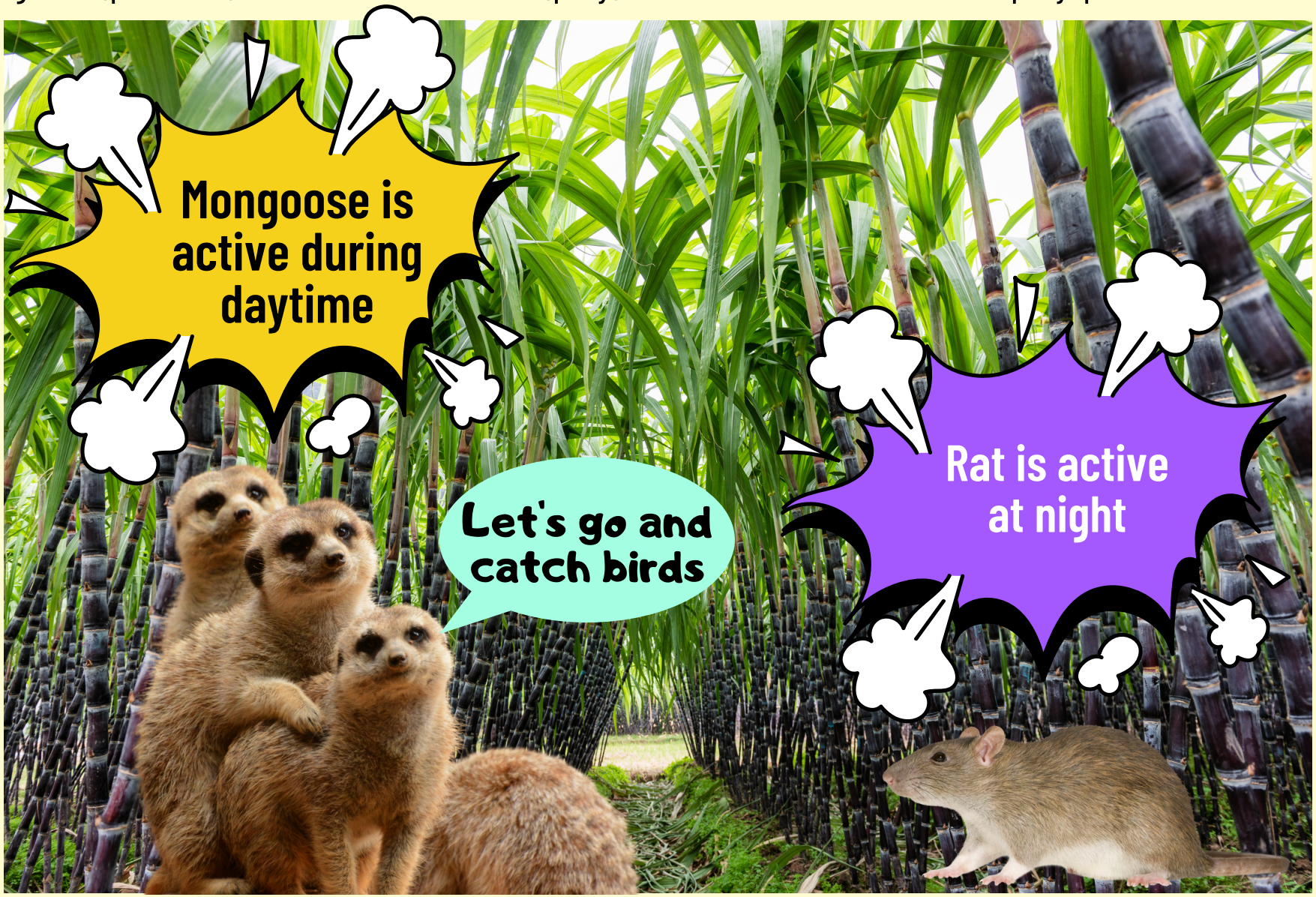
Wasps lay eggs in the eggs of butterflies & destroy them (Type of interaction: Parasitism)

Barn owl hunts rats for food (Type of interaction : Prey-predator)

ADVANTAGES OF BIOLOGICAL CONTROL	DISADVANTAGES OF BIOLOGICAL CONTROL
• More environmental-friendly • Cheaper • Does not harm the health of other • Does not cause crop pests to become resistant	• Takes a longer time to control the population of crop pests • Difficult to predict the results of biological control which involves living organisms • Needs more detailed and effective planning and management • Disrupts the balance of ecosystem if populations of the predator species or parasite become uncontrollable

BIOLOGICAL CONTROL USED WITHOUT PROPER PLANNING CAN CAUSE VARIOUS PROBLEMS

Example: A failed biological control in the sugarcane plantations on the islands of Hawaii.
Mongoose (predator) cannot catch the rats (prey) because the active time for prey-predator are not same.

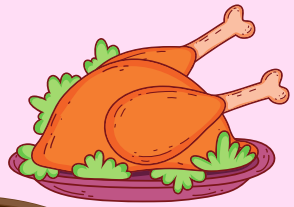


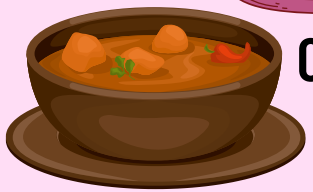
FOOD PROCESSING TECHNOLOGY

COOKING

Heating food: Blanching, frying, grilling, smoking, braising, stir-frying, baking & steaming

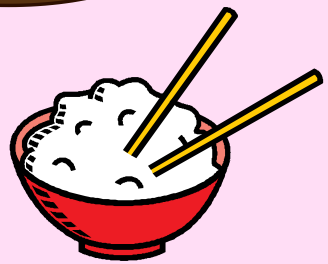
Grilled chicken





Chicken curry

Rice



Fried fish

FERMENTATION

The breakdown of complex substance into simpler substances through the action of bacteria, yeast or other useful microorganism

Glucose + yeast → ethanol + carbon dioxide

Soy sauce

Kimchi

Yoghurt

Tempe

DEHYDRATION / DRYING

Water is removed from food through dehydration/ evaporation by drying under the sun/ using flame / smoke / in the oven

Dried shrimp

Dried fruits

PASTEURISATION

Liquid is heated to a temperature below its boiling point to kill pathogens & then cooled quickly

Example: fresh milk is heated to a temperature of 63°C for 30 minutes/ to a temperature of 72°C for 15 second & cooled immediately

Milk

Fruit juices

FOOD PROCESSING TECHNOLOGY

CANNING

1. Can are sterilised & heated exceeding 115°C, under high pressure.
2. Food is put in the can.
3. Air in the can is removed.
4. Can is sealed.
5. Can is heated again & cooled quickly.

Purpose-to kill microorganisms & their spores.

sardines

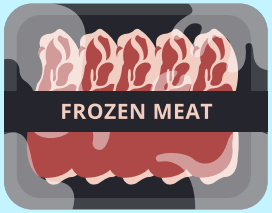
Fruits

Condensed milk

FREEZING

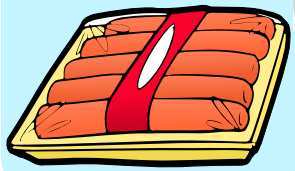
Food is kept at a temperature of 0°C/ lower (last longer).
Example-meat frozen at a temperature between -18°C to -24°C.

- Enzyme action stops
- The growth & reproduction of microorganisms are inhibited



meat

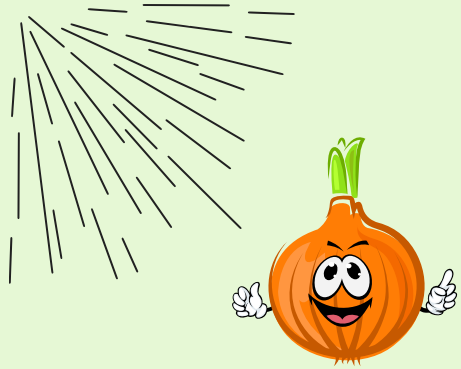

fish



IRRADIATION

Food is exposed to gamma ray/ ultraviolet ray/ X-ray.

- To kill microorganisms in raw meat.
- To kill insects in rice.
- To slow down seed germination, budding of root vegetables & ripening of fruits



VACUUM PACKAGING

Air is removed completely from container/ plastic bag before the package is sealed tight.

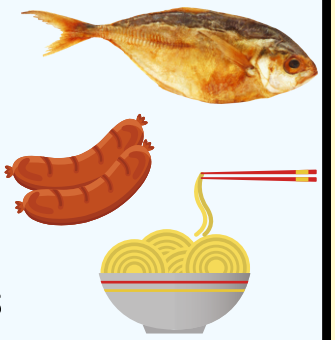
- Prevents growth of microorganisms in the package.
- Stops food oxidation.


vegetables


rice


durian

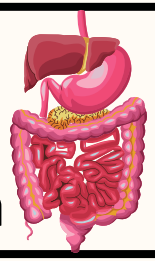
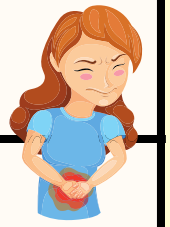
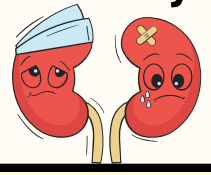
CHEMICAL SUBSTANCES USED IN FOOD PROCESSING

CHEMICAL SUBSTANCES	FUNCTION	EXAMPLES
PRESERVATIVES	• Prevents growth & reproduction of microorganisms • Reduces food spoilage • Makes food last longer	• Salt - seafood • Sugar - fruits • Vinegar – pickled food • Sodium nitrite/nitrate – meat, • Benzoic acid - juice, ketchup • Boric acid - noodles, fish balls 
COLOURING	• Add colour to food • Makes food look more attractive	• Pandan leaf, turmeric - cakes, rice • Tartrazine – soft drinks • Sunset Yellow – cordial (orange) • Carmoisine - cordial (red) 
BLEACH	• Bleaches unwanted natural colour from food	• Activated carbon –palm oil, cane sugar • Benzoyl peroxide –sugar, rice, flour 
FLAVOURING	• Makes food more delicious & fragrant • Enhances the natural flavour of food	• Sugar, salt, pandan leaf - cakes, ice creams • Monosodium glutamate (MSG) – instant noodles, soy sauce, chips.  

CHEMICAL SUBSTANCES USED IN FOOD PROCESSING

CHEMICAL SUBSTANCES	FUNCTION	EXAMPLES
STABILISER	• Prevents deposition of granules in liquid food • Improves texture & thickens food	• Starch – chilli sauce/ketchup • Gelatine - jelly • Agar – ice cream, instant soup, jelly • Acacia gum – ice cream, candy, jelly 
SWEETENER	• Sweetens food & drinks	• Sugar, palm sugar, honey -cakes, drinks • Aspartame - cordial, jam • Sorbitol – food for diabetic patients 
ANTIOXIDANT	• Slows down the oxidation of fatty food • Prevents fruits & vegetables from turning brown	• Ascorbic acid, Vitamin C – cooking oil • Tocopherol, Vitamin E - margarine, biscuit • Butylatedhydroxyanisole - vitamin pills 
EMULSIFIER	• Emulsifies substances which do not mix such as fat & water in food • Improves homogeneity, stability & texture of food	• Lecithin (from egg yolk/ soya beans) – ice cream, chocolate • Pectin - mayonnaise, pudding • Fatty acids such as monoglyceride, magnesium stearate - yoghurt, cheese 

IMPACT OF EXCESS CHEMICAL SUBSTANCES IN FOOD PROCESSING ON HUMAN HEALTH

CHEMICAL SUBSTANCE	IMPACT ON HEALTH
PRESERVATIVE	• Cancer • Disrupts the human digestive system • Allergy, rash & itchy skin  • Foetal defects in mother's womb • Damages liver & kidney 
COLOURING	• Cancer • Infertility • Food poisoning • Damages liver & kidney 
BLEACH	• Cancer • Food poisoning
FLAVOURING	• Cancer • High blood pressure • Heart diseases  • Mental retardation in children • Damages liver & kidney
SWEETENER	• Cancer • Diabetes mellitus • Allergy, rash & itchy skin • Obesity • Damages liver & kidney 
ANTIOXIDANT	• Retards body growth • Allergy, rash & itchy • Damages liver & kidney  

HEALTH FOODS

Natural food substances in a normal diet that maintain health & do not contain chemical substances.

Related issues :

- availability of health food
- high price
- processing method & chemical substances used in food processing.

HEALTH SUPPLEMENTS

Nutrients taken in the form of capsule pill, liquid & powder in pre-determined doses.

Related issues :

- difficult to determine the required dosage of health supplement accurately for different individuals.

NATIONAL FOOD SAFETY POLICY

The Drug Control Authority (DCA) is entrusted to register & monitor health supplements & traditional medicine before being marketed. Stickers with labels & QR codes will be affixed to bottles or boxes of health supplements & traditional medicine which have been approved & registered.

To protect consumers from :

- the risk of taking food & drinks which will harm human health
- fake health food & supplement

FOOD ACT 1983

1. To protect the public from dangers of health & fraud related to the preparation, sale & use of food, as well as any matters related to them.

2. Any parties found selling poisoned food or food that damages the health of users will be fined or jailed, or both if found guilty by the court of law.

FOOD REGULATIONS 1985

Example of Food Label

NAME OF FOOD
The name of food must be clear, accurate and not confusing.

NUTRITIONAL QUALITY
Shows the nutritional quality of the product.

NUTRITIONAL LABEL
Information about the nutritional content of the product.

LIST OF INGREDIENTS
Ingredients used in the product listed according to weight in descending order.

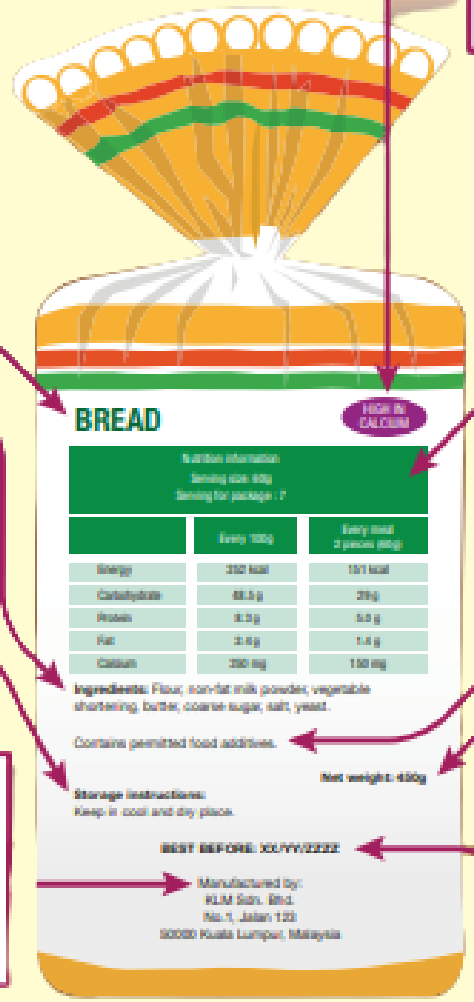
STATEMENT ON FOOD ADDITIVES
All permitted food additives such as preservatives, colouring, flavouring, additional flavours, antioxidants and conditioners should be stated.

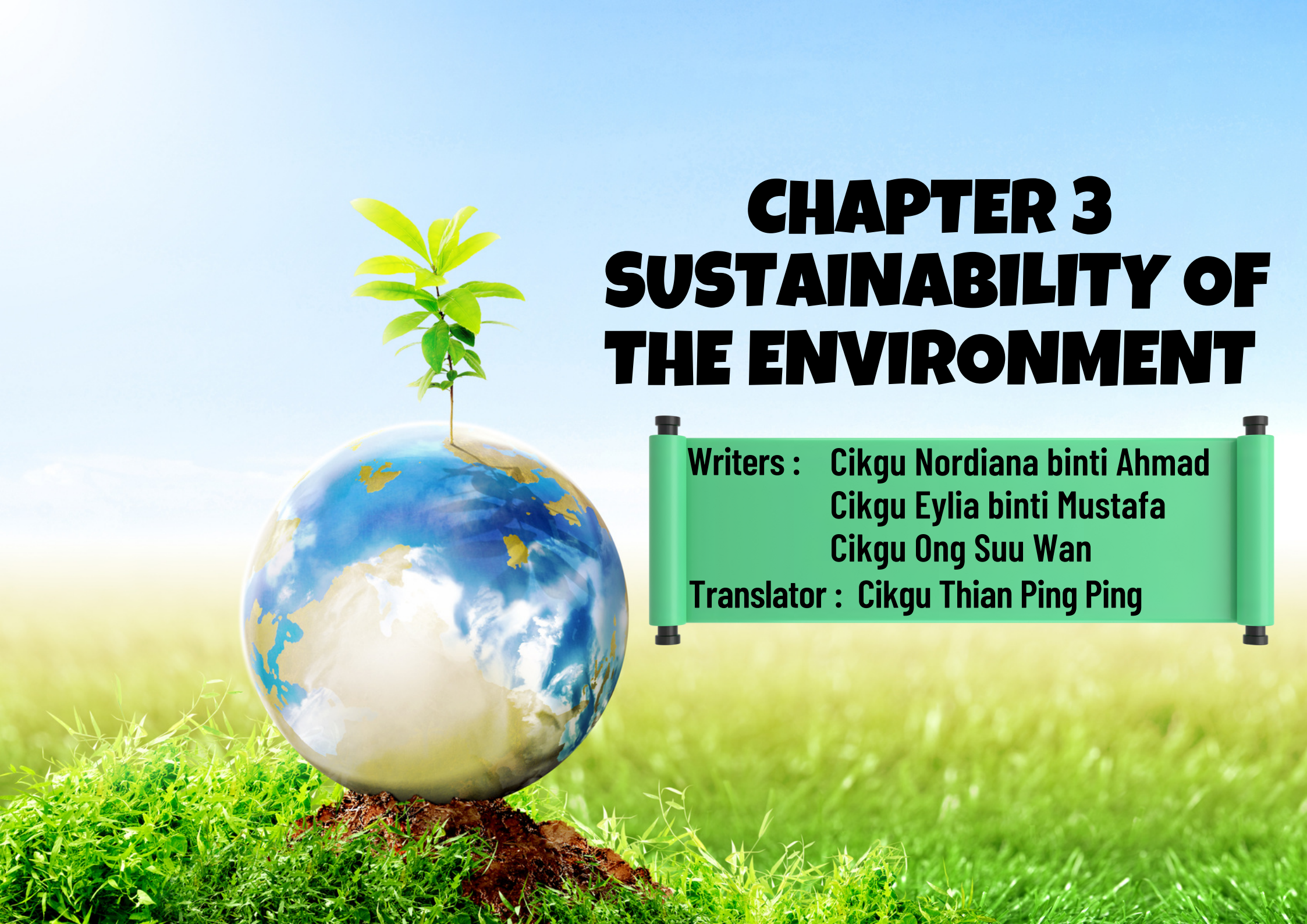
STORING INSTRUCTIONS
Follow the recommended storing instructions.

STATEMENT ON QUANTITY/ WEIGHT/VOLUME
Statement on the net weight or volume or minimum quantity of contents.

MANUFACTURING INFORMATION
Name and address of manufacturer/packaging/agent (including imported product).

EXPIRY DATE
Make sure that the chosen food is not past its expiry date.





CHAPTER 3
SUSTAINABILITY OF THE ENVIRONMENT

Writers : Cikgu Nordiana binti Ahmad
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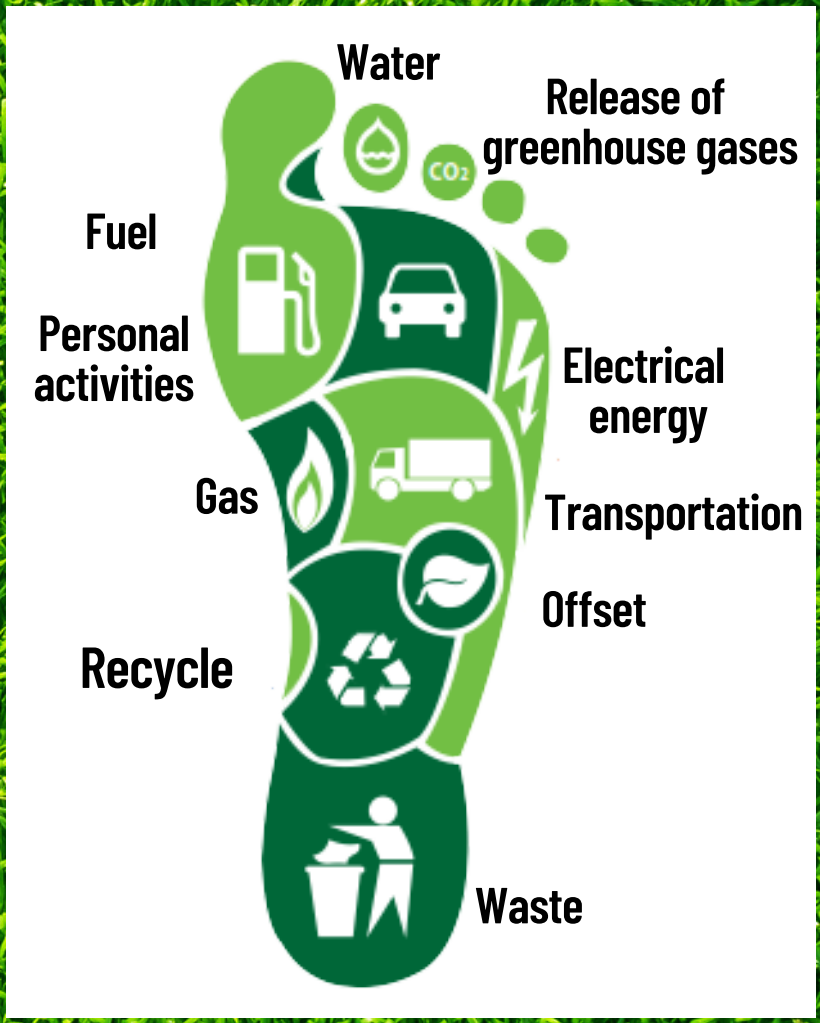
Cikgu Ong Suu Wan
Translator : Cikgu Thian Ping Ping

CARBON FOOTPRINT

Total amount of carbon dioxide released into the atmosphere **product** from individual **activity**, event, organisation, community or **product used** in daily life.

Examples of processes that reduce carbon footprint are:

- recycle,
- carbon balancing (offset) - process that reduce emission of greenhouse gas example planting tree.



ENERGY EFFICIENCY LABEL

The More The Star, The More The Energy Save

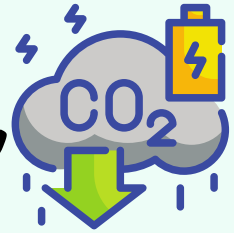
Aim :

- <u>provide more detailed information to help consumers make choices</u> about energy-efficient electrical appliances

Products labeled with a 5-star energy efficiency rating :

- 25% less electricity consumption than normal products
- 25% less carbon emissions during its period of use.

Lower Electricity Bill



Lower Carbon Footprint

CARBON FOOTPRINT AND CARBON HANDPRINT

Carbon Footprint of a product - **negative impacts** on environmental sustainability caused by a product throughout its life cycle.

Carbon Handprint of a product - **positive impacts** on environmental sustainability caused by a product throughout its life cycle.

CARBON HANDPRINT MEASURES

Use of materials with a low carbon footprint in product manufacturing

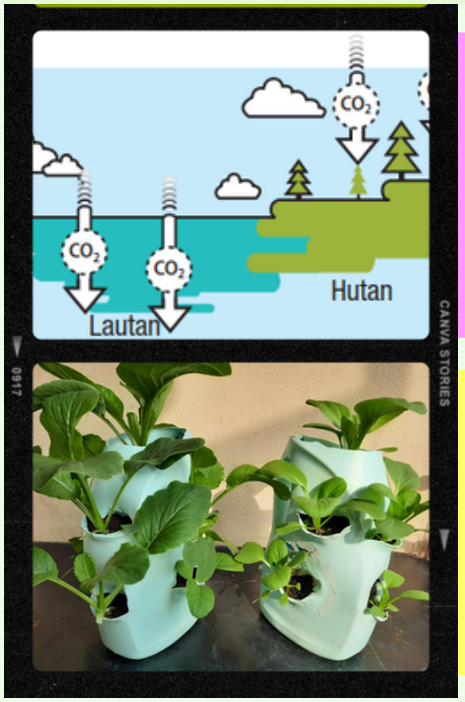
Cement is replaced by logs.

Extending the life cycle and increasing the efficiency of the product

Examples: rechargeable batteries and solar panels

Consumption of energy that releases less greenhouse gases and energy converters with high energy efficiency

Bakun hydroelectric power station



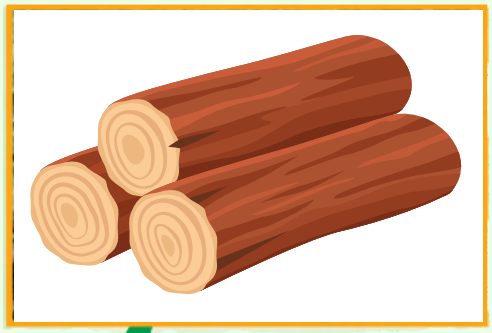
Greenhouse gas removal and carbon dioxide storage in carbon sinks

Carbon sinks - forests and oceans, function to remove carbon dioxide from the air.

Efficient waste management

Waste management based on the 5R concept (Refuse, Reduce, Recycle, Reuse, Rot)

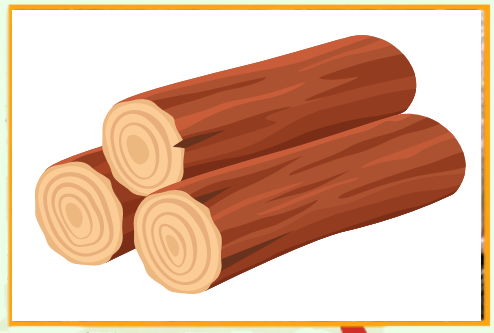
A PRODUCT LIFE CYCLE



Source

Recycle

Decay



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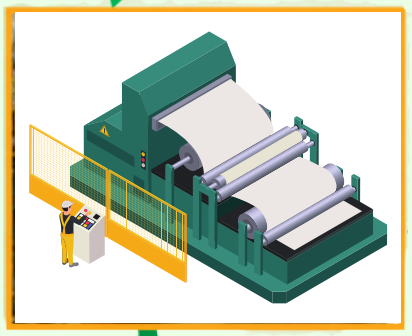
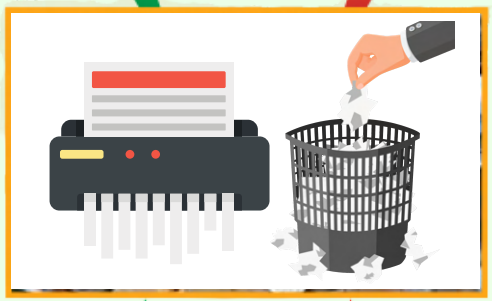


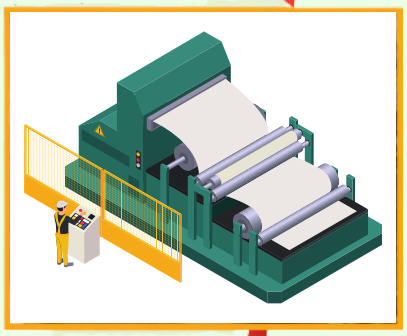
Manufacturing

Cradle-to cradle life cycle of product

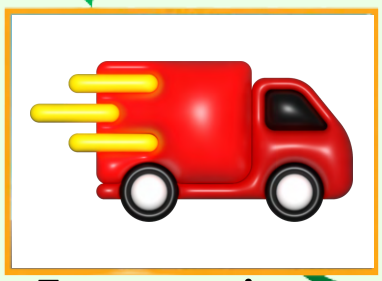


Disposal

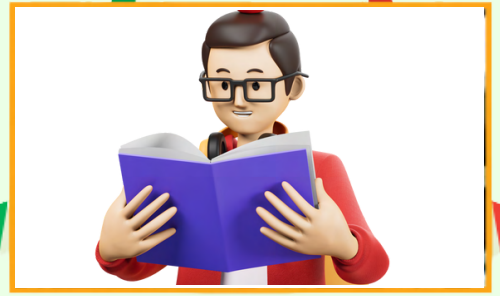
Cradle-to grave life cycle of product



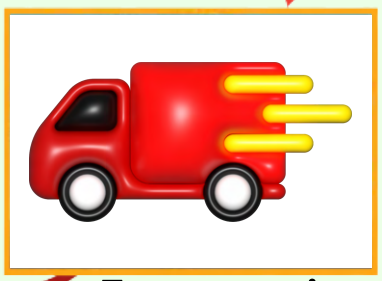
Manufacturing



Transportation



Consumption



Transportation

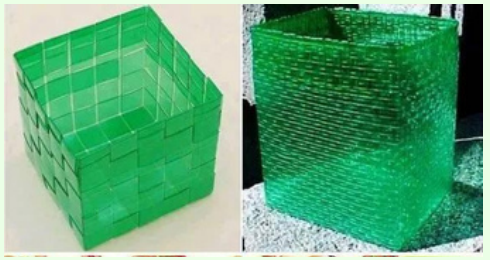
UPCYCLE

Produce a new product that has a higher value than the original product.

Used plastic bottles

Plastic broom

Vase



Plastic basket

MICROPLASTICS IN THE FOOD CHAIN

Microplastics:
Plastic pieces less than 5mm in size.

Microplastic

Nutritional issues that threaten human health

Solution:

- Reduce plastic waste
- Reduce the use of plastic products.

Plankton

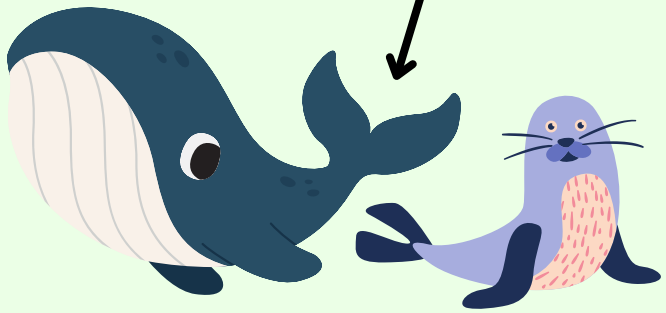
Larvae

Fish

Turtle

Bivalve organisms

Human



Marine mammals

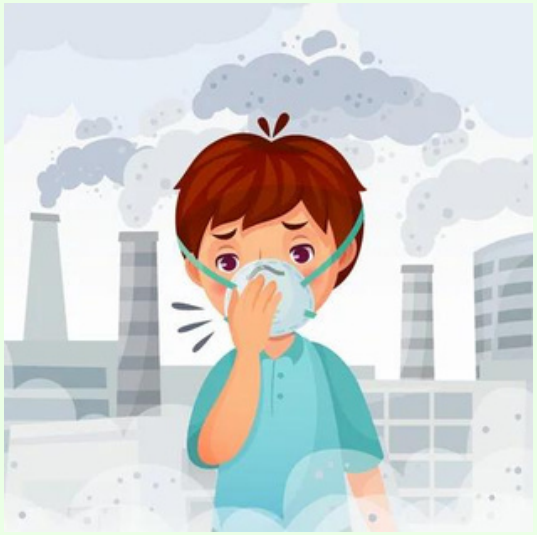
Transfer of microplastics between various organisms in the food web until it end up in the human body and marine mammals.

ENVIRONMENTAL POLLUTION

Environmental pollution is an unwanted change in physical, chemical or biological change in the components of the environment, namely air, water and soil.

Effects of Environmental Pollution :

- Harm and discomfort to all living things.
- Causes environmental issues such as flash floods.



