

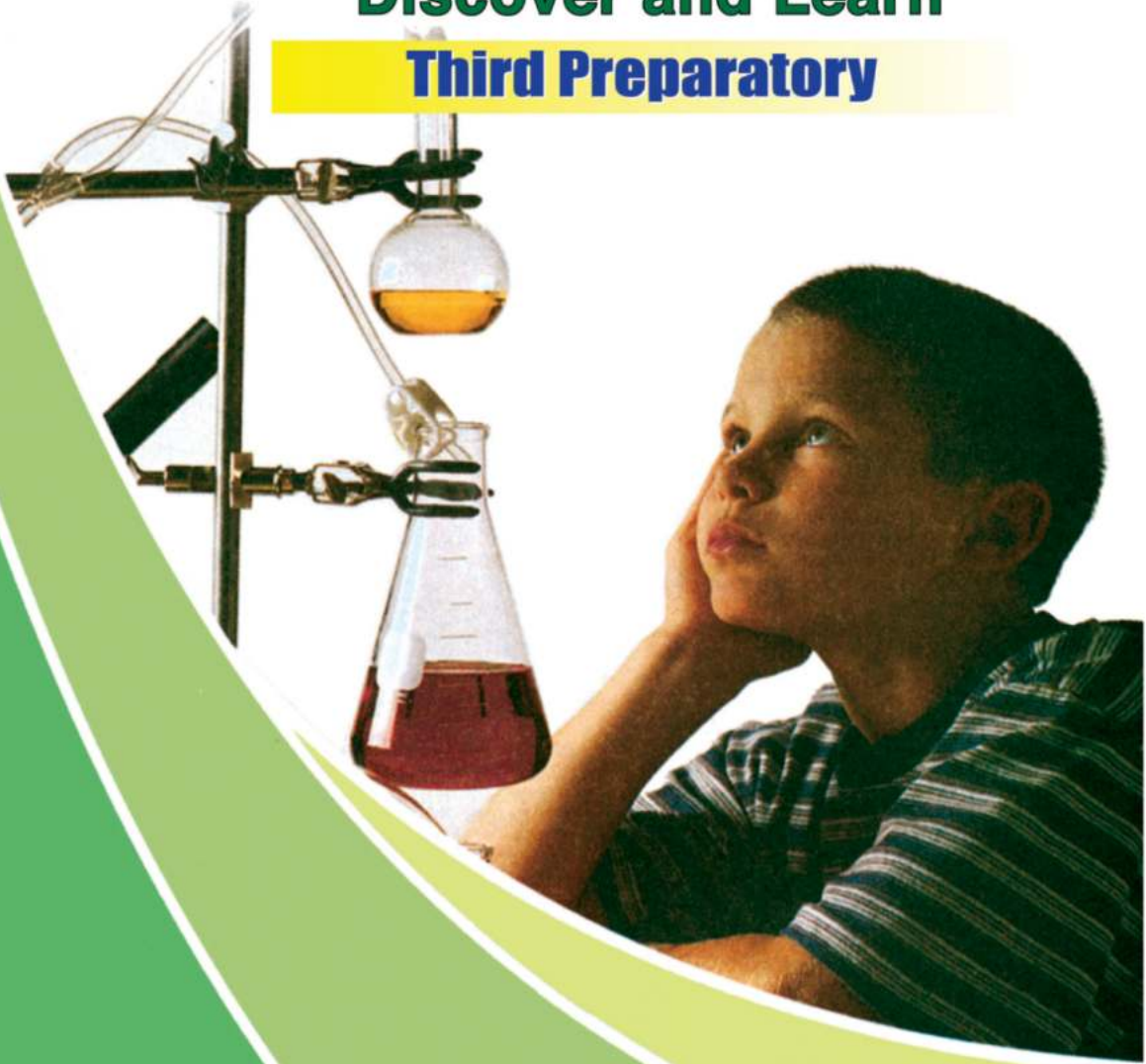


Arab Republic of Egypt  
Ministry of Education &  
Technical Education  
Central Administration of  
Book Affairs

# Science and Life

Discover and Learn

Third Preparatory



Second Term  
Student's  
Book

2022 - 2023

غير مصرح بتداول هذا الكتاب خارج  
وزارة التربية والتعليم والتعليم الفني



## Introduction

**This book** is considered a cornerstone in the third preparatory developed science curriculum, that achieves the objectives of developing curricula in order to cope with the 21<sup>st</sup> century.

Our curriculum aims to achieve the following educational directions:

- ★ Highlighting the relation between Science and Technology in the science domain and its reflection on the development process.
- ★ Emphasizing the suitable situations that distinguish the effect of the scientific and technological progress in producing knowledge.
- ★ Emphasizing students practicing their active and conscious behaviour toward using the technological outcomes.
- ★ Emphasizing students ability in the scientific thinking methodology, then the possibility for them to move from learning depending on receiving knowledge to learning depending on self-learning in an atmosphere of joy and amusement.
- ★ Students depending on exploring to reach information and gain much experiences through developing the essential thinking skills such as observation, analysis, concluding and reasoning.
- ★ Providing opportunities to students for practicing citizenship through the methods of self-learning and the team work spirit, negotiating and confessing, accepting others and rejecting extremists.
- ★ Enriching students with various life skills, and the practical capabilities through increasing all interests in the practical and scientific domain.

This book contains four integrated units, each one contains a set of integrated lessons achieving the concerned objectives.

We hope that this book may benefit our sons for the favour of our country Egypt.

*Preparation Team*



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## Safety in Science

Scientists know they must work safely when doing experiments. You need to be careful when doing experiments too. Here are some safety precautions to remember.

### Safety Tips

- ✓ Read each experiment carefully.
- ✓ Wear safety goggles when needed.
- ✓ Clean up spills right away.
- ✓ Never taste or smell substances unless directed to do so by your teacher.
- ✓ Handle sharp items carefully.
- ✓ Tape sharp edges of materials.
- ✓ Handle thermometers carefully.
- ✓ Use chemicals carefully.
- ✓ Dispose of chemicals properly.
- ✓ Put materials away after you finish an experiment.
- ✓ Wash your hands thoroughly after each experiment.





Second Term - Unit One

# Chemical Reactions

## Introduction

Biological process inside the human body are a group of biochemical reactions that aim to keep life according to fixed systems. Also, processes performed at factories which aim to produce different materials needed in life are chemical reactions.

So, industrial and agricultural productions, the continuation of living organisms and even the fuel inside Earth are all chemical reactions.



## UNIT OBJECTIVES



By the end of this unit, you will be able to :

- ✓ Identify the different types of chemical reactions.
- ✓ Distinguish between the reactions of thermal decomposition, simple and double substitution.
- ✓ Identify the concepts of oxidization, reduction, and concepts of oxidizing and reducing agents.
- ✓ Identify the concept of the speed of the chemical reaction.
- ✓ Identify the factors affecting the speed of the chemical reaction.
- ✓ Deduce the effect of both (the nature of reactants, concentration, temperature and catalysts) on the speed of a chemical reaction.
- ✓ Evaluate the importance of chemical reactions in our life.

## Included issues



Conservation of resources

## Integrating Sciences



- ◆ Biology : through identifying the role of enzymes.



Lesson 1  
Chemical reactions



Lesson 2  
Speed of the chemical reaction

# Chemical Reactions



## Lesson objectives

By the end of this unit, you will be able to :

- ✓ Identify the types of chemical reactions.
- ✓ Distinguish between thermal decomposition, simple and double substitution reactions.
- ✓ Identify the concepts of oxidization, reduction, oxidizing agent and reducing agent.



## Lesson terms

- ◆ Thermal decomposition reactions.
- ◆ Simple substitution reactions.
- ◆ Double substitution.
- ◆ Oxidization.
- ◆ Reduction.

Chemical reactions have a great importance in our life. For example, When gasoline is burnt in the car engines, it generates a power which makes move. Another example, plants food is produced by the photosynthesis process which depends mainly on the reaction of carbon dioxide with water.

Different types of medicines, fertilizers and artificial fibers are examples of the chemical products .

Chemical reaction is the breaking up of bonds in reactant molecules and the formation of new bonds in the products molecules .

### Are all chemical reactions similar?



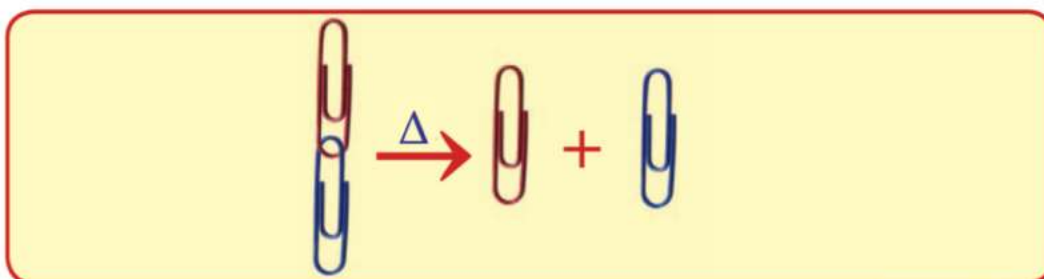
▲ Figure (1) : Chemical reactions occur in many aspects in our life.

Chemical reactions are different according to the processes which include and can be classified into many types.

## First: Thermal decomposition reactions.

In this kind of chemical reactions, the compound decomposes by heat into its simple components. It may decomposes completely into its simple elements or a more simpler compounds.

Decomposition reactions can be represented using paper clips as in the following figure:



▲ Figure (2) : Representation of thermal decomposition reactions.

### Activity

### Discover :

#### Some Substances decompose by heat

##### Tools:

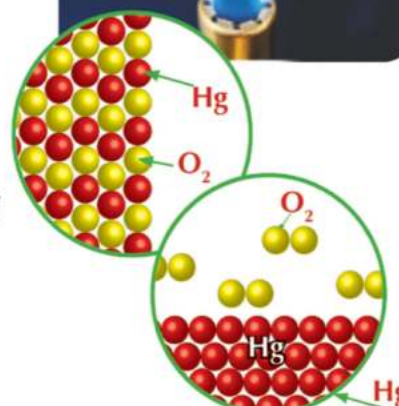
Red mercuric oxide – copper hydroxide – copper carbonate – copper sulphate – sodium nitrate – test tubes – flame – matches-test tube holder .

##### Procedures:

- 1 Put a little amount of mercuric oxide in a test tube.
- 2 Heat the mercuric oxide.
- 3 Get the lightened stick of matches close to the mouth of the tube.

##### What do you notice?

- 4 Repeat the previous steps with the other compounds.
- 5 Record your observations about each compound.



▲ Figure (3) : Thermal decomposition of red mercuric oxide

- Some metal oxides decompose by heat into the metal and oxygen. Red mercuric oxide decomposes by heat into mercury (silvery) which precipitates at the bottom of the tube and oxygen that evolves at the mouth of the tube. This causes the glowing of the match stick.



- Also, some metal hydroxides decompose when heated into metal oxide and water vapor. Blue copper hydroxide decomposes by heat into copper oxide (black) and water vapor.



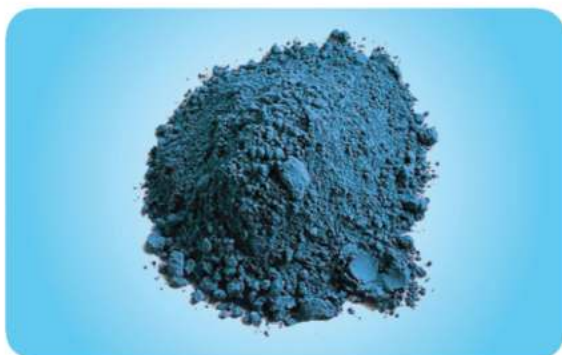
- Most metal carbonates decompose by heat to metal oxide and carbon dioxide. Green copper carbonate decomposes by heat to black copper oxide and carbon dioxide.



- Most metal sulphates decompose when heated to metal oxide and sulphur trioxide. blue copper sulphate decomposes by heat into black copper oxide and sulphur trioxide.



- Some metal nitrates decompose by heat and oxygen gas evolves. White sodium nitrates decompose by heat into yellowish white sodium nitrite and oxygen.



▲ Figure (4) : Copper hydroxide (blue coloured) decomposes by heating into copper oxide (black coloured)

## Second: Substitution reactions

Substitution reactions occur when there is an active metal that replaces another less active metal in another compound.

These reactions are identified by knowing the more active elements in the series of chemical activity. The series of chemical activity is an arrangement of the metals in a descending order according to their chemical activity. The element which is more active substitutes the less active one.

All elements above hydrogen in the series replace hydrogen in acid solutions, whereas the elements that follow hydrogen do not replace hydrogen in acids except under certain chemical conditions.

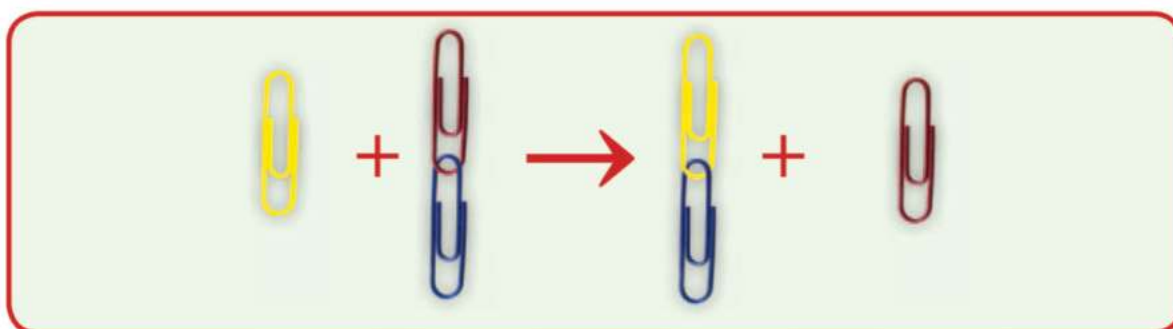
Potassium	K
Sodium	Na
Barium	Ba
Calcium	Ca
Magnesium	Mg
Aluminum	Al
Zinc	Zn
Iron	Fe
Tin	Sn
Lead	Pb
Hydrogen	H
Copper	Cu
Mercury	Hg
Silver	Ag
Platinum	Pt
gold	Au

▲ Figure (5) : The series of chemical activity

**Substitution reactions are classified into two types:**

### a) Simple substitution reactions:

- They are reactions in which an element replaces another one that the substituting element is more active than the substituted one.
- Substitution reactions can be represented by paper clips as follows:



▲ Figure (6) : Representation of simple Substitution reactions

### 1 A Metal substitutes the hydrogen of water or an acid :

Metals substitute hydrogen of water to produce metal hydroxide and hydrogen evolves as soon as metals substitute hydrogen of an acid forming acid salt and hydrogen gas evolves.

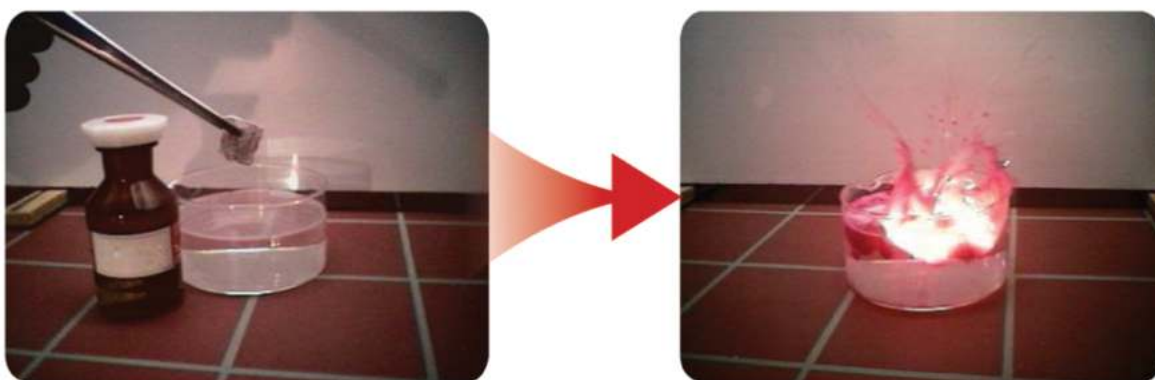
#### Activity

#### Discover :

### The reaction of water with sodium

#### Tools:

A very small piece of sodium – a glass of water - tongs



▲ Figure (7) : Reaction of water with sodium

#### Procedures:

- Place the very small piece of sodium in the glass of water by using tongs.

#### What do you notice?

.....

#### What do you observe?

.....

The reaction equation is :



Metals react with water as they substitute hydrogen of water to produce the metal hydroxide and hydrogen evolves .

#### Be alert

#### Important Notice

- Be careful when performing this reaction as this will lead to explosion and ignition. Put a very small piece of sodium kept under the kerosine.

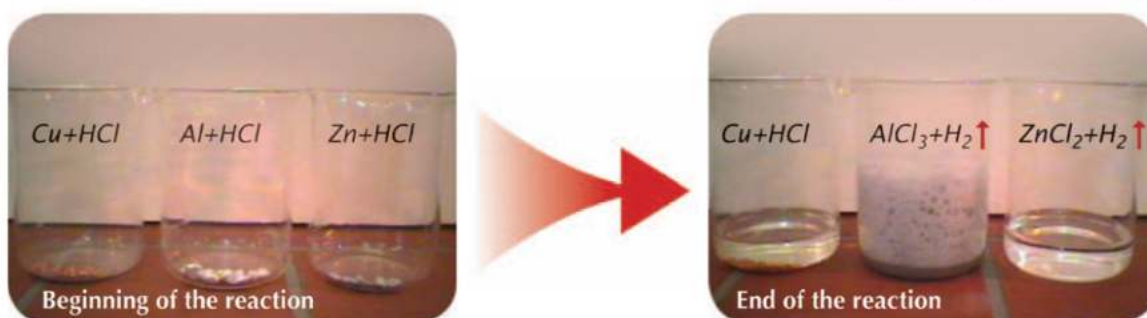
## Activity

## Discover :

## A metal substitutes the hydrogen of an acid

## Tools:

Diluted hydrochloric acid - 3 beakers - zinc - aluminium turning - copper turning



▲ Figure (8) : Metals react with acids where they substitute acid hydrogen

## Procedures:

- 1 Put a little amount of zinc in a beaker, put a few aluminium turning in the second one and a few copper turning in the third one.
- 2 Add a little diluted hydrochloric acid to each beaker.

