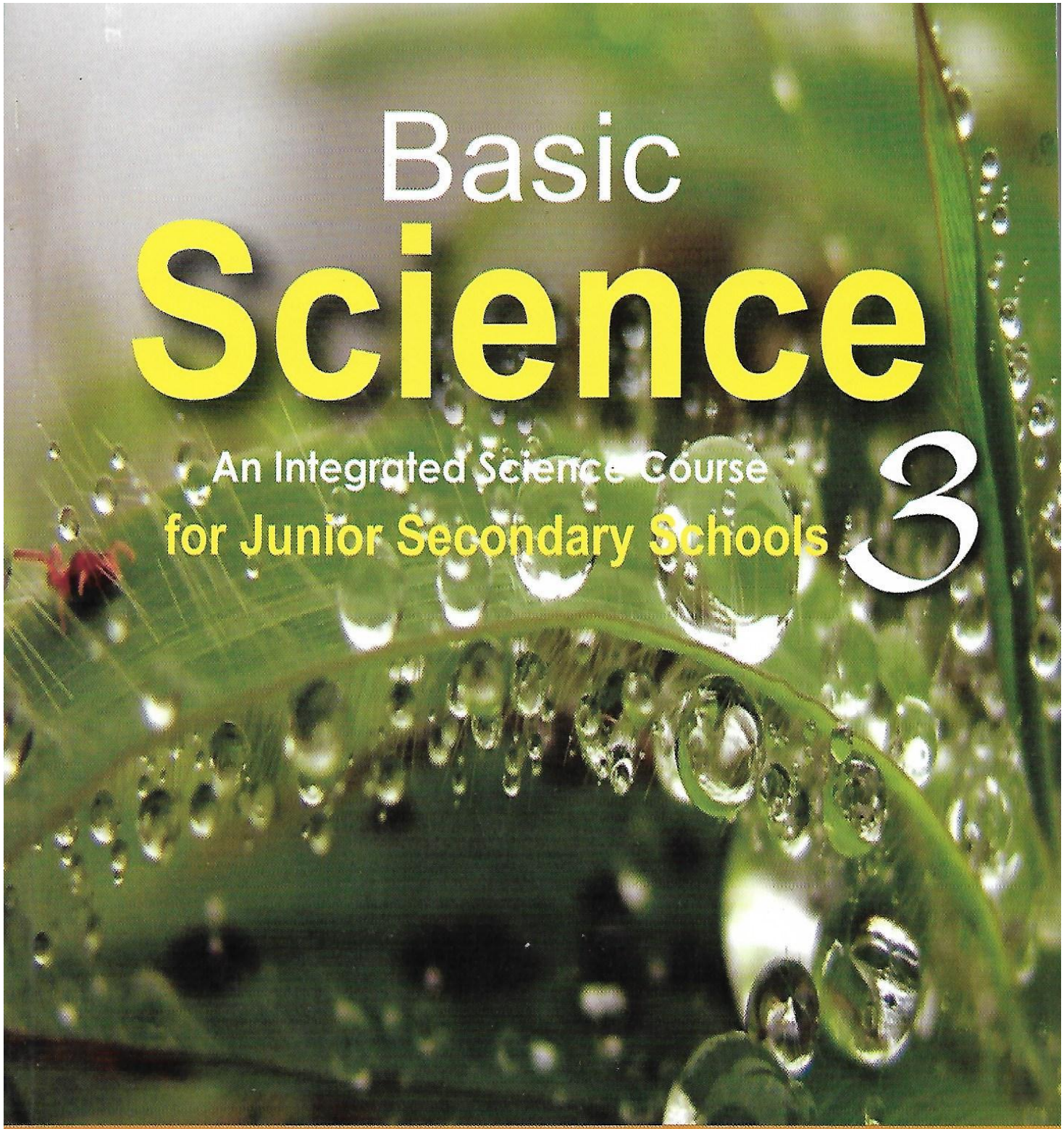

Basic Science 3

An Integrated Science Course for Junior Secondary Schools

LearnAfrica

F O C NDU
L O NDU
A O OLAREWAJU
E O SOMOYE

Basic Science

for Junior Secondary Schools

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Learning about your environment

Chapter 1 Family traits

Introduction

As you go about your daily activities, people may pass such comments as, 'You look like your father', or 'You look like your brother or sister'. They may even say you look like someone in your extended family such as your uncle, auntie, grandparent or even your great grandparent. Who in your family do people popularly say you look like? In what ways do you look like the person? Is it in your height, stature, colour of skin, facial appearance or colour of the eyes?

Among living things, offspring resemble their parents. Also offspring look like one another. Again, you can observe that while offspring resemble their parents and one another, no offspring is exactly like the parents or any other relation. No living thing is exactly like the other. Young ones differ from their parents and one another. Therefore, among living things, you can observe two features that exist side by side. These are **resemblance** and **difference**. In science, this difference is referred to as **variation**.

Resemblance occurs in living things at two levels as follows:

1 The first level of resemblance is where all offspring or individuals have the qualities of the parental type of organism. For example, all offspring of goats will resemble goats and not dogs, while all sheep will resemble sheep and not any other type of organism.

2 The second level of resemblance is where the offspring have particular qualities or characteristics of parents or other family members. These particular qualities or characteristics may be shape, size, height or colour. The characteristics may run in every member of the family from one generation to another. These characteristics that run in the family line from one generation to another are called **family traits.**

In this chapter, you will learn about family traits, genetics, and the importance of family traits.

Objectives

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

1 mention some traits that run in your family;
2 distinguish between dominant and recessive traits;
3 identify dominant and recessive traits in your family;
4 state the importance of family traits; and
5 trace your family genealogy.