SOURCE OF AIR POLLUTION

Source of Natural Air Pollution

Volcanic eruptions

Forest fires

Decaying organic waste

Dust storms

Source of Man-made Air Pollution

Exhaust gases from motorised vehicles

Blast furnaces

Industries

Garbage disposal sites

Releases greenhouse gases and toxic gases into the air

SOURCE OF WATER POLLUTION

Waste

Wastewater

Domestic waste (detergents)

Domestic waste (sewage)

Solid waste (rubbish)

Industrial waste such as grease

Chemical substances in agriculture

Chemical fertilisers

Pesticides

Oil spills

Oil spills from ships

Birds covered with oil spills

SOURCE OF LAND POLLUTION

Excessive use of fertilisers and pesticides

Inappropriate management of solid waste

Nuclear waste

Electronic waste

SOURCE OF THERMAL POLLUTION

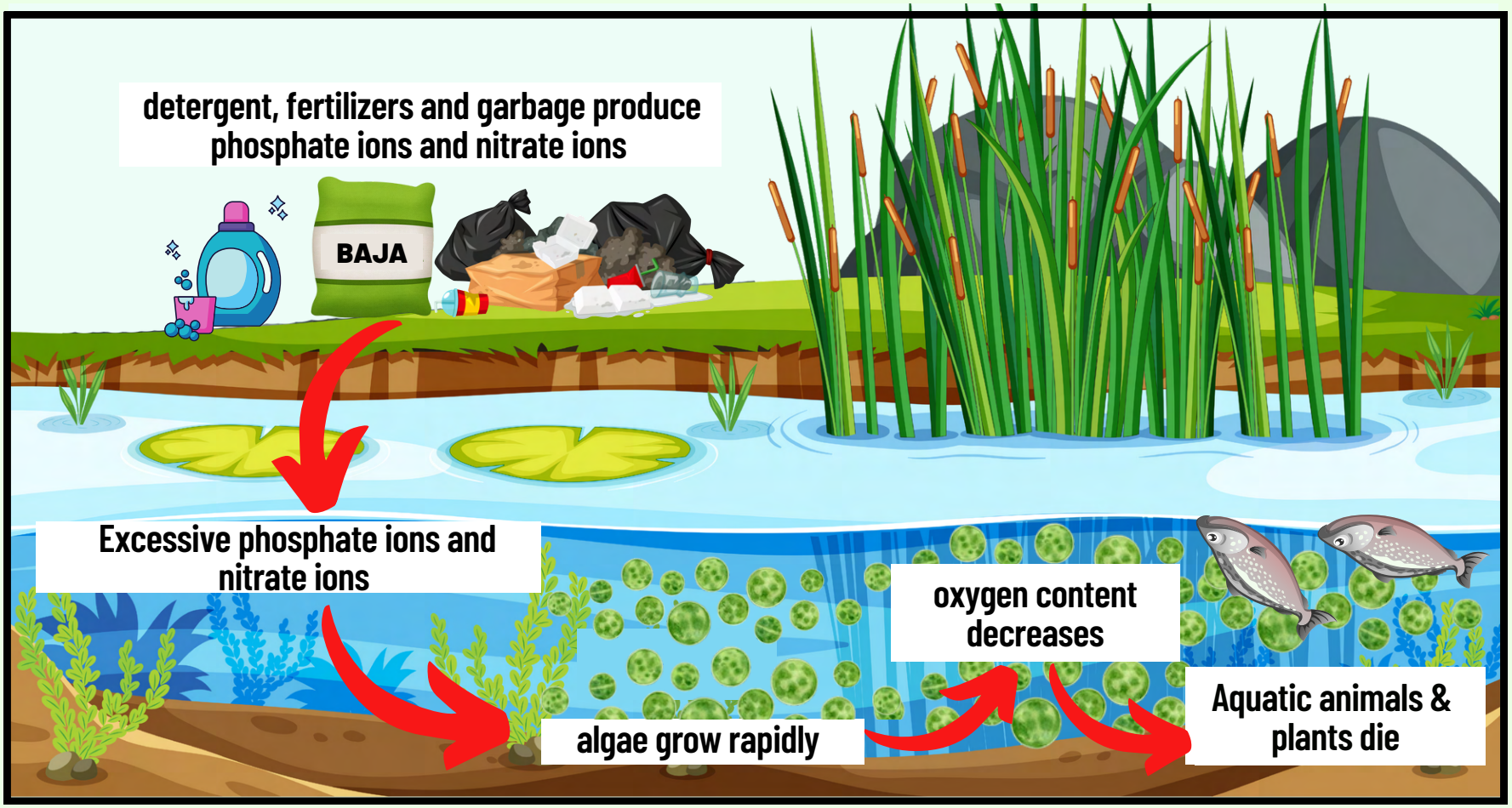
Deforestation

Industrial activities

Fuel combustion in vehicles or machines

EUTROPHICATION

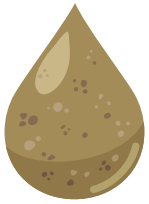
Ecosystem response to the addition of **phosphate ions and nitrate ions** (from detergents, fertilizers and garbage) into an **aquatic ecosystem**.

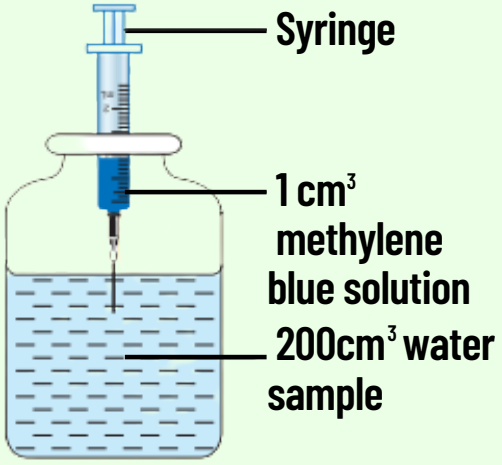


BIOCHEMICAL OXYGEN DEMAND (BOD)

The amount of dissolved oxygen required by microorganisms such as bacteria to decompose organic matter in a water source.

Pollution Level ↑ → Amount of Microorganisms ↑ → Amount of dissolved oxygen ↓ → BOD ↑ → Methylene blue solution decolourise fast ↓





The higher the level of pollution for a water sample,
the faster the methylene blue solution decolourises.

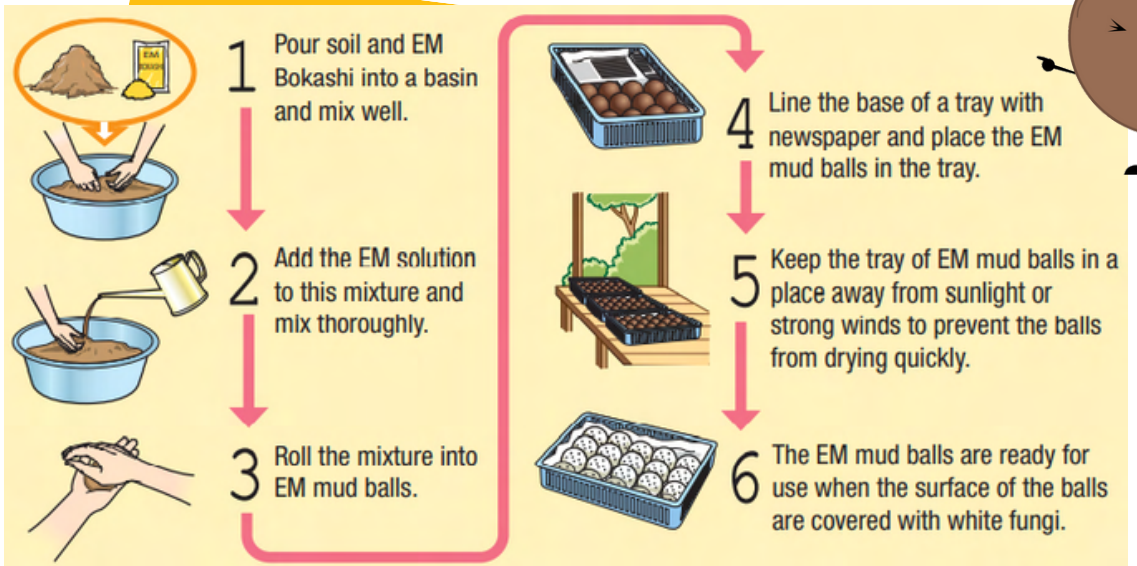
EFFECTIVE MICROORGANISM MUD BALLS (EM)

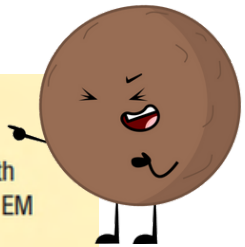
Contaminated Water Purification Methods Using Green Technology

Mud ball
Effective Microorganisms
(Effective Microorganism, EM)

EM mud balls are thrown into the river to treat polluted river water in Malaysia.

Preparation method





3 Types of Effective Microorganisms (EM)

Lactic acid bacteria

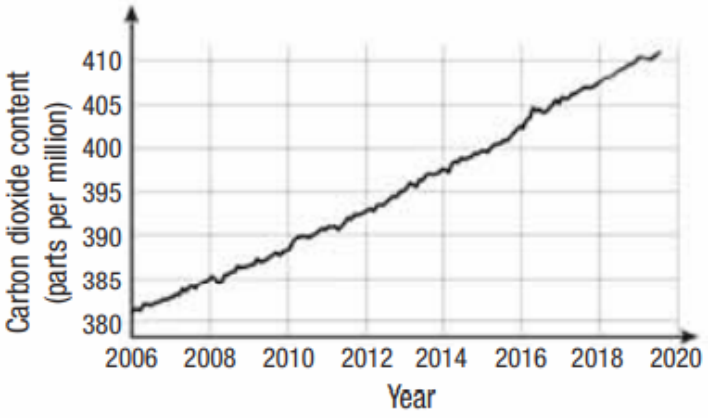
Treat sewage waste, remove foul odors, inhibit the growth of harmful microorganisms & facilitate decay.

Photosynthetic bacteria

Synthesize amino acids and sugars from organic matter for feeding aquatic animals and plants

Yeast

Produce essential materials for the growth of green plants.



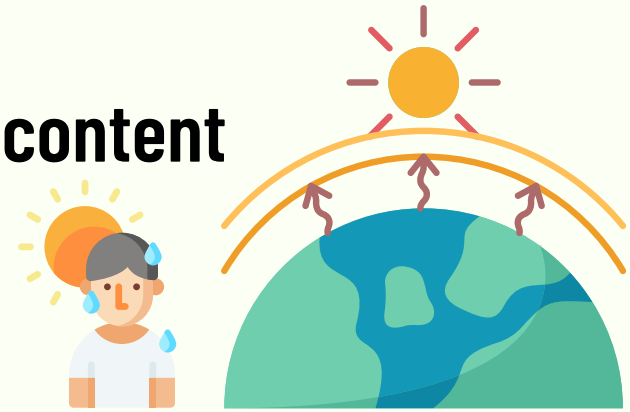
Source: https://climate.nasa.gov/

Figure 3.10 Graph of carbon dioxide content in the atmosphere

1. What can be observed about the carbon dioxide content in the atmosphere from 2006 to 2019?

*The carbon dioxide content in the atmosphere **INCREASED** from 2006 to 2019*

2. What are the adverse effects of carbon dioxide content high in the atmosphere?



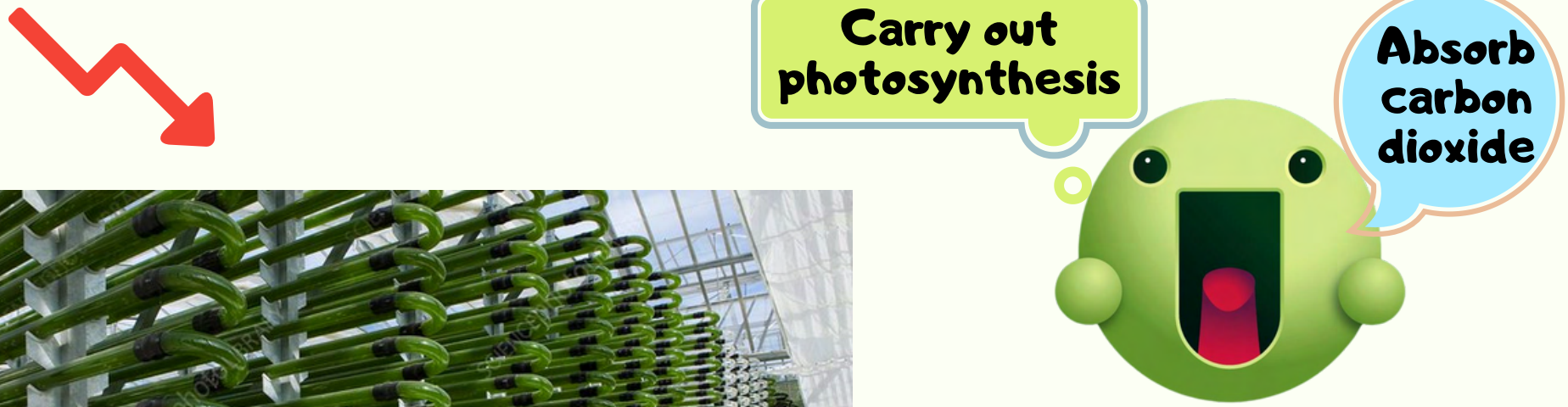
GLOBAL WARMING & THE GREENHOUSE EFFECT

3. Why should each individual play a role in reducing the carbon dioxide content in the atmosphere?

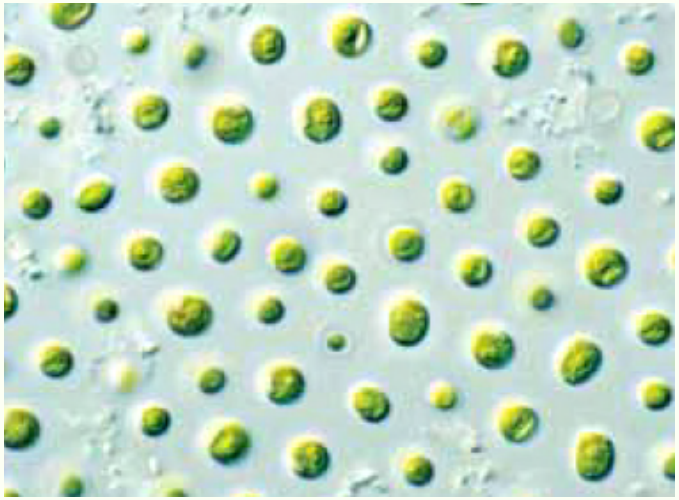
*We have only one earth, each individual has a role to **preserve and conserve** our environment for environmental balance*

NEGATIVE EMISSION TECHNOLOGY

is a technology that
remove carbon dioxide from the atmosphere



Microalgae plant



Marine microalgae in the sea

THE ROLE OF THE UNITED NATIONS (UN)

to

Addressing Environmental Issues on a Global Level

Climate change issues

Ensure clean drinking water supply

Protects the ozone layer from CFC that deplete the ozone layer

Appliances that release CFC

Banning toxic chemicals (DDT pesticides)

CONFERENCES AND INTERNATIONAL AGREEMENTS WHICH ORGANIZED BY THE UN

The **Rio** Conference on 1992 addresses global environmental issues

Kyoto Protocol in 1997 to reduce greenhouse gas emissions

The **Paris** Agreement in 2016 to reduce the content and release of greenhouse gases and limit the rise in global temperatures to 1.5°C

CHAPTER 4
RATE OF REACTION

Writers : Cikgu Marlina Azliza binti Rosli
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Translator: Cikgu Patriecia Audrey Fung

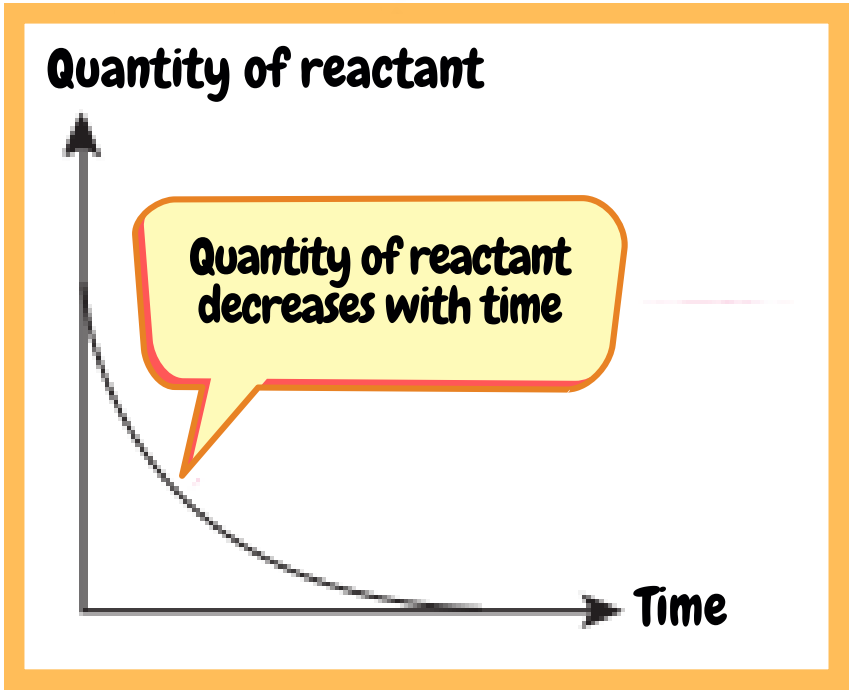
Chemical Reaction

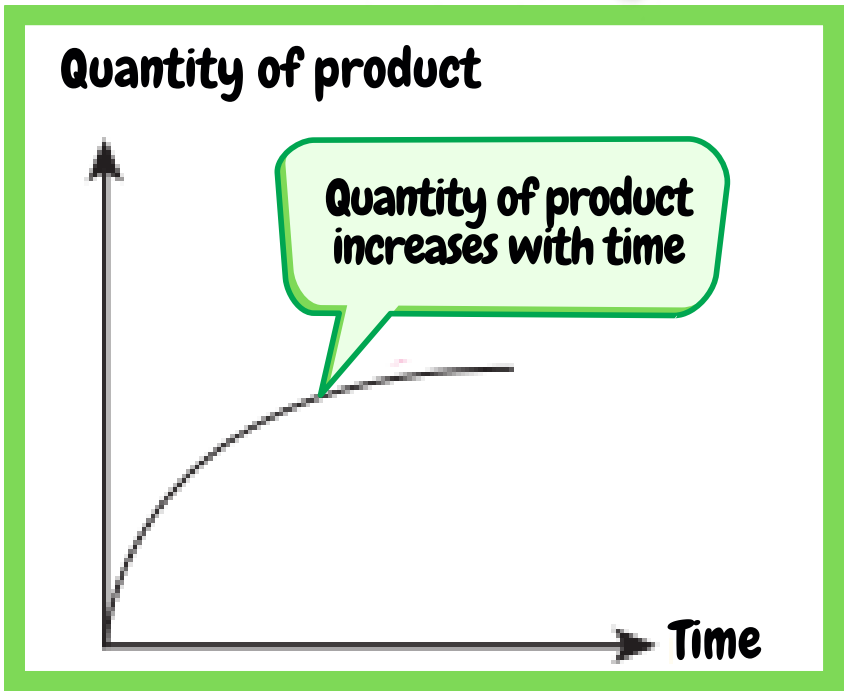
A chemical reaction is a process in which one or more reactants are converted to one or more products

Reactants → **Chemical reaction** → **Product**

Quantity ↓

Quantity ↑





Graphs of changes in quantities of reactant and product against time

Similarities and differences between fast reaction and slow reaction

FAST REACTION	SLOW REACTION

Similarities

- Quantity of reactant decreases
- Quantity of product increases

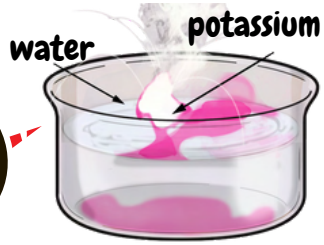
Differences

FAST REACTION	SLOW REACTION
Rate of reaction is high because the reaction happens quickly	**Rate of reaction is low** because the reaction happens slowly
Takes a **shorter time** to complete	Takes a **longer time** to complete
Example:	Example:

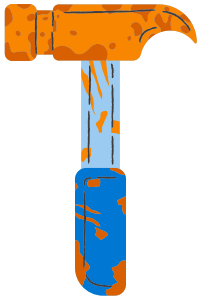
Burning of candle

Burning of butane gas

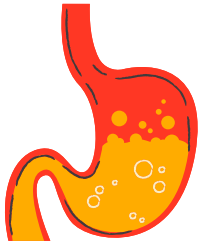
Bomb explosion



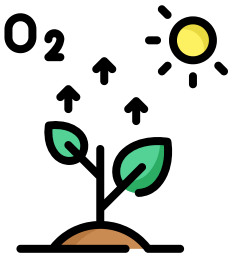
Reaction of reactive metal with water



Rusting of iron



Food digestion



Photosynthesis

Fermentation

Rate of Reaction

Rate of reaction is the change in the quantity of reactant or product per unit time.

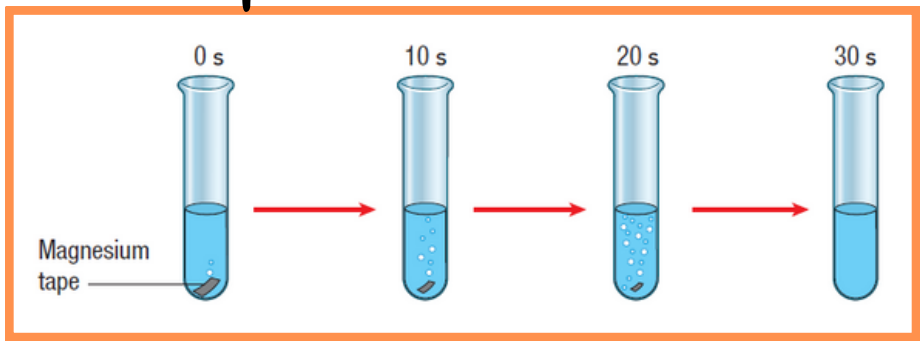
$$\text{Rate of reaction} = \frac{\text{Change in the quantity of reactant / product}}{\text{Time taken for the change to occur}}$$

Unit for rate of reaction :
- $cm^3 s^{-1}$
- $g\ s^{-1}$

Methods to determine the rate of reaction:

- Decrease in the mass, volume or concentration of the reactant in a certain period.

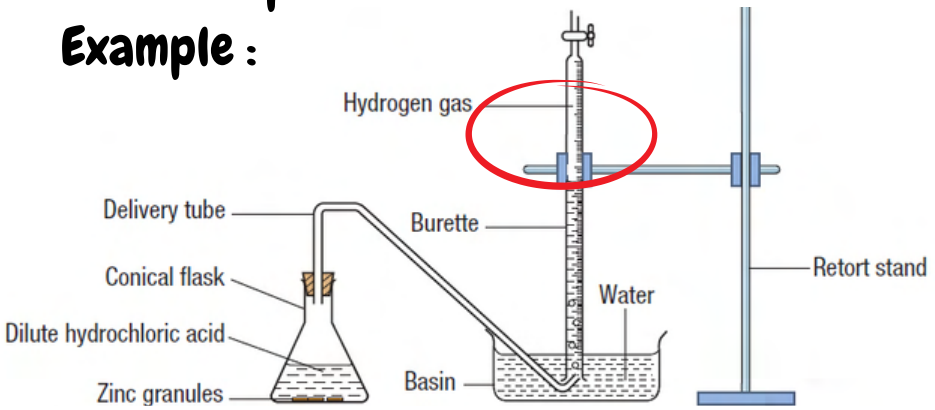
  Example :



Decrease in mass of magnesium tape in 30 seconds

- increase in the mass, volume or concentration of the product in a certain period.

  Example :



Increase in the volume of hydrogen gas in a certain period

Factors Affecting Rate of Reaction

TEMPERATURE

When the temperature of reactant increases, the rate of reaction increases

CONCENTRATION

When the concentration of reactants increases, the rate of reaction increases

PRESSURE

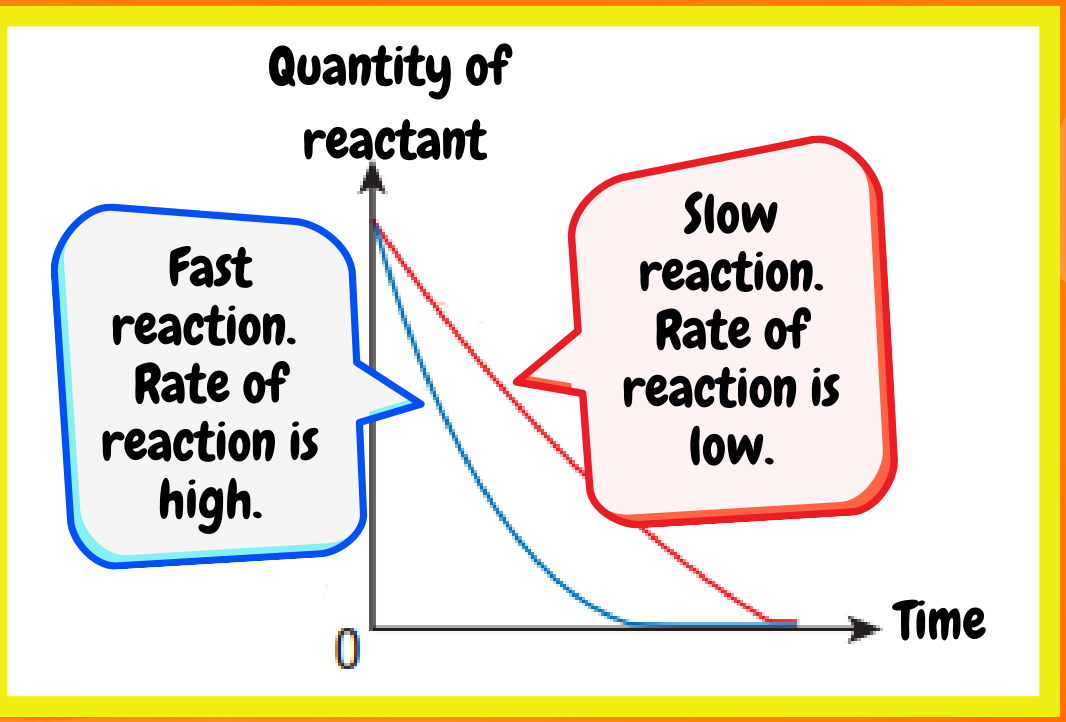
When pressure increases, the rate of reaction involving gaseous reactants increases

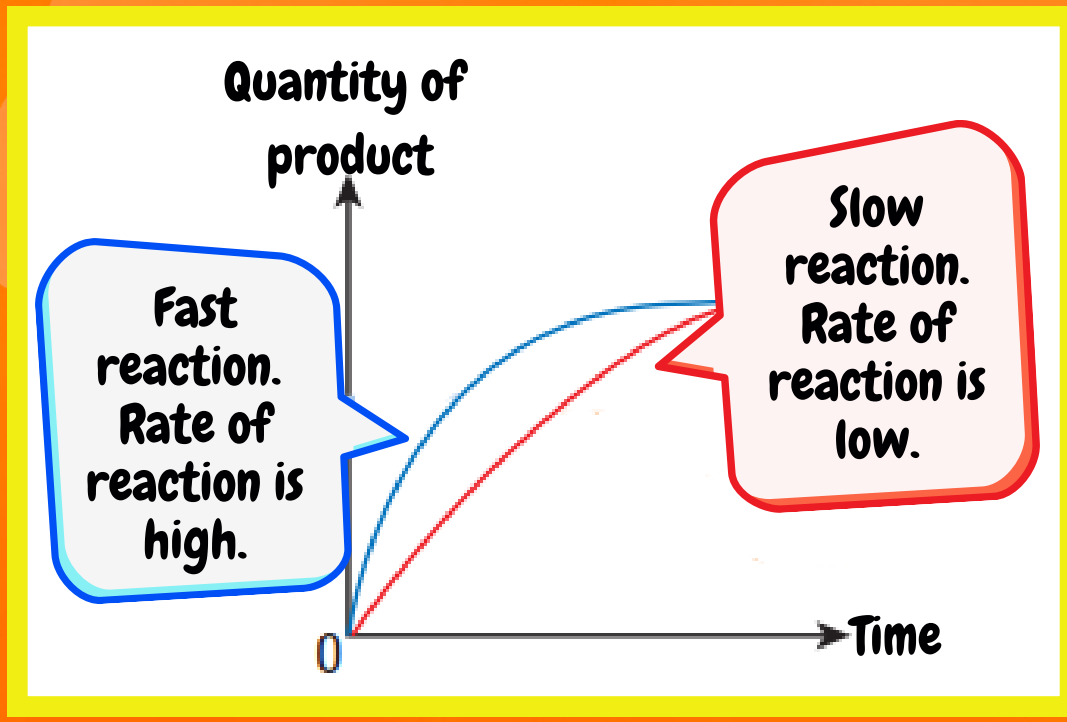
CATALYST

When catalyst is used in a reaction, the rate of reaction increases

SIZE

When the size of solid reactants decreases, the rate of reaction increases

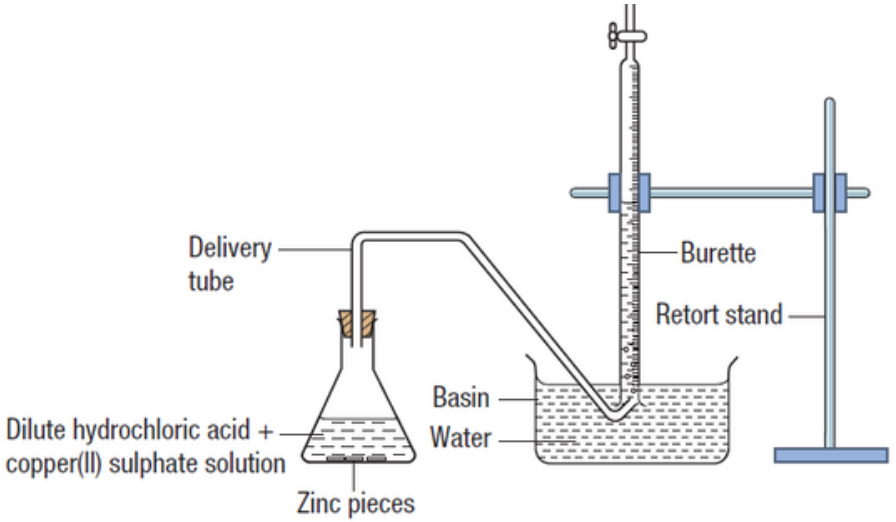




Graphs of changes in quantities of reactant and product against time

Ways to increase Rate of Reaction

- Use smaller size of solid reactants.
- Increase temperature of solution.
- Increase concentration of solution.
- Presence of catalyst.
- Increase pressure.