## What do you observe?

- What do you observe in the Zinc beaker? .....
- What do you observe in the aluminium beaker?.....
- What do you observe in the copper beaker? .....

## After a while

- What do you observe in the aluminium beaker? .....
- Does a reaction occur with the copper turning? .....

On adding dilute hydrochloric acid, it does not react with copper whereas it reacts with zinc immediately composing a salt and hydrogen gas evolves.



After short period of time Aluminium starts the reaction producing salt and hydrogen gas, although the Aluminium is before Zinc in the chemical activity series, Aluminium practically lates in its reaction with hydrochloric acid due to the presence of Aluminium oxide layer which isolates Aluminium from the acid, this layer takes a period to separate from metal and then metal exposes to reaction.



## 2 A Metal substitutes another metal in one of its salt solution.

- Some metals replace another metals that follows it in the series of chemical activity in one of its salt solution.

### Activity

### Discover :

#### Substitution of a metal instead of another one in one of its salt solution .

##### Tools:

Beaker - blue copper sulphate solution - pieces of magnesium

##### Steps :

- Put the pieces of magnesium metal in the beaker of blue copper sulphate.

##### Notice changes that occur :

.....

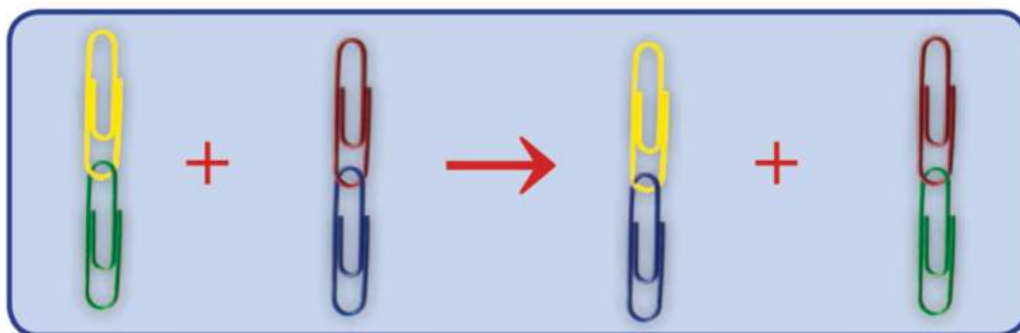
Magnesium is more active than copper. Thus, it substitutes copper in copper sulphate solution. A red copper precipitates in the beaker and the solution turns to magnesium sulphate.



▲ Figure (9) : Substitution of a metal instead of another one in one of its salt

## b Double substitution reaction

- It is a reaction where an exchange occurs between the ions of two compounds to form two new compounds. During this reaction, substitution occurs between reactants. Each element replaces the other to form two compounds different from the elements in the reactants.



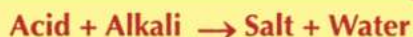
▲ Figure (10) : Representation of double substitution reaction



Double substitution reactions are classified into:-

### 1 Reaction between an acid and an alkali (neutralization)

- It is the reaction between an acid and an alkali forming salt and water .



For example, when hydrochloric acid reacts with sodium hydroxide, they produce sodium chloride (salt) and water. On heating the solution, water evaporates and sodium chloride remains.



### 2 Reaction of an acid with a salt

- Acids react with salts and the resultant depends on the type of both the acid and salt.

#### Activity

#### Discover :

#### The reaction of hydrochloric acid with sodium carbonate

##### Tools:

Hydrochloric acid - Sodium Carbonate powder - beaker contains a clear lime water - plastic bottle - a balloon

- Put an amount of hydrochloric acid in a bottle.
- Put some amount of sodium carbonate in a balloon.
- Insert the top of the balloon over the mouth of the bottle.
- Slowly turn over the balloon in a way that makes the amount of sodium carbonate fall into the bottle

What do you observe inside the bottle?

.....

What do you observe about the appearance of the balloon?

.....

- Carefully close the balloon and take it away of the bottle.
- Pass the gas collected inside the balloon into a clear lime water.

What do you observe ?

.....

Hydrochloric acid reacts with sodium carbonate forming sodium chloride, water and carbon dioxide gas which turbids lime water.



▲ Figure (11) : Reaction of hydrochloric acid with sodium carbonate and  $\text{CO}_2$  evolves.

### 3 Reaction of a salt solution with another salt solution

- Double substitution reactions between salt solutions are accompanied by the formation of a precipitate.
- When we add silver nitrate solution to sodium chloride solution, a white precipitate of silver chloride is formed



### C Oxidization and Reduction

- When hydrogen passes through hot copper oxide, hydrogen takes the oxygen away from copper oxide and water is formed. Copper oxide turns into copper.



- During this reaction, the hydrogen is oxidized because it got united with oxygen. On the other hand, copper oxide was reduced because oxygen is taken away from it.
- We can say that copper oxide is an oxidizing agent because it oxidized hydrogen. But hydrogen is a reducing agent because it reduced copper oxide to copper.

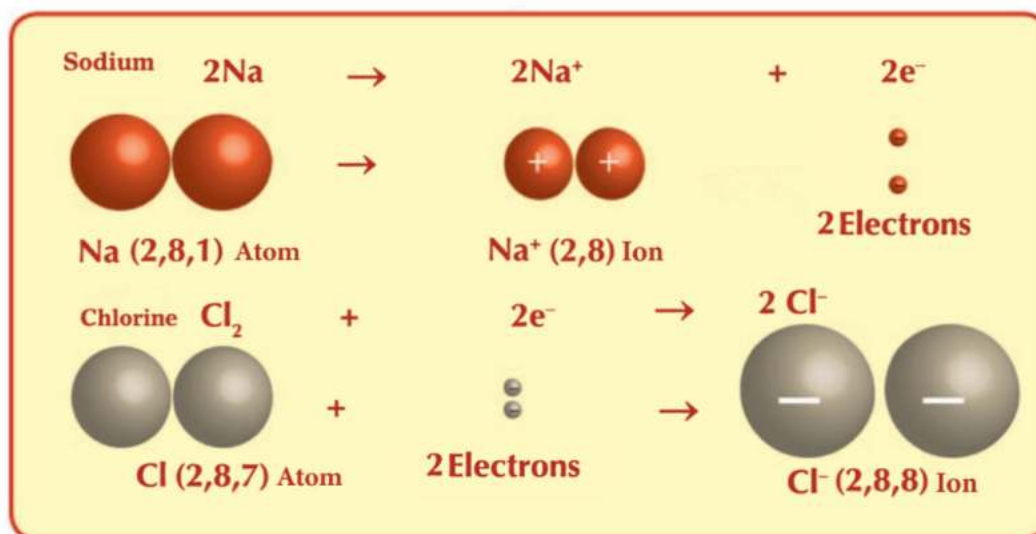
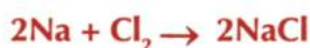
<b>Oxidization</b>	A chemical process which increases oxygen percentage or decreases hydrogen percentage in substance .	<b>Reduction</b>	A chemical process which decreases oxygen percentage or increases of hydrogen percentage in a substance.
<b>Oxidizing agent</b>	It is the substance which gives oxygen or takes away hydrogen during a chemical reaction	<b>Reducing agent</b>	It is the substance which takes away oxygen or gives hydrogen during a chemical reaction

- There are chemical reactions which include both oxidization and reduction processes although the absence of oxygen or hydrogen .
- The reaction of sodium with chlorine includes both oxidization and reduction processes. This reaction gives sodium chloride which is known as table salt.



▲ Figure (12) : Extraction of table salt from water of lakes

You have already learnt that sodium is monovalent because it loses one electron forming a positive sodium ion ( $\text{Na}^+$ ), whereas chlorine is also monovalent because it gains one electron giving a negative chloride ion ( $\text{Cl}^-$ ), so the following equation represents the previous reaction :



Notice that in this reaction, sodium atom turns into a sodium ion, whereas chlorine atom turns into a chloride ion.

The sodium atom lost one electron and turned from a neutral atom to positive ion (+1). This process is called oxidation.



electrons can not remain free, so they move to chlorine atom (gains electrons). and turns into a **negative** chloride ion (-1). This process is called reduction.



<b>Oxidization</b>	A chemical process in which the atom loses an electron or more.	<b>Reduction</b>	A chemical process in which an atom gains one electron or more.
<b>Oxidizing agent</b>	It is the substance which gains an electron or more during a chemical reaction.	<b>Reducing agent</b>	It is the substance which loses one or more electrons during a chemical reaction.

**Notice that the two processes of oxidization and reduction are concurrent processes.**

## Lesson 1 Exercises

- 1 Complete the following sentences:**
- a chemical process in which the atom loses an electron or more.  
Known as .....
  - ..... is the substance which gains one electron or more during a chemical reaction.
  - During ..... reactions, the compound decomposes by heat into its simple components.
  - ..... is the reaction between an acid and an alkali to form salt and water.
  - The ..... is the substance which gives oxygen or takes away hydrogen.
- 2 Write the scientific term for each of the following statements:**
- The breaking up of bonds of the molecules of the reactants and the formation of new bonds(.....)
  - A chemical process in which the atom gains one or more electrons(.....)
  - It is the substance which loses an electron or more during a chemical reaction(.....)
  - A reaction where an element substitutes another one(.....)
- 3 Illustrate by balanced symbolic equations the following reactions:**
- The reaction between hydrochloric acid and sodium hydroxide.
  - Adding silver nitrate solution to sodium chloride solution.
  - The effect of heat on red mercuric oxide.
  - The reaction of zinc with diluted hydrochloric acid.
  - The effect of heat on sodium nitrate.
- 4 Identify the process of oxidization, reduction, oxidizing agent and reducing agent in the reaction of sodium with chlorine to form sodium chloride NaCl:**
- Na : Atomic number ( 11 ) and electronic configuration  
Cl : Atomic number ( 17 ) and electronic configuration
- |                  |   |   |   |
|------------------|---|---|---|
| level<br>element | K | L | M |
| Na               | 2 | 8 | 1 |
| Cl               | 2 | 8 | 7 |
- 5 Complete the following equations:**
- $\text{NaCl} + \text{AgNO}_3 \rightarrow \dots + \dots$
  - $\text{Cu}(\text{OH})_2 \xrightarrow{\Delta} \dots + \dots$
  - $2\text{NaNO}_3 \xrightarrow{\Delta} \dots + \dots$
  - $2\text{HgO} \xrightarrow{\Delta} \dots + \dots$

# Rate of Chemical Reactions



## Lesson objectives

By the end of this unit, you will be able to :

- ✓ Identify the concept of the rate of a chemical reaction.
- ✓ Determine the factors which affect the rate of a chemical reaction.
- ✓ Deduce the effect of the nature of reactants, concentration, temperature and catalyst on the rate of chemical reactions.
- ✓ Aware that foods spoil by oxidation when left exposed.



## Lesson terms

- ◆ Rate of chemical reaction.
- ◆ Reaction temperature.
- ◆ Catalyst.

The chemical reaction is a process in which a chemical substance turns to another one.

Chemical reactions differ in the time they take to occur. For example, some reactions take very short time like fireworks. Some reactions are a relatively slower like the reaction of oil with caustic soda. there are some reactions are slowest and need several monthes to take place such as the formation of the iron rust. Other reactions may take mellions of years like those which occur inside the Earth to form oil.

**What is the speed of chemical reaction?**

**What are the factor affecting it?**



▲ Figure (13) : Iron rust is a very slow chemical reaction



▲ Figure (14) : A firework is a fast chemical reaction

## The definition of the speed of chemical reaction

To identify the meaning of the speed of a chemical reaction, we will study the following equation:

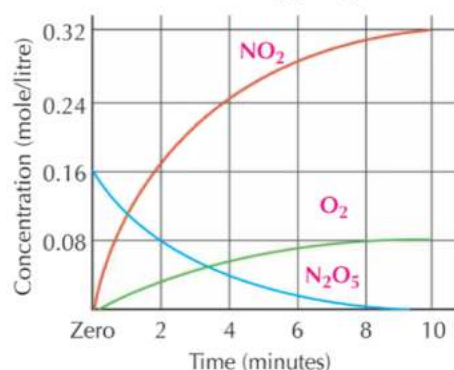
Nitrogen pentoxide breaks up into nitrogen dioxide gas and oxygen gas according to the following equation:



Oxygen atoms are collected together to form molecules that evolve. The following graph illustrates the rate of the dissociation of nitrogen pentoxide with time. The concentration (mole/litre) is represented on the vertical axis while time (minute) is represented on the horizontal axis :

- \* The blue graphical line represents the change in the concentration of nitrogen pentoxide gas.
- \* The red graphical line represents the change in the concentration of nitrogen dioxide gas.
- \* The green graphical line represents the change in the concentration of oxygen gas.

We notice that at the start of the reaction, the concentration of nitrogen pentoxide is 0.16 mole/litre, i.e 100%, while the concentration of both nitrogen oxide and oxygen is zero%. As time passes, the concentration of nitrogen pentoxide starts to decrease whereas the concentration of both nitrogen dioxide and oxygen starts to increase. By the end of the reaction, the concentration of nitrogen pentoxide becomes zero mole/litre, i.e zero%, whereas the concentration of the both nitrogen dioxide and oxygen increases, i.e. 100%. The following graph illustrates the breaking up of nitrogen pentoxide across time.



▲ Figure (15) : A graph that illustrates the breaking up of the nitrogen pentoxide

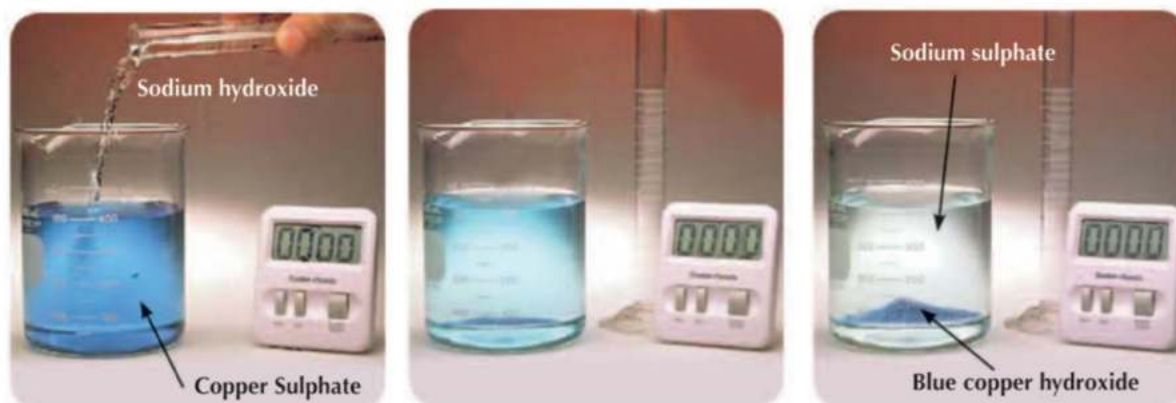
Examine the graph carefully and complete the following table:

Time (minute)	The concentration of reactants (mole/litre)		The concentration of products (mole/litre)	
	$\text{N}_2\text{O}_5$		$\text{NO}_2$	$\text{O}_2$
Beginning of the reaction				
After two minutes				
After four minutes				
After eight minutes				
At the end of the reaction				

The speed of a chemical reaction can be defined as follows:

**“The change in the concentration of the reactants and Products at a unit time ”**

The speed of chemical reaction can be practically measured by the rate of disappearance of a reactant or the rate of appearance of a products.



▲ Figure (16) :What happens to the color of solution as time passes ?

On adding sodium hydroxide to blue copper sulphate, colorless sodium sulphate forms and a blue precipitate of copper hydroxide is formed. The speed of this reaction is measured by the disappearance rate of copper sulphate color or the appearance rate of the precipitate.

## Factors affecting the speed of chemical reaction

The speed of chemical reaction depends on many factors:

- The nature of reactants.
- The concentration of reactants.
- The temperature of the reaction .
- Catalysts.

### a The nature of reactants

- The first factor which affects the speed of a chemical reaction is the nature of reactants. The nature of reactants includes the two following factors :
- The type of bonding in reactants.
- The surface area of reactants exposed to reaction.

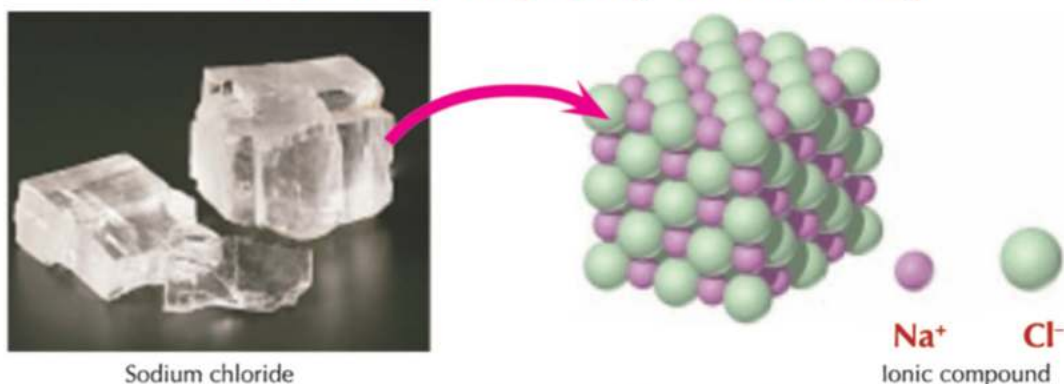
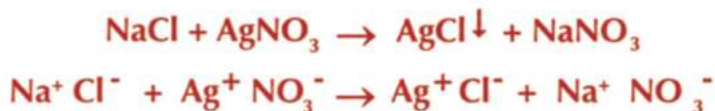
#### 1 Type of bonding in reactants

**We find that:**

##### Covalent compounds:

They are slow in their reaction because they do not decompose to form ions. this reaction takes place between molecules.

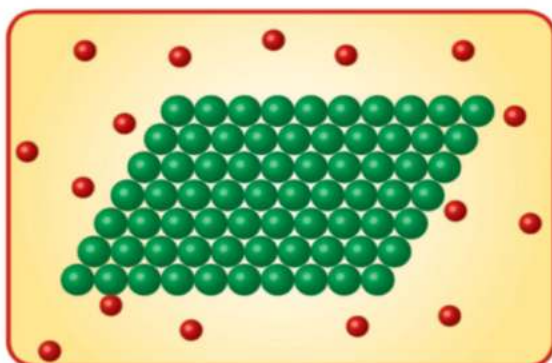
**Ionic compounds**: they are fast in their reaction because they decompose into ions. The reaction take place between the ions such as the reaction of sodium chloride with silver nitrate. Each of the two compounds dissociat up into its ions and then the reaction occurs between these ions.



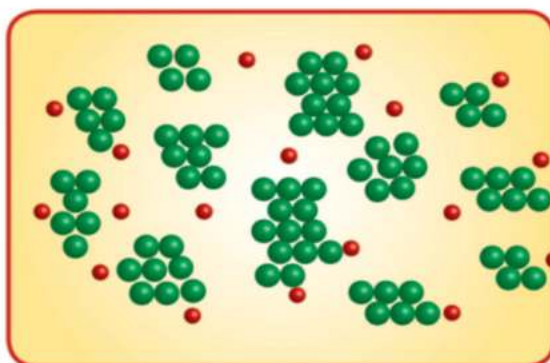
▲ Figure (17) :Ionic compunds decompose into ions.

## 2 Surface area of reactants exposed to reaction

The surface area of the reactants exposed to the reaction affects the speed of the chemical reaction. The larger the area exposed to the reaction, the faster the chemical reaction is.



▲ Figure (18) : The surface area exposed to the reaction is small



▲ Figure (19) : The surface area exposed to the reaction is large

The area exposed to the reaction is small. The red colored molecules react only with the molecules of the outer layer and do not react with the molecules inside the bulk of the reactant. (Figure18)

When the reactant decomposes, the surface area exposed to reaction increases, So, the red colored molecules react with most of the molecules of the outer layer as well as that inside the bulk of the reactant (Figure19)



## Activity

## Discover :

## Effect of surface area on the speed of a chemical reaction

## Tools:

Two equal amounts of diluted hydrochloric acid Two equal masses of iron ( one of them is iron filings and the other is one piece ) – two conical flasks- two syringes

## Procedures:

- 1 Put iron filings in conical flask (1) and the piece of iron in conical flask (2).
- 2 Put equal amount of diluted hydrochloric acid in both flasks.

## What do you observe?

.....

## Which reaction is faster?

.....

## How can you explain this?

.....

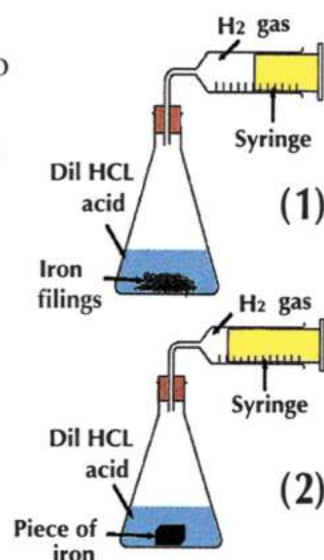
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The rate of the reaction of hydrochloric acid with the iron filings is more faster than the piece of iron. This is because the area exposed to the reaction in case of the iron filings is more bigger than that in case of piece of iron. Thus, the reaction is completed in case of iron filings in shorter time than that of the iron piece.



**We can deduce that the speed of chemical reaction increases by the increase of the surface area exposed to reaction**

Dr.Ahmed Zwait is an egyptian scientist who achieved Nobel Brize in chemistry in 1999 due to his awsome work in photographing the moments of the breaking up of bonds in reactants and the formation of new bonds by inventing a new LASER camera that capitures photos in a femtosecond. Use EKB to make a research on Dr .Ahmed Zwait his life and discoveries.then show what you gained with your classmates and teacher.



▲ Figure (20)

## b Concentration of the reactants :

- One of the factors that increase the rate of a chemical reaction is the increase in the concentration of reactants. This increases the number of collisions between molecules and consequently the speed of the reaction increases.



▲ Figure (21) : In a quiet street, the probability of collisions decreases like in the molecules of a substance with a low concentration



▲ Figure (22) : In a crowded street, the probability of collisions increases like the molecules of a substance with a high concentration

Figure ( 23 ) illustrates the effect of oxygen concentration on the rate of combustion. Figure ( A ) the combustion of the steel source used for cleaning aluminium in oxygen in the air . Figure ( B ) the combustion in a jar which contains pure oxygen . The combustion of the steel source used for cleaning aluminium in pure oxygen ( high concentration ) is faster than its combustion in oxygen in the air ( less oxygen concentration ) .



▲ Figure (23) : The effect of oxygen concentration on the rate of combustion

Activity

Discover :

**The effect of reactants concentration on the speed of the chemical reaction**

**Tools:**

2 pieces of magnesium of the same size - 2 test tubes- diluted hydrochloric acid - concentrated hydrochloric acid - pipette .

**Procedures:**

- 1** Put an amount diluted hydrochloric acid in tube "A" and an equal amount of concentrated hydrochloric acid in tube "B" by used pipette.
- 2** Put a piece of magnesium in each tube

**What do you observe?**

.....

**Which one contains more bubbles?**

.....

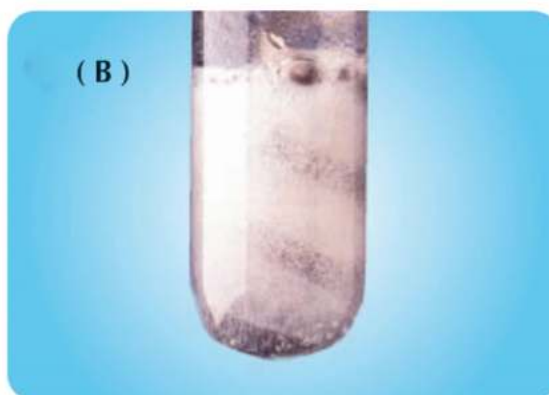
**How can you explain this?**

.....

.....



▲ Figure (24) : The reaction of a magnesium ribbon with diluted hydrochloric acid



▲ Figure (25) : The reaction of a magnesium ribbon in with concentrated hydrochloric acid

**We can deduce through this activity that the speed of a chemical reaction increases as the concentration of the reactants increases.**

### C The temperature of the reaction:

- which increases the number of collisions between molecules and consequently the rate of the reaction increases .Most of the chemical reactions speed up when the temperature increases

**What do you do to preserve food for a long period of time? What do you do to cook food faster?**



▲ Figure (27) : Food gets spoilt quickly if not frozen because of the chemical reactions done by bacteria. Cooling food at low temperature slows down those reactions.



▲ Figure (26) : If you want to cook eggs faster, you increase the temperature so as to increase the chemical reaction that helps in cooking food.

### Activity

### Discover :

### The effect of temperature on the speed of chemical reactions

#### Tools:

2 similar beakers – 2 effervescent tablets – hot water – cold water

#### Procedures:

**1** Fill half of the first beaker ( A ) with cold water and the second one ( B ) with hot water.

**2** Add an effervescent tablet to each of the beakers.

#### What do you observe?

.....

#### Which is faster in effervescence?

.....

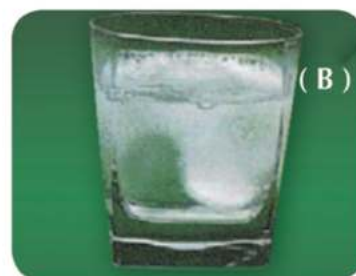
#### How can you explain this?

.....

**We can conclude that the speed of a chemical reaction increases when the temperature of the reaction increases.**



▲ Figure (28) : Effervescent tablet in a glass of cold water



▲ Figure (29) : Effervescent tablet in a glass of hot water

## d Catalysts

- A catalyst is a substance which changes the rate of the chemical reaction without being changed. Some chemical reactions are so slow but they speed up when a catalyst is added. Most catalysts speed up the chemical reaction and this is called a positive catalysts. Other catalysts are used to slow down a chemical reaction and this is known as a negative catalysts.

**Catalyst has some characteristics which are :**

- 1** it changes the rate of the reaction but do not affect either its beginning or stopping.
- 2** No chemical changes or decrease in mass occurs to the catalyst before or after the reaction.
- 3** it is bonded to reactants but get separated from them rapidly to form the resultants at the end of the reaction.
- 4** it decreases the energy needed for the reaction.
- 5** A small amount of the catalyst is often enough to complete the reaction.



### Activity

### Discover :

### The decomposition of hydrogen peroxide

#### Tools:

Hydrogen peroxide – manganese dioxide – 2 test tubes.

#### Procedures:

- 1** Put an equal amount of hydrogen peroxide in the two test tubes.
- 2** Put a small amount of manganese dioxide in one tube of them.

#### What do you observe?

.....

.....

#### Which release more oxygen bubbles?

.....

#### How can you explain this?

.....

- The release of gas bubbles (oxygen gas) increases in the tube which contains manganese dioxide in respect to the other tube.
- Manganese dioxide acts as a catalyst increases of hydrogen peroxide decomposition speed.



▲ Figure (30) : Manganese dioxide helps in the increase of hydrogen peroxide decomposition speed.

## Activity

## Discover :

## Effect of enzymes on speed of a chemical reaction

**Tools:**

Hydrogen peroxide – a piece of sweet potato – a glass beaker.

**Procedures:**

- Fill a half of the beaker with hydrogen peroxide.

**What do you observe?**

.....

- Put the piece of the sweet potato in the beaker as in fig. (31).

**What do you observe?**

.....

**Which of the two cases produce more oxygen bubbles?**

.....

**How can you explain this?**

.....

- Gas bubbles (oxygen gas ) evolves.
- We can conclude that sweet potato includes a chemical substances ( oxidase enzyme) helps in decomposition of hydrogen peroxide faster and oxygen gas evolves this enzyme acts as catalyst.



▲ Figure (31) : Oxidase enzyme in potato helps in decomposition of hydrogen peroxide.

## Integrating

## Biology

- The human body contains thousands types of enzymes. Each type has a specific function. Without enzymes, man can never breathe, move, or even digest food.
- A molecule of one enzyme can do its task million times per minute. The reaction occurs in the presence of enzymes is more rapidly than that without their presence - thousands or even millions times.

## Lesson 2 Exercises

### 1 Complete the following sentence:

- a At the beginning of the chemical reaction, the concentration of reactants is ..... %
- b The change in the concentration of reactants and resultants in a unit time is known as .....
- c The increase in concentration of reactants makes the rate of a chemical reaction .....
- d The reactions of the covalent compounds are .....
- e Sodium chloride powder reacts ..... than a cube of sodium chloride of the same mass.
- f A substance which increases rate of chemical reaction without sharing in the reaction is called .....

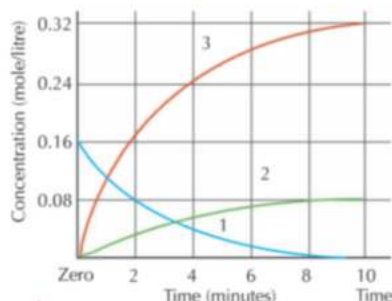
### 2 Give reasons for:

- a The fridge is used to preserve food.
- b Reactions between ionic compounds are fast whereas reactions between covalent compounds are slow.
- c The speed of the chemical reaction increases as the concentration of the reactants increases.

### 3 The following equation explains the decomposition of a compound:



The following graph illustrates the change in concentration of reactants and resultants in respect to time. Write the name of substance which is indicated by each number.



### 4 Illustrate each of the following by an experiment :

- a The importance of a catalyst in a chemical reaction.
- b The effect of the surface area on the rate of a chemical reaction.
- c The effect of temperature on the rate of a chemical reaction.

## Enriching activity

### Usage of sodium bicarbonate in your life

#### Polishing of a metal

- It is used in polishing silver by using a piece of aluminium foil, while washing so silver restores its shine.
- Any decorative metal pieces made of copper or chrome are rubbed with a cloth wet with water and immersed in sodium bicarbonate



#### In the Kitchen

- Add a little amount of it in the bottom of a waste basket before putting the bag to prevent the bad odours .
- Soak the legumes in water and add a little amount of sodium bicarbonate to help in decreasing the bloating that accompanies eating legumes.
- Add a little amount of sodium bicarbonate in the kitchen's sink and pour on it boiling water, and notice that the draining of the sink is faster.



legumes

#### In the garden

- Place sodium bicarbonate without any additives in the places where ants come out, and with time you will notice their disappearance.

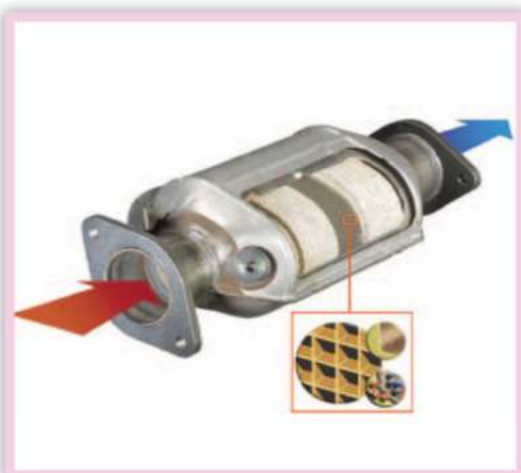




## Science, Technology and Society

### Life Application

#### The catalytic converter

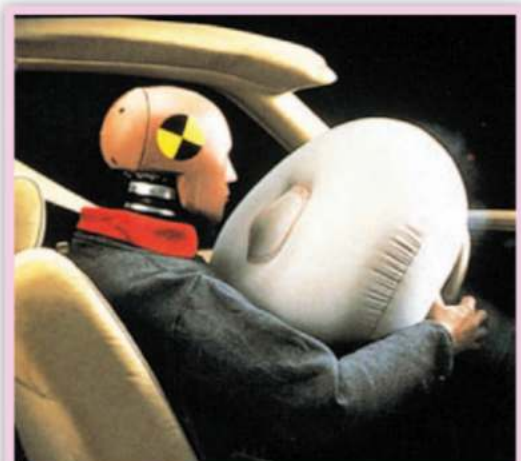


Most modern cars are equipped with a catalytic converter that helps in the treatment of harmful gases. It is composed of ceramic cells similar to bee cells, but they are covered with thin layer of a catalytic metal as platinum.

The idea of using this converter is based on the exposure of the largest part of the surface of the catalytic substance to the current of the emitted gases from the engine so as to economize the use of these metals .

### Technological Application

#### Air bags



Car air bags are considered one of the most important safety means at emergencies. They are designed in a way that they get inflated at an extreme speed within only 40 mm second on the occurrence of the car crash with another object. Then, they get vacuumed rapidly to ensure both the motorist's clear vision and proper movement. This leads to the decomposition and explosion of sodium azid compound forming sodium and nitrogen that fills the air bag on crashing.



## Unit 1 Exercises

### 1 Complete the following sentences:

- a The breaking up of bonds in the molecules of reactants and formation of new bonds is called .....
- b The speed of chemical reactions ..... due to the increase of temperature.
- c Oxidation and reduction are two ..... processes.

### 2 Correct the underline words :

- a The increase in the concentration of the reactants increases the number of collisions between molecules so that the speed of reaction decreases. ( )
- b Most metal carbonates decompose on being heated into metal and carbon dioxide. ( )
- c The reactions of ionic compounds are slower than that of the covalent compounds. ( )

### 3 Write the scientific term for the following:

- a Chemical reactions in which the compound is decomposed by heat into simple components.
- b The change in the concentration of reactants and products in the time unit.
- c A substance that increases the speed of the chemical reaction without interfering in it or being consumed.
- d A chemical process in which an atom of the element gains one or more electron.

**4 Write the symbolic balanced equations for the following:**

- a** The reaction of water with sodium.
- b** The decomposition of sodium nitrate by heat.
- c** Placing of a piece magnesium ribbon in a solution of copper sulphate.
- d** The reaction of hydrochloric acid with sodium hydroxide.

**5 Explain the following**

- a** The occurrence of effervescence on putting a piece of aluminium in diluted hydrochloric acid.
- b** The rate of the reaction of hydrochloric acid with iron
- c** Preservation of food in the freezer.

**6 Compare between each of the following:**

- a** Simple substitution and double substitution reactions.
- b** Heating of both the metal oxide and metal hydroxide .

**The Second Term - Unit two**

# **Electric Energy and Radioactivity**

## **Introduction**

Electricity is a hidden energy that can not accurately described. Yet, we identify it through its various effects and features. It is the light in the electric lamp that illuminate our nights. It is the heat of electric heaters and irons. It is the mechanical energy of engines. It is the sounds in the radio, cassette recorder and telephone. It is the waves that do different tasks. It is rays like the X-ray used in medical diagnosis. This is in addition to so many usages that Allah Almighty creates to serve man in life. Besides, it is a clean energy that does not pollute the environment.



## UNIT OBJECTIVES

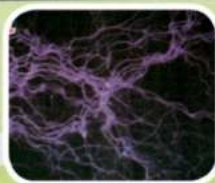
By the end of this unit, will be able to :

- ✓ Identify the concepts of current intensity, potential difference and the electric resistance.
- ✓ Identify the instruments used for measuring the current intensity, potential difference and electric resistance.
- ✓ Identify the units for measuring the current intensity, potential difference and electric resistance.
- ✓ Identify some of the sources of the electric current.
- ✓ Compare between the alternating-current and direct-current.
- ✓ Compare between the methods of connecting the electric cells in electric circuits.
- ✓ Identify the phenomenon of radioactivity.
- ✓ List examples of radioactive elements.
- ✓ Identify the safe uses of the nuclear energy.
- ✓ Identify the harmful effects of radioactive pollution and the method of protection.
- ✓ Appreciate the importance of electric energy in our life through its multiple applications.



## Included issues

- ◆ Peaceful uses of energy.
- ◆ Protection from radiation.



**Lesson 1**  
Physical properties of the electric current



**Lesson 2**  
Electric current and electric cells



**Lesson 3**  
The radioactivity and the nuclear energy

# Physical Properties of the Electric Current



## Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify the concepts of the current intensity, the potential difference, and the electric resistance.
- ✓ Identify the instruments used for measuring the current intensity, the potential difference, and the electric resistance.
- ✓ Determine the units for measuring the current intensity, the potential difference, and the electric resistance.