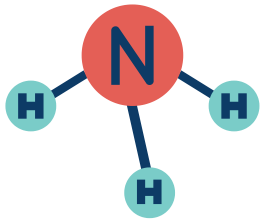


HABER PROCESS
PRODUCTION OF AMMONIA

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Nitrogen : Hydrogen
1 : 3

Ammonia

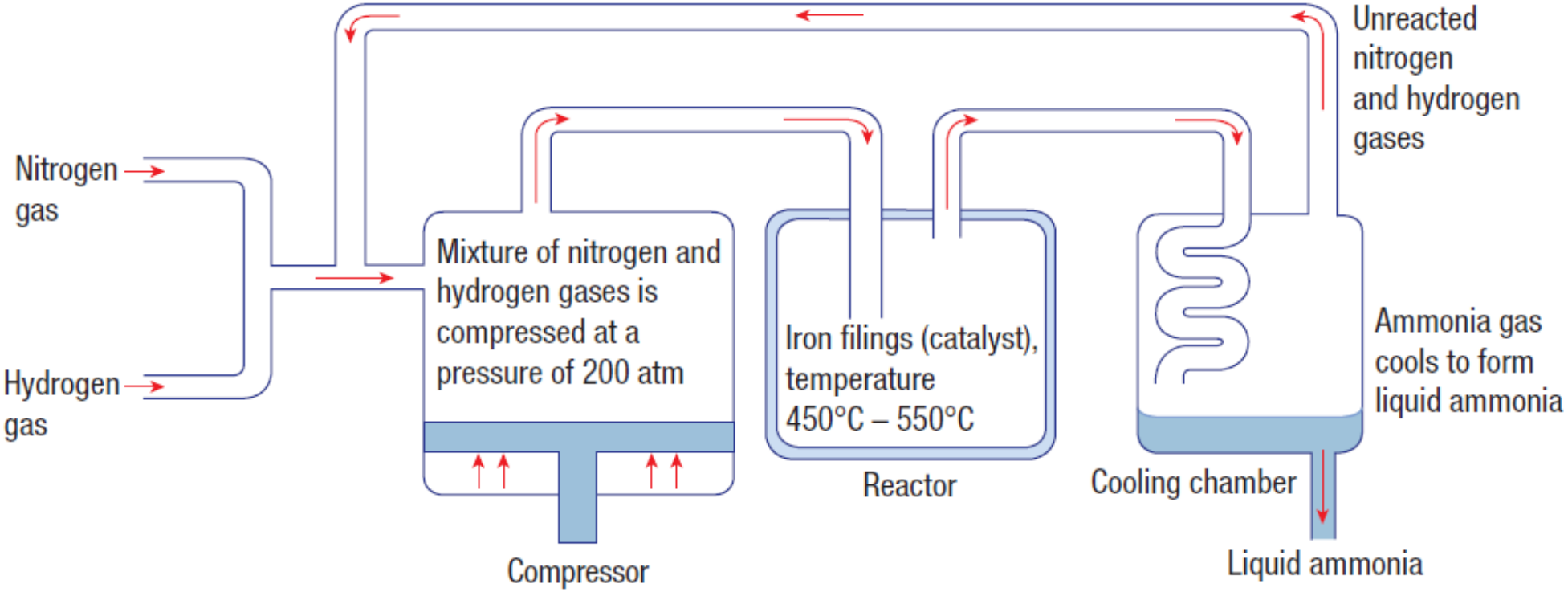


Factors that increases the rate of reaction:

Temperature = 450 – 550 °C

Catalyst = Iron filings 

Pressure = 200 atm



CONTACT PROCESS

PRODUCTION OF SULPHURIC ACID

$$\underset{\text{Sulphur}}{S} + \underset{\text{Oxygen}}{O_2} \longrightarrow \underset{\text{Sulphur dioxide}}{SO_2}$$

$$\underset{\text{Sulphur dioxide}}{2SO_2} + \underset{\text{Oxygen}}{O_2} \rightleftharpoons \underset{\text{Sulphur trioxide}}{2SO_3}$$

$$\underset{\text{Sulphur trioxide}}{SO_3} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

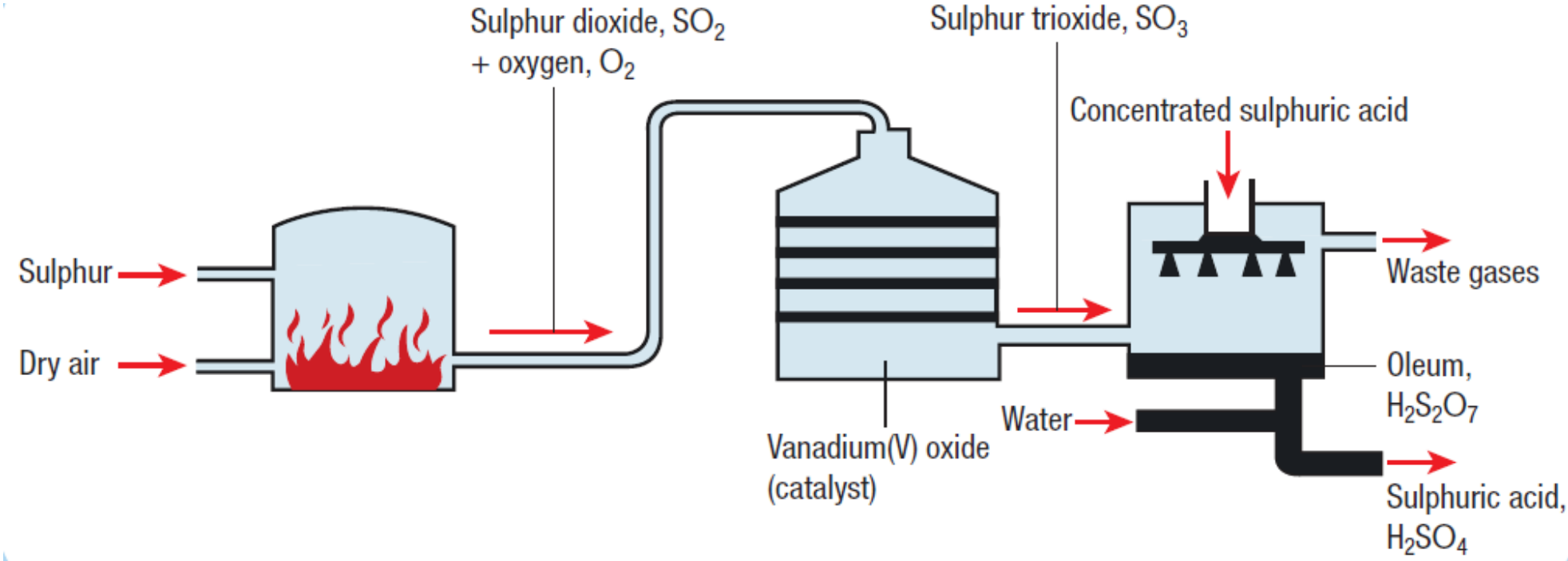
$$\underset{\text{Oleum}}{H_2S_2O_7} + \underset{\text{Water}}{H_2O} \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$

Factors that increases the rate of reaction:

Temperature = 450°C

Catalyst = Vanadium (V) oxide

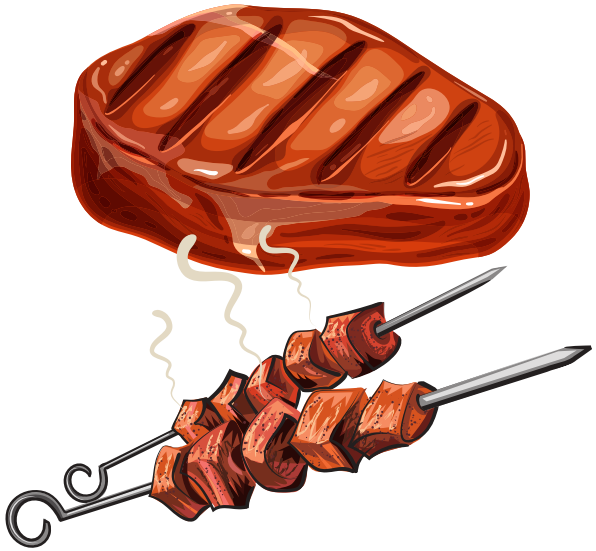
Pressure = 1 atm



Applications of the Concept of Rate of Reaction in Daily Life

- Refrigerator lowers the temperature of food or drinks kept in it.
- Lowering the temperature inhibit the growth of microorganisms and slows down food spoilage.

- A pressure cooker speeds up cooking time.
- High pressure in a pressure cooker increases the boiling point of water. Thus food can be cooked at temperatures above 100°C



- Small cut meat cooks faster.
- The total surface area of meat exposed to heat is greater.

Chapter 5
Carbon Compound

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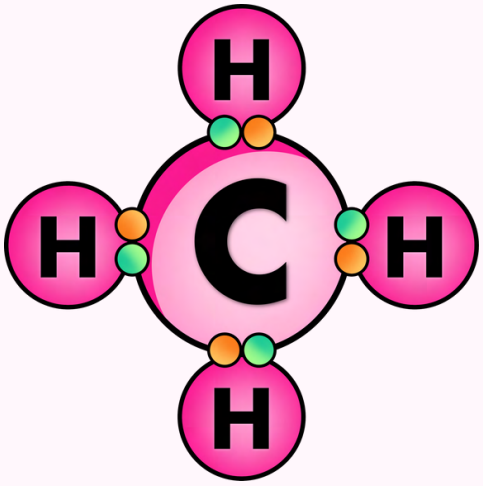
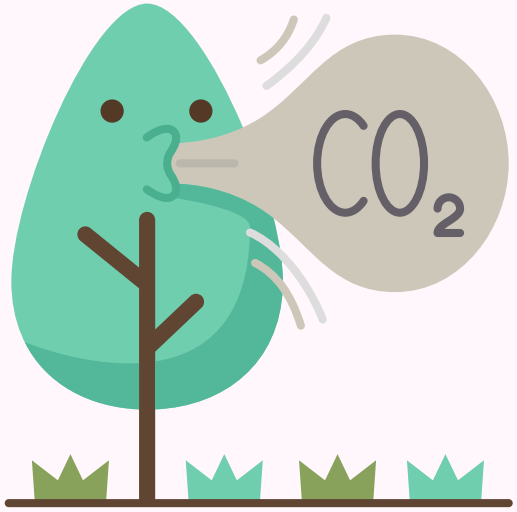
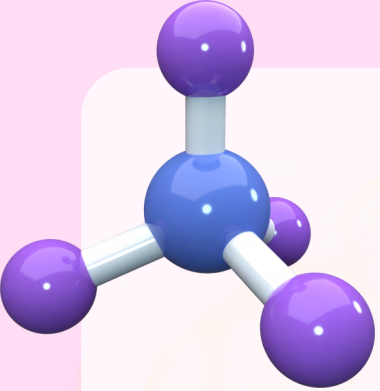
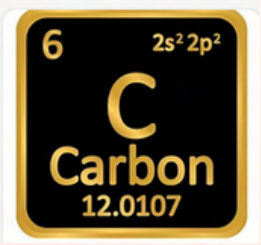
Cikgu Noor Afidah binti Abdul Jalil









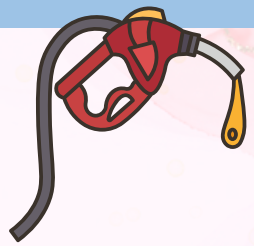
CARBON COMPOUND

Compound that **contains element carbon, C**

ORGANIC CARBON COMPOUND

Sources from living organisms

Petroleum, coal, silk



INORGANIC CARBON COMPOUND

Sources from non living organisms

Limestone, carbon dioxide

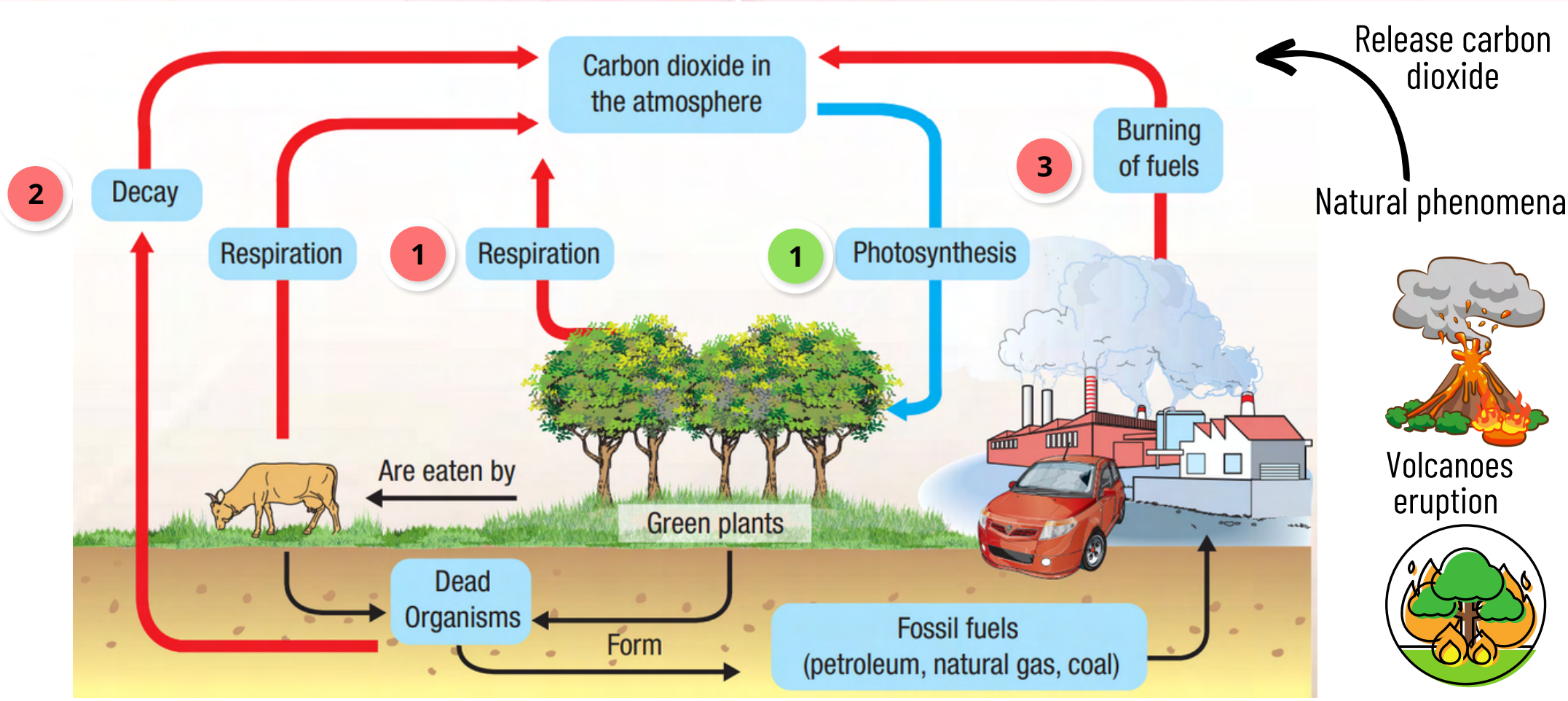
CARBON CYCLE

3 processes that <u>release carbon dioxide</u> :

1. **Respiration**
2. **Decaying**
3. **Fuel combustion**

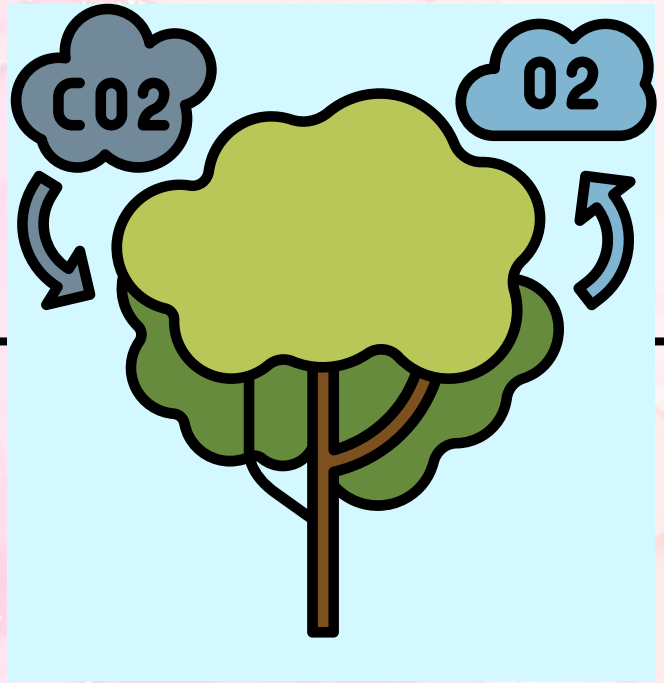
1 process that <u>absorb carbon dioxide</u>:

1. **Photosynthesis**



THE IMPORTANCE OF PHOTOSYNTHESIS

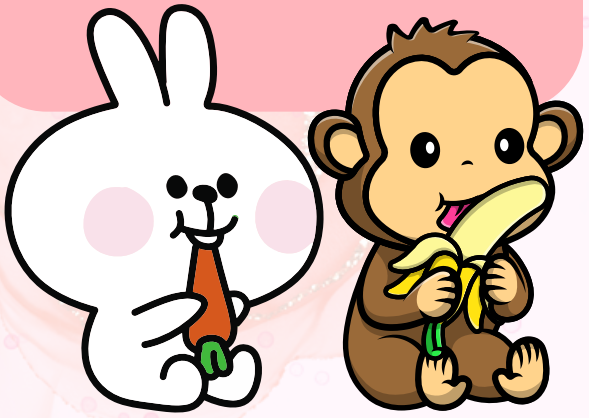
Remove excess carbon dioxide from air to balance the contain of carbon dioxide.



Increase the volume of oxygen in the air.

Enable the green plant to carry out **photosynthesis.**

Provide foods for animals.



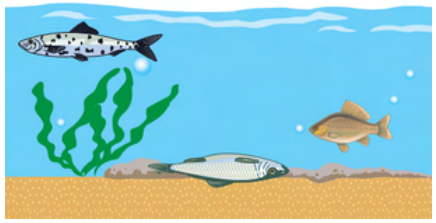
HYDROCARBON

Organic carbon compound that only contain hydrogen and carbon elements.

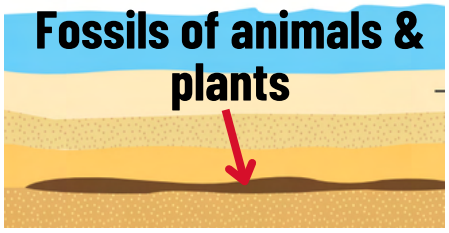
HYDROCARBON COMPOUND FROM NATURAL SOURCES

Petroleum, Natural gas, Coal

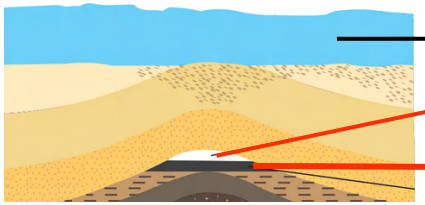
FORMATION OF PETROLEUM AND NATURAL GAS



Dead marine life, buried in the seabed.

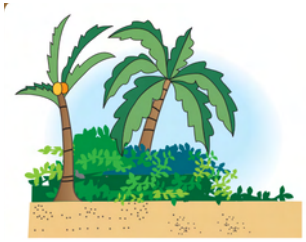


Over millions of years, **buried deeper and deeper** into the seabed under thick layers of rock and mud.

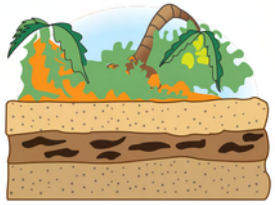


The combined **effects of pressure** by the layers of sand and mud**, heat** and **decomposition caused by bacteria** changes the buried into **petroleum** and **natural gas.**

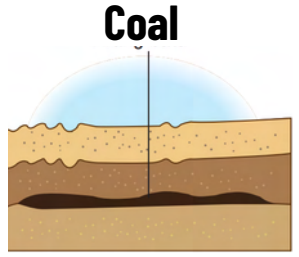
FORMATION OF COAL



Millions of years ago, **dead plants were naturally buried** underground.

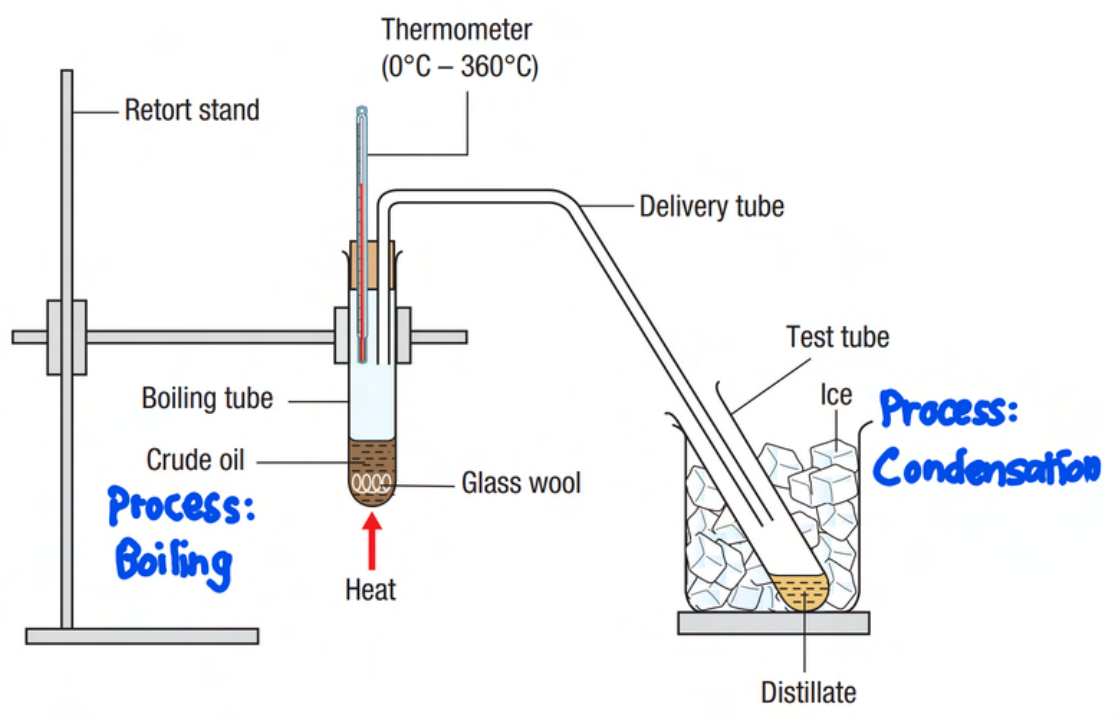


Over millions of years, **the remains become** buried deeper and deeper into the ground under thick layers of rocks.



The combined effects of **pressure exerted by the layers of rock, heat** and **decomposition caused by bacteria** changes the buried plant fossils into **coal.**

FRACTIONAL DISTILLATION IN LAB



Pecahan *Fraction*	Julat suhu (°C) *Range of temperature (°C)*	Warnanya *Colour*	Kelikatan *Viscosity*	Kebolehbakaran *Flammability*
1	Suhu bilik – 80 *Room temperature –80*	Tidak berwarna *Colourless*	Cair *Not viscous*	Sangat mudah *Very easy*
2	80 – 150	Tidak berwarna *Colourless*	Sedikit likat *Slightly viscous*	Mudah *Easy*
3	150 – 230	Kuning muda *Pale yellow*	Likat *Viscous*	Sukar *Difficult*
4	230 – 250	Kuning *Yellow*	Sangat likat *Very viscous*	Paling sukar *Most difficult*

1. Name the method of separation used in this activity.
Fractional distillation

2.Is petroleum a compound or a mixture? Give your reasons.
Mixture because the petroleum fractions have different boiling points.

3. Name the distillate obtained from the fractions labelled as follows:
(a) Fraction 1: **Petrol**
(b) Fraction 2: **Naphtha**
(c) Fraction 3: **Kerosene**
(d) Fraction 4: **Diesel**

4. What characteristic of the petroleum fractions is applied in the fractional distillation of petroleum?
Different boiling points.

COMPARISON

SATURATED HYDROCARBONS & UNSATURATED HYDROCARBONS

SATURATED HYDROCARBONS	UNSATURATED HYDROCARBONS

Similarities

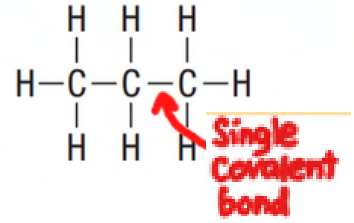
- only contain hydrogen and carbon elements
- organic carbon compounds

Differences

SATURATED HYDROCARBONS

Have single covalent bonds between carbon atoms (C-C)

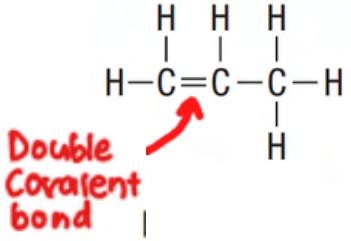
COMPOUNDS THAT SATURATED WITH HYDROGEN



Example : alkane

UNSATURATED HYDROCARBONS

Have at least one double covalent bond (C=C) between carbon atoms

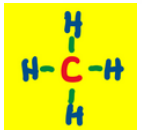
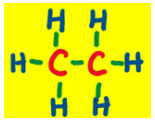
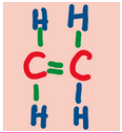
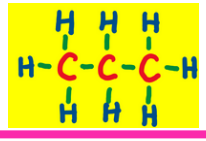
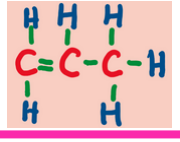
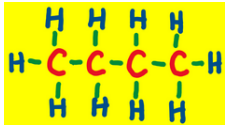
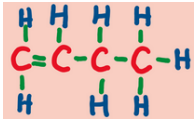
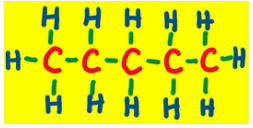
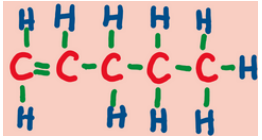
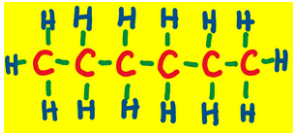
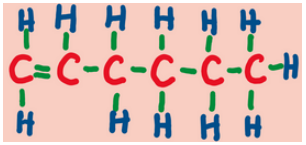


COMPOUNDS THAT UNSATURATED WITH HYDROGEN

Example : alkene

ana- single
Saturated

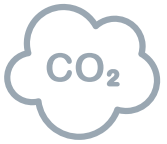
HOMOLOGOUS SERIES : A SPECIFIC GROUP OF ORGANIC COMPOUNDS WHICH HAVE SIMILAR CHEMICAL PROPERTIES

NUMBER OF CARBONS C	ALKANE C – C	ALKENE C = C
General formula:	$C_n H_{2n+2}$	$C_n H_{2n}$
1 METH.....	 METHANE	NONE
2 ETH.....	 ETHANE	 ETHENE
3 PROP.....	 PROPANE	 PROPENE
4 BUT.....	 BUTANE	 BUTENE
5 PENT.....	 PENTANE	 PENTENE
6 HEX.....	 HEXANE	 HEXENE

ALCOHOL

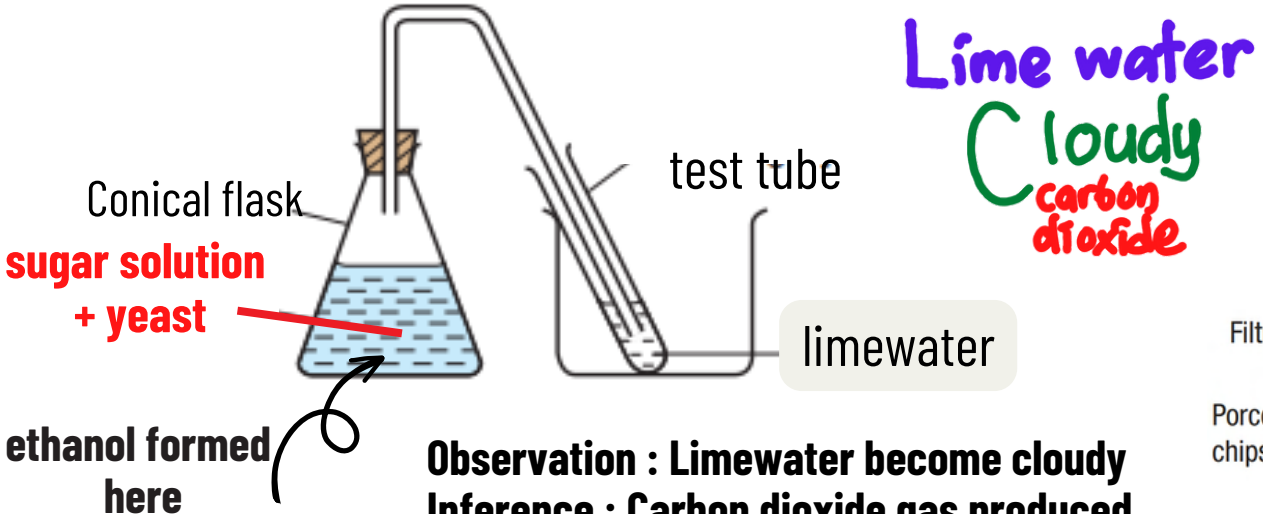
- organic carbon compound
- contains **CARBON, HYDROGEN AND OXYGEN** elements

ALCOHOL PREPARATION PROCESS



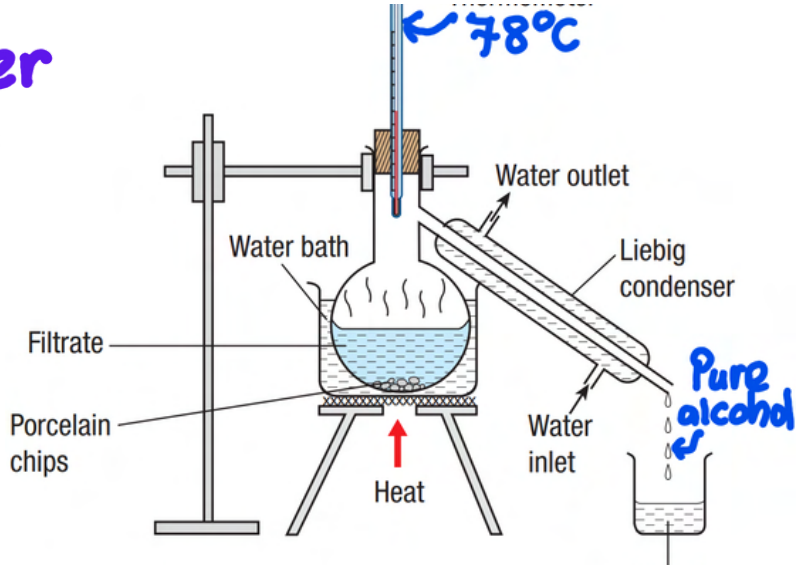
Glucose —(**zymase** (enzyme in **YEAST**))→ Ethanol + Carbon dioxide

FERMENTATION PROCESS



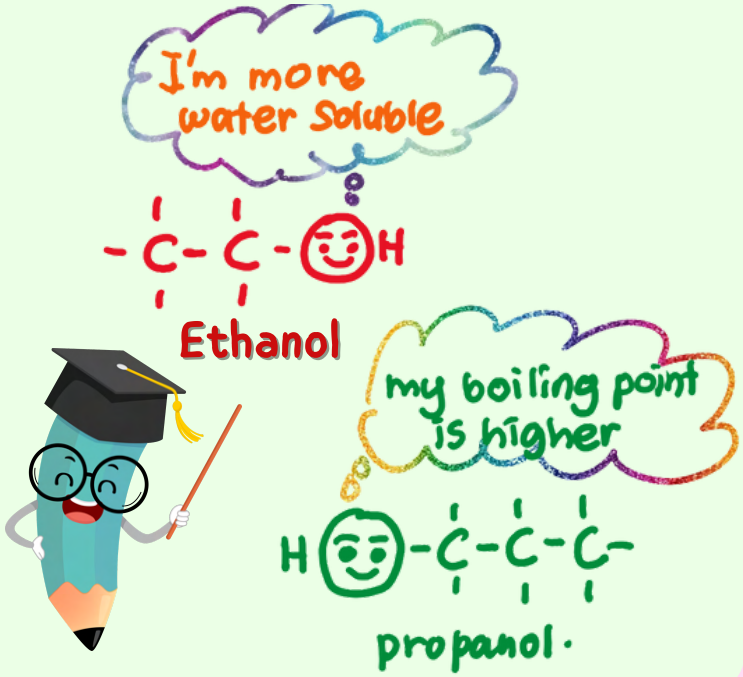
Observation : Limewater become cloudy
Inference : Carbon dioxide gas produced

DISTILLATION PROCESS



THE PHYSICAL PROPERTIES OF ALCOHOL

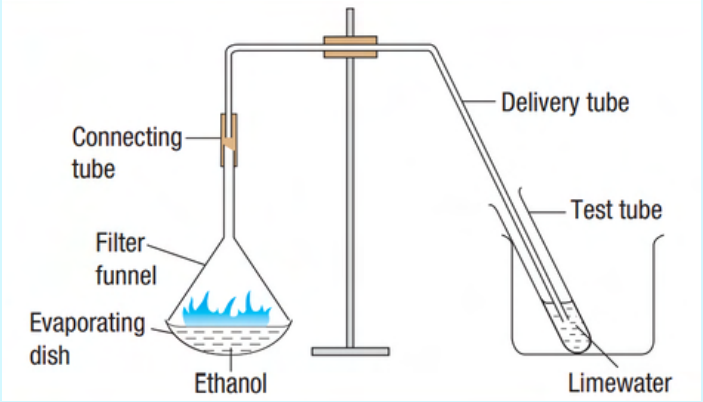
- **colourless**
- **liquid** at room temperature
- has a **distinctive smell**
- the **boiling point increases** when its number of carbon atoms increases
- the **solubility in water decreases** when its number of carbon atoms increases



THE CHEMICAL PROPERTIES OF ALCOHOL

COMBUSTION OF ALCOHOL

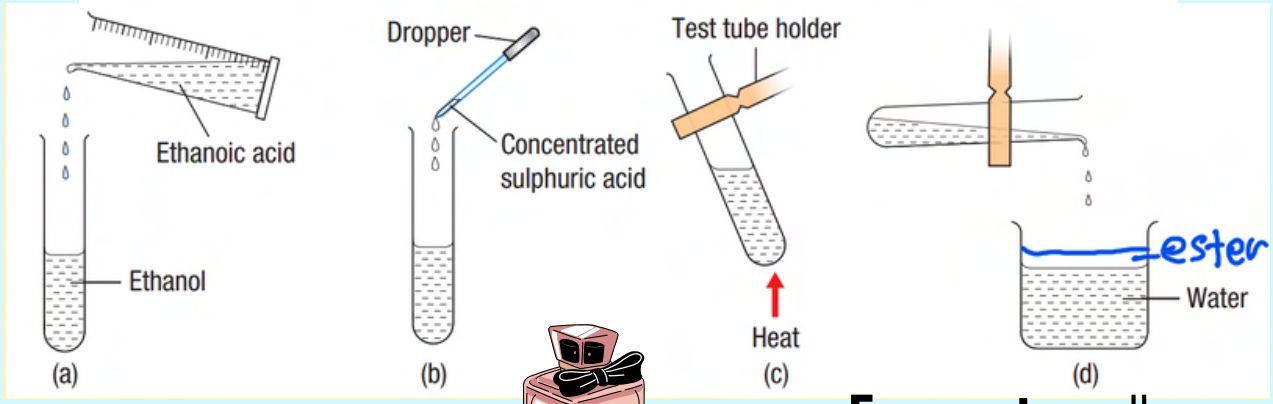
Ethanol + oxygen → Carbon dioxide + water



- ethanol burns with a blue flame **without soot**.
- releases carbon dioxide gas that **turn limewater cloudy.**

ESTERIFICATION

Ethanol + Ethanoic acid —(concentrated sulphuric acid (catalyst))→ Ester + water



Ester

- **Fragrant** smell
- **Insoluble** in water

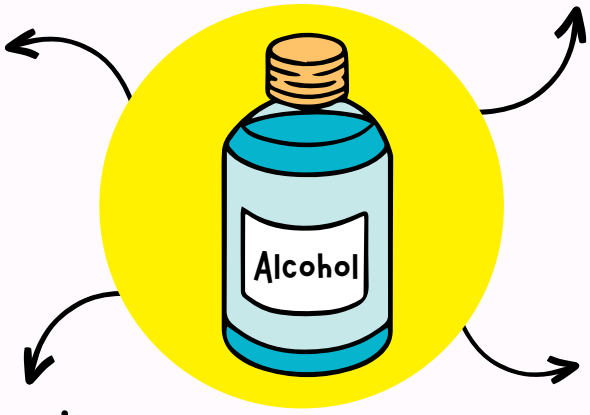
USES OF ALCOHOL IN DAILY LIFE

Fuel

- burns with a blue flame
- a complete and clean combustion **without soot** (Eco-friendly)
- used as a **biofuel** for motorised vehicles in Philippines

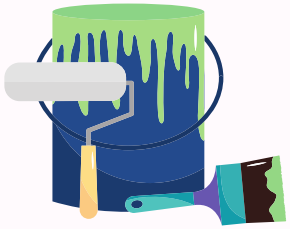
Medicine

- an **antiseptic** and **disinfectant** to kill microorganisms
- a **solvent** for various types of medicine



Industry

- a **solvent** in industry because it can dissolve organic substances
- food processing,
- cosmetics
- paint
- an **antifreeze** in industries

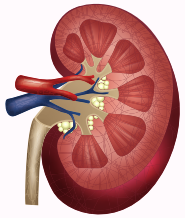


Cosmetics

- a **solvent** for various cosmetics such as perfume, lotion and lipstick

EFFECTS OF EXCESSIVE ALCOHOL CONSUMPTION

- Damage to brain cells
- Compromised coordination and nervous system
- Disruptions to body balance
- Difficulty in estimating

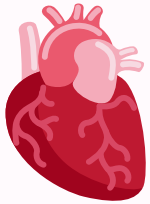


- Kidney damage due to overactive elimination of waste substance

- Blurred vision

- Frequent urination

- Increased rate of breathing



- Increased rate of heartbeat
- High blood pressure

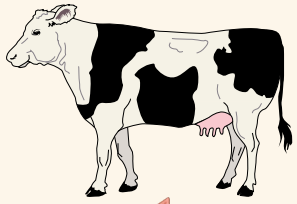
- Damage liver cells
- Liver cells die and harden
- Cirrhosis
- Liver cancer

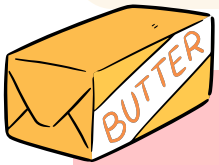
FATS

SIMILARITIES
- Organic compounds containing carbon, hydrogen and oxygen
- Do not dissolve in water

1 SATURATED FATS







ANIMAL SOURCES

- **Solid** at room temperature
- **High** melting point
- Number of hydrogen atoms in the molecule is **maximum**
- Addition of hydrogen atoms to molecule is **not possible**

2 UNSATURATED FATS






PLANT SOURCES

- **Liquid** at room temperature
- **Low** melting point
- Number of hydrogen atoms in the molecule is **not maximum**
- Addition of hydrogen atoms to molecule is **possible**

EFFECTS OF EXCESSIVE INTAKE OF FATS ON HEALTH

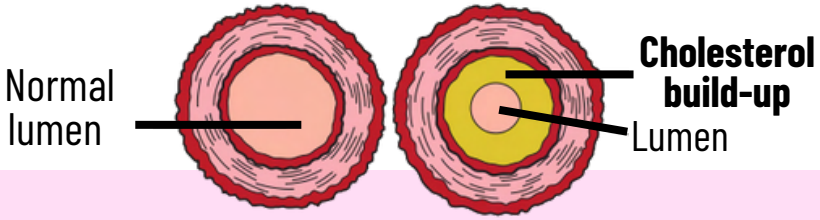
A

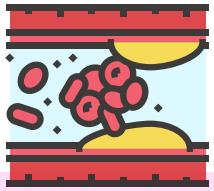
increase cholesterol level in blood → form gallstones → block the bile duct → cause jaundice

B

Cholesterol **accumulates** and **deposits** on the inner artery walls → **The artery lumen** become **narrow** → **Disrupt or block** flow of blood → **Atherosclerosis**

- **Fatal heart attack**
- **Stroke**
- **Hypertension**





HEALTHY TIPS

1. **reduce saturated fat** intake in diet
2. **take unsaturated fat** to reduce blood cholesterol level

IMPORTANCE OF CHOLESTEROL

- building of cell membranes
- synthesising bile
- synthesising sex hormones
- producing vitamin D

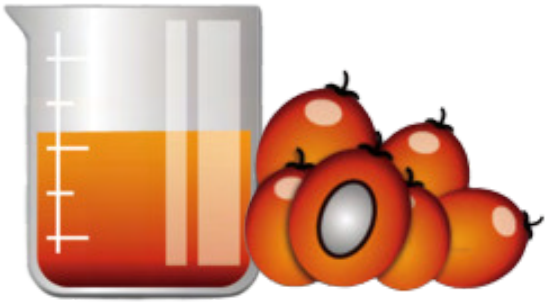
STRUCTURE OF OIL PALM FRUIT

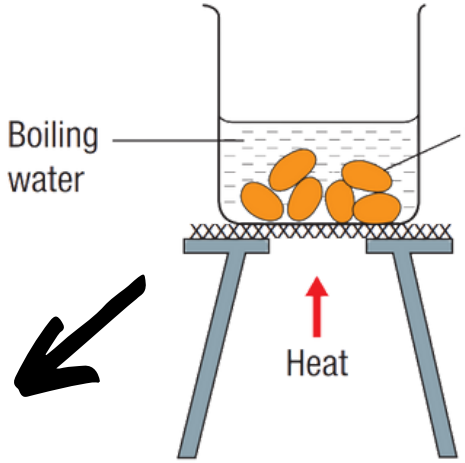
PULP (MESOCARP)
contains the most palm oil

SHELL (ENDOCARP)
does not contain oil

KERNEL
contains the best quality palm kernel oil

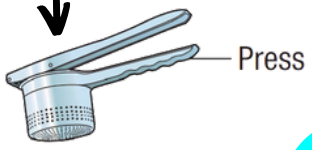
PALM OIL EXTRACTION IN LABORATORY

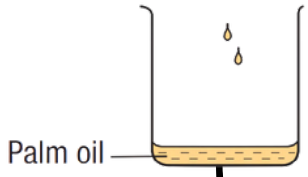




Boiling
kills microorganisms & softens the pulp

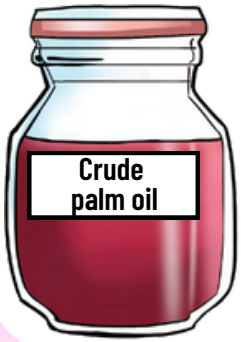
Pulp





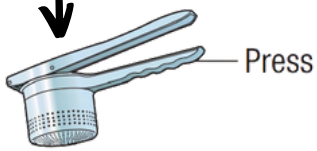
palm oil (PO)

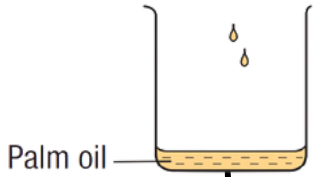
red in colour
more quantity



palm oil to be squeezed using press

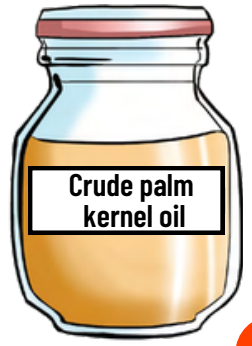
Kernel





palm kernel oil (PKO)

yellow in colour
fewer quantity



THE INDUSTRIAL EXTRACTION PROCESS OF PALM OIL

Bunch of oil palm fruits

↓

Sterilisation
palm fruits is sterilised with steam to **kills** microorganisms & **softens** the pulp

↓

Threshing
The oil palm fruits are **detached** from their **bunches**

↓

Digestion
The oil palm fruits are reheated at a high temperature and pounded by rotating beater arms to **separate** the pulp from the shell.

↓

Pulp [Extraction of palm oil (PO)]
The pulp is **squeezed** with a hydraulic or spindle press to **extrac**t PO.

↓

Filtration
The pulp fibres are **separated** from the PO

↓

Purification
Steam is flowed through the PO to remove odour and eliminate acid.
PO flows through **activated carbon** to be decolourise.

↓

Pure Palm Oil (PO)

Kernel [Extraction of palm kernel oil (PKO)]
The kernel is separated from shell
The kernel is dried
PKO is extracted from it with a hydraulic or spindle press

↓

Filtration
The kernel is separated from the PKO

↓

Pure Palm kernel oil (PKO)

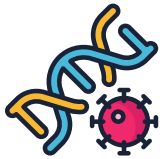
COMPONENTS OF PALM OIL

- Components of Palm Oil
  - Glycerol
  - Fatty acid
    - Saturated fatty acid
      - Palmitic acid
      - Stearic acid
    - Unsaturated fatty acid
      - Oleic acid
      - Linoleic acid

THE CHEMICAL PROPERTIES OF PALM OIL

Oxidation

Palm oil molecule + **oxygen** ⟶ **free radicals** (harmful to human health)

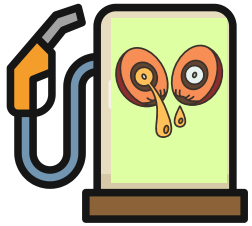


Hydrolysis

Palm oil molecule + **water** ⟶ **glycerol + fatty acid**

Esterification

Fatty acid molecules of palm oil + **alcohol** ⟶ **ester** (palm oil biodiesel)



The content of **saturated fats** and **unsaturated fats** is **balanced**

constitute less than 1%
sterol, phosphatides, triterpene and aliphatic alcohols

Antioxidants (carotene and vitamin E) slow down or stop the oxidation process.

Rich in **vitamin A** & **E**

PALM OIL-BASED PRODUCTS

Chocolate

Medicinal capsules

Ice cream

Soap

Cooking oil

Shampoo

Margarine

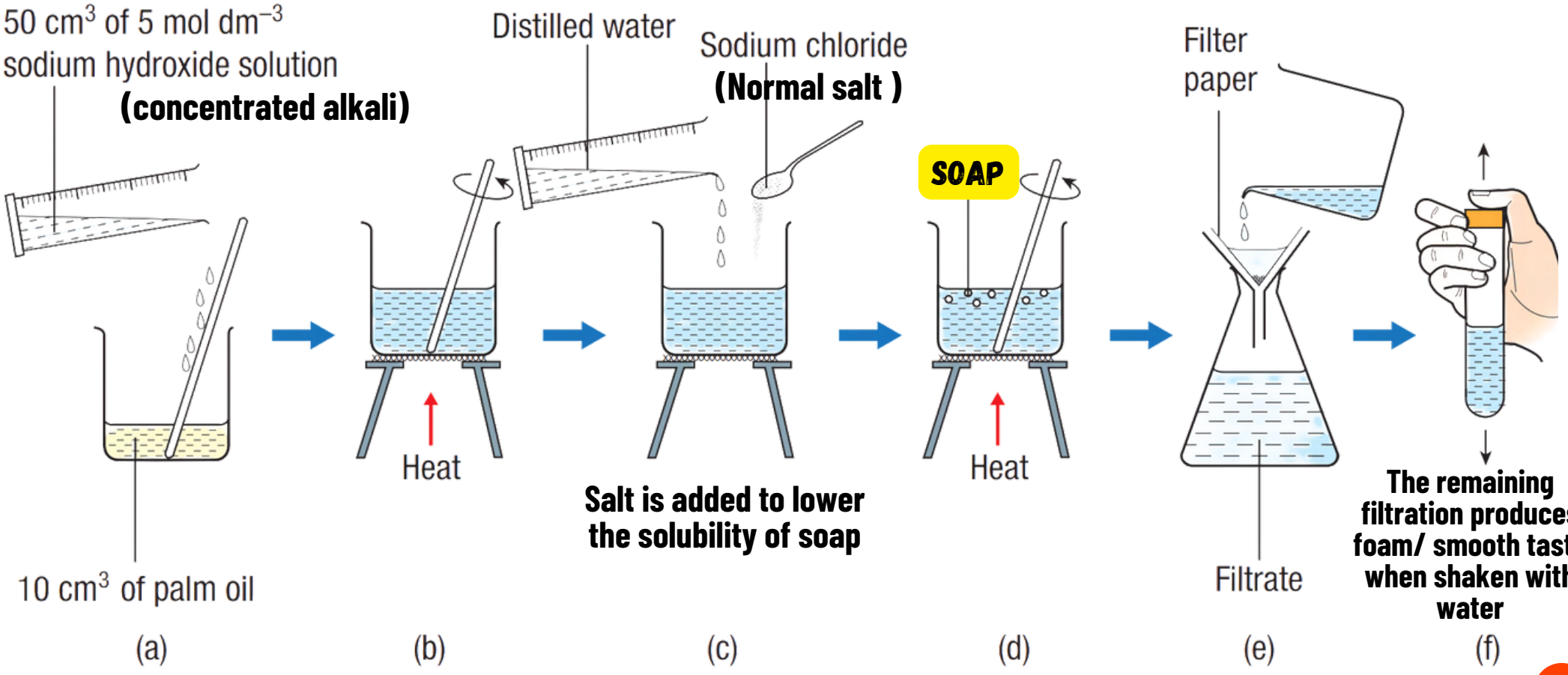
Cosmetic

SOAP PRODUCTION

SAPONIFICATION PROCESS

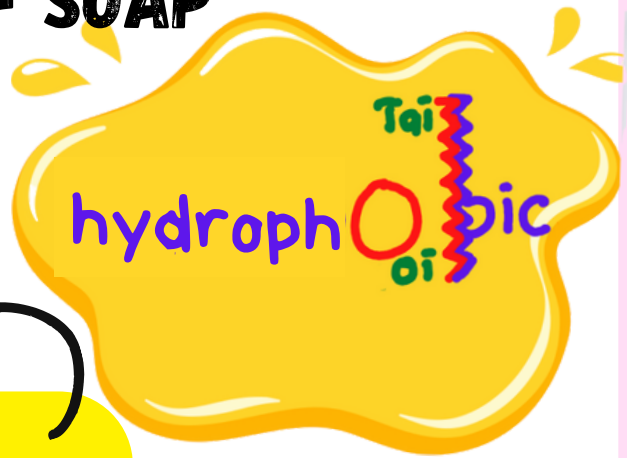
Saponification
Soap
oil + alkali

Oil + Concentrated alkali → **Fatty acid salt + Glycerol (SOAP)**
(concentrated sodium hydroxide or concentrated potassium hydroxide)



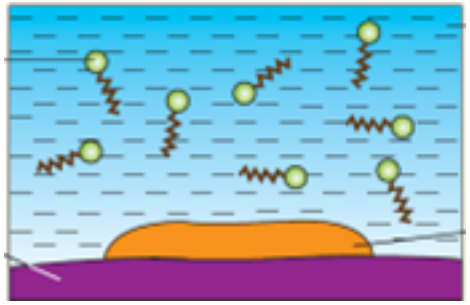
MOLECULAR COMPONENTS OF SOAP

HEAD
'hydrophilic'
dissolve in water

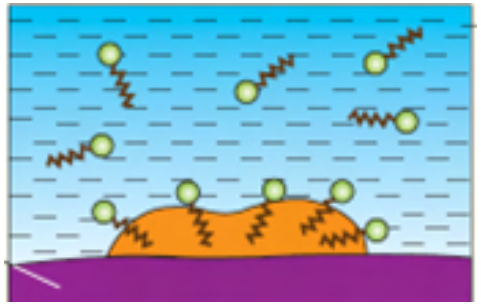


TAIL
`hydrophobic'
dissolve in oil or
grease.

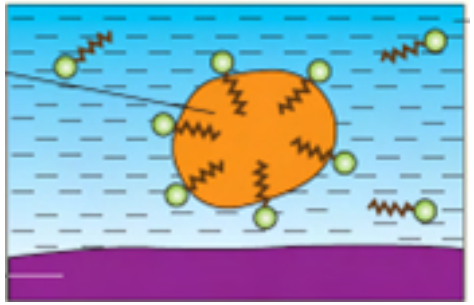
CLEANSING ACTION OF SOAP



Head/hydrophilic part of soap molecules will dissolve in water



Tail/ hydrophobic part of the soap molecules will dissolve and attach to the greasy dirt on the cloth



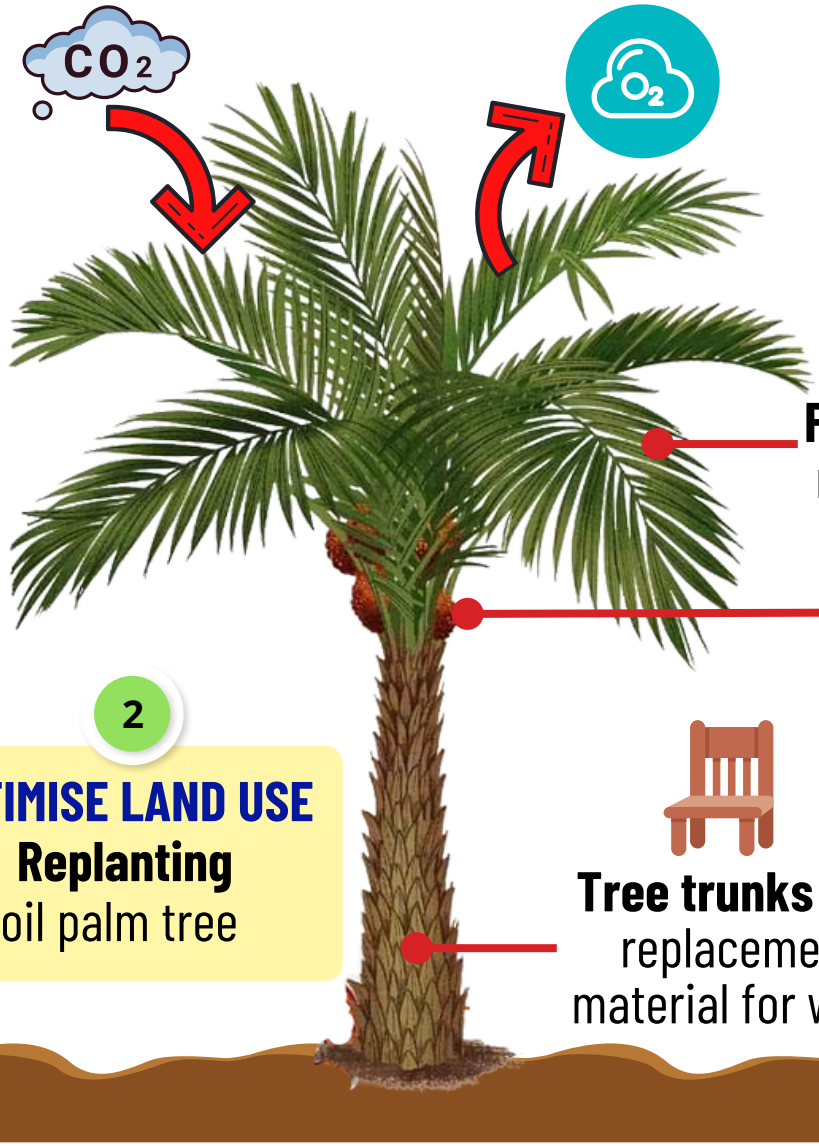
Brushing will **dislodge the greasy dirt** from the cloth surface. **Soap bubbles** produced by soapy water **trap greasy droplets. Rinsing** will **removes greasy dirt.**

SUSTAINABLE MANAGEMENT AND ITS IMPORTANCE IN THE PALM OIL INDUSTRY

1

QUALITY OF AIR IMPROVES

Carbon dioxide is absorbed and **oxygen is released** during **photosynthesis** process



2

OPTIMISE LAND USE

Replanting oil palm tree

3

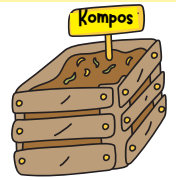
ZERO WASTE

Oil palm waste is converted into **multi-purpose products**

Fronds are made into fertiliser

Tree trunks as a replacement material for wood

Empty bunch made into compost

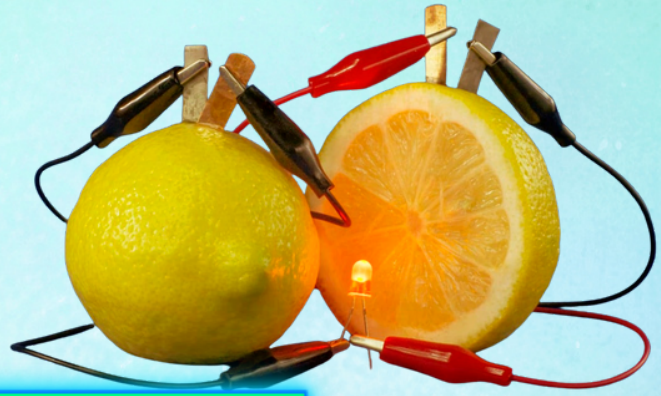


Shells are burnt to boil water

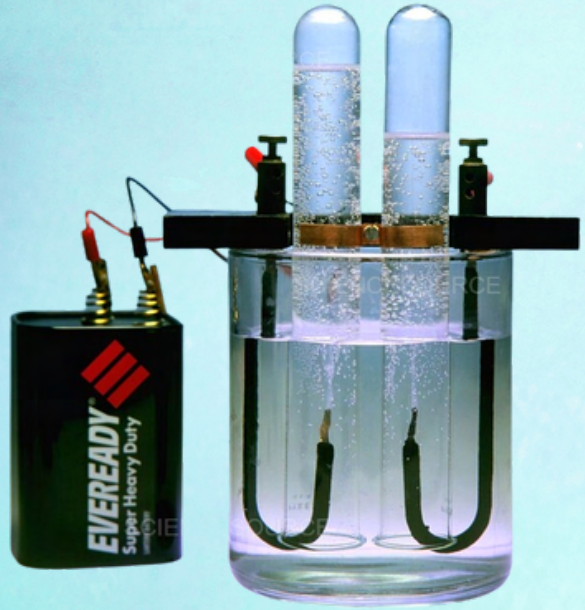
Pulp fibre is made into carpets and textile

Sewage water of palm oil mills (POME) turned into biogas and fertilisers

CHAPTER 6



ELECTROCHEMISTRY



Writers : Cikgu Wan Rizalmi bin Wan Hanafi
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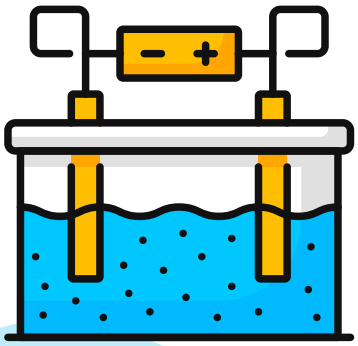
Cikgu Norbaizura binti Mohd Rashid

Translator : Cikgu Thian Ping Ping

Electrochemistry is a study in chemistry that relate between electrical and chemical phenomena.

2 types of electrochemical cells



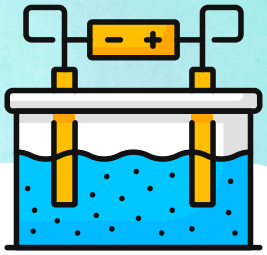
ELECTROLYTIC CELL

- Electrolysis process
- Electrical energy is converted to chemical energy

CHEMICAL CELL

- Also known as voltaic cell or galvanic cell
- Chemical energy is converted to electrical energy

ELECTROLYSIS

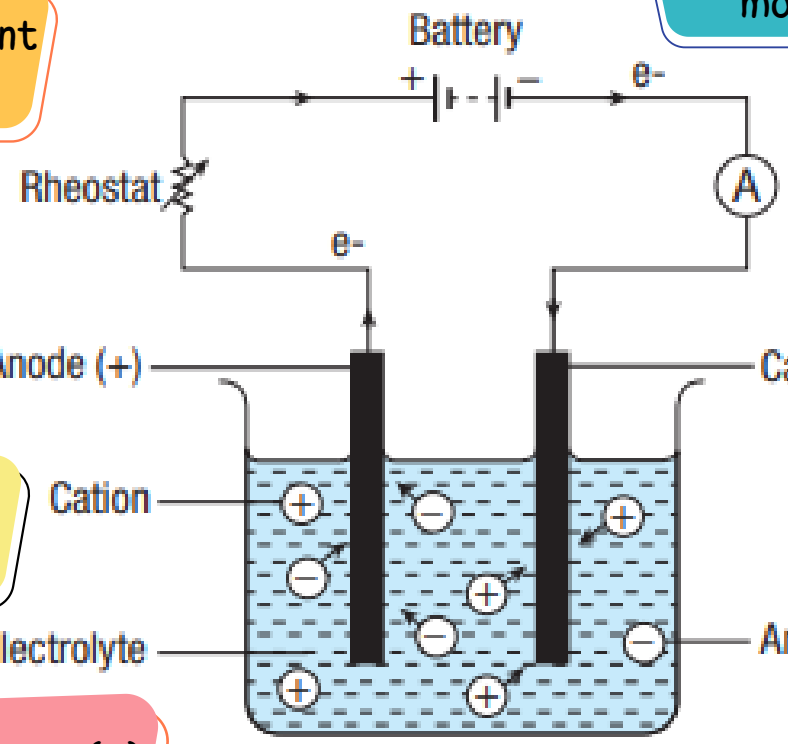


Decomposition of a compound (molten or aqueous) into its constituent elements by electric current.

Electrical source

Electron movement

Control electric current flow in the circuit



Electrode connected to the positive terminal of battery

Electrode connected to the negative terminal of battery

Positive ion moves to cathode

Negative ion moves to anode

Liquid containing cation (+) and anion (-)

ELECTROLYTIC CELL

Electrolyte cannot conduct electricity in solid state because ions cannot move freely to conduct electricity.

Substances that allow electric current to flow through in the molten or aqueous state

ELECTROLYTE

VS

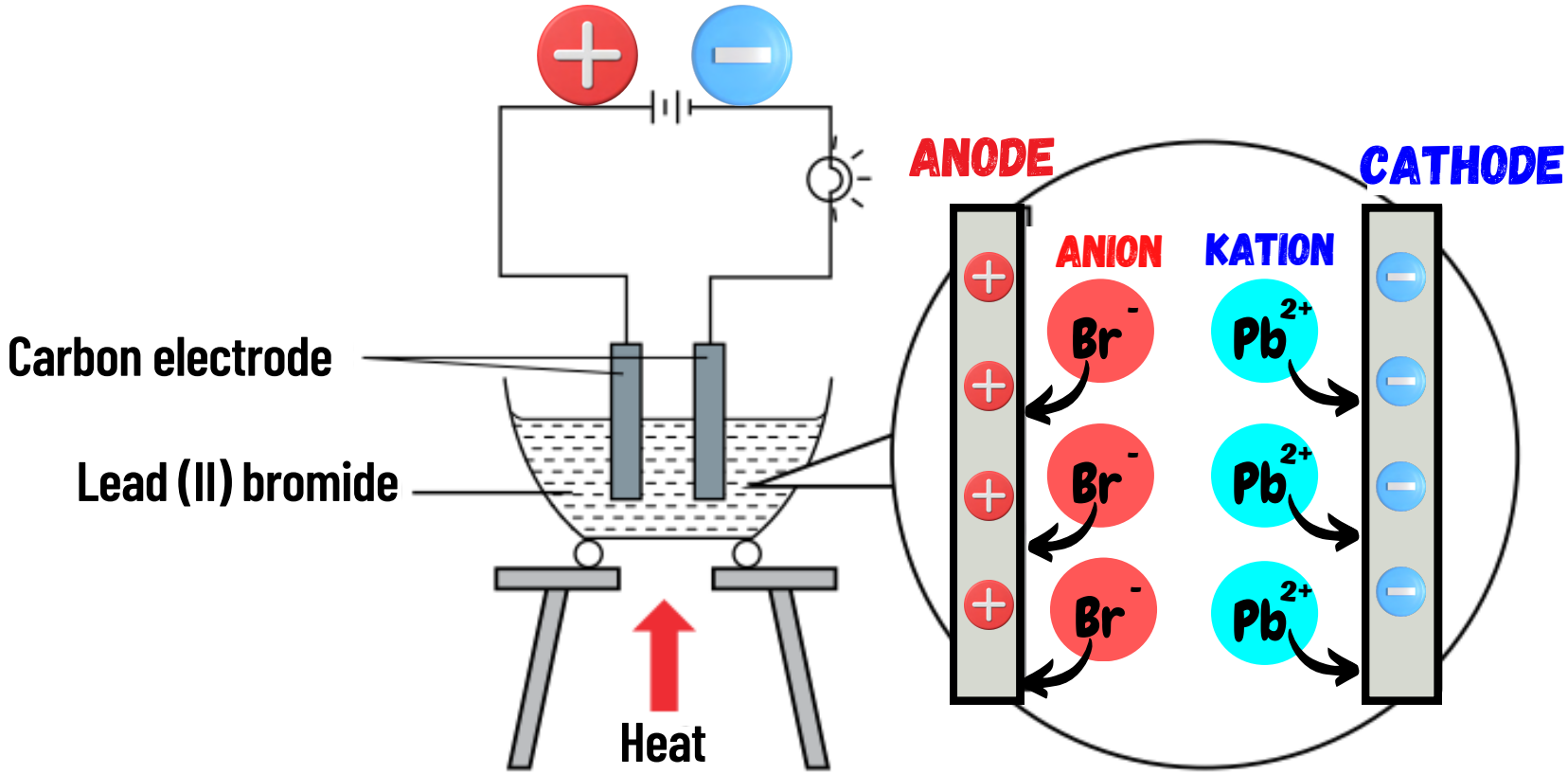
NON-ELECTROLYTE

Substances that do not allow electric current to flow through in the molten or aqueous state

- Molten lead(II) bromide
- Molten sodium chloride
- Sodium hydroxide solution
- Copper(II) sulphate solution

- Ethanol
- Naphthalene
- Acetamide
- Glucose solution

ELECTROLYSIS OF MOLTEN LEAD(II) BROMIDE



ANODE

- Negatively charged bromide ion (ANION) moves to the anode (positive electrode)
- Discharged to form bromine gas.