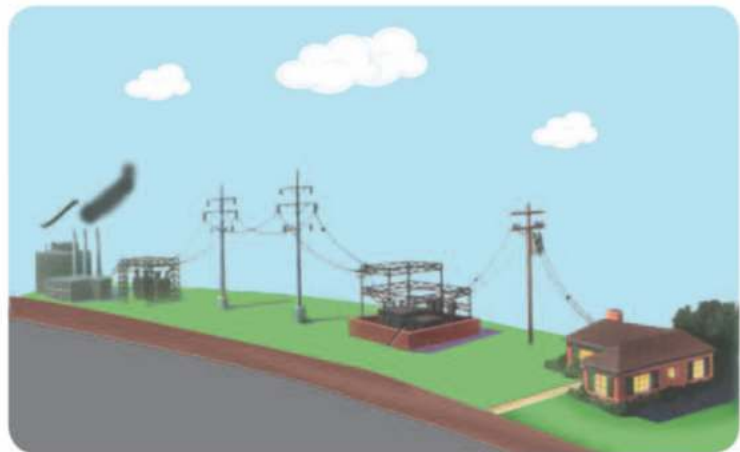
## Lesson terms

- ◆ Electric current.
- ◆ Current intensity.
- ◆ Potential difference.
- ◆ Electromotive force.
- ◆ Electric resistance.

There is no doubt that you cannot live in your house without electricity. The electric appliances are around you everywhere. You will not be able to read this book at night unless you switch on the electric lamp, and you will not be able to switch on the radio and hear the news unless there was electric current. The same goes for all aspects of life.

You might know that the electric current is generated in electric power stations that are away from your house by hundreds or thousands of kilometers.

**What is meant by the electric current ? How is it generated?  
How does it reach your house?  
What are its properties?**



▲ Figure (1) : Connecting electric power from the electric power station to the houses

## How is the electric current generated? What is meant by the electric current ?

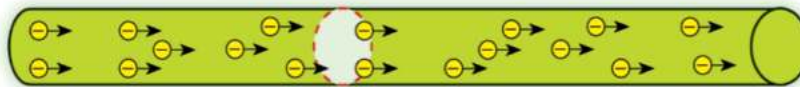
You have previously studied the composition of the atom and knew that the protons are present in the nucleus while the electrons revolve around the nucleus in outer orbits affected by an attraction force (with the nucleus). in the absence of this attraction force, the electrons become free. On connecting a wire with an electric source, electrons move in the wires( conductors ) creating the electric current. due to the potential difference in the circuit

Therefore, we can define the electric current as the flow of electric negative charges (the electrons) in a conducting substance (as a metal wire).

### Question

#### for thinking

If you pass an electric current in a circuit and the lamp lights up, is the intensity of light determined by the number of electrons passing in the wire?



▲ Figure (2) : The flow of electrons in the electric wire

## Physical properties of the electric current:

There are several physical concepts of the electric current as the current intensity potential difference and resistance.

### 1 Current intensity (I) :

It is the quantity of electricity in Coulomb or the electric charges flowing through a cross - section of the conductor in one second.

coulomb:the charges which transmitted by a current with one ampere intensing in one second

### How to measure the current intensity ? what are its measuring units?

It is measured by using instrument called an Ammeter that is symbolized by the sign  $\text{---}(\text{A})\text{---}$  when drawing electric circuits. The measuring unit of the current intensity is known as Ampere. We can define Ampere as a quantity of charge of 1 Coulomb passing through any cross - section of the conductor in one second.



▲ Figure (3) : Ammeter

$$\therefore \text{Current intensity (I)} = \frac{\text{Quantity of charge (coulomb) (Q)}}{\text{Time (second) (t)}}$$

**Example :**

- Calculate the current intensity due to the flow of 5400 coulombs through a cross - section of a conductor for 5 minutes.

**Solution:** Time in seconds =  $5 \times 60 = 300$  s

$$\text{Current intensity} = \frac{\text{quantity of charge}}{\text{time}} = \frac{5400}{300} = 18 \text{ Amperes}$$

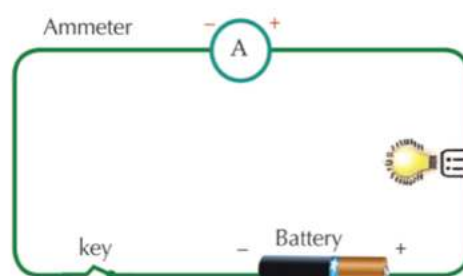
**Activity****How is the Ammeter used? Why ?**

- 1 Make a circuit as shown in figure (4).
- 2 Close the key of the circuit.

**Observe:**

**What do you observe on the pointer of the ammeter?**

**What does the reading of the pointer of the ammeter indicate?**



▲ Figure (4) : The Ammeter connected in an electric circuit

- We can conclude that Ammeter used to measure the electric current intensity and connected in an electric circuit on series

**2 The electric potential difference (V) :****What is meant by electric potential of a conductor ?**

It is the state of an electric conductor that shows the transfer of the electricity from or to it ,when it is connected to another conductor.

**In order to understand what the potential difference means, and how does electricity move from one conductor to another, try to understand the following example:**

Heat transfers from a hot object (A) to a cold object (B) when they are connected with a metal rod (Figure 5), and it continues to transfer until the temperature of both objects becomes equal. The transference of heat does not depend on the size of the two objects, but on the difference in their temperatures. The temperature difference determines the transference of heat to and from an object.

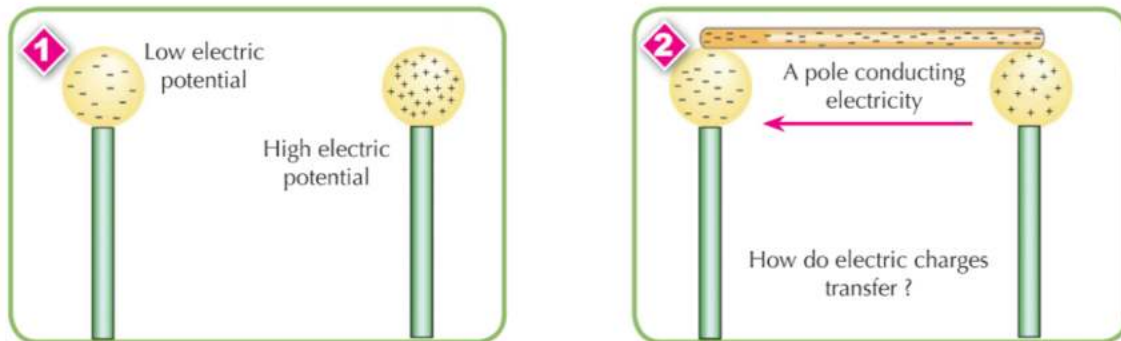


▲ Figure (5) : Heat transference by conduction



**Similarly, for electricity:**

The potential difference between two conductors determines the transference of the electric charges to and from an object when it is conducted to another conductor. If two charged conductors touch and the electric potential of one conductor is higher than the electric potential of the second (Figure 6) then the electric current will flow from the first conductor to the second conductor until their potential becomes equal. The transference of the charges does not depend on their amount, but on the conductor potential in comparison to the other conductor.



▲ Figure (6) : Flow of electric current depending on the potential difference between 2 conductors

We can define the potential difference between the two poles of a conductor as follows:

**It is the value of the work done to transfer a quantity of electric charges of one Coulomb between the two poles of this conductor.**

$$\therefore \text{Potential difference} = \frac{\text{Work (joule)}}{\text{Amount of electricity (Coulomb)}} = ( \quad ) \text{ in volts}$$

**Example :**

- If the work done to transfer an electric charge of 300 coulombs between two points is 33300 Joules, calculate the potential difference between the two points .

$$\text{The potential difference} = \frac{\text{work done}}{\text{amount of electricity}} = \frac{33300}{300} = 111 \text{ volts}$$

### How to measure the potential difference? What is its measuring unit?

The Voltmeter (Fig.7) is used to measure the potential difference between two poles of a conductor.

Its symbol is  $\text{---}\text{V}\text{---}$  when drawing electric circuits. The measuring unit of the potential difference is known as the Volt. Volt is the potential difference between the two poles of a conductor on doing a work of 1 joule to transfer a quantity of electricity (1 Coulomb).

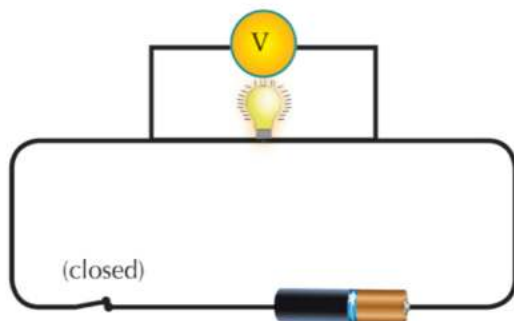


▲ Figure (7) : Voltmeter

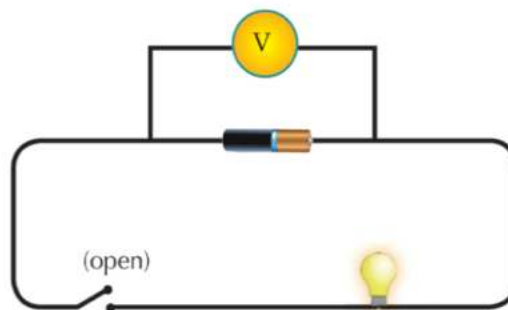
### How is the Voltmeter connected in a circuit?

It is connected in parallel.

- The Voltmeter is also used to measure the potential difference between the two poles of a battery, which is known as the electromotive force (e.m.f) which can be defined as the potential difference between the two poles of the battery when the electric circuit is open. Hence, no electric current passes through. E.m.f is measured in Volt.



▲ Figure (8) : Measuring the potential difference between the 2 ends of an electric lamp



▲ Figure (9) : Measuring the potential difference of a battery or (e.m.f)

### 3 The electric resistance (R) :

- During the flowing of an electric current through conductors (the wires), it faces an obstruction. The electric resistance can be defined as: the opposition that the electric current faces during its passage through a conductor.
- How to measure the electric resistance? What are its measuring units?
- An instrument known as the **Ohmmeter** is used to measure the electric resistance. The electric resistance measuring unit is known as the Ohm.

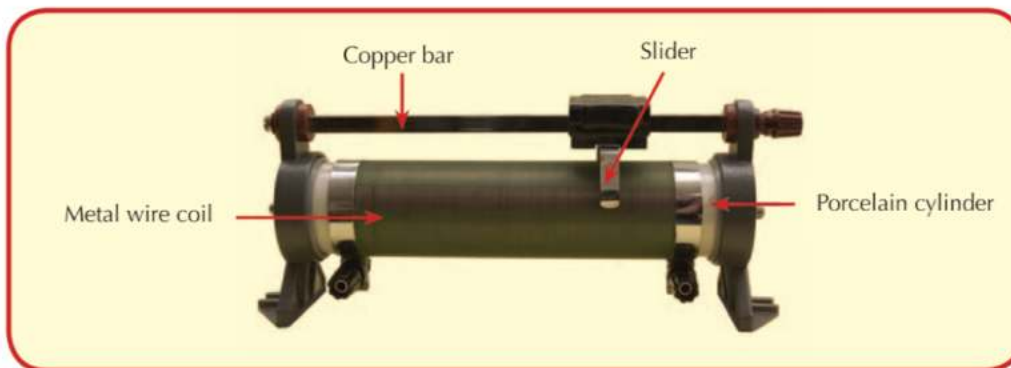
**The Ohm is the resistance between two points of a conductor when a constant potential difference of 1 volt, applied to these points, produces a current of 1 ampere in the conductor.**

### Types of electric resistance :

- 1 Constant, (it's symbol in an electric current is  $\text{~~~~~}$ )
- 2 Variable (Figure 10), it's symbol in an electric current is  $\text{~~~~~}$

### The variable resistance (The Sliding Rheostat):

It is a resistance that you can change it's value in order to adjust the value of the current intensity and potential difference in the different parts of the circuit.



▲ Figure (10) : The variable resistance (The Sliding Rheostats)

### Components of the variable resistance :

- 1 Metal wire of high resistance, coiled around a cylinder made of an insulating substance as porcelain.
- 2 Thin copper sheet is touching the wire and can slide over it for the whole length of the cylinder and known as the slider.

### Variable resistance idea of work:

Through the sliding of the flexible sheet on the wire coil, you can control the resistance that the current faces on passing through wire, and that is by controlling the length of the wire that enters the circuit where the current passes and thus controls the current in the circuit. Hence, if the length the wire increases, the resistance increases and the current intensity decreases.

#### Information

##### Enriching information

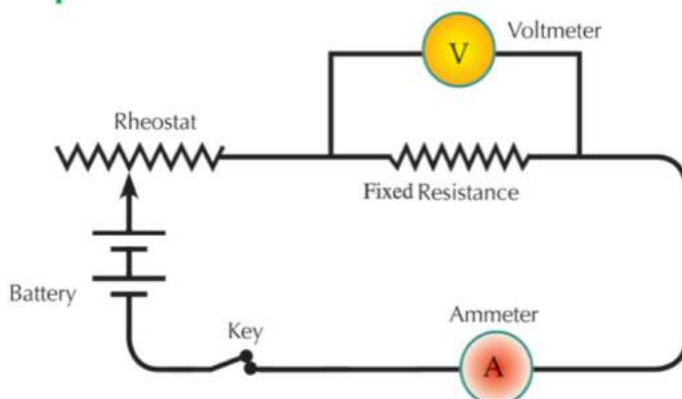
- Inside the fuel tank of a car, there is a buoy connected to a changeable resistance that controls the flow of the electric current in the car's fuel scale. When the level of the fuel is low, an electric current flows in a circuit causing the deviation of fuel pointer indicating that the car needs to the fuel.

### The relationship between the current intensity and the potential difference (Ohm's law):

Is there a relationship between the intensity of a current passing through an electric conductor, and the potential difference between its poles? To answer this question conduct the following experiment:

#### Activity

#### Discover the relation between current intensity and potential difference :



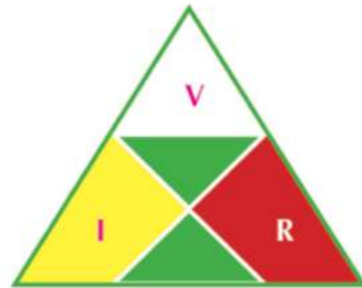
▲ Figure (11) : verification of ohm's law

- 1 Connect an electric circuit (Figure 11) consisting of a battery, variable resistance (rheostat), ammeter (connected in series), voltmeter (connected in parallel with a fixed resistance), and a key, and all are connected in series.
- 2 Switch On electric current to the circuit through an On/Off key and observe the current intensity in the circuit (reading of the ammeter in amperes) ( $I$ ), and the potential difference between two ends of fixed resistance (reading of the voltmeter in volts) ( $V$ ).
- 3 Change the resistance value by using the Rheostat; therefore, the values of ( $I$ ) and ( $V$ ) will change. Record their values?.
- 4 Repeat the above steps several times by changing the resistance each time. Find the values of ( $I$ ) and ( $V$ ) each time.
- 5 Find the result of dividing  $\frac{V}{I}$  in each time.
- 6 Record your results in the following table:

Current intensity ( $I$ ) in Amperes	Potential difference ( $V$ ) in Volts	$(\frac{V}{I})$

**What do you observe about the results you have obtained?**

- Dividing  $\frac{V}{I} = \text{constant value}$ .
- This constant value equals the conductor's resistance and its symbol is (R) and its unit is (Ohm).
- Therefore,  $V/I = R$  and this relationship is known as Ohm's law.
- i.e. the potential difference between the two ends of a conductor is directly proportional to the intensity of the current passing through this conductor when the resistance is constant.



▲ Figure (12) : A triangle that illustrates the relationship between the potential difference and current intensity

**Ohm:** It is the resistance of a conductor which allows the passing of an electric current its intensity is one ampere and the potential difference between its two terminals is one volt.

**Ampere:** It is the current intensity passing through a conductor whose resistance is one ohm and the potential difference between its poles is one volt.

**Volt:** It is the potential difference between the two poles of a conductor whose resistance is one ohm and the intensity of the current passing through it is one ampere.

**Ohm's Law:**

The electric current intensity passing through a conductor is directly proportional with the potential difference between its ends when the temperature is constant.

$$V = \text{constant} \times I$$

In other words:

$$V = R \times I$$

as (R) is the constant

Therefore, resistance = Potential difference (V)/current intensity (I)

From this relationship, resistance can be defined as the ratio between the potential difference of the two ends of a conductor and the current intensity passing through it.

**Example:** If an electric current of 0.2 amperes passes through an electric heater and the potential difference between its two ends is 220 Volts, calculate the heater's resistance.

**Solution:** Resistance = Potential difference (V)/current intensity (I) =  $220/0.2 = 1100 \text{ Ohm}$

**History****Scientists with a history**

- George Simon Ohm is a German scientist who discovered the quantitative properties of electric currents. He discovered a law in electricity that was named after him. The measurement unit of the electric resistance was also named after him.

## Lesson 1 Exercises

### 1 Complete the following sentences:

- a The potential difference between the two terminals of a conductor is ..... proportional to the intensity of the current passing through it at constant temperature .
- b The ..... is used to measure the current intensity in units known as .....
- c ..... is measured by using the voltmeter and has a measuring unit known as .....
- d The ..... is used to measure the electromotive force of a battery in units known as the .....
- e On connecting two charged conductors, the electric current passes from the conductor with ..... potential to the conductor which has ..... potential.

### 2 Choose the correct answer for each of the following statements:

- a The ..... is used to measure the electromotive force of a battery.  
(Voltmeter–Ohmmeter-Ammeter)
- b The sliding Rheostat are used to change ..... and ..... in the electric circuit.  
(The current intensity and potential difference – the resistance and potential difference – current intensity and resistance).
- c The Ammeter is used to measure ..... in the electric circuit.  
(The potential difference – the current intensity – the resistance)
- d The unit of measuring the electric resistance is .....  
(Ampere – Volt – Ohm)
- e The unit of measuring the current intensity is .....  
(Ampere – Volt – Ohm)

### 3 Write the scientific term corresponding to each of the following statements:

- a The opposition the electric current during its flow in the conductor.
- b The flow of electric negative charges in a conducting material (metal wire).
- c The quantity of electric charges that flow through a conductor in a time of one second
- d The state of an electric conductor that shows the transfer of electricity from or to it when it is connected to another conductor.
- e The resistance of a conductor when the potential difference of volt between its ends produces a current of ampere.