CATHODE

- Positively charged plumbum (II) ion (CATION) moves to the cathode (negative electrode)
- Discharged to form solid plumbum

ELECTROLYSIS

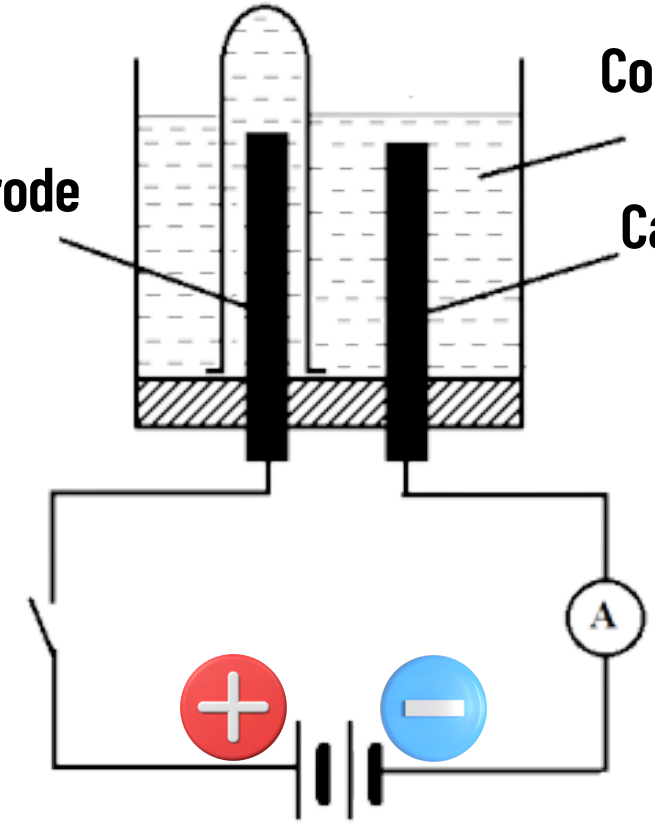
COPPER(II) SULPHATE SOLUTION

ANODE

- Hydroxide ion dan sulphate ion (anion) move to the anode
- Hydroxide ion is selected to be discharged to form oxygen gas

CATHODE

- Copper (II) ion dan hydrogen ion (cation) move to the cathode.
- Copper ion is selected to be discharged to form solid copper (brown deposited)



ANION

OH^- Hydroxide ion

SO_4^{2-} Sulphate ion

Hydroxide ions are selected to be discharged because the hydroxide ion is less electronegative than sulphate ion

CATION

H^+ Hydrogen ion

Cu^{2+} Copper (II) ion

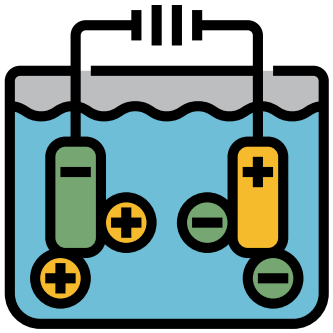
Copper (II) ions are selected to be discharged because Copper (II) ions is less electropositive than hydrogen ions

ELECTROCHEMICAL SERIES

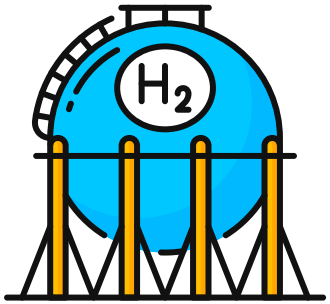
Cation		Anion
Potassium ion, K^+	Ease of discharge increases	Fluoride ion, F^-
Sodium ion, Na^+		Sulphate ion, SO_4^{2-}
Calcium ion, Ca^{2+}		Nitrate ion, NO_3^-
Magnesium ion, Mg^{2+}		Chloride ion, Cl^-
Aluminium ion, Al^{3+}		Bromide ion, Br^-
Zinc ion, Zn^{2+}		Iodide ion, I^-
Iron(II) ion, Fe^{2+}		Hydroxide ion, OH^-
Tin ion, Sn^{2+}		
Lead(II) ion, Pb^{2+}		
Hydrogen ion, H^+		
Copper(II) ion, Cu^{2+}		
Silver ion, Ag^+		

Ion becomes less electropositive and easier to discharged

Ion becomes less electronegative and easier to discharge



FACTORS AFFECTING THE PRODUCTS IN ELECTROLYSIS



POSITION OF IONS IN THE ELECTROCHEMICAL SERIES

The higher the position of a metal in the electrochemical series, the easier it is for the metal to donate electron(s).

Ions at the bottom of the electrochemical series have higher tendencies to be discharged.

CONCENTRATION OF ELECTROLYTE

Negative ions which are more concentrated are more likely to be discharged at the anode.

Positive ions to be discharged at the cathode is influenced by the position of the cation in the electrochemical series.

TYPES OF ELECTRODE

If the metal used as the anode is the same as the metal ion in the electrolyte, then the metal at anode will ionise to form positive ions that dissolve into the electrolyte and then discharged to form metal atom and then deposited at the cathode.

ELECTROLYSIS PRODUCTS TEST

Glowing wooden splinter test (test for oxygen gas)

- Insert a glowing wooden splinter into the test tube containing the gas.
- If the glowing wooden splinter ignites, the gas in the test tube is oxygen.

Burning wooden splinter test (test for hydrogen gas)

- Bring a burning wooden splinter close to the mouth of the test tube containing the gas.
- If the gas explodes with a 'pop' sound, the gas in the test tube is hydrogen.

Moist blue litmus paper test

- Place a piece of moist blue litmus paper close to the mouth of the test tube containing the gas.
- If the moist blue litmus paper turns red, the gas in the test tube is acidic.
- If the colour of the moist blue litmus paper bleaches, the gas in the test tube is halogen gas.
- If the moist blue litmus paper does not change colour, the gas in the test tube is alkaline or neutral.

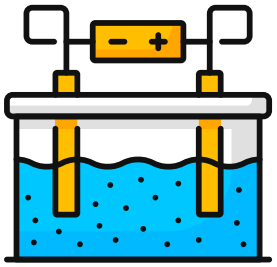
Moist red litmus paper test

- Place a piece of moist red litmus paper close to the mouth of the test tube containing the gas.
- If the moist red litmus paper turns blue, the gas in the test tube is alkaline.
- If the moist red litmus paper does not change colour, the gas in the test tube is acidic or neutral.

APPLICATION OF ELECTROLYSIS IN INDUSTRIES

EXTRACTION OF METALS

- Metals like potassium, sodium, calcium and aluminium are extracted from their ores / salt through electrolysis.



ELECTROLYSIS

PURIFICATION OF METALS

- Anode: Impure metal
- Cathode: Pure metal
- Metal at the anode will dissolve into the electrolyte to form ions.
- These ions will move to the cathode to be discharged and deposited at the cathode as PURE METAL.

METAL ELECTROPLATING

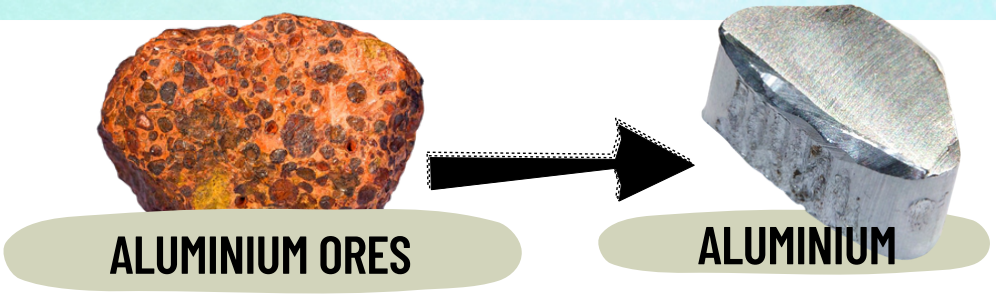
- Gold, platinum and silver are electroplated on other metals
- To make the metal look more attractive and to withstand corrosion

WASTEWATER TREATMENT USING ELECTROCOAGULATION

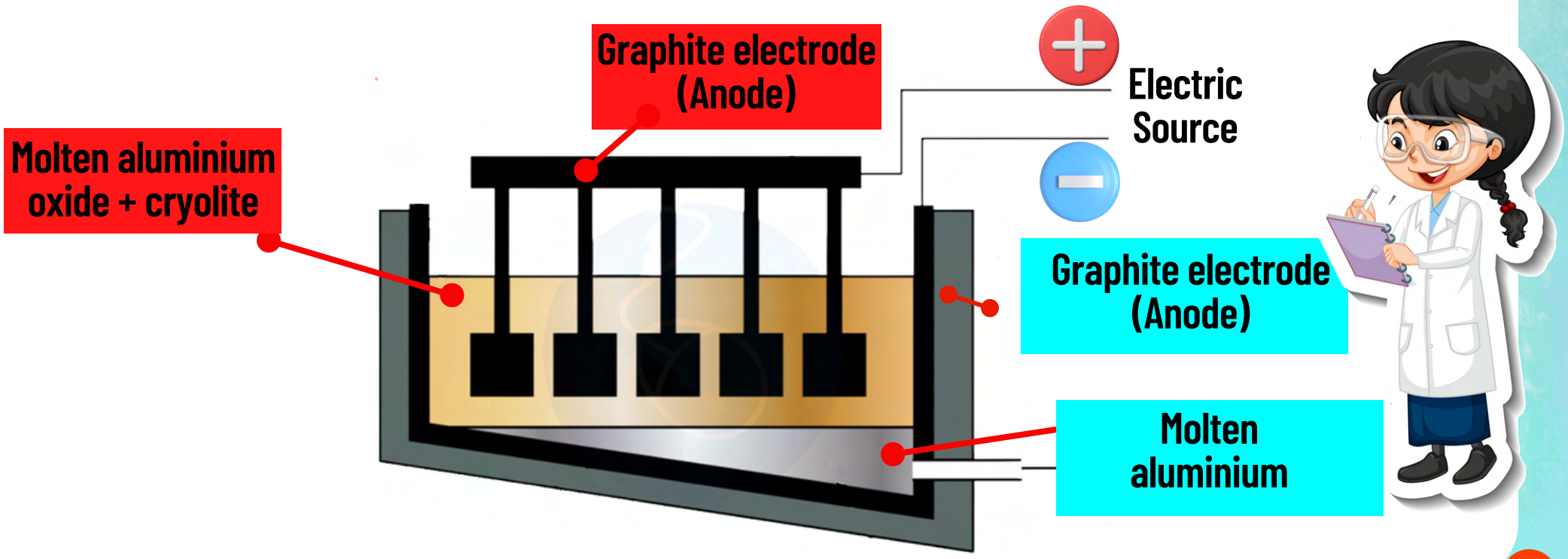
- Innovative technique to treat wastewater.
- Apply 2 processes - electrolysis & coagulation

APPLICATION OF ELECTROLYSIS IN INDUSTRIES

1. EXTRACTION OF METALS

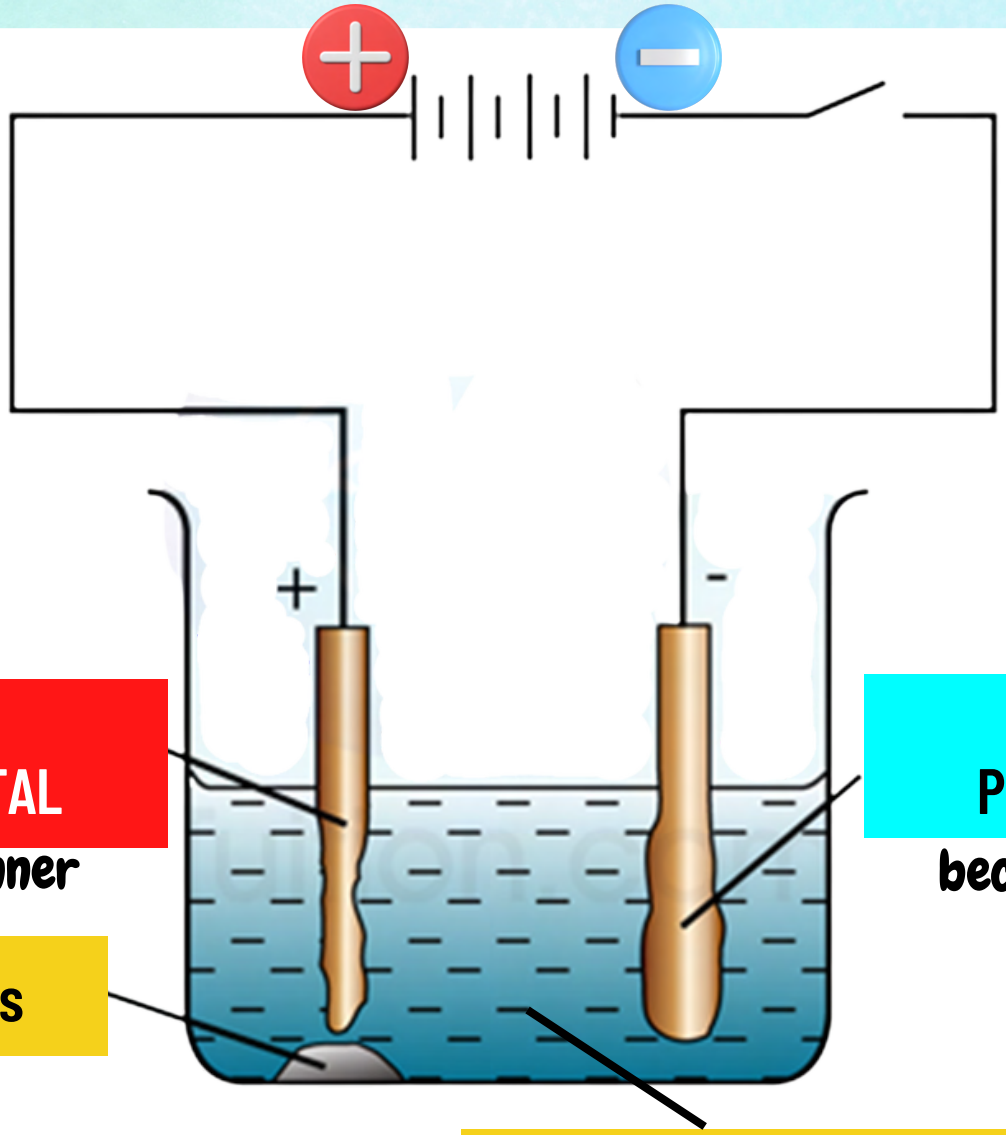


Metals like potassium, sodium, calcium, magnesium and aluminium are extracted from their molten ores or salts through electrolysis.



APPLICATION OF ELECTROLYSIS IN INDUSTRIES

2. PURIFICATION OF METALS



During electrolysis, the metal at the anode will dissolve into the electrolyte to form ions which will move to the cathode to be discharged and deposited at the cathode as PURE METAL.

ANODE
IMPURE METAL

becomes thinner

CATHODE
PURE METAL

becomes thicker

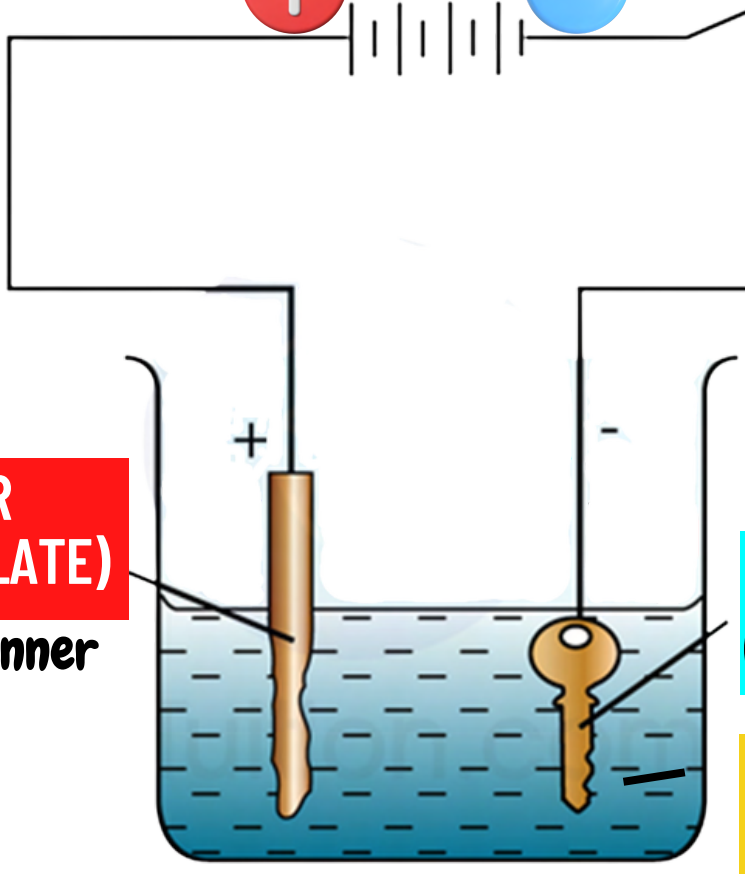
Impurities

COPPER(II) SULPHATE SOLUTION

blue color of solution is not change

3. ELECTROPLATING OF METALS

Copper electrode becomes thinner as it dissolves in electrolyte to become copper (II) ions.



Copper (II) ions move and deposited at the cathode / electroplating the key.

COPPER (ELECTROPLATE)

becomes thinner

IRON KEY (METAL TO ELECTROPLATE)

COPPER (II) SULPHATE SOLUTION

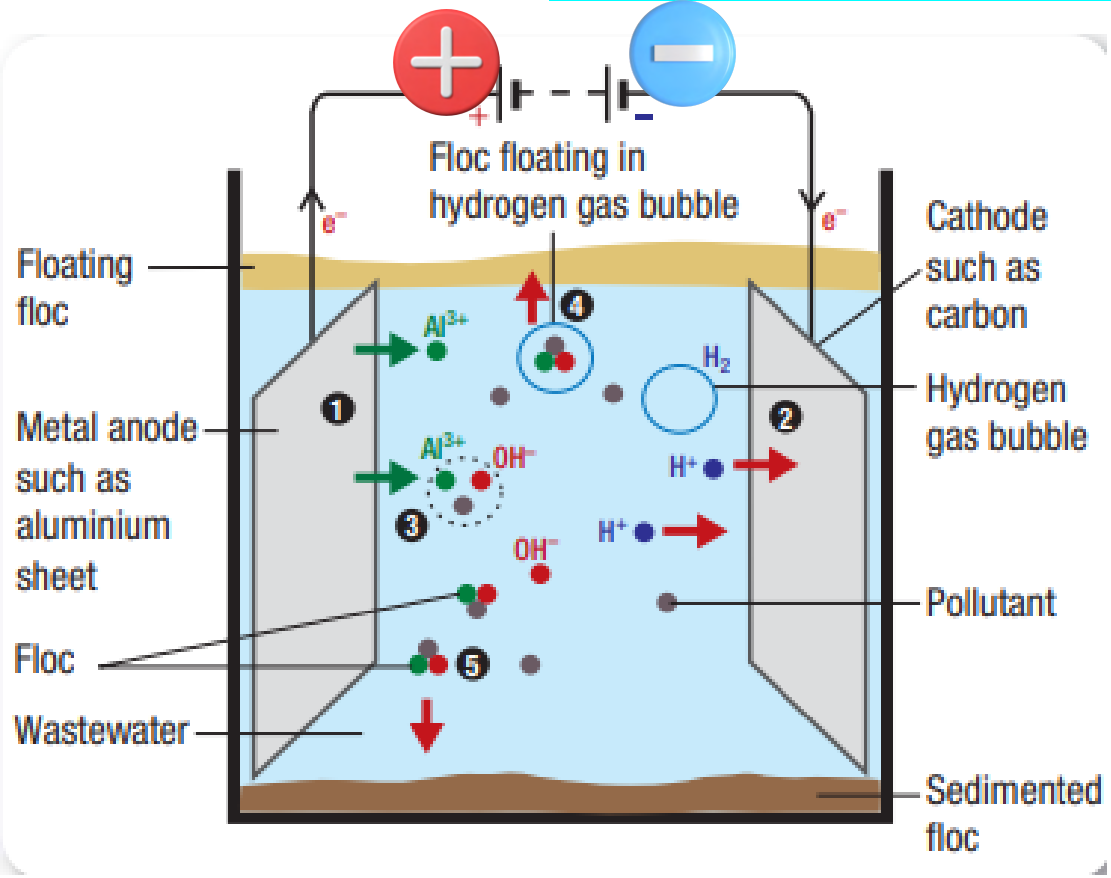
APPLICATION OF ELECTROLYSIS IN INDUSTRIES

4. WASTEWATER TREATMENT USING ELECTROCOAGULATION

ELECTROLYSIS

1 (ANODE) Aluminium iomises in the electrolyte to produce positively charged aluminium ions.

2 (CATHODE) Hydrogen ions are selected to be discharged to form hydrogen gas. Hydrogen gas bubbles are released from the cathode & rise to the water surface.



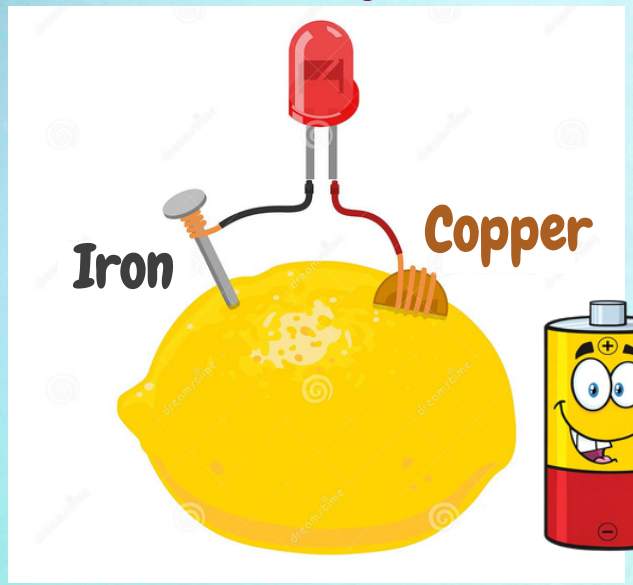
COAGULATION

3 Coagulation occurs when aluminium ions, hydroxide ions & pollutants in the wastewater combine to produce coagulants known as floc.

4 Floc, trapped in hydrogen gas bubbles released from the cathode, are brought up to the water surface.

5 The remaining flocs sinks & accumulates at the base.

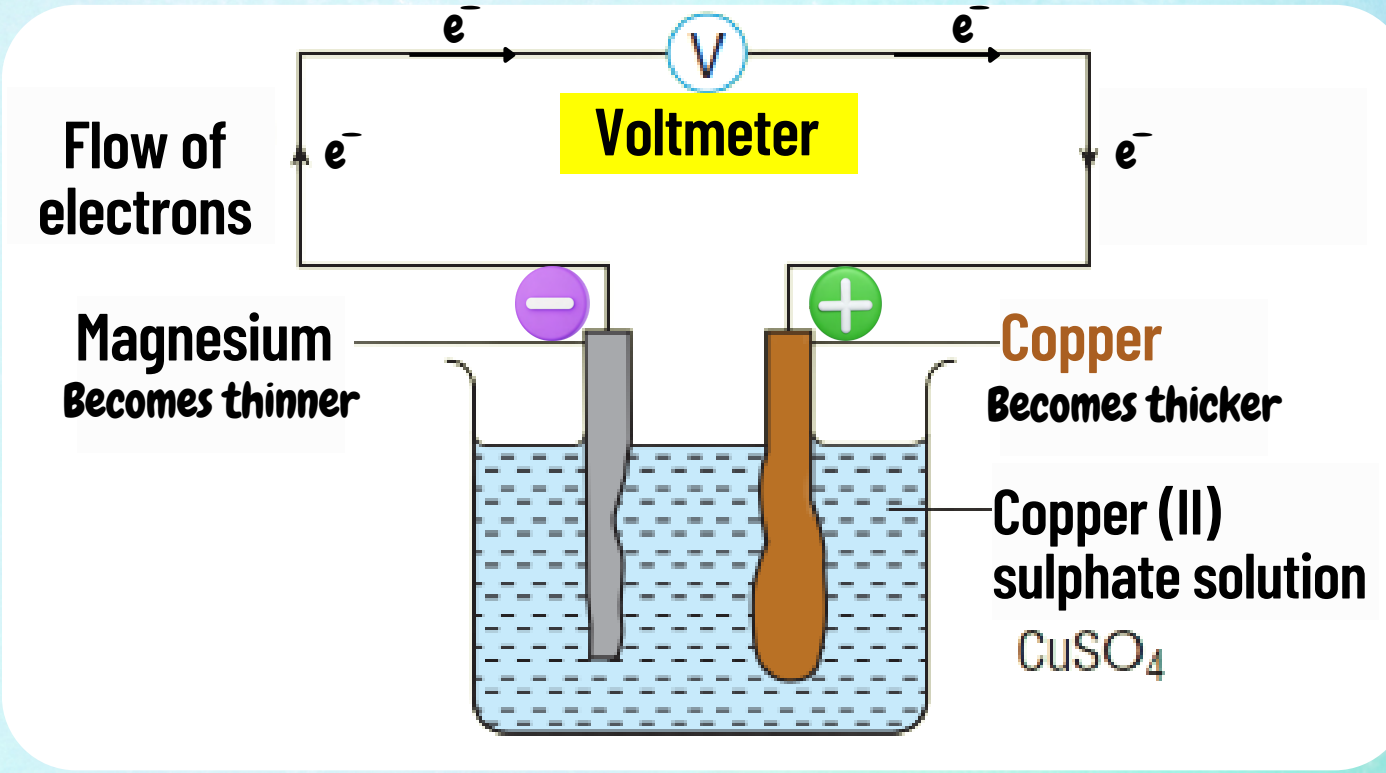
CHEMICAL CELL



A cell that **produces electricity** through chemical reactions that occur in it

Energy change :

Chemical energy → Electrical energy

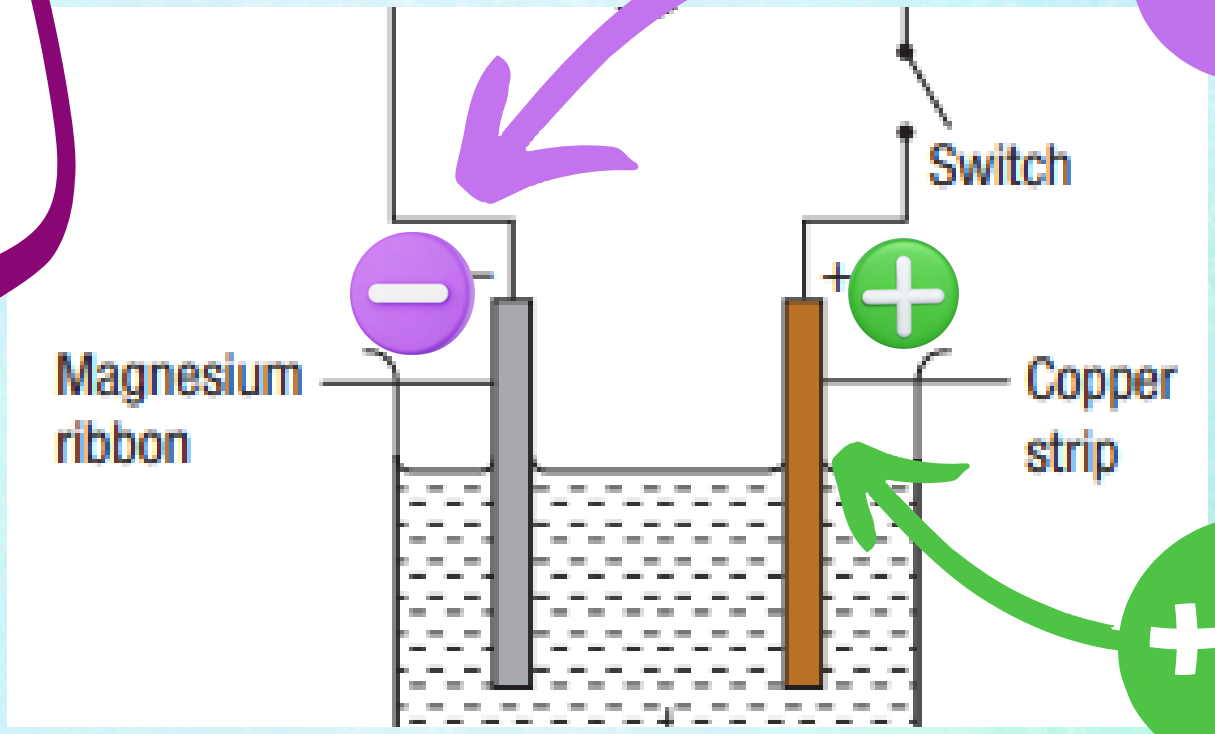


2 different metals immersed in an electrolyte & connected through the external circuit with connecting wires.

DETERMINE CHEMICAL CELL TERMINAL

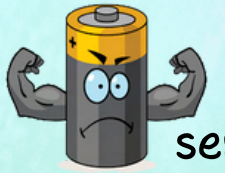
NEGATIVE TERMINAL

More electropositive metals donate electron



POSITIVE TERMINAL

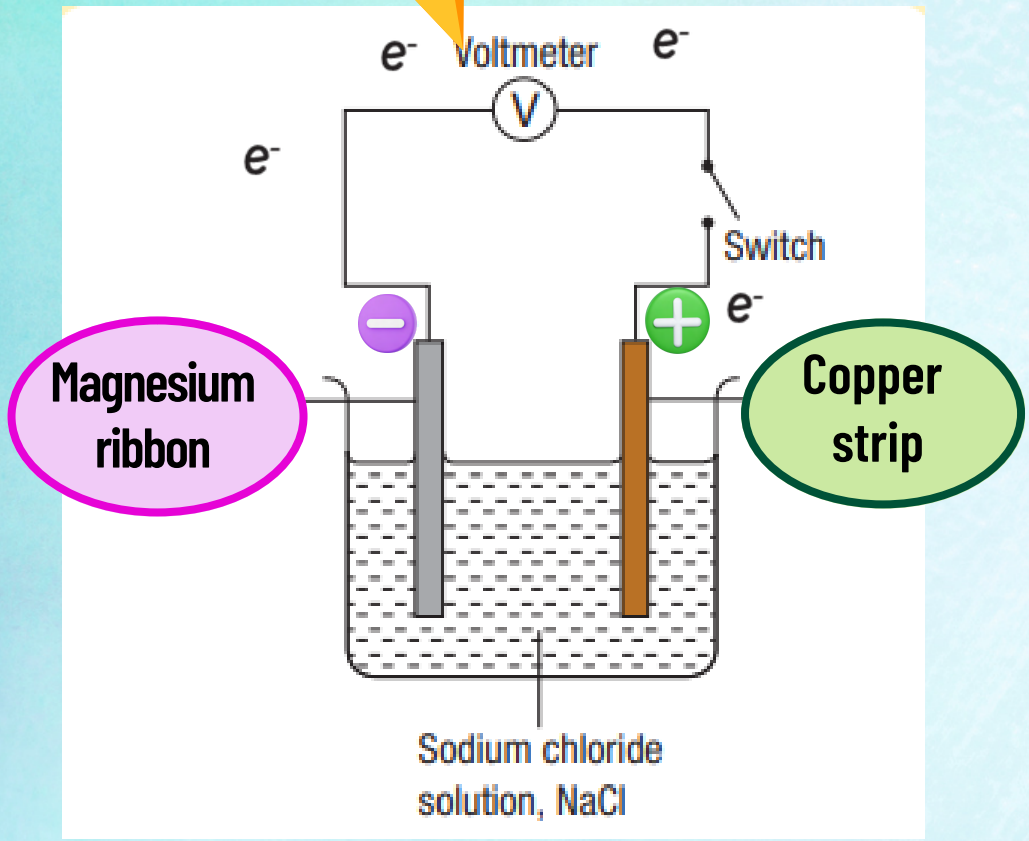
Less electropositive metals receive electron



The further apart the metal pair is in the electrochemical series, the higher the voltmeter reading/ brighter the light bulb.