# Electric Current and Cells



## Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify some sources of the electric current.
- ✓ Compare between the alternating- current and the direct-current.
- ✓ Compare between the methods of connecting the cells in electric circuits.
- ✓ Appreciate the importance of using batteries in facilitating more important applications in our life.



## Lesson terms

- ◆ Direct current.
- ◆ Alternating current.
- ◆ Connecting electric cells in series.
- ◆ Connecting electric cells in parallel.

Electricity plays an important role in our everyday life.

In the previous lesson you knew what electric current means. Do you know some of its sources and types?

## Some sources of the electric current:

**There are two ways to generate the electric current:**

- ① Converting the chemical energy to electric energy in electrochemical cells (batteries or dry cells ) the electric current produced in known as the " direct current " .
- ② Converting the mechanical energy to electric energy by using the electric generator (dynamo). The electric current produced is called the "alter - nating current " .



▲ Figure (13) : Some sources of the electrical energy

## Types of the electric current

There are two types of electric current:

### 1 The direct electric current:

- It's an electric current with constant intensity. It flows in one direction through the electric circuit, since the electrons flow from one pole of the electro chemical cell passing through all the components of the circuit , to the other pole .
- This current is produced from electrochemical cells as the dry cell .
- The direct current can only be transported for short distances.
- It is used in electroplating and in operating of some electric appliances.
- It cannot be converted into an alternating current.

### 2 The alternating electric current:

- It's an electric current with variable intensity and direction . It flows in two opposite directions, where the electrons flow in one direction at the beginning, then starts to flow in the opposite direction . This cycle is repeated many times with high speed .
- This current is produced from the electric generators as the dynamo.
- The alternating current can be transported to short and long distances.
- It is used in lightening houses, streets and operating electric appliances.
- It can be converted to direct current.



▲ Figure (14) : Graphic representation of the electric current types

Now you can compare between the direct current and the alternating current using the following table:

Aspects of comparison	Direct current	Alternating current
Direction	.....	.....
Intensity	.....	.....
Source	.....	.....
Transport	.....	.....
Uses	.....	.....
Conversion to one another	.....	.....

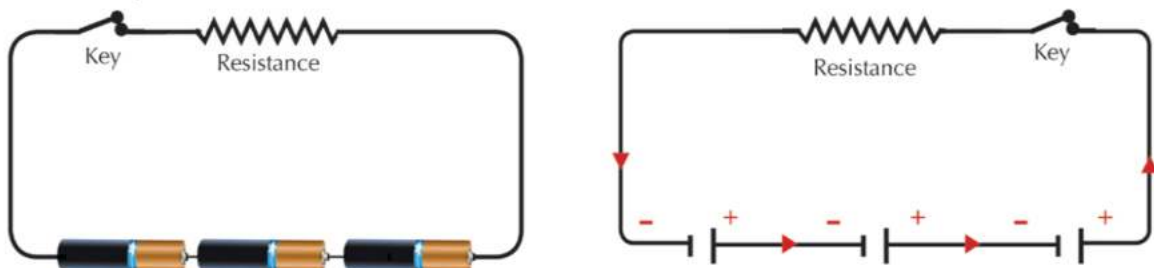


## Methods of connecting the electric cells in a circuit

To obtain batteries, the electric cells are connected in different ways, such as:

### 1 Connection in series:

- It is done by connecting the negative pole of the first cell to the positive pole of the second cell with a copper wire, then connecting the negative pole of the second cell to the positive pole of the third cell and so on. The positive pole of the first cell and the negative pole of the last cell are considered the two poles of the electric battery.

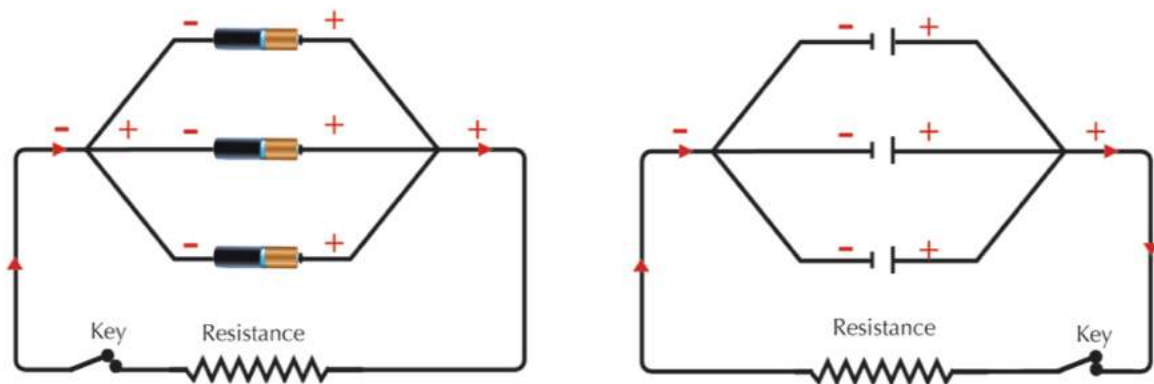


▲ Figure (15) : Connection of electric cells

- Electric cell is represented in the drawing by (  $\text{---} \text{---} \text{+}$  ) and they are two straight parallel lines . The longer line represents, the positive pole and the shorter one represents the negative pole.

### 2 Connection in parallel:

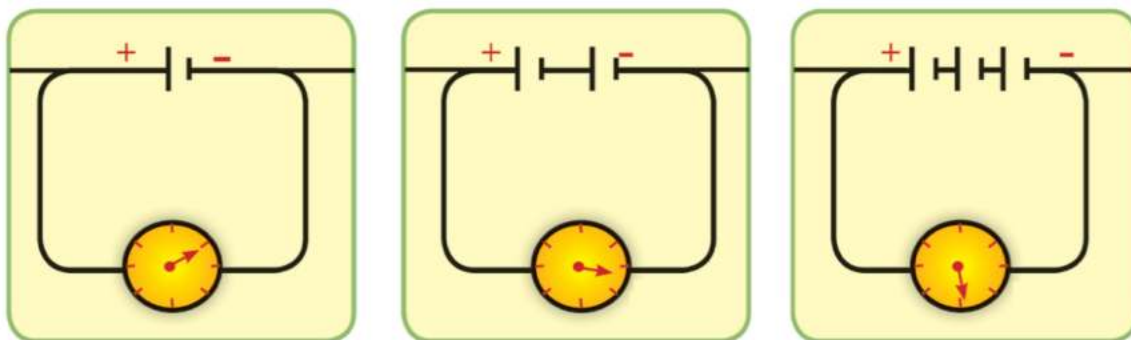
- It is done by connecting the positive poles of all electric cells together, and connecting the negative poles of all cells together with copper wires. Therefore, there'll be one positive pole and one negative of the battery that are the two poles of battery.



▲ Figure (16) : Connection of electric cells

## Activity

### Measuring the electromotive force (e.m.f) of cells connected in series :



▲ Figure (17) : Measuring the e.m.f of several electric cells connected in series.

- 1** Make an electric circuit consisting of one cell and a voltmeter. Determine e.m.f reading in the voltmeter ( $E_1$ ).
- 2** Connect another electric cell similar to the first cell in series. Determine e.m.f reading ( $E_2$ ).
- 3** Connect another similar cell in series with the other two cells. Let us assign the e.m.f reading in this case be ( $E_3$ ).

**What do you observe about the three values of e.m.f ?**

**What's your conclusion?**

- 1** The e.m.f in the second case is twice the emf in the first case, i.e. ( $E_2$ ) is twice the value of ( $E_1$ ).
- 2** The e.m.f in the third case is three times the emf in the first case, i.e. ( $E_3$ ) equals three times the value of ( $E_1$ ).

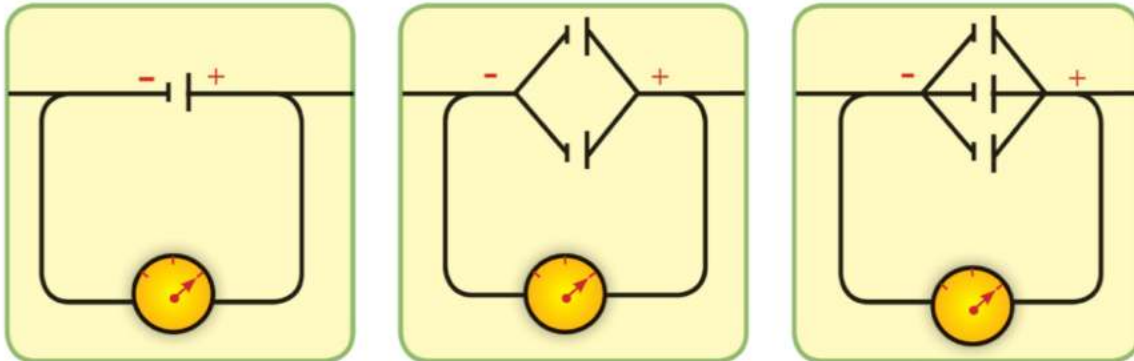
#### Conclusion:

- e.m.f of a battery made up of cells connected in series = the sum of e.m.f.s of these cells  
i.e.  $E = E_1 + E_2 + E_3$
- e.m.f of a battery made up of similar cells connected in series :  
e.m.f of the battery = e.m.f of one cell  $\times$  n  
where "n" is the number of similar cells .

## Activity

### Measuring e.m.f of electrodes connected in parallel :

- Repeat the previous experiment but connect the cells in parallel and let e.m.f reading in each step be  $(E_1)$ ,  $(E_2)$ , and  $(E_3)$ .



▲ Figure (18) : Measuring the e.m.f of several electric cells connected in series.

**What do you observe about the three values of e.m.f ? What's your conclusion?**

**Observation:**

- The reading in the third case is the same as in the second case and the same in the first case, i.e.  $E_1 = E_2 = E_3$ .

**Conclusion:**

- The e.m.f of several similar cells connected in parallel equals the e.m.f of one electric cell.
- i.e. e.m.f of the battery = e.m.f of one cell.

**Example :**

A battery consists of three electric cells, the e.m.f of cell each cell is 3 volts, calculate the electromotive force when the cells are connected : (1) in series (2) in parallel

**Solution :**

- Cells connected in series: e.m.f (battery) = e.m.f (one cell)  $\times$  n (number of cells) =  $3 \times 3 = 9$  volts.
- Cells connected in parallel: e.m.f battery = e.m.f one cell = 3 volts

## Lesson 2 Exercises

### 1 Complete the following sentences:

- a The electric current is generated from a dynamo due to converting ..... energy to ..... energy.
- b Electric cells produce ..... current while the dynamo produces..... current.
- c There are two types of electric current which are , ..... and.....

### 2 Choose the correct answer in the following:

- a The direct current is used in .....  
(lightening houses and streets – operating appliances - all the previous )
- b In the electric cell, ..... energy is converted into electric energy  
(kinetic - magnetic - chemical)
- c One of the properties of the direct current is .....  
(change value – change direction- constant value and direction)

### 3 Put (✓) or (x) in front of the following statements and correct the false ones

- a The electromotive force of several cells connected in series equals e.m.f of one cell. ( )
- b The dynamo produces alternating electric current. ( )
- c In electric cells and batteries, chemical energy is converted into electric energy . ( )

### 4 You have three similar cells, the electromotive force of each is 1.5 volt, explain by using diagrams how you can connect them to obtain an e.m.f of:

- a 1.5 volts
- b 3 volts
- c 4.5 volts

# Radioactivity and Nuclear Energy



## Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify the phenomenon of radioactivity.
- ✓ List examples of radioactive elements.
- ✓ Identify the peaceful usages of the nuclear energy.
- ✓ Identify the harmful effects of radioactive pollution and means of prevention.
- ✓ Give an opinion about the importance of nuclear energy use in the peaceful aspects of human.



## Lesson terms

- ◆ Radioactivity.
- ◆ Nuclear Energy.

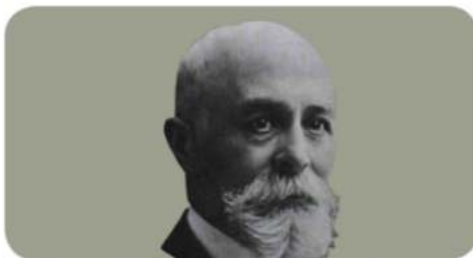
You previously knew that the elements consist of atoms and the atom's mass is concentrated in the nucleus . Also, you knew that the composition of the atom is responsible for the chemical and physical properties of the element.

The atom's nucleus is considered as energy store. This energy originates due to a force that binding the nucleus components and overcoming the repulsion force between the positively charged protons that found inside the nucleus.

These forces are the source that gives the atom its tremendous force which is known as the (nuclear energy).

## Discovering the radioactivity phenomenon:

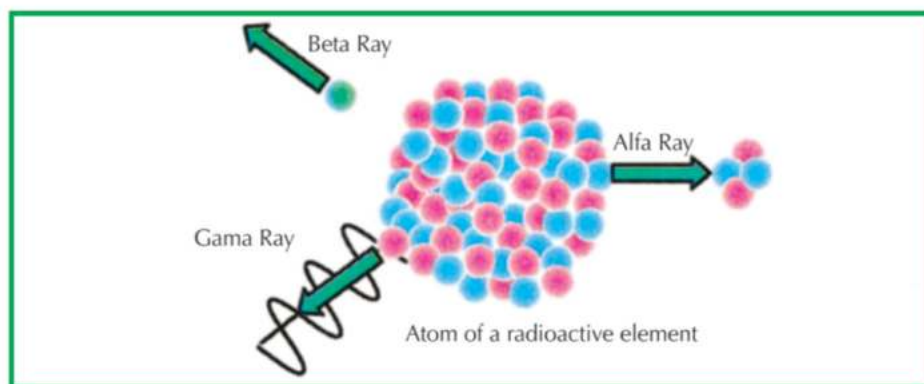
The radioactivity was known for the first time by the French scientist "Henry Becquerel" who discovered the emission of an unseen rays from the uranium element that has the capacity to penetrate through solid objects.



▲ Figure (19) : The scientist Henry Becquerel

## What is meant by the radioactivity phenomenon?

The radioactivity phenomenon is defined as the spontaneous decaying of the atom's nuclei of some radioactive elements that are present in nature in an attempt to achieve a more stable composition, where the atom nuclei of these elements contain a number of neutrons more than the number required for its stability. Therefore, it is unstable due to its excess energy. These elements are known as natural radioactive elements. Some of the examples of these radioactive elements are radium, uranium, cesium polonium, rubidium, selenium and zirconium.



▲ Figure (20) : Radioactivity

### Types of Radioactivity:

#### Natural radioactivity :

It is the radiation produced from the radioactive elements present in nature.

#### Artificial radioactivity :

It is the radiation or nuclear energy that is either released during nuclear reactions that can be controlled and which are done in nuclear reactors (peaceful uses) or that can not be controlled in the case of nuclear bombs (military uses).



### Scientists with a history

- Dr. Aly Mostafa Moshrafa is an Egyptian scientist who was described by Einstein that he is one of the greatest physicists in the world. He has great theories in the fields of atom and radiation. Basics of manufacturing the atomic bomb were based on his theories. He gave his objection to this matter and called for the necessity of exploiting the atom and radiation for the benefit of humanity. Use EKB to search for the achievements of arabian and forgen scientists in the nuclear energy



Dr. Aly Mostafa Moshrafa

## The peaceful uses of nuclear energy

The scientists were interested in finding beneficial uses of the nuclear energy. And that was by controlling the amount of energy released from the nuclear reactions conducted in nuclear reactors, therefore, can be used in peaceful uses in a lot of fields as:

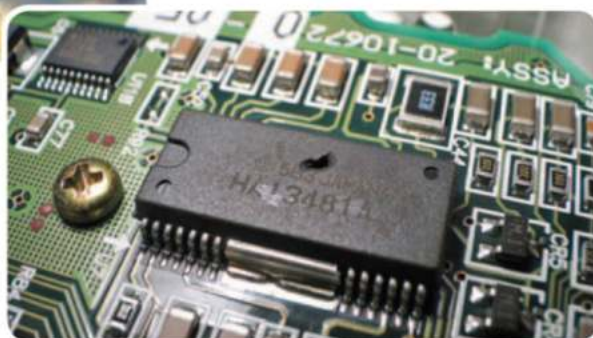
- 1 In the medical field:** To treat and diagnose diseases like cancer.
- 2 In the agricultural field:** To eliminate pests and to improve of some plant races.
- 3 In the industrial field:** To convert sand to silicon sheets which is used in manufacturing computer processors and programmed electric circuits that are used in electric appliances and also used to discover the defects in manufactured products.
- 4 In the electricity generation field:** The temperature produced from the nuclear energy is used to heat water till boiling . The water steam produced is used to operate the turbines to generate electricity.
- 5 In the space exploration field:** It is used as a nuclear fuel used by rockets that fly in space.
- 6 In the drilling field:** Used in the search and the drilling for petroleum and underground water.



In the space exploration field



In disease diagnosis field



In industry

▲ Figure (21) : Some uses of nuclear energy

## Risks and harmful effects of radioactive pollution and means of protection:

There are two sources of radioactive pollution:

### 1 Natural sources:

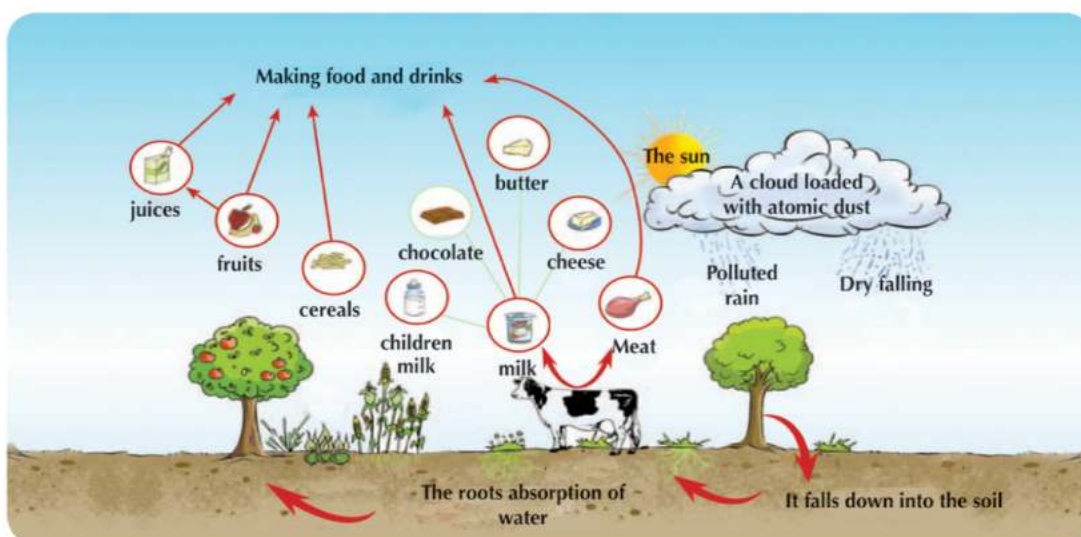
- They are represented by the natural radiation sources found on the surface of earth and in the cosmic radiation that comes from outer space.

### 2 Artificial sources:

- They take place as a result of the explosion of nuclear bombs that some countries experiment every once in a while . They are also due to nuclear reactors. All this leads to raising the amount of radiation and its varieties in the environment surrounding , which leads to radioactive pollution of the environment .
- The Chernobyl accident resulted in the pollution of food products by radioactive elements. On the 26 of April 1986, an explosion occurred in the Russian reactor as a result of an error in operation. This resulted in the melting of the reactors core which lead to a nuclear explosion and consequently the release of many of the radioactive elements forming an atomic cloud that was carried by the wind to most of the countries in eastern and western Europe. The peak of the pollution was when rain fell in May of the same year carrying the radioactive elements with it to the surface of earth.



▲ Figure (22) : Inside a nuclear reactor



▲ Figure (23) : An image that illustrates the way by which food is polluted by radioactive elements



In the previous figure, We notice that pollution from the clouds loaded with the atomic dust reaches earth either by dry falling or by falling with rain to earth. Therefore, the plants and soil are polluted by the fallen radioactive isotopes and thus herbivores as cows and sheep. Thus their milk products and meat will all be polluted by radiation.

What are the radioactive isotopes (isotopes are atoms that contain the same number of protons and different number of neutrons) which are found in polluted food?

It has been known that the elements that are found in the polluted food after the Chernobyl accident are iodine and cesium isotopes. They are elements produced from the decay of the nuclear fuel (uranium – 235) when absorbing the neutrons and carried by the clouds and wind as an atomic radioactive dust.

## The radiation effects on the human body

The radiation effects on the human body differs with the duration of the exposure to the radiation. This effects can be divided in two groups:

### 1 The effects of exposure to a large dosage of radiation for a short time:

- This will lead to the damage of each of the bone marrow, spleen, the digestive system and the central nervous system. The bone marrow is responsible for forming the blood cells is affected by radiation. This will reduce the number of red blood cells which causes the feeling of being sick, having a sore throat accompanied by nausea, vertigo and diarrhea.

### 2 The effects of exposure to small doses of radiation for a long period of time:

- If a person is exposed to small doses of radiation for a long time (months or years), the most important effects are:

#### a - Physical and genetic effects :

The changes that appear on a living organism as a result of exposure to radiation are called physical changes.

#### b - Genetic effects :

The radiation could result in genetic changes as it causes changes in the sex chromosomes composition which results in abnormal births.

#### c - Cellular effects :

Radiation causes changes in the cells composition. The chemical composition of the hemoglobin changes and it becomes incapable of carrying oxygen. Thus, exposure to large doses of radiation destroys the cells.



▲ Figure (24) : Exposing to radiation causes genetic changes

## Ways of Protection from Radiation

- 1** Those who work with radioactive elements in laboratories and hospitals should wear protective gloves and clothes from radiation.
- 2** Setting special laws to oblige the nuclear reactors to cool the hot water down before pouring it into seas and lakes.
- 3** The nuclear wastes are get rid of by different methods depending on the strength of the radiations they emit:
  - (a) The nuclear wastes that emit weak or intermediate radiation intensity are buried underground after being surrounded by a layer of cement or rocks.
  - (b) The nuclear wastes that emit strong radiation are deeply buried underground.
- 4** The following conditions should be considered on burying the radioactive wastes:
  - (a) These radioactive wastes should be buried remotely away from streams of underground water to avoid their pollution.
  - (b) The region chosen to store radioactive wastes should be stable and not exposed to earthquakes or volcanoes.

### The safe dose when exposed to nuclear radiation:

In general, we should not be exposed to nuclear radiation. The limit of the safe dose of radiation for those people who work in radiation field should not exceed 20 milli-Sievert per year. However, the safe dose of radiation for public should not exceed 1 milli-Sievert per year.

The Sievert (sv) is the international unit of measuring the radiation absorbed by the human body. (1 milli-Sievert =  $10^{-3}$  Sievert).

### The effective safe dose of radiation differs according to:

- 1- The person's age.
- 2- The interval of being exposed to radiation.
- 3- The body tissue exposed to radiation.



▲ Figure (25) : Wearing gloves and protective clothes to protect against radiation

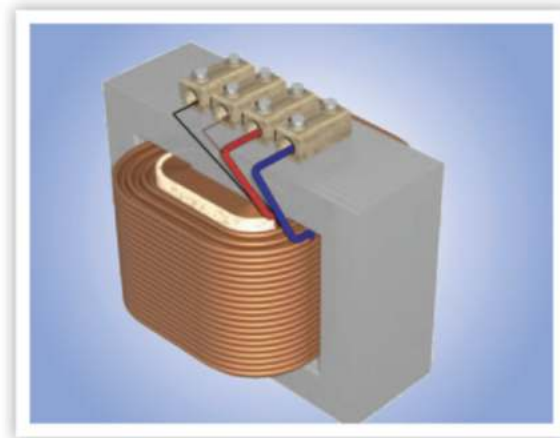


▲ Figure (26) : Some wastes are placed deeply inside the earth after surrounding it with a layer of cement or rocks

## Technological application

### The electric potential at home and in electric equipments:

- You may know that the electric voltage at home is 220 Volt. But, what if you get a device operated by voltage of 110 Volt? Of course you know that if you connect the device directly at home, it will break down. You should use a device known as "The electric transformer" by which you get the required voltage



Electric transformer

( 110 Volt out of 220 Volt (a step down transformer that reduces voltage). Search for the types of the electric transformers using the school library and the internet. Write a report to be attached to your portfolio.



- The nuclear explosion in bombs and atomic reactors leads to radioactive pollution causes a dangerous harms of the environment for hundreds of years. Use EKB to make a research on radioactive pollution ,its causes the way of protection then show what you gained with your classmates and teacher.

## Lesson 3 Exercises

### 1 Choose the correct answer for each sentence:

- a** The radioactive phenomenon was discovered by the scientist .....  
.....  
(Ohm – Becquerel – Ampere)
- b** The ..... effects of radiation is a result of changing the sex  
chromosomes of the cells.  
(physical – genetic– cellular)
- c** Those who work with radioactive elements should not be exposed to  
radiation in amounts more than ..... millisievert yearly  
(5 - 8 - 10)
- d** ..... is a nonradioactive element  
(radium – uranium – iron)
- e** The measuring unit of absorbed radiation is the .....  
(curie – sievert – roentgen)

### 2 Give reason:

- a** The areas chosen for storing radioactive wastes should be more steady.
- b** Radiation has genetic effects.
- c** After the Chernobyl accident, radioactive isotopes were found in the food  
products.
- d** Radioactivity has natural sources and also artificial ones .
- e** Some elements are called radioactive elements.

### 3 Write the scientific term that corresponds each of the following statements:

- a** The process of spontaneous decaying of atoms of some elements present  
in nature to reach a more stability.
- b** The radiation and nuclear energy emitted during nuclear reactions that  
can be controlled and carried out at nuclear reactors.
- c** The changes that take place to the living organism due to its exposure to  
radiations.
- d** The measuring unit of the absorbed radiation.



## Science, Technology and Society

### Enriching activity

#### Make a lemon battery (in series and in parallel):

##### Tools and materials used:

Fresh ripe lemons – small ribbons of copper – 4 small ribbons of lead – copper wires for connection – paper clips – two small electric lamps.

##### Procedures:

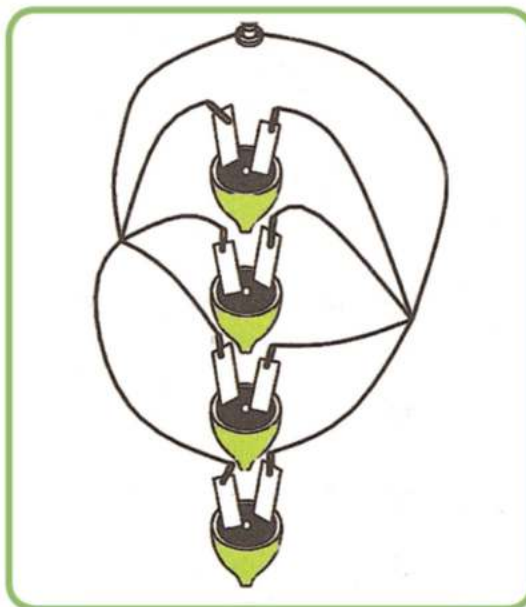
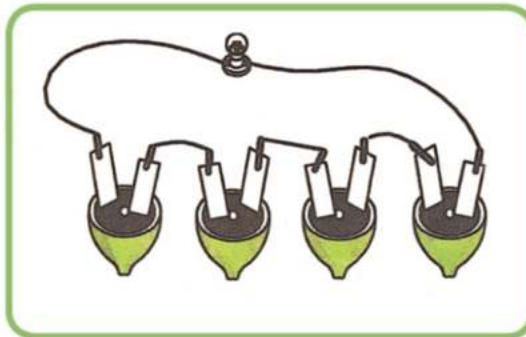
- 1 Cut the lemons into halves.
- 2 Fix ribbons of both copper and lead and fix the wires as in the figure .
- 3 Connect the free ends of ribbons together and with a small electric lamp .

##### Record your observations.

.....  
.....

##### Analyze your conclusions:

- Which battery has its cells connected in series? Which battery has its cells connected in parallel?
- Which battery caused the lighting of the lamp with greater intensity?
- How can you improve the lighting of the lamp connected to the battery that caused the lamp to light with less intensity?



## Unit 2 Exercises

### 1 Write the scientific term that responds to each of the following statements:

- a The flow of electric charges in a conductor.
- b The electric current of constant intensity and direction.
- c The resistance of a conductor that allows the passing of an electric current of 1 Ampere through it when the potential difference between its two ends is 1 Volt.
- d The intensity of the electric current flowing in an electric circuit when an electric charge of 1 Coulomb passes within the conductor's cross-section in 1 second.
- e The device used to measure the intensity of the electric current passing in a conductor.
- f The electric state of a conductor that shows the transference of electricity from and to it.
- g The measurement unit of the electromotive force of the electric cell.
- h The measuring unit of the absorbed radiation.
- i The natural decaying of the atoms of some elements in nature as an attempt to reach a more stable composition.

### 2 Choose the correct word:

- a Direct current can be produced from .....  
(electrochemical cells – electric generators – electric power stations)
- b The ..... is the measuring unit of the electric charges .  
(coulomb – ampere – volt)
- c The ..... is the measuring unit of the electromotive force .  
(coulomb – ampere – volt)
- d The ..... is used to measure the electric resistance.  
(ammeter – voltammeter – ohmmeter)
- e The ..... is the measuring unit of the current intensity.  
(coulomb – ampere – ohm)
- f The mathematical relation of Ohm's law is .....  
( $R = V/I$ ,  $I = R/V$ ,  $R = V \times I$ )
- g You should not be exposed to radiation more than ..... millisievert yearly.

( 5 - 15 - 20 )

**3 Give reasons for the following:**

- a** It is better to use the alternating current rather than the direct current.
- b** The voltmeter is connected to both poles of the battery in the electric circuit.
- c** Rheostat is used in some electric circuits.
- d** Some cells are connected in the electric circuit in series.
- e** Some cells are connected in the electric circuit in parallel.
- f** The electromotive force of a battery whose cells are connected in series is greater than that one whose cells are connected in parallel.
- g** Some elements are called "the radioactive elements".
- h** Radiation has genetic effects.

**4 Calculate the potential difference between the two ends of a vacuum cleaner whose resistance is 22 Ohms and the current intensity passing through it is 10 Amperes .**

**5 You have 4 similar electric cells. The potential difference of each one is 1.5 Volt. Illustrate by drawing how you connect them to get batteries of e.m.f of:**

- a** 6 Volt.
- b** 4.5 Volt.
- c** 3 Volt ( in two ways ).
- d** 1.5 Volt.

**The Second Term - Unit Three**

# Genetics

## Introduction

Genetics explains to us the existence of the similarity between you and your brothers or sisters as well as the differences in some external traits.

This is because genetic traits transfer from a generation to another according to basics and laws that geneticists reached.

Genetic traits transfer through the reproduction. In the asexual reproduction, the offspring are exactly similar because they are produced from one parental cell. In the sexual reproduction, there are similarities and differences between offspring as they are resulted from the mating of two individuals.





## UNIT OBJECTIVES

By the end of this unit, you will be able to :

- ✓ Identify the difference between the hereditary and acquired traits.
- ✓ Identify Mendel's laws of heredity.
- ✓ Identify the concept of the dominant and recessive traits.
- ✓ Determine the dominant and recessive traits in Mendel's experiments on the pea plant.
- ✓ Identify some of the dominant and recessive traits in the human being.
- ✓ Identify the concept of gene.
- ✓ Identify the different types of mutations.
- ✓ Appreciate the efforts of geneticists in discovering how traits are transferred through generations.

## Included issues

- ◆ Preserving the resources.



**Lesson 1**  
The main principles  
of heredity

# The Main Principles of Heredity



## Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Determine the difference between the hereditary and acquired traits.
- ✓ Explain why Mendel chose the pea plant for his experiments.
- ✓ Identify Mendel's two laws of heredity.
- ✓ Identify the concept of the dominant and recessive traits.
- ✓ Determine the dominant and recessive traits in Mendel's experiment of the pea plant.
- ✓ Determine some of the dominant and recessive traits in the human being.
- ✓ Identify the concept of the gene.
- ✓ Identify the role of the genes in determining the traits of the living organisms.
- ✓ Appreciate the scientists role in discovering the nucleic acids structure and their role in genetics.



## Lesson terms

- ◆ Hereditary traits
- ◆ Acquired traits.
- ◆ Dominant traits.
- ◆ Recessive traits.
- ◆ The gene

Thousands of years ago, Man has observed that some traits are transmitted from one generation to another and scientists have called them “**hereditary traits**” like the color of the hair, the color of the skin, the numbers of fingers and the blood groups. Some traits are not transmitted from one generation to another and they are called the “**acquired traits**”.

Now, you might wonder:

**How hereditary traits are transmitted from one generation to another and why some traits of the parents appear in the offspring?**

The experiments by Mendel placed the basics for the scientific studies of heredity. According to the results reached by Mendel and over the years, heredity scientists have gathered a lot of information on the reasons why the living beings have the forms they have, or behave the way they do. How did Mendel start his experiments and what are the results that he reached?



▲ Figure (1) : The scientist Mendel (The founder of heredity)

## Experiments of Mendel















Mendel chose the pea plant to conduct his research and his choice of this plant was due to the following reasons :

- 1 It is easy to plant the pea plant and it grows fast.
- 2 The life cycle of the pea plant is short.
- 3 The flowers of the pea plants are hermaphrodite, and thus it can self pollinate.
- 4 It can easily be artificially pollinated (human intervention).
- 5 Pea plant produces large numbers of offspring in a generation.
- 6 There are several types of peas that have pairs of contrasting traits that can be recognized easily. Some of the plants are long stemmed and others are short stemmed. The flowers of some of the plants are white and others are red. The pods of the peas could be green in color or yellow and so on.



▲ Figure (2) : The pea plant

Despite the numerous different traits of the pea plant, Mendel chose seven main traits to conduct his experiments and the following figure shows these traits:

Seed Shape	Seed Color	Pod Shape	Pod Color	Flower Color	Flower Position	Stem Height
 Smooth	 Yellow	 Swollen	 Green	 Red	 Side	 Tall
 Wrinkled	 green	 Sinuous	 yellow	 white	 end	 Short

Mendel studied the inheritance of each pair of the contrasting traits separated by following specific scientific steps. To explain that, we follow these steps in studying the seed color trait of the plant:

### Mendel's experiment to study the seed color of the pea plant:

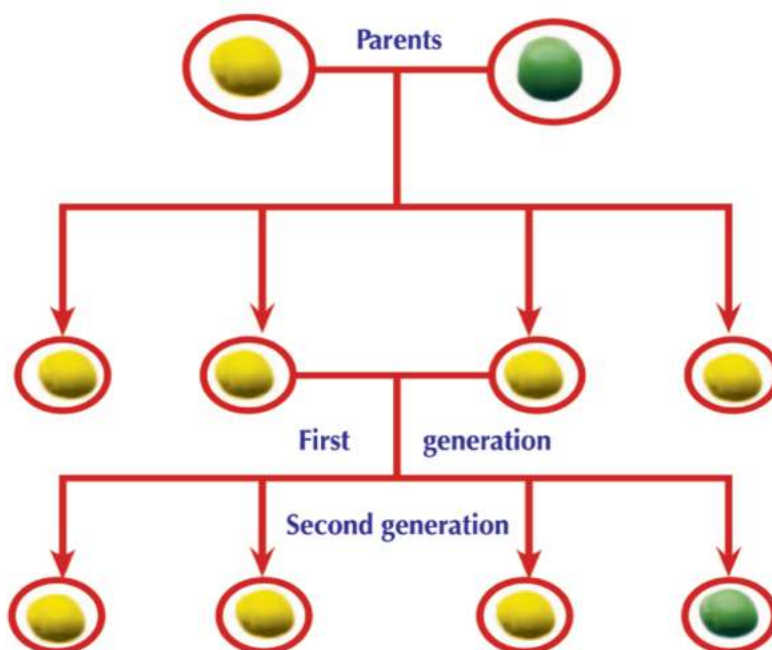
- 1** Mendel planted a pea plant that produces yellow seeds and a pea plant that produces green seeds for several generations to make sure of the purity of these traits. Thus, the yellow seeds produced yellow seeds plants generation after another, and the same goes for the green seeds plants. Mendel was able to do that by self pollination of these plants for several generations.
- 2** After making sure of the purity of the yellow and green seeds traits of the plants, he planted the seeds of these plants (parents) . When plants were produced carrying flowers, Mendel removed the stamens of their flowers before the another becomes mature to avoid a self pollination.