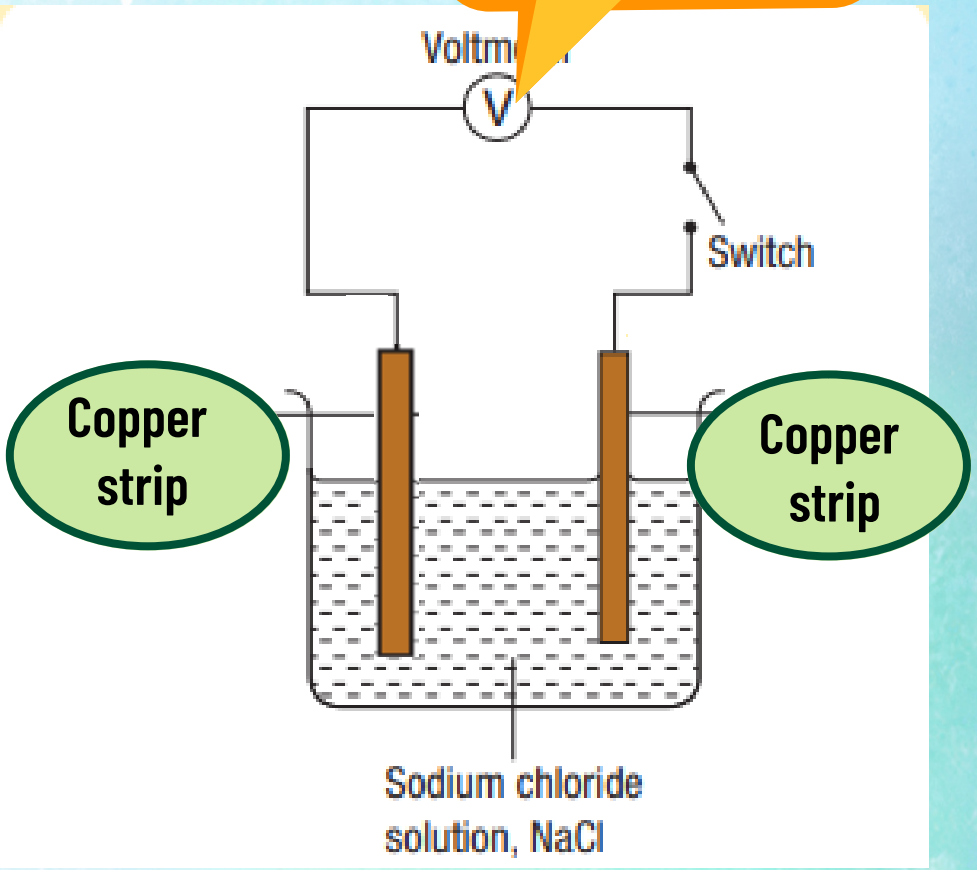
SIMPLE CELL ANALYSIS

Needle voltmeter
DEFLECTED



Electron movement takes place because the electrodes are made up of different type of metals (Magnesium-Copper).

Needle voltmeter
NOT DEFLECTED



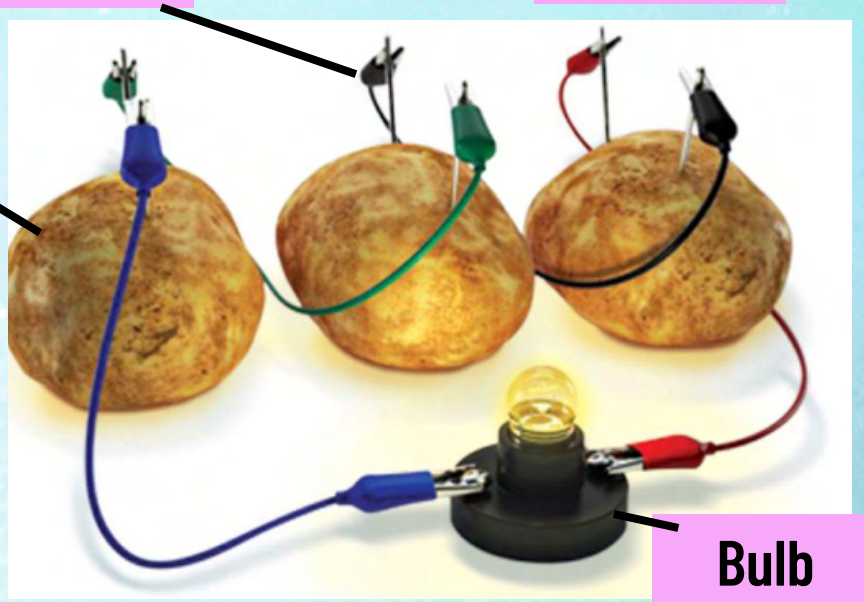
No electron movement take place as both the electrodes are from the same type of metal (Copper-Copper).

CREATE A SIMPLE CELL

You are given three potatoes, three iron nails, three copper rods, a bulb and a connecting wire with a crocodile clip. Using these materials, design a simple chemical cell with the following characteristics:

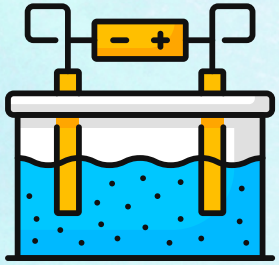
(a) a simple chemical cell that can light a bulb with maximum brightness.

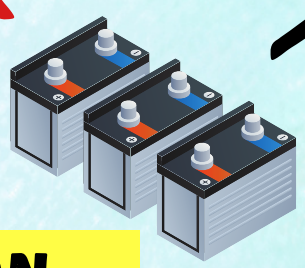
(b) a simple chemical cell that lasts the longest when lighting a bulb.



- Potatoes contain electrolyte
- Zinc rod is the negative terminal
- Iron needle is the positive terminal
- Electron moves from the zinc plate to iron nail
- Electron movement produces electric current

COMPARISON





ELECTROLYTIC CELL

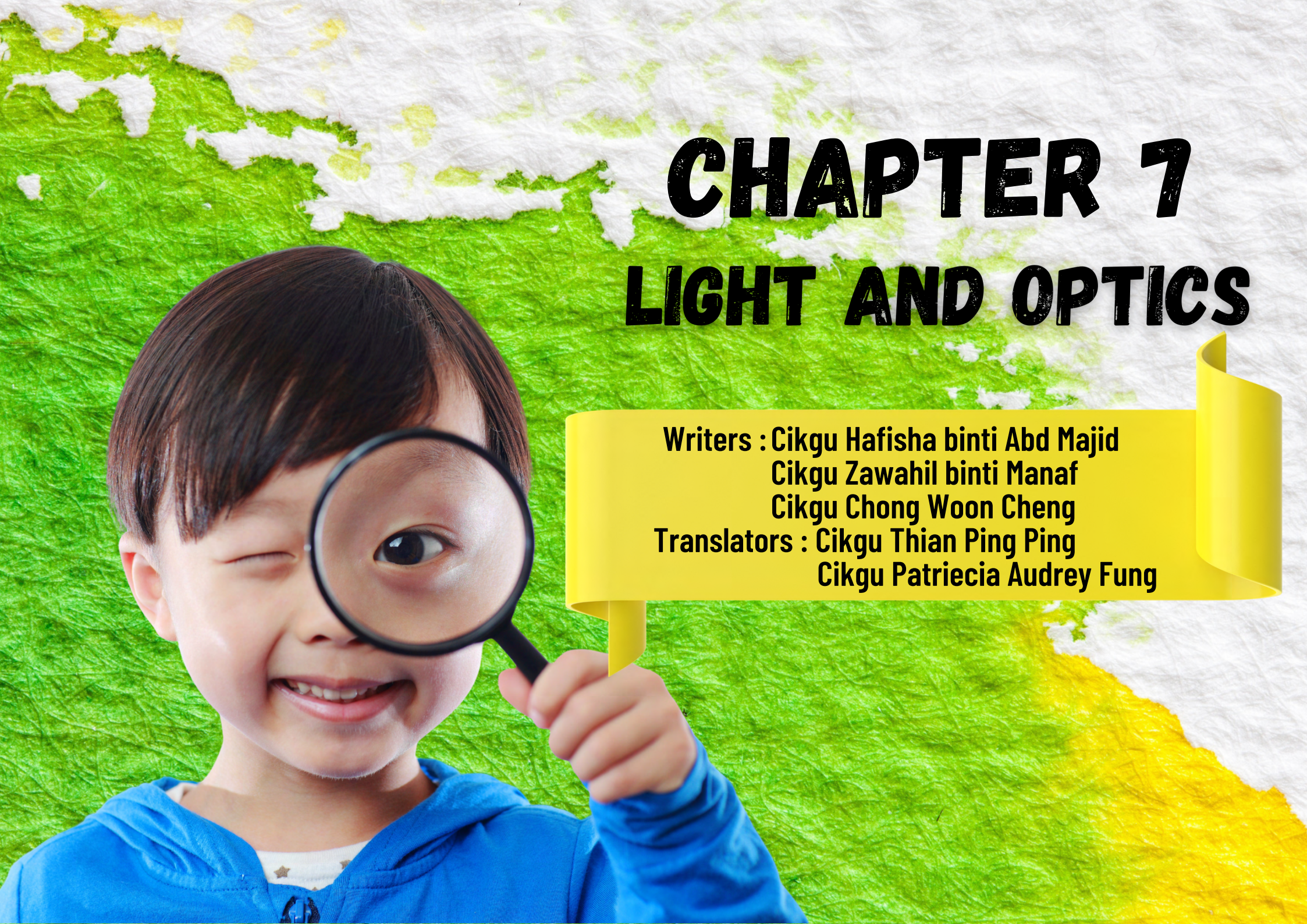
- Have electric source (Dry cell)
- 2 electrod carbon / 2 same metals
- Electrical energy change to chemical energy
- +ve terminal donates electron (ANODE)
- -ve terminal receives electron (CATHODE)
- Electron moves from +ve terminal to -ve terminal

CHEMICAL CELL

- No electric source
- 2 different metal electrodes
- Chemical energy change to electrical energy
- -ve terminal donates electron
- +ve terminal receives electron
- Electron moves from l -ve terminal to +ve terminal

Contain electrolyte

Formed by positive electrode and negative electrode



CHAPTER 7
LIGHT AND OPTICS

Writers : Cikgu Hafisha binti Abd Majid
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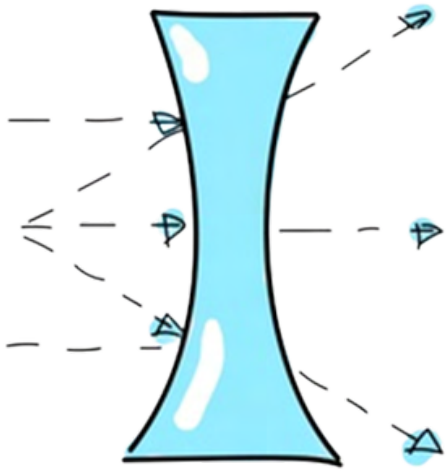
LENS

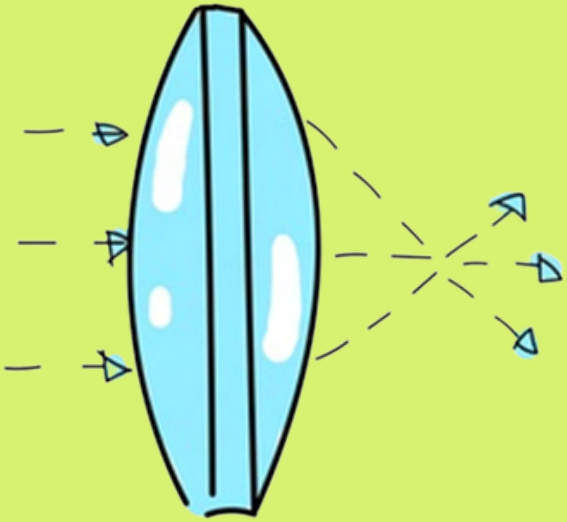
is a translucent medium like glass that has one or two curved surfaces and is divided into 2 types

CONCAVE LENS

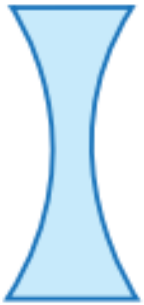


DIVERGE LIGHT

CONVEX LENS



CONVERGE LIGHT



Biconcave

Planoconcave

Concave meniscus

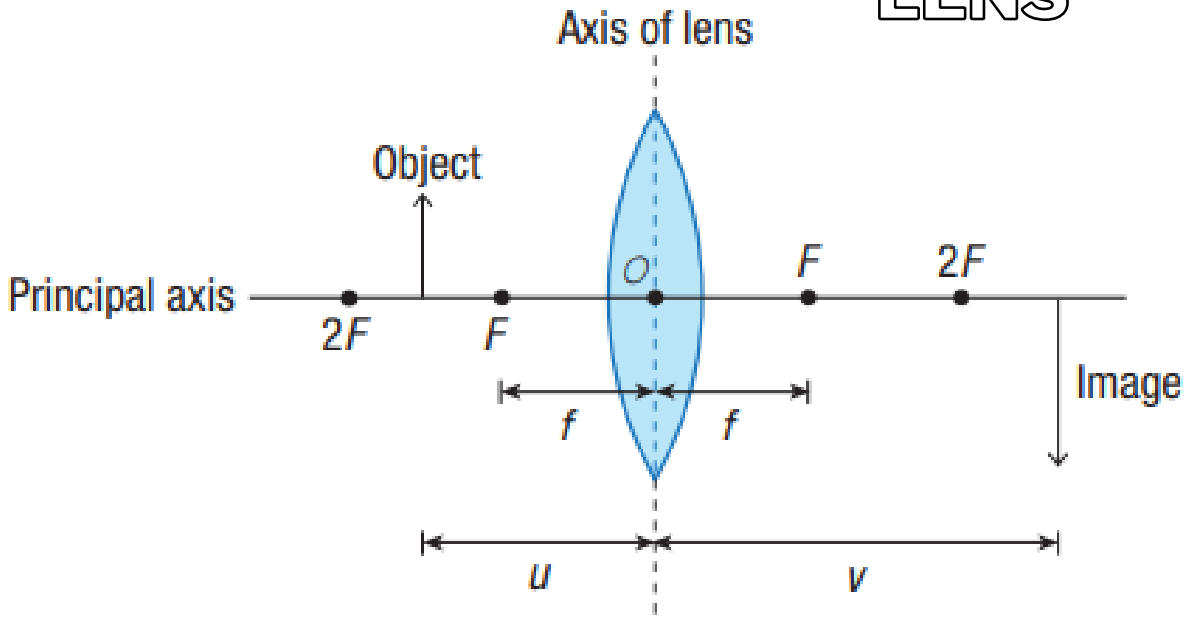
Biconvex

Planoconvex

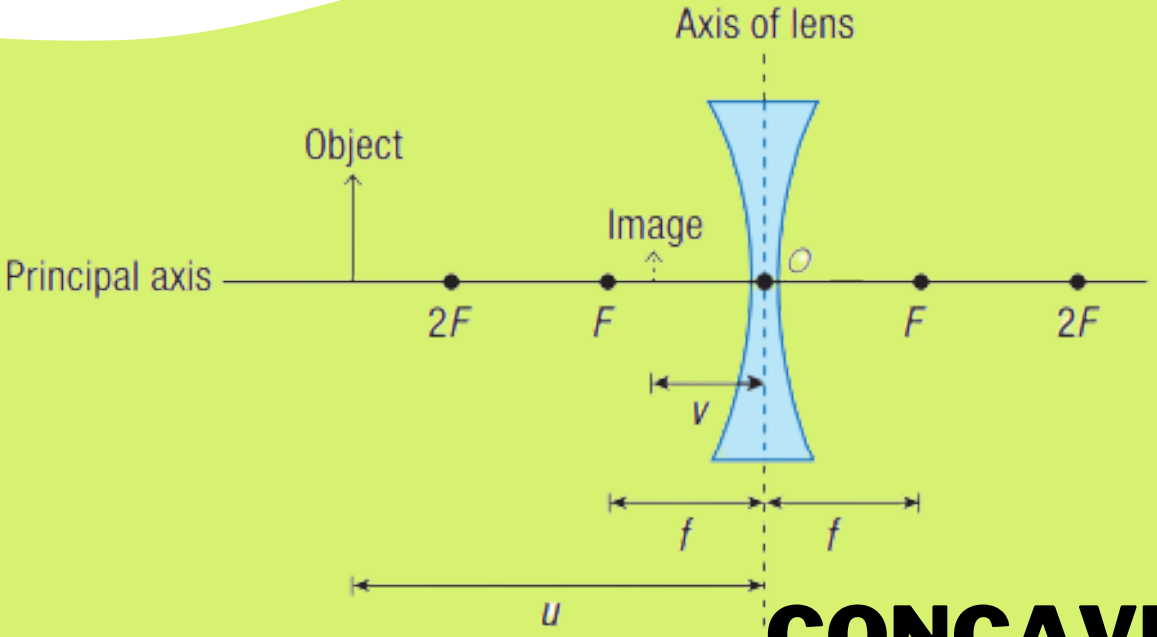
Convex meniscus

OPTICAL TERM	EXPLANATION
Optical centre, O	Point at the centre of the lens.
Principal axis	A straight line which passes through the optical centre of a lens and the focal point, F.
Axis of lens	Straight line which passes through the optical centre and is perpendicular to the principal axis.
Focal point, F	A point on the principal axis that converge or diverge light rays.
Focal length, *f*	The distance between the focal point, F and the optical centre.
Object distance, u	The distance between the object and the optical centre.
Image distance, v	The distance between the image and the optical centre.

CONVEX LENS



CONCAVE LENS

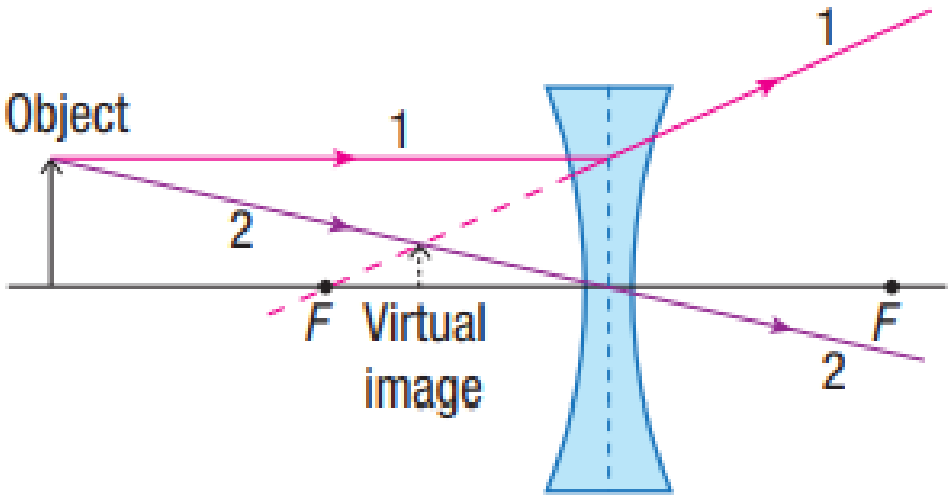


METHODS FOR DRAWING RAY DIAGRAM

CONCAVE LENS

CHARACTERISTICS OF THE IMAGE

- Virtual
- Upright
- Diminished
- Formed between the object and the concave lens

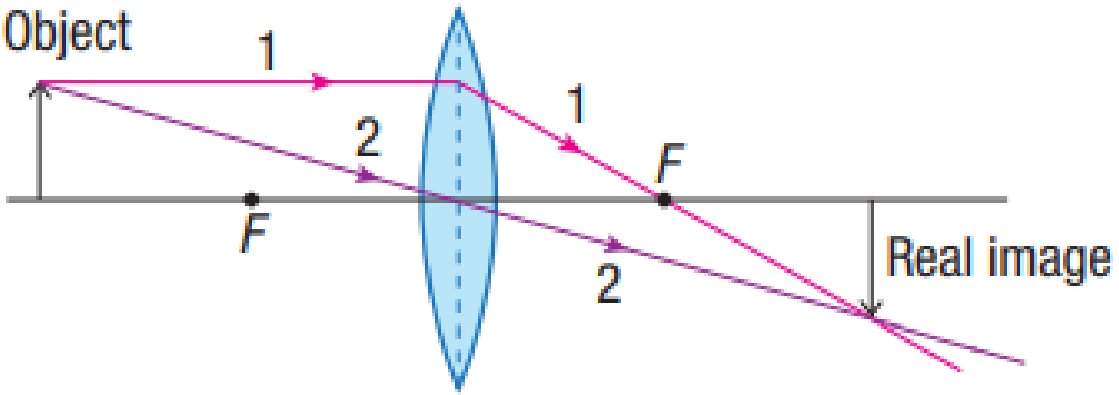


1. A ray of light traveling through the optical center, O is not refracted.
2. A ray of light parallel to the principal axis is refracted and appears to travel from the principal focus, F.
3. A ray of light moves towards the principal focus, F is refracted parallel to the principal axis.
4. The point of intersection of the light rays is a point on the image.

1. Drawing for ray diagram, convex lens/ concave lens must use RULER.
2. Must has ARROW for ray diagram, BEFORE pass through lens and AFTER it.
3. Must draw CLEAR IMAGE, at intersection of the light rays and image must have ARROW.
4. REAL image (formed after lens), drawing is DIRECT LINE.
5. VIRTUAL image (formed before lens) , drawing is DOTS LINE.

METHODS FOR DRAWING RAY DIAGRAM

CONVEX LENS



CHARACTERISTICS OF THE IMAGE

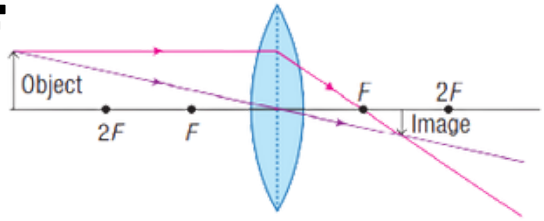
- Real
- Inverted
- Diminished

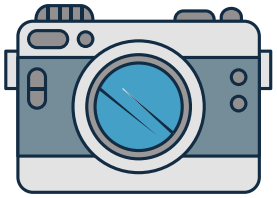
1. A ray of light traveling through the optical center is not refracted.
2. A ray of light parallel to the principal axis is refracted and travels through the principal focus, F.
3. The point of intersection of the light rays is a point on the image.

RAY DIAGRAM TO DETERMINE THE IMAGE FORMED BY CONVEX LENS

1 OBJECT IS FURTHER THAN 2F

- Real
- Inverted
- Diminished

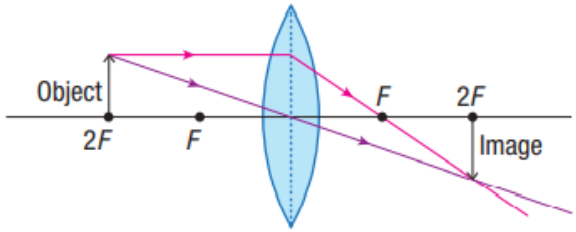




Camera

2 OBJECT IS AT 2F

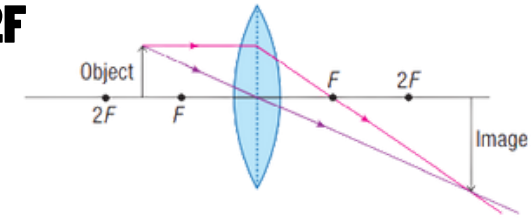
- Real
- Inverted
- Same size



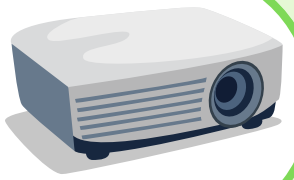
Photostate machine

3 OBJECT IS BETWEEN F AND 2F

- Real
- Inverted
- Magnified



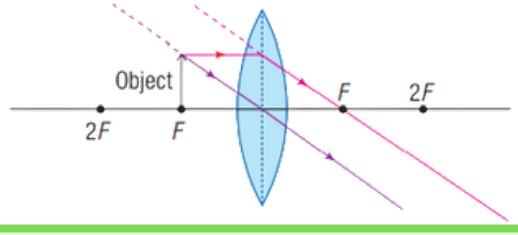
Microscope

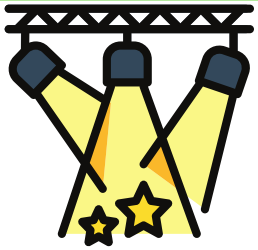


Slide projector

4 OBJECT IS AT F

- Virtual
- Upright
- Magnified
- Image is at infinity

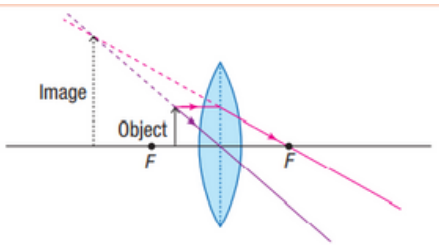




Spotlight

5 OBJECT IS BETWEEN F AND OPTICAL CENTRE

* Virtual
* Upright
* Magnified



Magnifying glass

FINAL IMAGE FORMATION OF MICROSCOPE

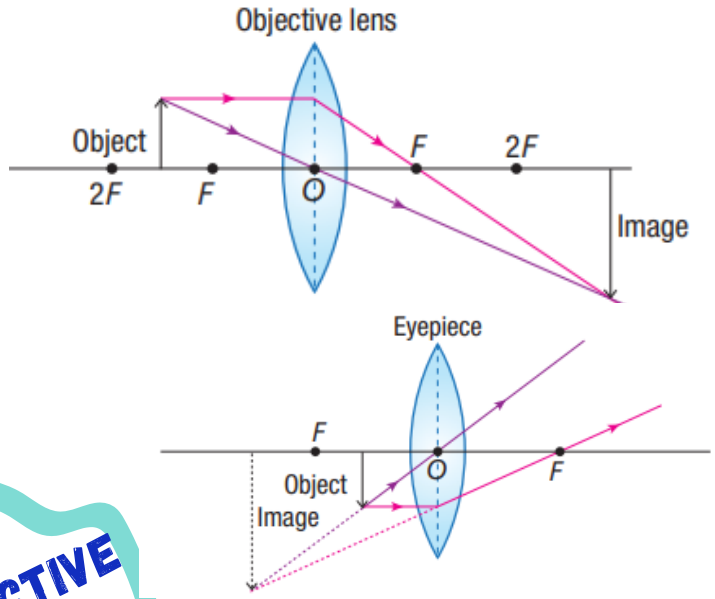


IMAGE CHARACTERISTICS : OBJECTIVE LENS

- Real
- Inverted
- Magnified

IMAGE CHARACTERISTICS : EYEPIECE

- Virtual
- Upright
- Magnified

FINAL IMAGE CHARACTERISTICS – MICROSCOPE:

- Virtual
- Inverted
- Magnified

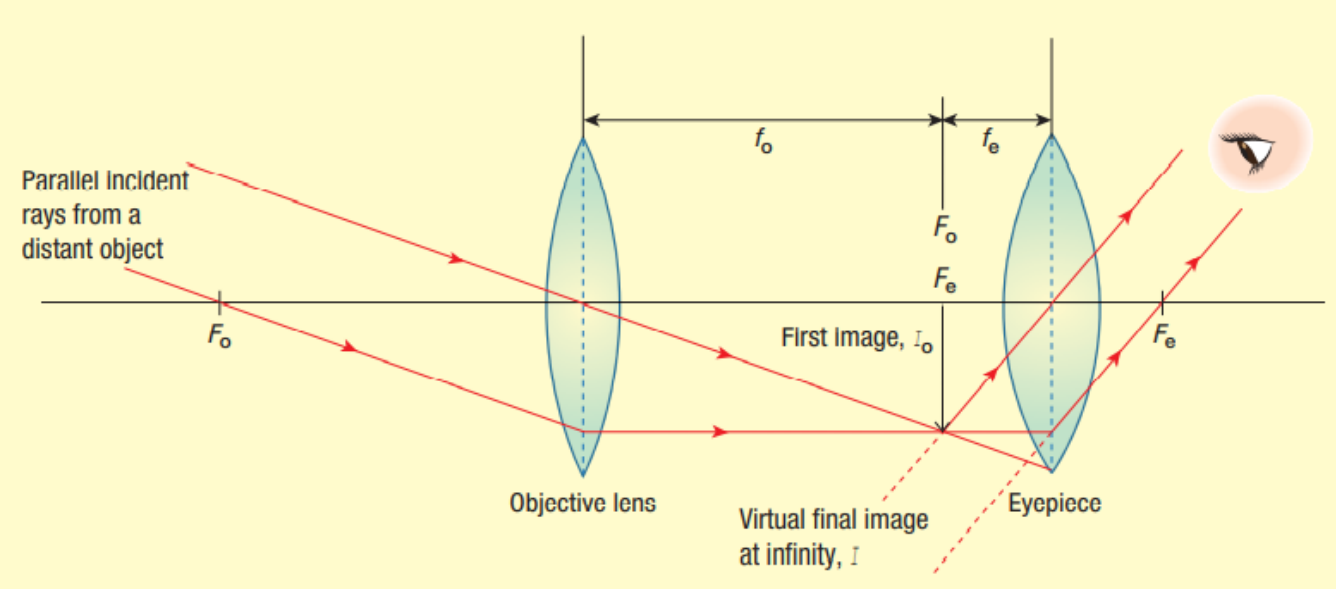
How is the image formed by the microscope?

A microscope has an objective lens and an eyepiece. The eyepiece magnifies the image formed by the object lens.

HOW TO DETERMINE MAGNIFYING POWER OF A MICROSCOPE ?

Magnifying power EYEPIECE × Magnifying power OBJECTIVE LENS

FINAL IMAGE FORMATION OF TELESCOPE



FINAL IMAGE CHARACTERISTICS – TELESCOPE

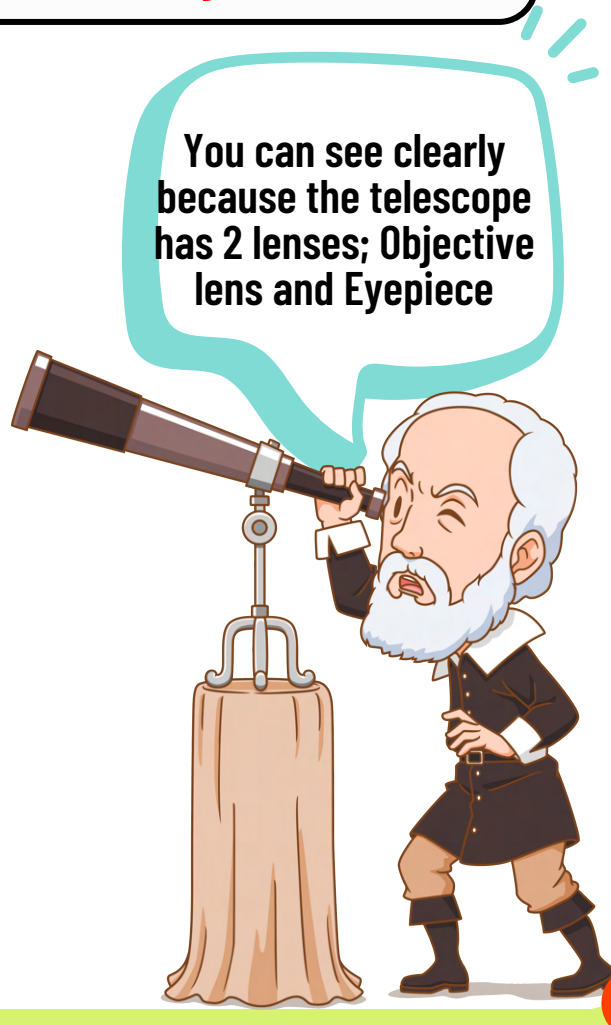
- Virtual
- Inverted
- Magnified

IMAGE CHARACTERISTICS : OBJECTIVE LENS

- Real
- Inverted
- Diminished

IMAGE CHARACTERISTIC : EYEPIECE

- Virtual
- Upright
- Magnified



APPLICATION OF LENS IN OPTICAL INSTRUMENTS

Examples of optical instrument that use lens applications

A DSLR (digital single-lens reflex) camera with two different lenses

High resolution closed circuit camera (CCTV)

Spy cameras in security devices

Technological developments in the field of optics

The thickness of the lenses in smart phones and closed circuit televisions is only a few millimeters thick

A flat lens that is only a few microns thick (1 micron = 0.001 mm)

The shorter the focal length of the lens, the wider the field of view

CHAPTER 8: FORCE & MOTION

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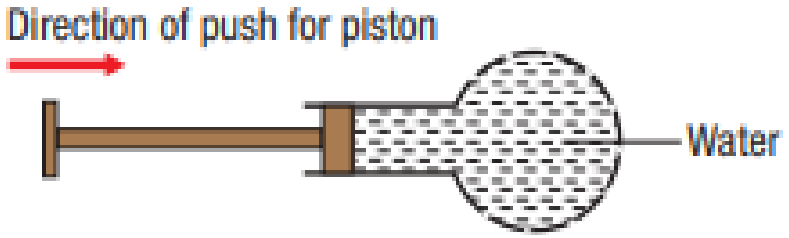
Translator : Cikgu Che Fathanah binti Che Man

Pascal's principle

The **transmission of pressure** exerted on a **fluid** (liquid or gas) in an **enclosed system** is **uniform** throughout the fluid and in **all directions**.