**Why did Mendel remove the stamens from the flowers of the plants?**

.....

- 3** By means of cross pollination, Mendel pollinated the flower of the plants that produces yellow seeds with pollen grains from a plant that produces green seeds. He also pollinated the flower of the plants that produces green seeds with pollen grains from a plant that produces yellow seeds , then he covered the stigmas of the pistils to avoid cross pollination .

**Why did he covers the stigmas ?**



Mendel observed that all the plants produced only yellow seeds and the green color of the seeds disappeared completely in the plants of first generation. Mendel named the trait of yellow color of the seeds the "dominant trait" that is it dominates the other trait. He named the trait of the green color of the seeds the "recessive trait"

- 4** Mendel let the first generation plants self pollinate, then planted the resulting seeds swollen and got the second generation plants, some with green seeds representing only a quarter of the produced plants, but the plants with yellow seeds represent three quarters of the second generation.

## The principle of complete dominance

Mendel repeated the same experiment for the seven other traits of the pea plant and got the same results. He found out that the long-stem trait dominates the short - stem trait, the red color of the flower dominates the white color, the side position of the flower trait dominates the end position, the smooth seed trait dominates the wrinkled one, the swollen pod shape trait dominates the sinuous, and the green pod color trait dominates that of the yellow color. He observed that one of each pair of traits disappears completely in the first generation then the two contrasting traits appear in the second generation in a ratio of approximately 3:1.

Mendel named the trait that appears in all individuals of the first generation as "the dominant trait" and named the other trait that disappears in the individuals of the first generation as "the recessive trait".

The principle of complete dominance : is the appearance of a dominant hereditary trait in the individuals of the first generation when two individuals are crossed over, one of them carries a pure trait contrasting the trait carried by the other individual.

**What did Mendel deduce from the previous experiment?  
Mendel deduced the following :**

- 1** The color of the seed depends on (factors) present in the plants transmitted from one generation to another by means of gametes. There is a factor that determines the yellow color of the seed and another factor that determines the green color of the seed.
- 2** When these factors meet in the first generation, the yellow color factor is dominant over the green color factor that is recessive and this leads to the production of only yellow seeds in the first generation.
- 3** When the gametes in the first generation are produced by meiosis, these factors separate (segregate) from each other, then they meet again on the production of the second generation.



▲ Figure (4)



Figure (5)

- 4 If the yellow color factor meets with the green color factor another time, the result is a yellow seed, but if the green color factor meets with another green colour factor the result is a green seed.

### Mendel's first law: The law of segregation of factors :

Mendel made several assumptions to explain the appearance of the dominant trait and the disappearance of the recessive trait in the first generation in the experiments of the pea plant that he studied, and these assumptions are:

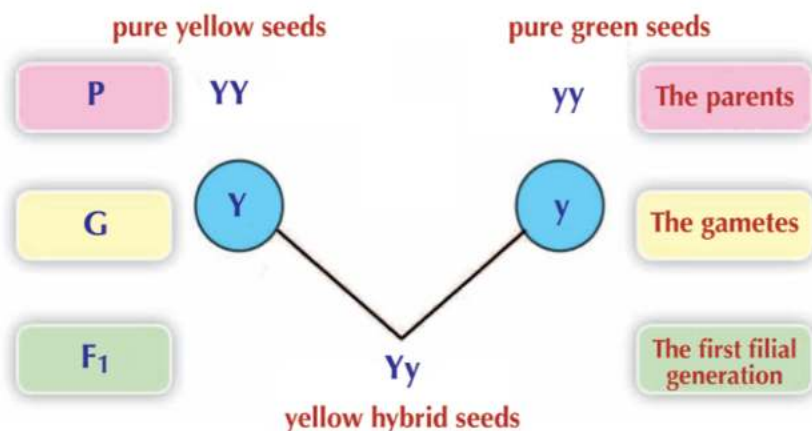
- The hereditary traits are transmitted from the parents to the offspring by means of hereditary factors which are now known as the genes.
- In a living organism, every hereditary trait is controlled by two hereditary factors (one from the father and the other from the mother). These factors are similar or homozygous if the trait is pure and not similar (different) if the trait is impure or heterozygous and the living organism that carries an impure trait is called a hybrid.
- The two hereditary factors in every trait separate when the gametes are formed, where each gamete carries one factor for each hereditary trait.

Mendel has summarized the previous assumptions in a law known as Mendel's first law or the law of segregation as he named it, and it states:

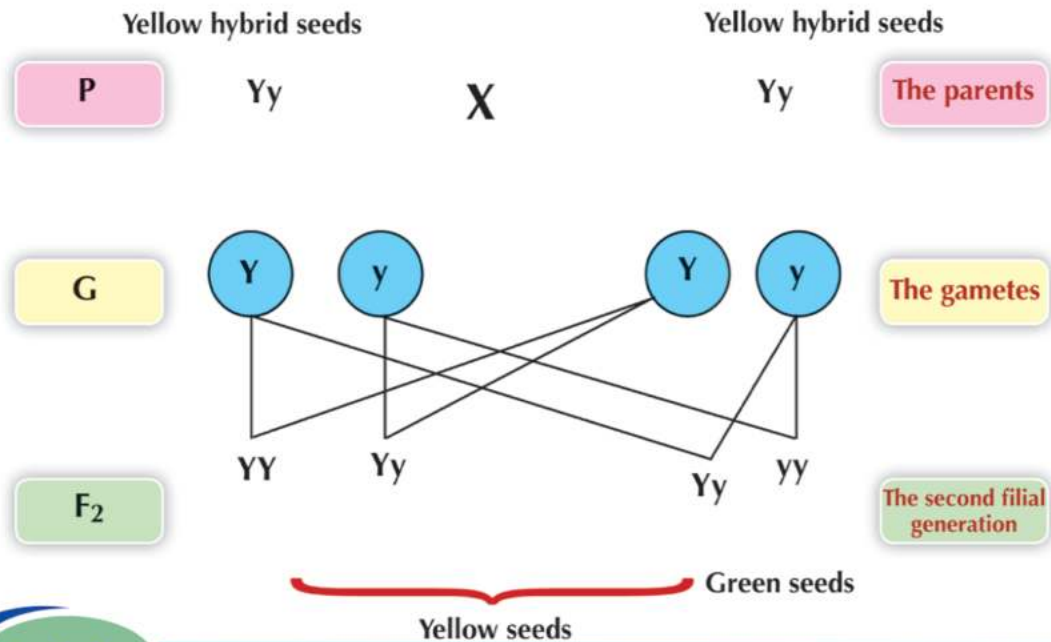
“When two members of any pair of Homozygous hereditary traits are different from each other, only the dominant trait appears in the F1 generation, while the two traits appear in the F2 in the ratio of 3 dominant : 1 recessive.”

### Using symbols to represent the results of the experiment:

If we choose a symbol to represent the color of the seeds in the plant and we symbol the dominant color (yellow) by the letter (Y) and we symbol the recessive color (green) by the symbol (y), therefore the pea plant with pure yellow seeds becomes (YY) and the pea plant with pure green seed becomes yy and we can represent the crossing-over between the two plants by using the symbols as follows:



When the experiment continues and we let the plants of the first generation self pollinate, we get the second generation that we symbol as follows:



### Activity

### Discover the results of pollinating two pea flowers that are different in colour

The following figure represents the results of crossing-over between two different color flowers of the pea plant. By referring to what you have learned, answer the following questions:

The contrasting traits are .....

The dominant trait is .....

The recessive trait is .....

#### Explain your answers

.....

If the flowers resulting from the first generation are self pollinated, express by drawing and symbols the results of the second generation.



The scientist Mendel is the founder of heredity. Use EKB to look for videos, pictures, and ppt about the work of Mendel. then show what you gained with your classmates and teacher.

## Mendel's second law: The law of independent assortment of hereditary factors.

Mendel continued his experiments on the pea plant by studying how two pairs of contrasting traits are inherited. He conducted a mixed pollination between two pea plant where one carries two pure dominant traits (tall stem and red flowers) and the other carries two recessive traits (short stems and white flowers).

Mendel observed that all the first generation plants had tall stems and red flowers and when he left the first generation plants to self pollinate to produce the second generation individuals he got the following plants:



▲ Figure (6)

9	3	3	1
Tall stem, red flowers	Tall stem, white flowers	Short stem, red flowers	Short stem, white flowers

**From the previous results, observe the following:**

- In the first generation all the plants had tall stems and red flowers, thus the two dominant traits appeared.
- In the second generation the ratio of the number of red flower plants (dominant) to white flowers (recessive) was 12 : 4 thus 3 : 1, and the ratio of the number of tall stem plants (dominant) to short stem plants (recessive) was 12 : 4 thus 3 : 1.

**And from this Mendel deduced his second law (independent assortment of the hereditary factors ) which states :**

“When two Homozygous individuals bearing two or more pairs of alleles are crossed each pair of traits is assorted at random and is inherited independently of the other and will appear in the F<sub>2</sub> generation in the ratio 3:1”

### Information

#### Enriching information:

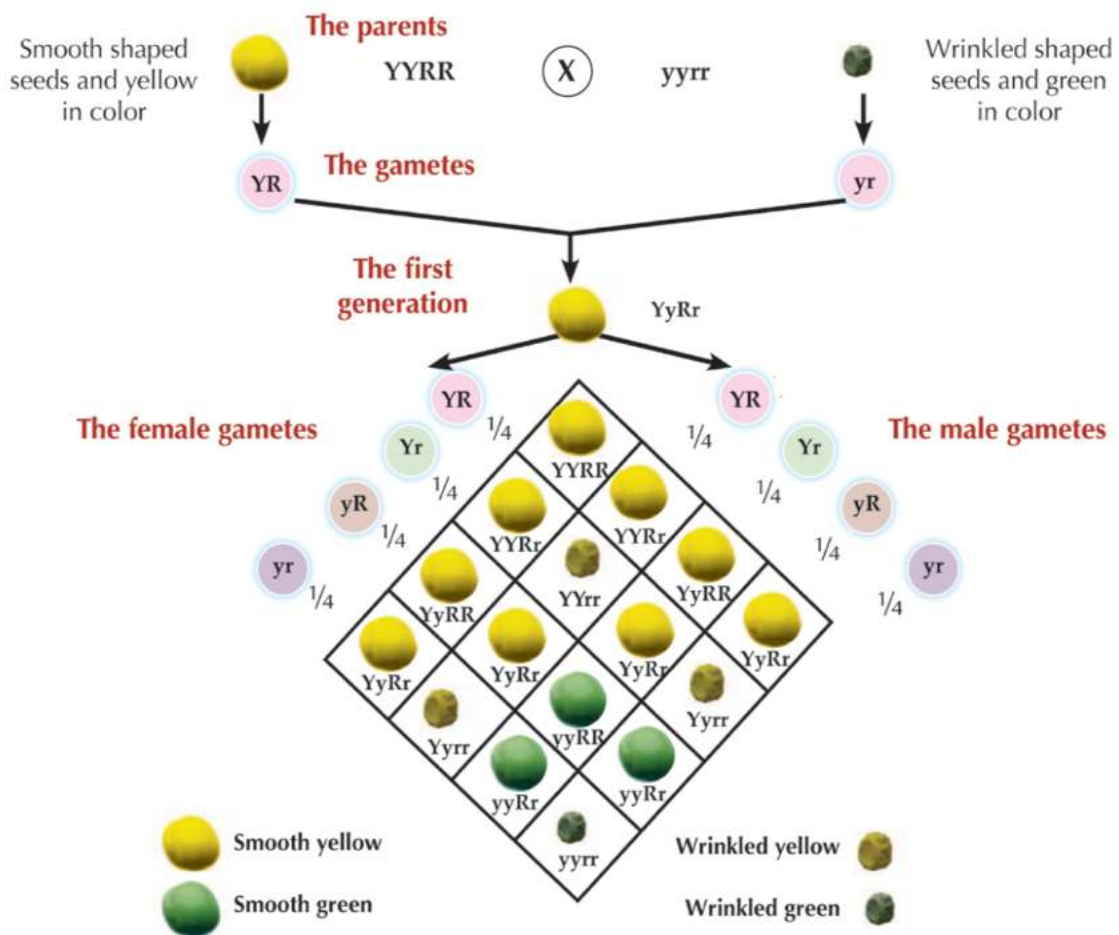
- At the beginning of the present century, many experiments were conducted to apply Mendel's laws of heredity on a number of traits in the animals and the plants. The results showed that inheriting some traits followed Mendel's laws, but there were cases that did not completely follow Mendel's laws, and it was agreed to name them the non-Mendelian heredity.



Activity

### Discover the inheritance of two pairs of the contrasting traits

The following figure shows the results of the mixed pollination between two pea plants where one carries two dominant pure trait, the smooth seeds and yellow colored seeds, and the other carries two recessive traits, the wrinkled seeds and green colored seeds.



#### Observe the figure and answer

- What are the traits that appeared in offspring of the first generation?
- Are they dominant or recessive traits?
- How many types of gametes produced in individuals of the first generation?
- Describe the second generation plants.
- What is the ratio of the green seeds to the yellow ones in the second generation?
- What is the ratio of the smooth seeds to the wrinkled ones in the second generation?

## The dominant and recessive traits in the human being

Many human hereditary traits follow the Mendelian heredity where the trait is controlled by one pair of genes. It can be dominant or recessive. The individuals who receive at least one dominant gene from either parent will have the dominant trait, and those who receive a recessive gene from both parents will have the recessive trait. Observe the following figures to identify some of the traits that follow the complete dominance principal in the human being:



▲ Figure (7): The ability to roll the tongue is one of the dominant traits in the human being



▲ Figure (8): The free ear lobe trait dominates the attached ear lobe trait.



▲ Figure (9): The curly hair trait dominates the straight hair trait



▲ Figure (10): The wide eyes trait dominates the narrow eyes trait



▲ Figure (11): The presence of cheek dimples trait dominates the no dimples trait



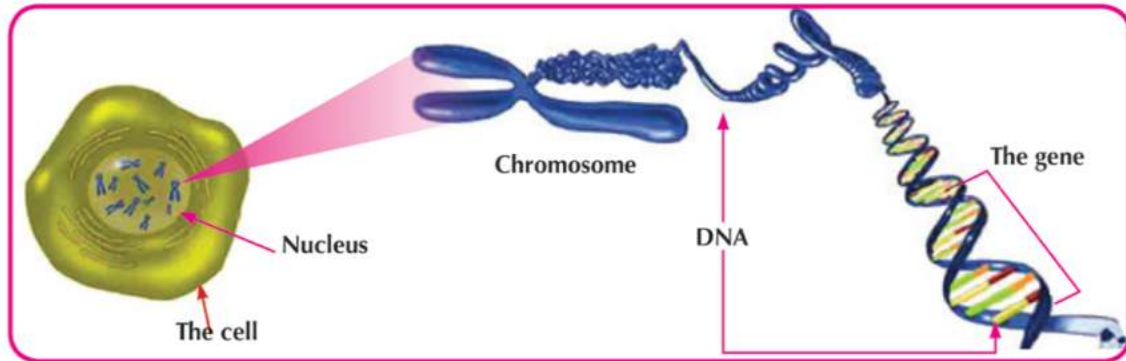
▲ Figure (12): The absence of freckles in the face trait is the dominant trait and the presence of freckles is the recessive trait



## The genes

### What are the genes?

You know that the chromosome is chemically consisted of a nucleic acid called DNA bind with the protein. The nucleic acid is what carries the hereditary traits of the living organism. Scientists have found that the genes are DNA parts present on the chromosomes.



▲ Figure (14) The hereditary material inside the nucleus of the cell.



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Watson and Crick have constructed a model of DNA consist of two strands coiled around each other forming a double helix shape.

The Gene is considered a part of DNA which consists of smaller structural units called Nucleotides.

Search by using (EKB) for the efforts of Watson and Crick in exploring the structure of DNA and the importance of this in the development of genetics. the demonstrate what you get to your classmates and your teacher.

### Information

#### Enriching information

- The Danish scientist Johansen used the term gene instead of the hereditary factor and introduced the term the "genotype" for the gene structure in the living organism, and the term "phenotype" for the hereditary trait that appear on the living organism.

## How do the genes perform their functions?

The genes control the body growth, features and functions. The scientists Badel and Tatum discovered the means of how the gene controls the appearance of a trait, where they found that every gene gives a special enzyme. This enzyme is responsible for the occurrence of a reaction resulting in a protein showing a specific hereditary trait. The two scientists received for that a Nobel Prize in the year 1985.

Let us take an example for the inheriting the trait of eyes colour, If you inherit one gene from one of your parents and it is responsible for the brown color of eyes trait which is the dominant trait, then the gene works on forming a protein where this trait appears on you.



▲ Figure (16): The brown eyes trait is dominant over the colored eyes

▲ Figure (17): The Black hair is dominant over the light colour hair.



## Science, Technology and Society

### Technological application:

#### The bio-technology collaborating with the traditional ways to combat malnutrition:

Around 500,000 people every year are affected by losing their sight, and this is due to the deficiency in vitamin (A). It is one of the important elements of nutrition that its deficiency leads to malnutrition. Deficiency in vitamin (A) is widespread in those who depend on eating rice. The rice does not contain pro-vitamin (A) or what is known as carotene (a substance which is converted into vitamin A in the body). Solving this problem is done by producing rice that contains pro-vitamin (A), and it depends on changing the genetic structure of the rice crop. This is done by inserting the genes that result in the creation of the pro-vitamin (A) compound inside the tissue that stores the starch in the plant seeds.

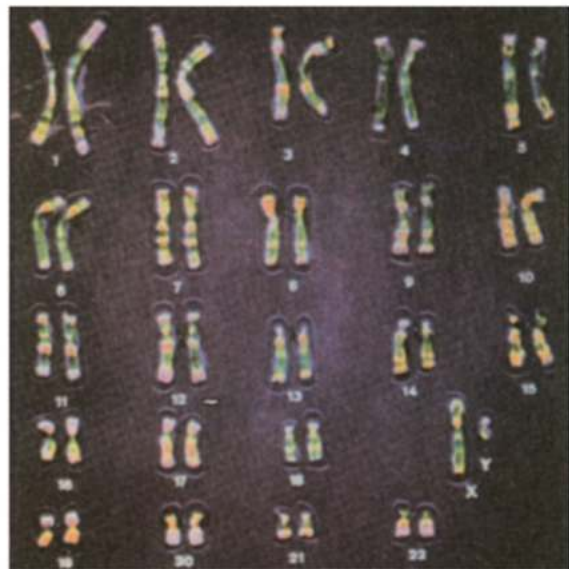
## Life application

### The human genome project

This project started in October 1990 with the aim of discovering all of the human inheriting factors (the genes). The project also aims to discover and determine the complete sequence of all the 3 billion pair of nitrogenous bases. The scientists have called the twenty first century the hereditary century due to the importance of this discovery.

The scientists decided to work hard to obtain a detailed very precise map for the sequence of the nitrogenous bases, and predicted that drawing this map will help to a great extent to understand the human biology and identify the single differences in the genome between one person and another. They discovered that although more than 99% of the DNA is similar in humans, the single difference could affect to a great extent the acceptance of the individual to the harmful environmental effects like bacteria, viruses, poisons, chemicals, medicines and various treatments.

Scientists believe that drawing a map will help them to identify the genes responsible for the various diseases like cancer, diabetes, vascular diseases, mental diseases, and to identify the various hereditary functions to the human. The project also is interested in the effect of the various mutations on the function of the genes.



The human chromosomes

## Lesson Exercises

### 1 Mention the scientific term:

- a A science that researches the transmission of the hereditary traits from one generation to another by the studying the similarities and differences between the parents and their offspring.
- b The characters ready to be transmitted from one generation to another.
- c The trait that appears in all individuals of the first generation in Mendel's experiments.
- d The appearance of a hereditary trait in the individuals of the first generation when two individuals are crossed one of them is carrying a pure hereditary trait contrasting the trait carried by the other individual.
- e It is chemically consisted of a nucleic acid called DNA combined with protein.
- f They are parts of DNA on the chromosomes and control the hereditary traits of the individual.
- g A trait that appears in the all first generation members.

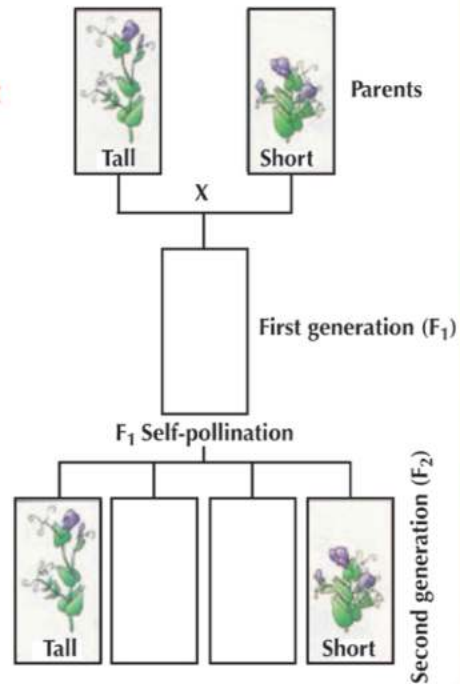
### 2 Explain:

- a Mendel's selecting the pea plant to conduct his experiments.
- b When a pure yellow pod pea plant is pollinated with a pure green pod pea plant, they produce plants that are all with green pods.
- d The ability of rolling the tongue is a dominant trait in the human being.

## Lesson Exercises

**3** The figure illustrates the mixed pollination between the flowers of the short pea plant and another tall one, determine :

- The individuals of the first generation.
- Complete the missing individuals of the second generation and describe the individuals of the second generation.
- Use symbols while expressing in the previous experiment.



**4** Define each of the following :

The gene – The chromosome – The recessive trait

**5** Put ( ✓ ) or ( X ) in front of the following statements and correct in the false ones:

- Genes are parts of DNA found in the cytoplasm of the cell.
- When a pure, short stem pea plant is pollinated with a hybrid, long stem one; all produced plants are short stem
- The free ear lobe is a dominant trait
- The presence of cheek dimples is a recessive trait

## Unit 3 Exercises

- 1 Place the mark ( ✓ ) or ( X ) in front of the following sentences and correct the mistakes:**
  - a** The acquired traits are transmitted from one generation to another
  
- 2 Mention the scientific term:**
  - a** The appearance of a hereditary trait in the individuals of the first generation after the mating between two individuals, where one carries a pure hereditary trait that contrast the trait that the other individual carries.
  - b** The traits that are not transmitted from one generation to another.
  - c** Parts of the DNA that are present on the chromosomes and carry the hereditary traits of the individual.
  
- 3 Mendel placed a group of assumptions to explain the appearance of the dominant trait and the disappearance of the recessive trait in the first generation in the experiments that he carried with the pea plant. Explain these assumptions.**
  
- 4 Explain:**
  - a** An experiment to explain the law of independent assortment of the hereditary factors.
  - b** How the genes perform their functions.
  
- 5 Compare between the following :**
  - a** The dominant trait and the recessive one with giving examples.



**6 Explain**

- a** Mendel chose the pea plant in conducting his experiments.
- b** When you pollinate a pure tall stem pea plant with a short stem pea plant, it produces plants all are tall stems.
- c** The free ear lobe is dominant over the attached ear lobe.

**7 Use symbol to express the results from the pollination between:**

- a** White flower pea plant with another red flower
- b** Long stem, green pod pea plant with another short stem, yellow pod

Showing Parents, Gametes, First and Second generation in each crossing.



The Second Term - Unit Four

# Hormones

## Introduction

The human body contains a group of organs known as endocrine glands that excrete chemical substances known as hormones that collaborate in their functions to achieve the homeostasis in human body.



## UNIT OBJECTIVES

By the end of this unit, you should be able to :

- ✓ Identify the concept of the hormone.
- ✓ Mention some hormones and their function in human body.
- ✓ Identify the role of hormones in homeostasis in human body.
- ✓ Identify some diseases results from hormone disorder in human body.

### Included issues

- ◆ Preventive health.
- ◆ Homeostasis.
- ◆ Hormone disorder.



## Lesson 1 Hormones in the human body

# Hormones in the Human Body



## Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify the concept of hormone.
- ✓ Mention some hormones and their function in human body.
- ✓ Identify the role of hormones in homeostasis in human body.
- ✓ Identify some diseases results from hormone disorder in human body.



## Lesson terms

- ◆ Hormones
- ◆ Endocrine glands.

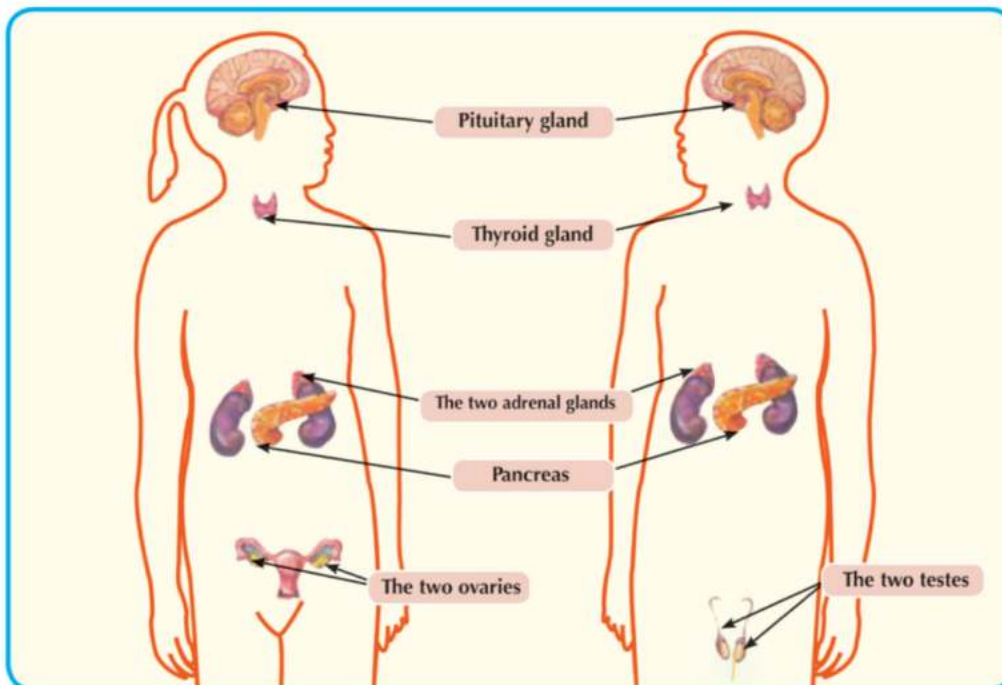
As you have learned, the function of the nervous system is to organize and coordinate both the activities and functions of the organs of living organisms. However, scientists' experiments and researches proved that there is another form of organizing and coordinating these activities and functions. This form is performed by chemical substances secreted by special cells in the body. These secretions, known as hormones, work in collaboration with the nervous system to do this task.

## The concept of the hormone

The hormone is a chemical substance (or a chemical message) that controls and organizes most of the vital activities and functions in the bodies of living organisms.

- Hormones are secreted in the body by some organs called endocrine glands or ductless glands (figure 20) as they secrete their hormones directly in the blood stream without passing in ducts. These glands secrete more than 50 hormones in the human body.
- Cells that the hormone affects are almost located away from the endocrine gland that secretes them. So, blood is the only way for the hormone to reach its site of action or what is known as the target cells .

## The most important endocrine glands in the human body



▲ Figure (20): Endocrine glands in the human body

### (1) Pituitary gland:

Below the brain, there is a small gland in the size of a pea seed which is called the pituitary gland. In spite of its small size, it is called the “master gland” or the “main gland” because it secretes hormones that regulate the activities of most of the other endocrine glands. It consists of two lobes; each one secretes various types of hormones.

Among these hormones secreted by the pituitary, there is what is known as “growth hormone” that controls the speed rate of the growth of your muscles, bones and other organs of your body. This hormone determines the height that you will reach when you become a grown up person.

In addition to growth hormone, the pituitary secretes a group of hormones. Some of these hormones activate the thyroid and the two adrenal glands. Others activate the sexual glands (the two testes and the two ovaries) when the person is about to reach adulthood and others activate the mammary glands to secrete milk, and another hormone which facilitates the process of delivery, and another hormone which regulates the amount of water in the body.

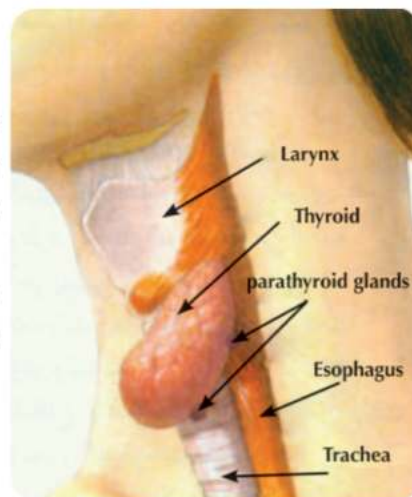
### Science

#### technology & society

- Why do the vocal cords of females make voices louder than those of vocal cords produced by males? This occurs because the sex hormones in the mature male body cause an increase in the thickness of the vocal cords. So, the thin vocal cords in a female's larynx vibrate faster than the thick vocal cords in a male's larynx.

## (2) Thyroid gland :

It consists of two lobes located in the front side of the neck on both sides of the trachea and linked together by a small part. Thyroid secretes a hormone called or thyroxin that plays a main role in the food assimilation processes in the body. It liberates the necessary energy of the human body from food. Thyroid also secretes the hormone "calcitonin" that controls the level of calcium in the blood. Figure (21)



▲ Figure (21): Thyroid and parathyroid glands

## (3) Pancreas :

You previously studied the role of pancreas in the digestion process. Determine the position of the pancreas in figure (22). In addition to the role of pancreas in the digestion process, it is considered an endocrine gland as well. It secretes a hormone called "insulin". This hormone helps the sugar transporting from blood to the body's cells as it can be used to release energy. So, this hormone reduces the level of sugar in the blood.

Also, pancreas secretes a hormone called "glucagon" whose function contradicts the function of the insulin hormone. It raises the level of sugar in the blood through stimulation the liver to convert the stored glycogen into glucose that release into the blood stream to be available to the body's cells.



▲ Figure (22): Pancreas

## Some hormones of endocrine glands and their functions

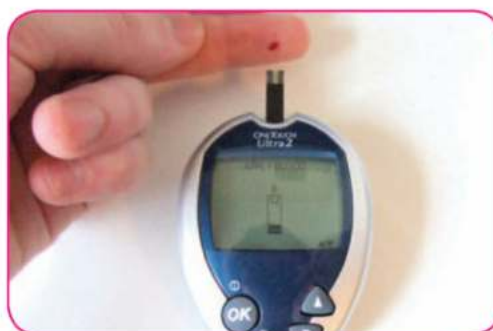
Gland	Hormones	Function
Pituitary	Growth hormone	Regulate the growth of the body as a whole
	Thyroid stimulating hormone	Stimulate thyroid to secrete its hormones
	The activating hormone of sexual glands	Affects the development of sex organs prior to adulthood
Thyroid	Thyroxin	Librates the energy necessary for the body from food
	Calcitonin	Controls the calcium levels in the blood
adrenal glands	Adrenalin	Stimulates body's organs to respond to emergencies
Pancreas	Insulin	Stimulates the storage of glucose sugar in liver.
	Glucagon	Stimulates the release of glucose sugar from the liver
The two ovaries	Estrogen	Appears female secondary sex characteristics
	Progesterone	Promotes the growth of endometrium
The two testes	Testosterone	Appears the male secondary sex characteristics

## Some diseases resulted from the hormone disorder in human body

There is a state of an accurate balance among the endocrine glands. However, one of these glands does not sometimes work properly. Consequently, the balance of these glands gets disturbed and Man has a state of a hormone disorder in his body. The result is one of the hormone disorders as shown in the following table:



▲ Figure (25): The goiter disease resulting from the enlargement of thyroid



▲ Figure (26): Measuring the concentration of sugar blood (glucose) for persons suffer from diabetes.

### Some diseases resulted from the hormone disorder in the human body

Disease	Description	Reason
Dwarfism	The body stops growing so the person becomes a dwarf.	Decrease of secretion in the growth hormone at the childhood.
Gigantism	A continuous growth in the limbs' bones so the person becomes a giant.	Increase of secretion in the growth hormone at the childhood.
Simple goiter	Enlargement of thyroid gland and the neck.	Decrease of secretion in the thyroxin hormone due to the lack of iodine in food as it enters in the hormone's structure.
Exophthalmic goiter	Enlargement of thyroid gland accompanied by loss of weight, tension and exophthalmoses.	Increase of secretion in the thyroxin hormone with large amounts.
Diabetes	Feeling very thirsty and multiple urination times.	Due to the decrease in the secretion of the insulin hormone, the cell's are unable to use glucose.



Science

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- In the past, scientists did not know why some persons do not grow to the normal size and stay as dwarfs. Then, it was discovered that pituitary gland in the bodies of those dwarfs secretes extremely small amounts of the growth hormone. Through this discovery, scientists treated some of these cases by injecting the human growth hormone extracted from newly dead corpses in the children's bodies whose pituitary gland do not produce enough amount of the growth hormone. The amounts of the growth hormone that they could get were extremely small and not enough in addition to the possibility of containing some microbes that may cause infection by various diseases.
- In 1979, scientists succeeded in manufacturing sufficient amounts of the human growth hormone by genetic engineering technology. They managed to insert a human gene (that carries instructions for the formation of a human growth hormone) into DNA nucleic acid of the bacterial cells. In this way, they were able to produce and collect large amounts of the human growth hormone by great numbers of bacteria (in which this gene was inserted). Then, this hormone was refined and experiments and researches conducted on it proved its validity for the human use in 1985. This hormone succeeded in treating children of limited growth.

## Lesson 4 Exercises

### 1 Complete the following sentences:

- a Hormones are directly secreted into the blood stream by .....
- b A chemical substance that controls and regulates the of functions of the most of body organs is known as .....
- c Thyroxin is a ..... that regulates food assimilation in your body .
- d When the secretion of the growth hormone decreases at the childhood,man suffers from the .....
- e When the amount of glucose decreases in the blood, pancreas secretes of.....hormone.
- f When the amount of iodine decreases in the food ,the secretion of the .....hormone decreases from .....gland.
- g The.....hormone is secreted when the rate of glucose sugar increases in the blood

### 2 Write the scientific term that corresponds to each of the following statments :

- a A chemical message that controls and regulates the activites and functions of the most of body organs .
- b Organs secreting hormones in the human body .
- c The result when one of the endocrine glands does not act properly .
- d A gland secrets a hormone that regulates the growth of the human sexual organs .

### 3 Put a (✓) or ( x ) in front of the following statements and correct the false ones :

- a Thyroid secrets a hormone that organizes the growth and development of sexual organs in the human body . ( )
- b The calcitonion hormone controls the level of calcium in the human body . ( )
- c The glucagon hormone is secreted by pituitary gland . ( )
- d The iron element shares in composing thyroxin hormone. ( )

### 4 Give reasons:

- a The height of some persons may reach 2 meters .
- b The two adrenal glands have an important role when man is exposed to emergency.
- c Pancreas is a double-function gland .
- d Thyroid gland plays an important role in controlling the level of calcium in the blood.
- e Pituitary gland is called the « master gland »
- f The height of some persons may reach less than half meter .

### 5 Choose the right answer in each of the following statements:

- a The .....hormone librates the needed energy from the food stuff .  
(growth – esterogen – thyroxin)
- b The hormone responsible for the appearance secondry sexual male characteristics is the..... hormone . ( progesterone - testosterone - adrenalin )

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٤ ألوان	طبع الغلاف:
٨٠ جم أبيض	ورق المتن:
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