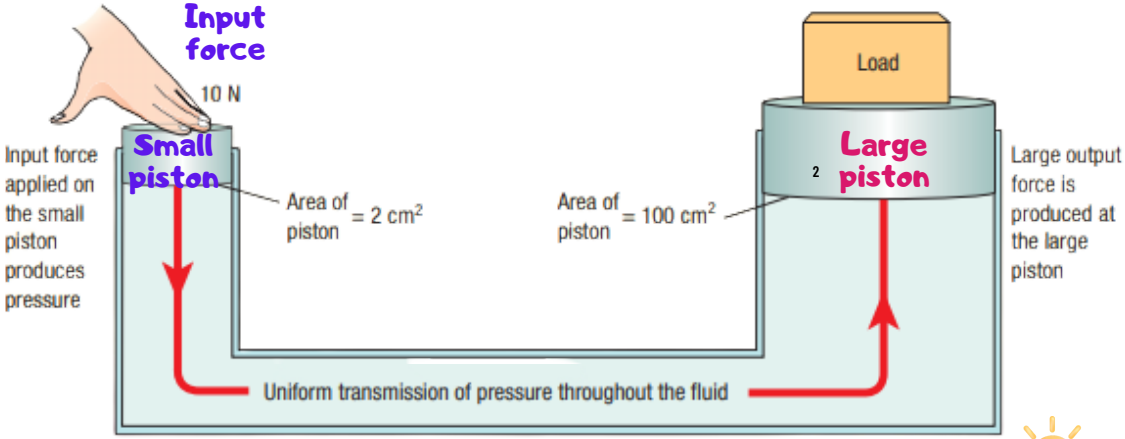
Water to shoot out through fine pores in all directions. The pressure will be transmitted uniformly in a fluid with the same magnitude.



Hydraulic system (Based on Pascal's principle)

Uses : to carry out heavy work/ to lift heavy loads

Pressure at small piston = Pressure at large piston



$$\text{Pressure at small piston} = \text{Pressure at large piston}$$

$$\frac{\text{Input force}}{\text{Area of small piston}} = \frac{\text{Output force}}{\text{Area of large piston}}$$

$$\frac{10\text{N}}{2\text{cm}^2} = \frac{\text{Output force}}{100\text{cm}^2}$$

$$\text{Output force} = \frac{10\text{N} \times 100\ \text{cm}^2}{2\text{cm}^2}$$

$$= 500\ \text{N}$$

Fluid (water/oil) is used because :
- **do not have a fixed shape**
- **cannot be compressed**

Oil is more suitable to use because:
- **can reduce friction**
- **prevent rusting**

Application of Pascal's principle in daily life

Hydraulic jack

Hydraulic brake

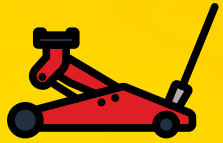
Dental chair

Excavator

Crane

Garbage truck

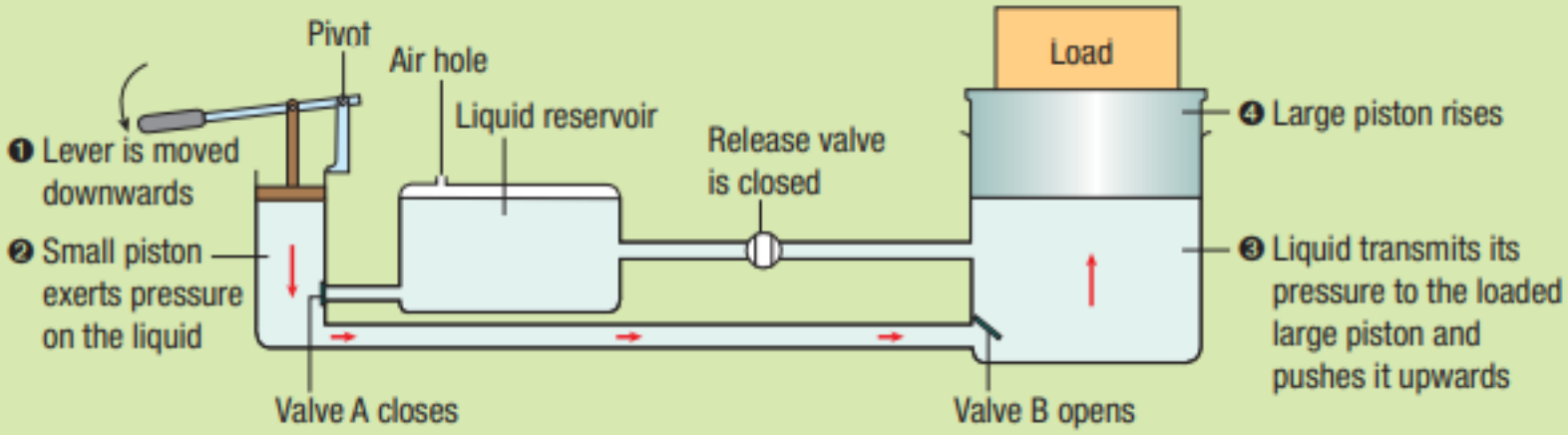
Hydraulic Jack System



To lift heavy loads such as cars in workshops.

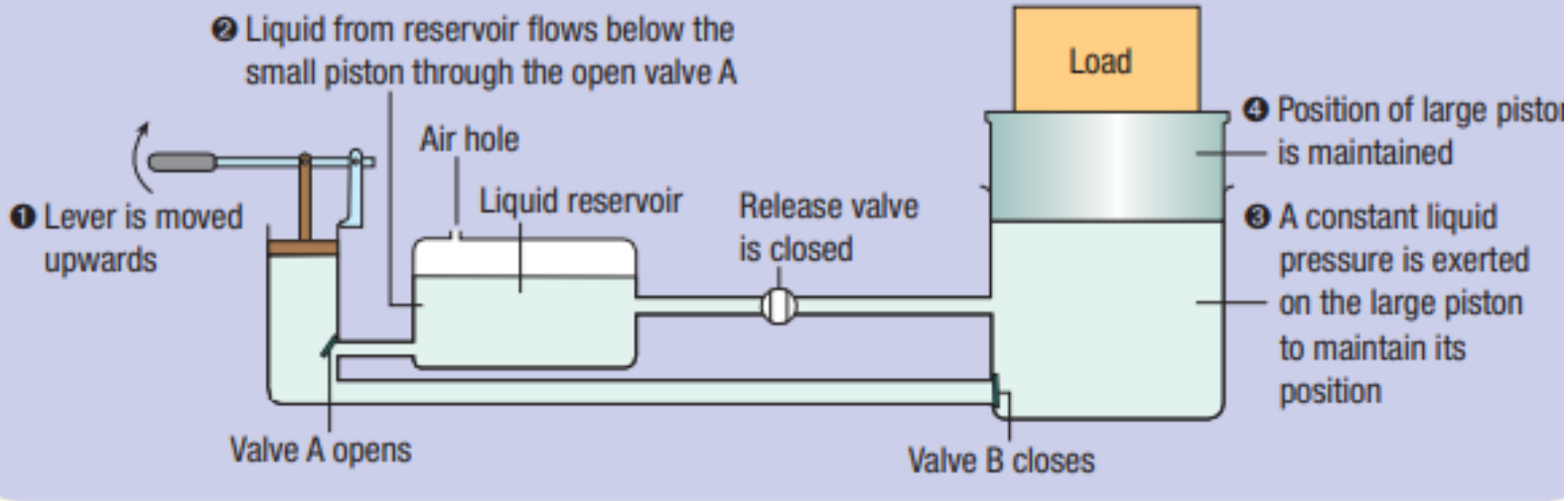
(a) Increasing the height of a loaded large piston

The lever is moved downwards with the release valve closed, valve A closes and valve B opens
(The lever is moved downwards and upwards a few times to lift the load to a desired height)



(b) Maintaining the height or the position of the large piston

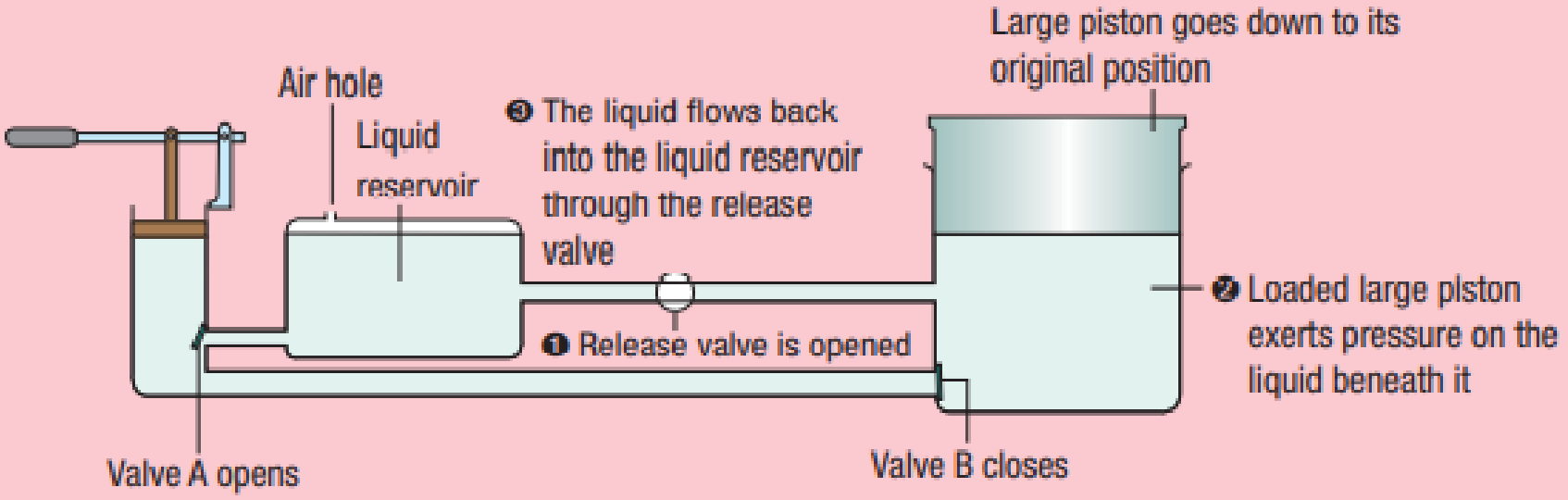
The lever is moved upwards with the release valve closed, valve A opens and valve B closes



Hydraulic Jack System

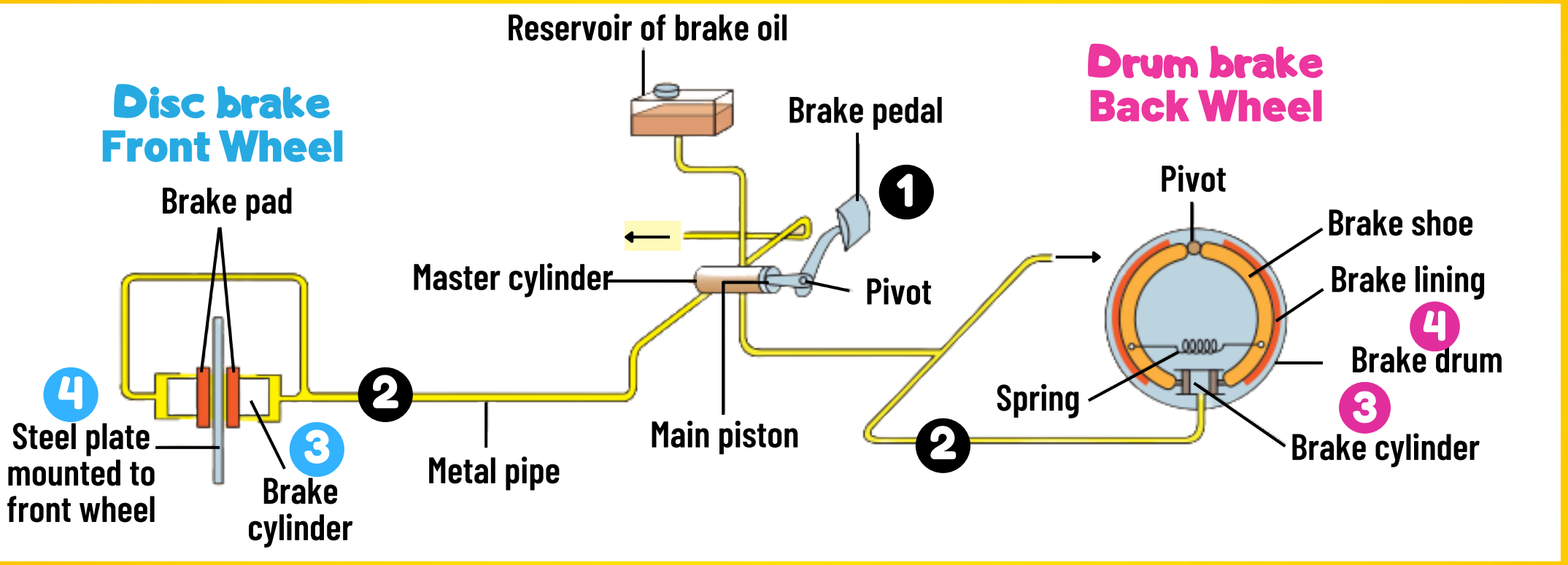
(c) Lowering the large piston back to its original position

The release valve is opened, valve A opens and valve B closes



Hydraulic Brake System

To slow down/ stop wheeled vehicles such as moving cars.



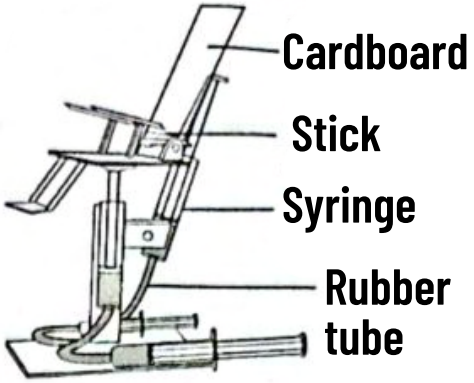
Disc brake (Front wheel)	Drum brake (Back wheel)
1 The brake pedal is pressed to push in the master cylinder piston to exert pressure on the brake oil.	
2 This pressure is transmitted uniformly by the brake oil through the metal pipes to the brake cylinders of the front & back wheels.	
3 This pressure pushes the piston in the brake cylinder which presses the brake pad onto the steel plate in the disc brake.	3 This pressure pushes the piston in the brake cylinder which presses the brake shoe onto the brake lining on the drum brake
4 The frictional force between the brake pad & the steel plate slows down/ stops the rotation of the front wheels.	4 The frictional force between the brake lining & the brake drum slows down/ stops the rotation of the back wheels.

Dental Chair

Pressure is transmitted uniformly and generate larger output force that pull the chair up.

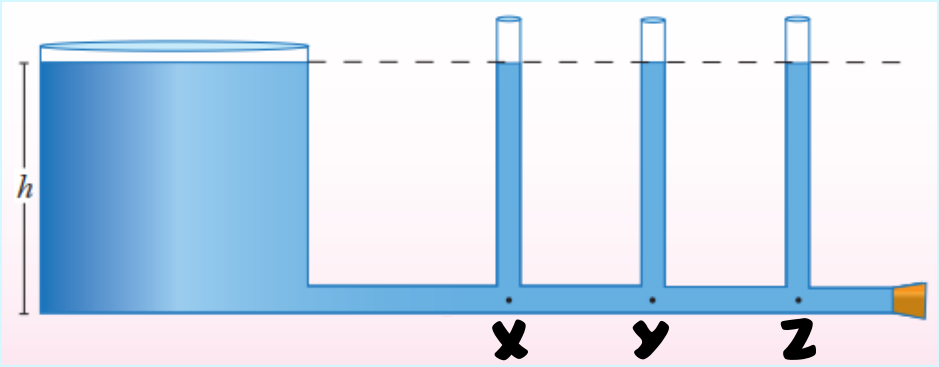
<u>Smaller input force is exerted</u> when the pedal is pressed that <u>produce pressure on the oil in the cylinder.</u>

Create/Design Question



Bernoulli's principle

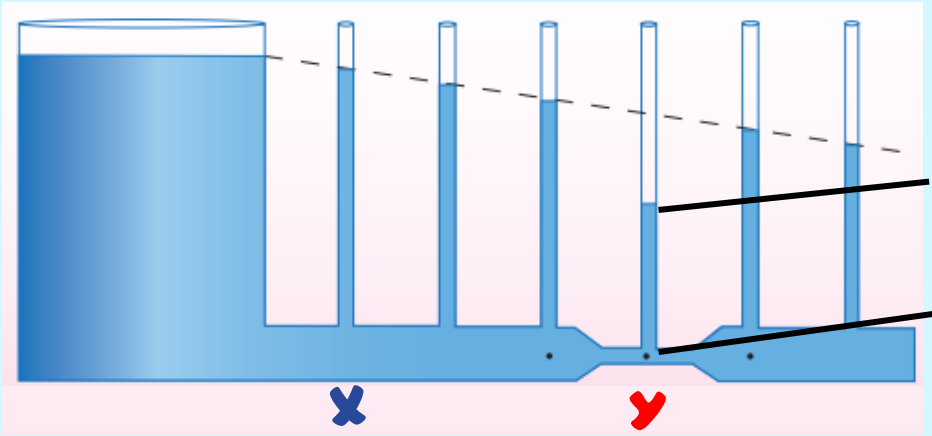
When the fluids flow through **the narrow part**, its **velocity increases** & **pressure decreases.**



In enclosed tube,

- **the fluid is not flowing**
- zero velocity
- **same pressure at X, Y and Z**
- same level of fluid

Venturi Tube - Non-uniform tube with a narrower centre.



The lowest level of water

higher velocity, lower pressure

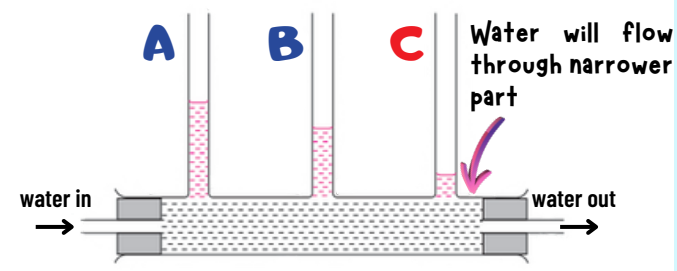
At narrower tube, Y :

- **highest velocity**
- **lowest pressure**
- lowest water level

known as **Venturi effect**

At tube , X :

- **lowest velocity**
- **highest pressure**
- highest water level

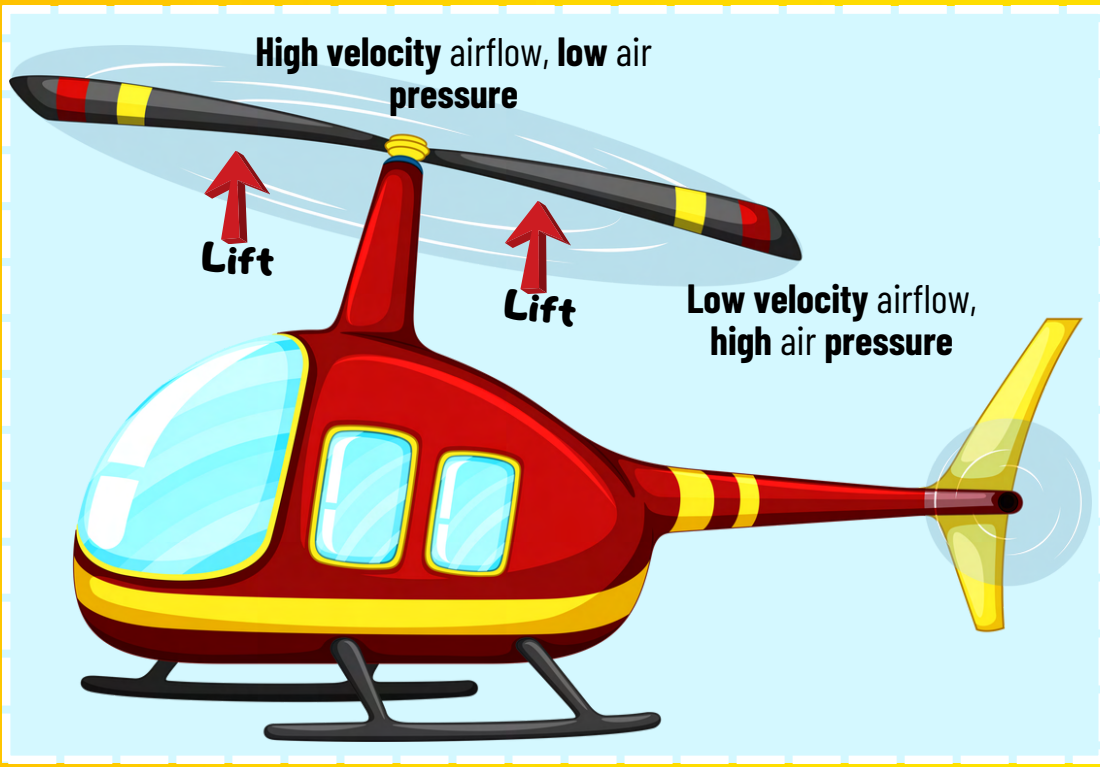


At tube, C :

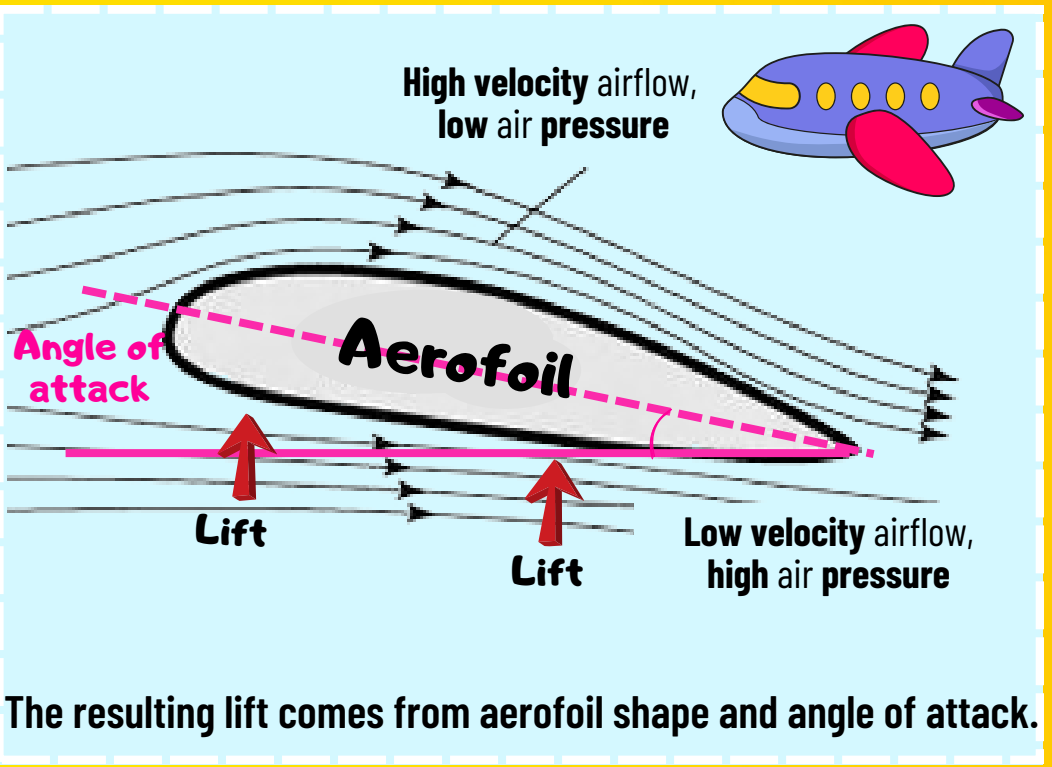
- **highest velocity**
- **lowest pressure**
- lowest water level

Application of Bernoulli's principle in daily life

Helicopter

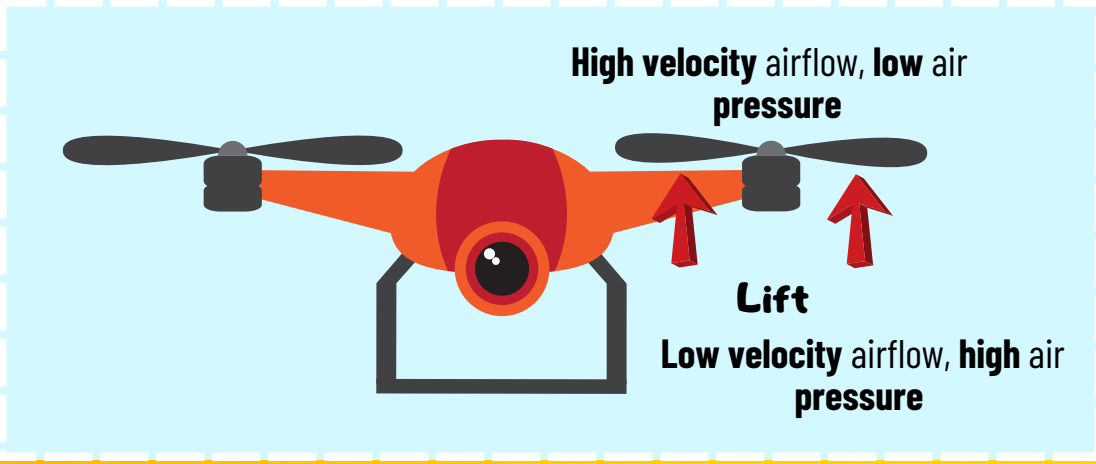


Aerofoil-shaped wings of an aeroplane

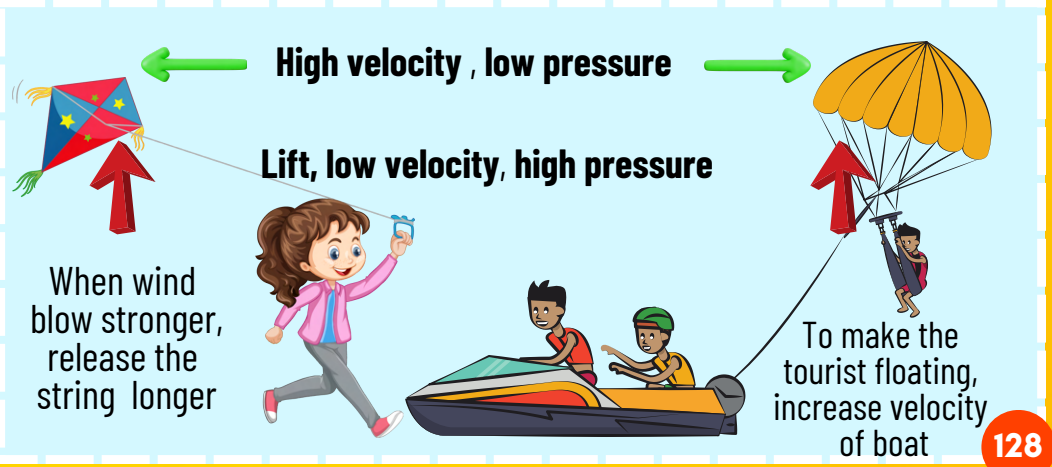


The resulting lift comes from aerofoil shape and angle of attack.

Drone

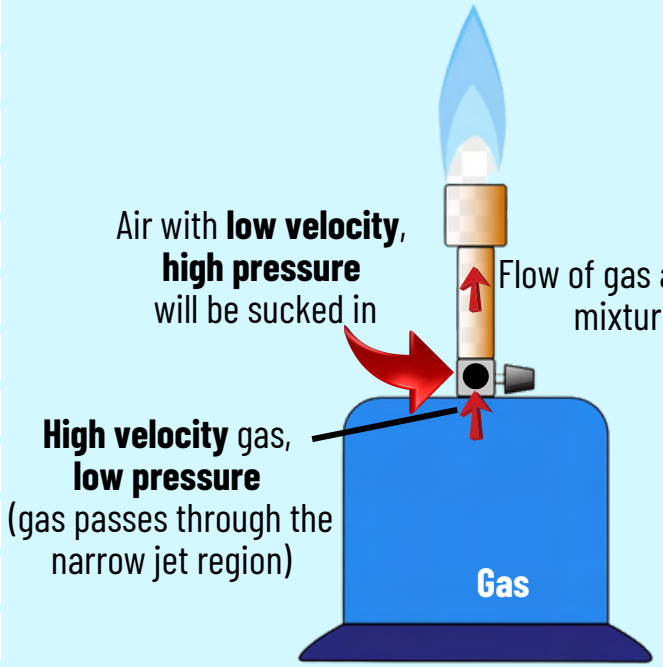


Kite and Parasailing

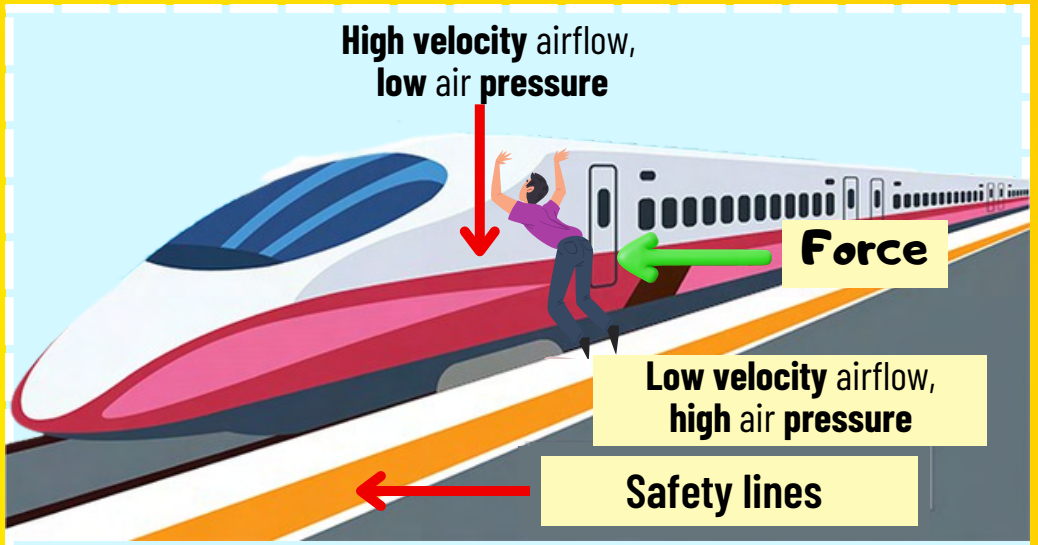


Application of Bernoulli's principle in daily life

Bunsen burner

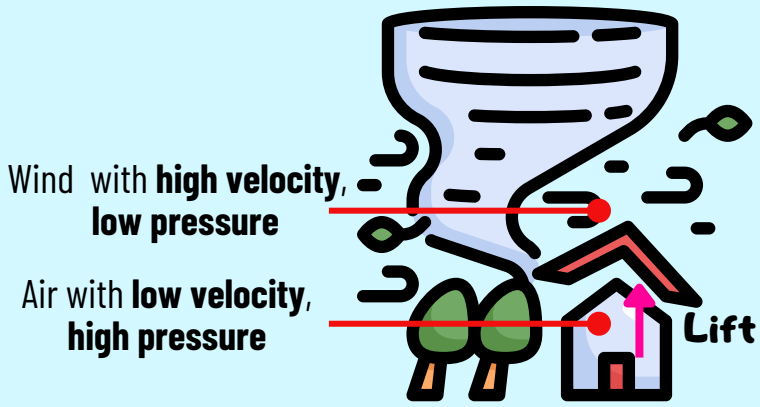


Safety lines near railway tracks at a railway station



Airflow has high velocity, low pressure exists between the fast moving train and the man standing near it. If the man standing over safety lines, he will be pushed by the force towards the speed train.

Storm blow off roofs

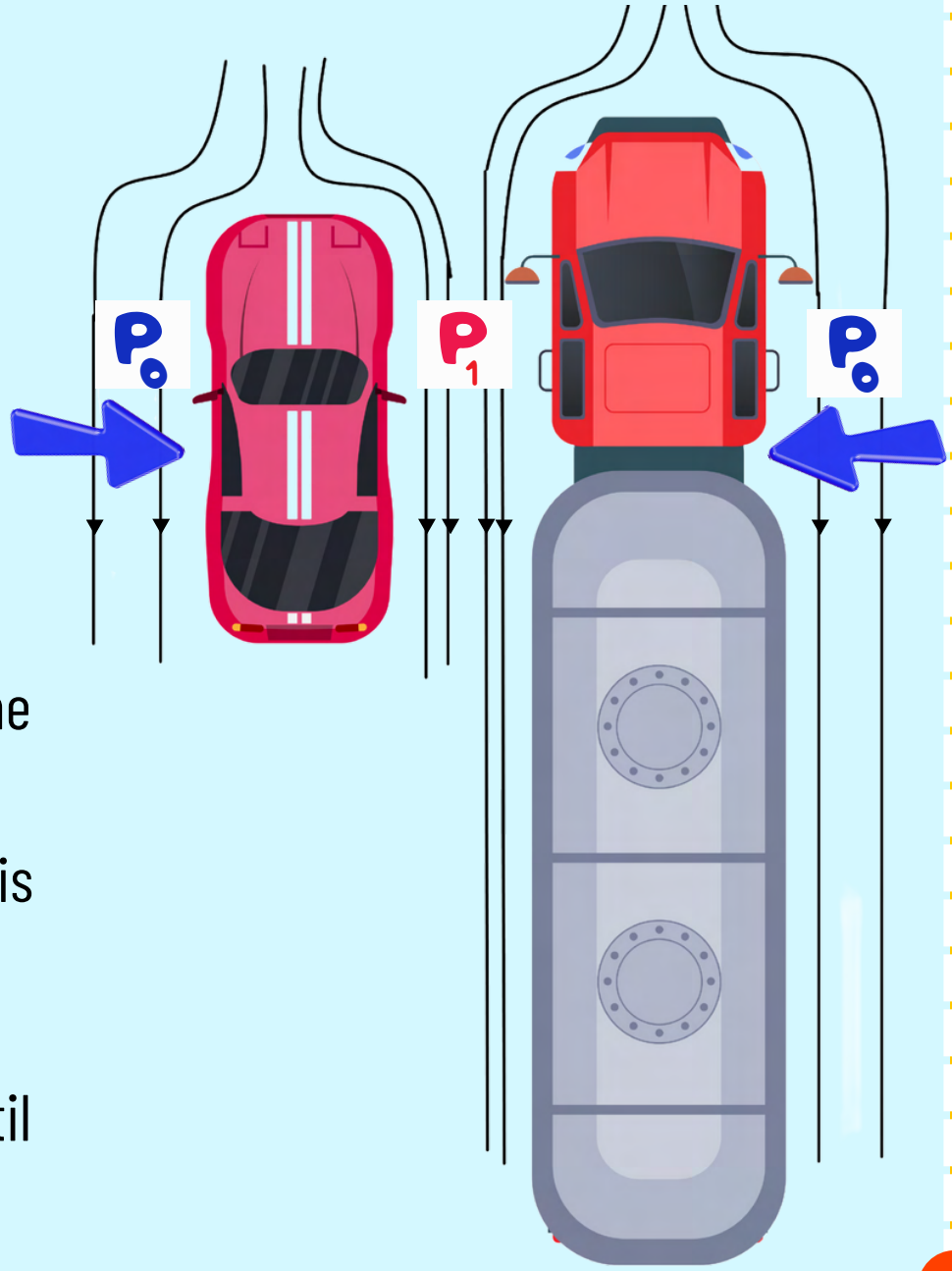


Suggestion:

- **Nail the roof.**
- **Build a roof at the steepness of 30° to reduce the resistant of wind.**

Example questions for Application of Bernoulli's principle

The diagram shows two vehicles move in same velocity and produced different pressure P_0 dan P_1.



(a) Which pressure is **lower** ?

P_1

(b) Explain your answer ?

Based on **Bernoulli's principle**, when air flow through **narrow area** (between two vehicles), the **velocity increase** and **pressure**, P_1 **decrease.**

(c) Why the situation of two vehicles as in diagram is dangerous?

Pressure, P_0 **is higher** than P_1 causes both of **vehicles pushed approaching** each other until **collide**.

CHAPTER 9 : SPACE TECHNOLOGY

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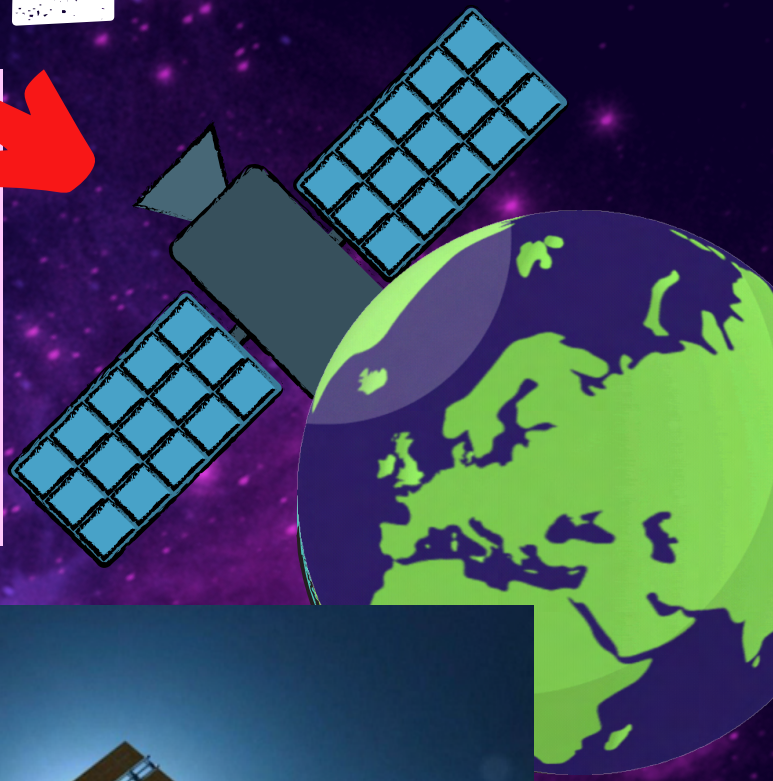
SATELLITE

SATELLITE

Object which orbits planets or stars.



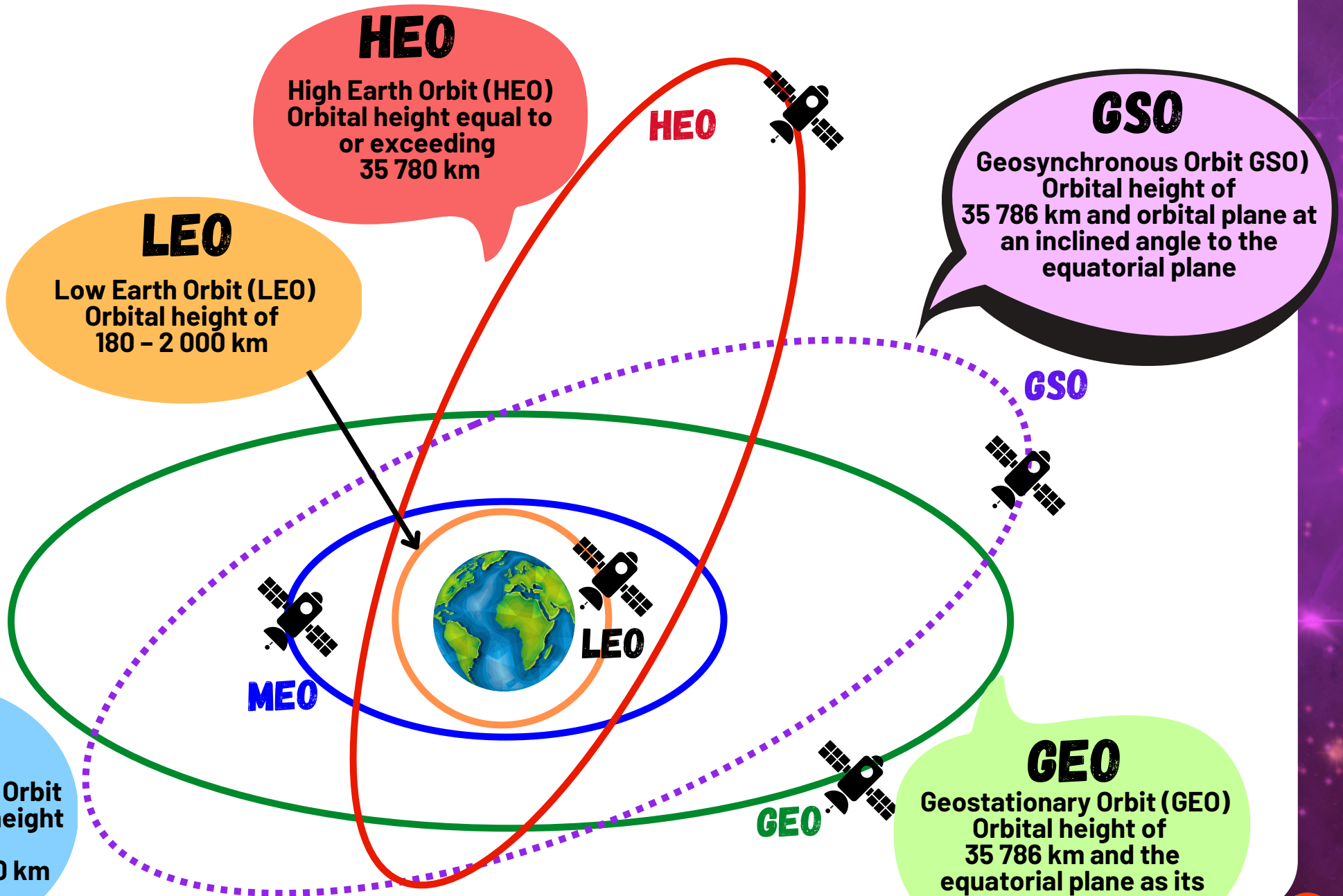
NATURAL SATELLITE

Moon is a natural satellite which orbits Earth.

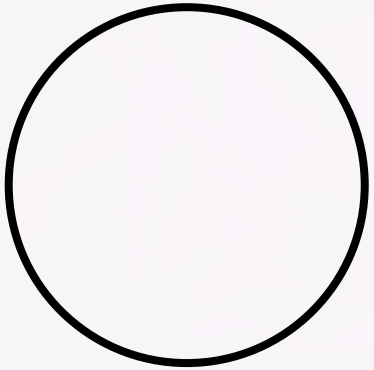
MAN-MADE SATELLITE

TYPES OF SATELLITE ORBITS

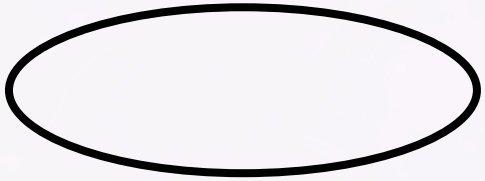
grouped according to orbital height (altitude)



ORBITAL SHAPES



PERFECTLY CIRCULAR-ORBIT
ORBIT GEO

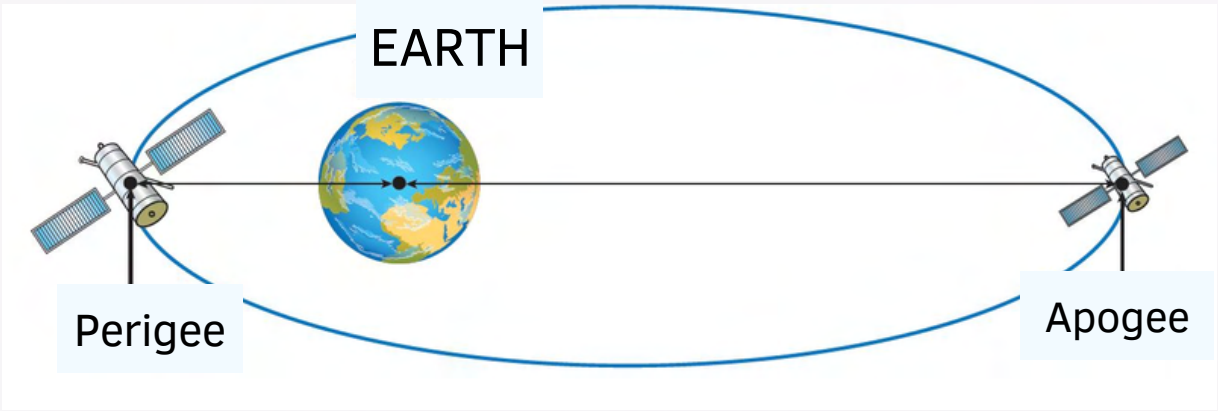


ELLIPTICAL-ORBIT
ORBIT MEO & HEO

LEO and GSO :
perfectly circular OR
elliptical

APOGEE AND PERIGEE OF A SATELLITE IN AN ELLIPTICAL ORBIT

PERIGEE
the **position** of the satellite which is **nearest** to the planets or stars encircled by the satellite.

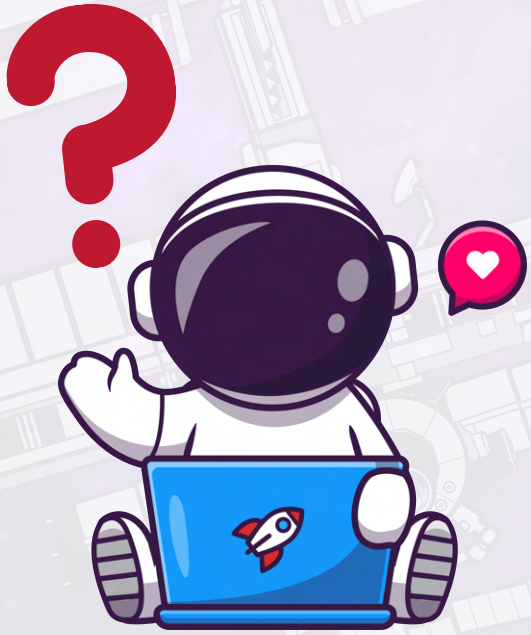


APOGEE
the **position** of the satellite which is **furthest** from planets or stars encircled by the satellite.

RELATIONSHIP BETWEEN ORBITAL HEIGHT AND SATELLITE VELOCITY

DO YOU KNOW ?

The higher the orbital height of a satellite, the lower the satellite speed for it to remain in orbit.



WHY ?

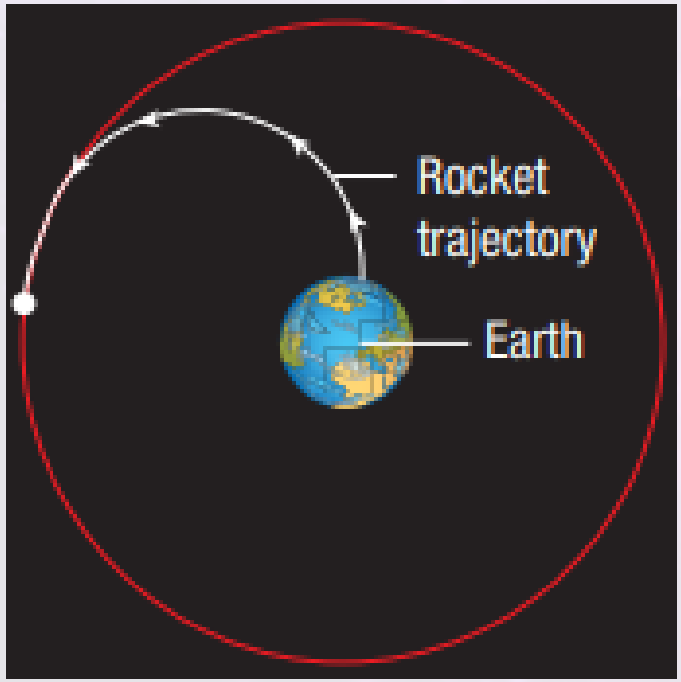
The gravitational force on a satellite decreases when the orbital height of the satellite increases.

LAUNCH AND PLACEMENT OF SATELLITE INTO ORBIT

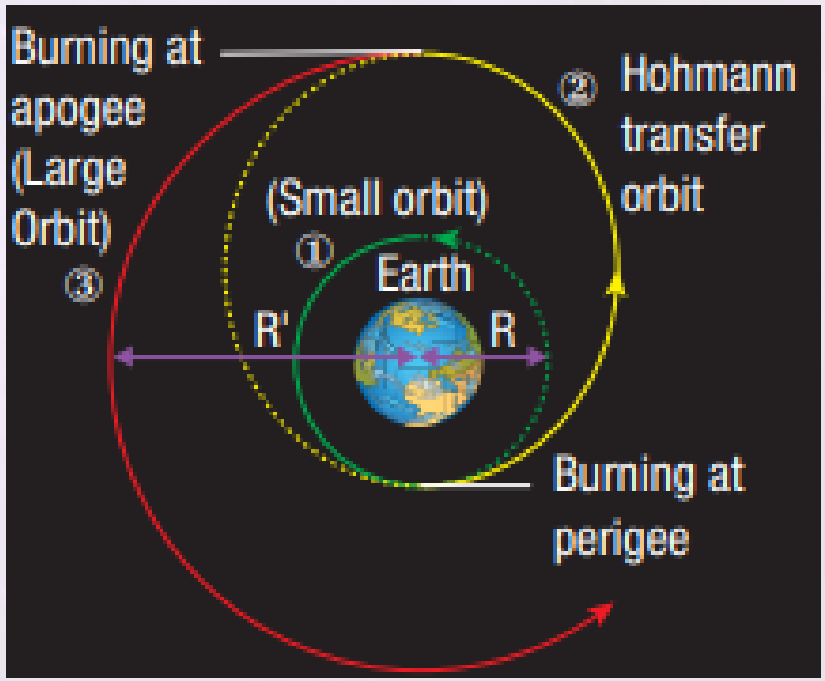
DO YOU KNOW ?

Satellite is launched and placed into orbit directly OR through Hohmann transfer orbit.

Direct launch into orbit through rocket trajectory

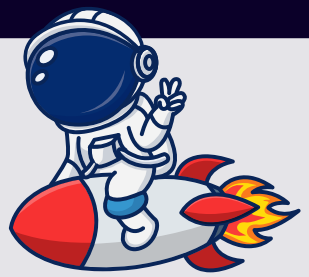


Satellite is launched and placed into orbit directly OR through Hohmann transfer orbit.



Hohmann transfer orbit : -

- to launch satellites into high elliptical orbits.
- uses the least amount of energy in its journey from one orbit to a higher orbit.

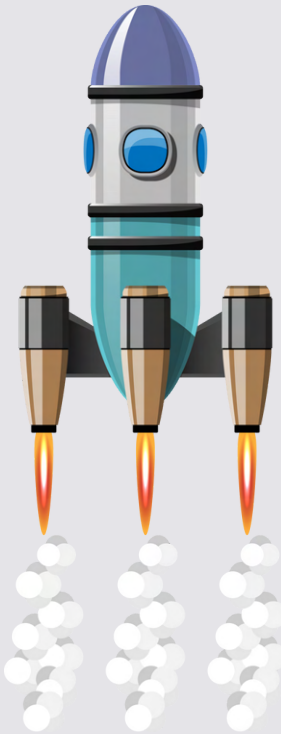


LAUNCH AND PLACEMENT OF SATELLITE INTO ORBIT

2 types of launch vehicles

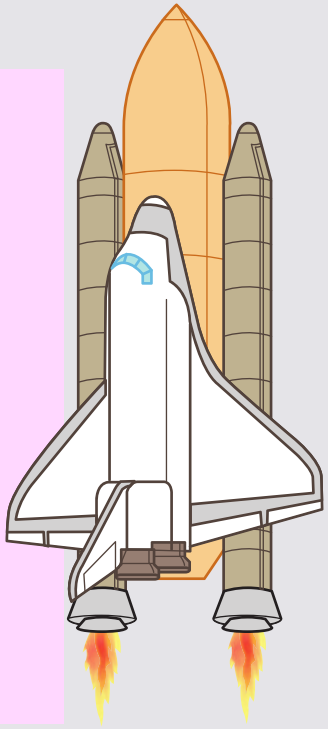
Launch vehicles that are only used once (expandable launch vehicle - ELV)

Consist of several rockets stages that are discarded sequentially as their fuel exhausted and the vehicle gains altitude and speed.



Launch vehicle reusable (reusable launch vehicle - RLV)

Contains vehicle stages that may be recovered by a launch operator for future use in the operation of a substantially similar launch vehicle.



SIMILARITIES AND DIFFERENCES BETWEEN ELV AND RLV

SIMILARITIES

- Use rocket to launch to the space
- To launch satellite
- To bring astronauts

DIFFERENCES

ELV

- Only used once
- Lower launch costs
- The risk of mission failure is lower
- Not able to move between planets
- Example : Rocket

RLV

- Reusable
- Higher launch costs
- The risk of mission failure is higher
- Able to move between planets
- Example : Spaceship

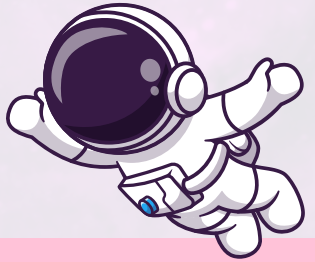
FUNCTION OF INTERNATIONAL SPACE STATION (ISS)

Involve five space agencies :

- NASA (America)
- ROSCOSMOS (Russia)
- JAXA (Japan)
- ESA (Europe)
- CSA(Canada)

International Space Station (ISS):

- Space station in Low Earth Orbit, LEO
- Orbits the Earth every 90 minutes.
- Astronauts on the ISS are floating because there is zero gravity on the ISS.



Dato' Dr Sheikh Muszaphar Shukor Al Masrie bin Sheikh Mustapha (are Malaysians who first arrived at the ISS).

Function of ISS:

- Provide place for the astronaut crew in space.
- Provide place in space to allow astronauts to conduct scientific research while in space.

ZERO GRAVITY

The condition where no significant gravitational force effect is felt.

Participants of indoor skydiving will float in air and feel a condition of zero gravity.

WHY?

This condition occurs because the thrust produced by a very strong flow of air upwards on the participants is equal in value to their weight but in the opposite direction

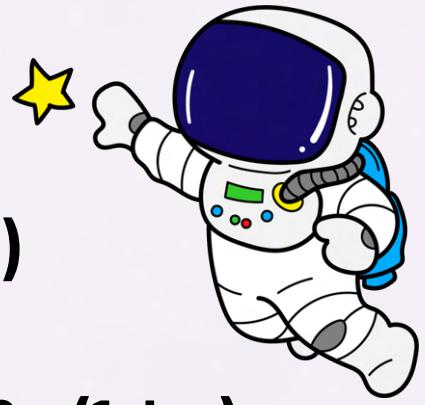
WEIGHT = UPTHRUST = NO SIGNIFICANT EFFECTS OF GRAVITY

METHODS FOR TRACKING SPACE STATIONS

The frequency of the ISS orbiting Earth in a day can be calculated by using its orbital height and speed.

1 Period of orbit, $T = \frac{\text{Length of orbit}}{\text{Speed of satellite}}$

$= 2\pi \times \frac{(\text{Orbital height} + \text{Radius of Earth})}{\text{Speed of satellite}}$

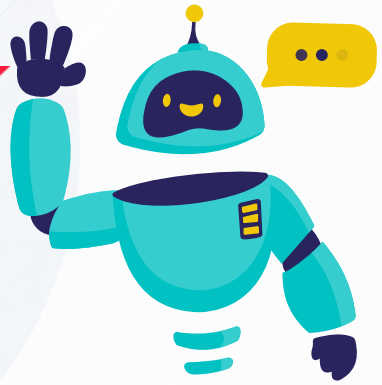


2 Frequency of the ISS orbiting Earth in a day $= \frac{86\,400 \text{ s (1 day)}}{\text{Period of orbit, T}}$

TRACKING THE POSITION OF SPACE STATIONS USING SMARTPHONE APPLICATIONS

Download the applications such as *ISS Detector*, *ISS Finder*, *ISS Spotter*, *GoISSWatch* or RunaR in samrtphone to trace the position of Space Stations.

EXAMPLE



Radius of Earth = 6 378 000 m
Orbital height = 1 882 000 m
Speed of satellite = 2400 m/s
π = 3.142

$$\text{Period of orbit (T)} = \frac{2 \times 3.142 \times (1\,882\,000 + 6\,378\,000)}{2400}$$

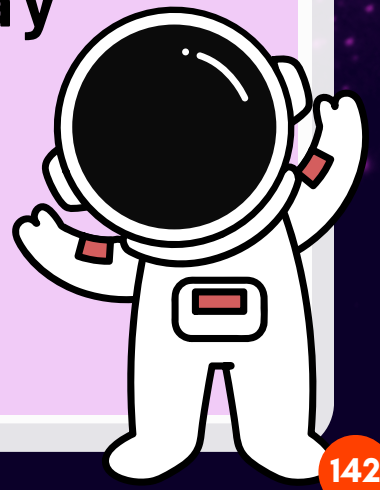
$$= 21\,627 \text{ s}$$

Frequency of the ISS orbiting Earth in a day

$$= \frac{86\,400 \text{ s}}{21\,627 \text{ s}}$$

$$= 3.995$$

~ 4 times in a day



IMPACT OF RAPID DEVELOPMENT IN SPACE TECHNOLOGY

DISADVANTAGES

Increase waste in space (space junk).

- The more space junk is the higher the risk of collision of satellites with space junk.

Example : Weather satellite, GOES, usually change its orbit several times to avoid collision with space junk.

ADVANTAGES

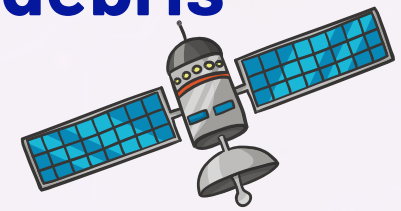
Increase in research and development activities in various fields such as:

- Human health
- Response towards climate change and disasters
- New innovative technology
- Global education
- Development in space economy

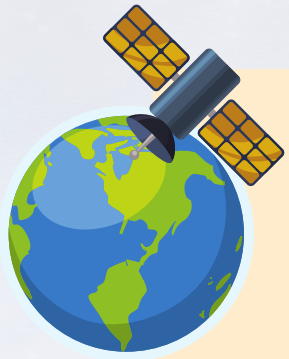
EXAMPLES OF SPACE JUNK

1. Used parts of ELV
2. Non-functioning spaceship

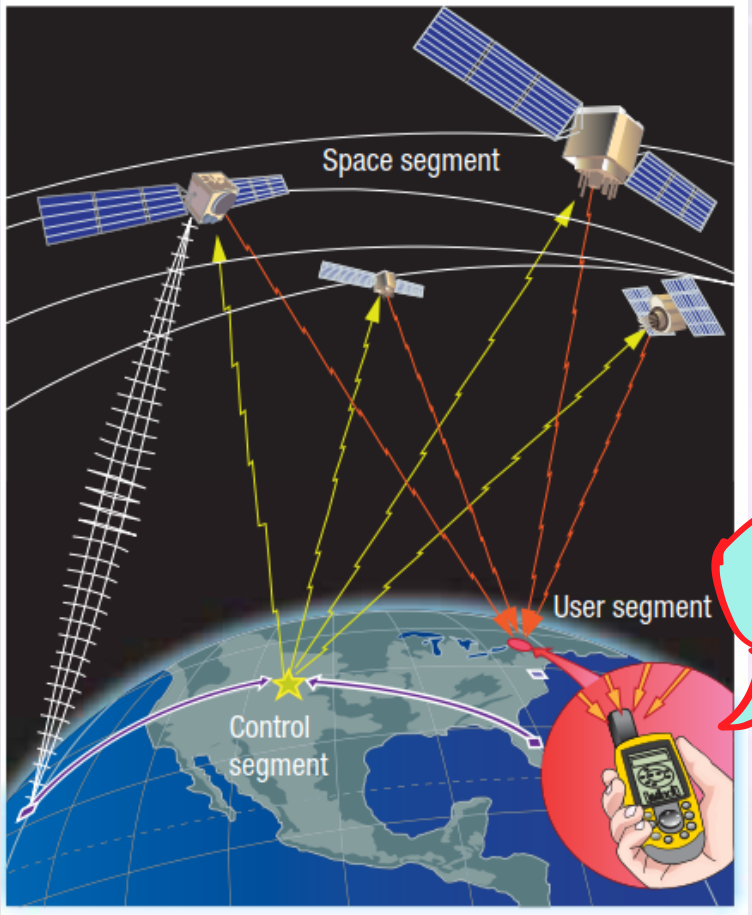
3. Exhausted rockets
4. Non-functioning satellites
5. Satellite debris



WHAT IS GPS?



Global Positioning System (GPS) is a navigation system which gives information on location and time to its users in all weather conditions.



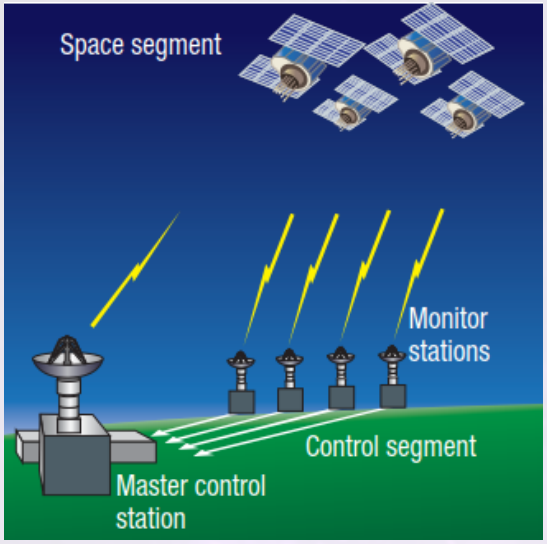
GPS is made up of <u>three segments:</u>

- **control segment**
- **space segment**
- **user segment**

How many GPS satellites ?

At least 4 GPS satellites can be seen from the horizontal axis at any time from all locations on Earth.

CONTROL SEGMENT



Made up of :

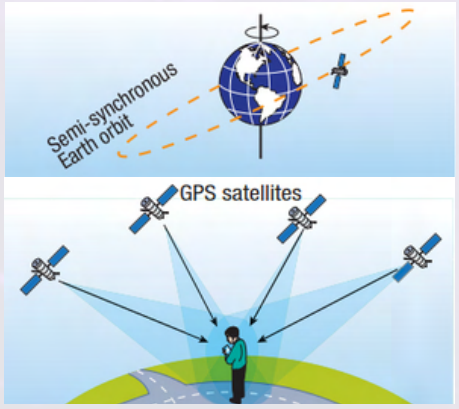
- master control station
- alternative master control station
- command and control antennas
- monitor stations

Signals received from the GPS satellite are sent to the master control station which will generate navigation messages on Earth.

The information sent from the antenna on Earth to the GPS satellite includes

- GPS satellite position
- time correction factor for the GPS satellite clock
- atmospheric data
- almanac

SPACE SEGMENT



GPS satellites orbit Earth at an orbital height of 20 000 km. The orbit of a GPS satellite is usually known as a semi-synchronous Earth orbit.

At least 4 GPS satellites can be seen at an angle of 15^{o} or more from the horizontal axis at any time from all locations on Earth.

USER SEGMENT

5°26'25"N 100°18'32"E
Georgetown, Pulau Pinang

A GPS user is anyone who uses a GPS receiving device such as a smartphone .

Location of a place can be written in two formats, Degrees, minutes and seconds (DMS) or Decimal degree (DD).

EXAMPLE OF WRITING IN FORMAT DMS & DD

GPS coordinate:

(a) National Planetarium, Kuala Lumpur

DMS format coordinates : 3°08'22.04"N (Latitude) 101°41'22.53"E (Longitude)
DD format coordinates : 3.139456 101.689593

Positive value represents latitude in the **northern** hemisphere

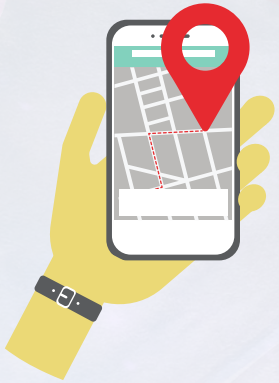
Positive value represents longitude to the **east** of Greenwich Meridian

(b) Copacabana, Rio de Janeiro

DMS format coordinates : 22°58'14.60"S (Latitude) 43°10'56.51"W (Longitude)
DD format coordinates : – 22.970722 – 43.182365

Negative value represents latitude in the **southern** hemisphere

Negative value represents longitude to the **west** of Greenwich Meridian



INFORMATION SENT FROM GPS SATELLITES TO THE GPS RECEIVER

- Position of GPS satellite
- The time the signal is sent

USES OF GPS

For navigational purposes in various types of transport such as land, sea, air and space transport.

EXAMPLE OF APPLICATIONS THAT USE GPS

- waze
- Google Maps

REFERENCE

Tho Lai Hoong & Thum Lai Chun, (2020). Text book Science KSSM Form 5. Petaling Jaya : Sasbadi Sdn. Bhd.

DOODLE RESOURCE FOR SCHOOL STUDENT

Puan Ida Norlida and Puan Ruby Maria