Family traits

Family traits are the ways in which family members are alike. A family trait is a genetic likeness that is passed through parents' genes to their children. Traits are the qualities or characteristics that make us unique. All living things have qualities by which they are identified.

Traits are passed from parents to offspring. Some traits are inherited while some traits are learned. **Inherited** traits are passed from parents to offspring. **Learned traits** are acquired through practice and imitation. Family and cultural traditions often influence learned traits. There are four major types of traits.

1 *Physical traits:* These describe the way one looks. Physical traits are inherited. They include:
   a) shape of your face, forehead, eyes, nose, mouth or ears.
   b) colour of your hair, skin or eyes.
   c) size of your head, eyes, mouth or nose.
   d) height of the body.
   e) albinism.
2 *Health traits:* These determine one's chance of getting certain types of diseases. Examples are sickle-cell anaemia, heart diseases, and mental illness. Health traits are inherited.
3 *Behavioural traits:* These describe the way one acts. Family and traditions often influence the way individuals behave. Children may by imitation and practice acquire the walking style of someone in their environment or family. Behavioural traits are learned. Examples are walking, dancing, speaking, singing, and running. They are special abilities.
4 *Blood type:* e.g. blood group (A, B, AB, O), genotype (AA, AS, SS) and the rhesus factor (positive and negative).

Some family traits are beneficial and advantageous while some others are not. For example, some families are known and respected for their special abilities such as dancing or singing or intelligence. These abilities and qualities that provide us advantages over other people are beneficial traits. An example of traits that are not beneficial is sickle cell anemia.

Activity 1.1 Identifying your family physical traits

Materials required

Your science notebook, biro

Procedure

1 Observe your family members. Start from your siblings, your father, your father's parents, and your father's siblings. Make a list of notable physical traits which run in your family, from grandfather or grandmother to your father and to your siblings and yourself. Label this list as inherited traits from father.
2 Start your observation again from your siblings, your mother, your mother's parents and your mother's siblings. Make a list of notable physical traits which run in your family from maternal grandfather or grandmother to your mother and to your siblings and yourself. Label this list as inherited traits from mother. Present the two lists in a table as in Table 1.1.

Table 1.1 My family physical traits

Serial No.	Family physical traits	Source (father or mother)

Activity 1.2 Identifying your family health traits

Materials required
Your science notebook, biro

Procedure
1 Make a list of diseases which run in your family. Examples are high blood pressure, stroke, blindness, heart disease, epilepsy, sickle cell and anaemia.
2 Trace the source of each disease, whether it comes from your father's side or your mother's side.
3 Label this list as my family health traits.
4 Present the list in a table as in Table 1.2 in your science notebook.
5 Submit your science notebook to your teacher.

Table 1.2 My family health traits

Serial No.	Family health traits	Source (father or mother)

Activity 1.3 Identifying your family behavioural traits

Materials required
Your science notebook, biro

Procedure
1 Make a list of special abilities which run in your family, e.g. dancing, singing, wrestling, speaking, running, fishing, and swimming.
2 Trace the source of each ability, whether it comes from your father's side or your mother's side.
3 Label this list as my family behavioural traits as in Table 1.3 in your science notebook.
4 Submit your science notebook to your teacher.

Table 1.3 My family behavioural traits

Serial No.	Behavioural traits	Source (father or mother)

Activity 1.4 Identifying your family traits

Materials required
Your science notebook, biro

Procedure
1 Study the observations you made in Activities 1.1 – 1.3.
2 Identify which of the traits you observed are beneficial to you and which ones are not beneficial or are dangerous to you.
3 Present your findings as in Table 1.4 in your science notebook.
4 Submit your science notebook to your teacher.

Table 1.4 My family traits

Serial No.	Beneficial family traits	Dangerous family traits

Heredity

Living things are made up of cells. The cells have nuclei (singular nucleus) which contain chromosomes. The chromosomes contain genes which determine the characteristics that are passed on from parents to offspring. From Activities 1.1 – 1.3, it should be clear to you that family traits are transmitted from parents to offspring and, thus, from

one generation to the next. In science, the transmission of characteristics or traits from parents to offspring is referred to as **heredity**. By heredity, it is expected that you have inherited some traits from your parents which you will probably transmit to your own children and so on. Inherited traits are transmitted from one generation to another.

Your own children are expected to look like you. But at times this does not happen. For instance, your parents may show the trait of tallness, whereas you and any of your siblings may show the trait of shortness. This is because there are **variations** in heredity. The study of heredity and variations is called **genetics**.

Genetics

Genetics helps scientists to understand the process by which inheritance of traits occurs in organisms. The first well-known scientific study on inheritance of traits was carried out in the middle of the 19th century by a monk named **Gregor Mendel**. He carried out his study in the garden of the monastery where he lived. He used the garden pea for his experiment. His careful study of the garden pea plant paved the way for modern genetics. Mendel's experiment is the first well-known scientific study on the inheritance of traits. His experiment helped to explain what happens in the transmission of hereditary traits from parents to children.

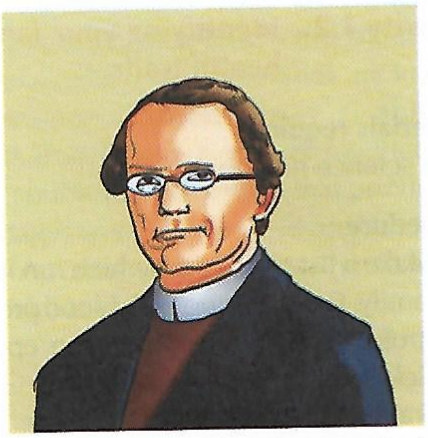


Fig. 1.1 Gregor John Mendel (July 22, 1822 – January 6, 1884)

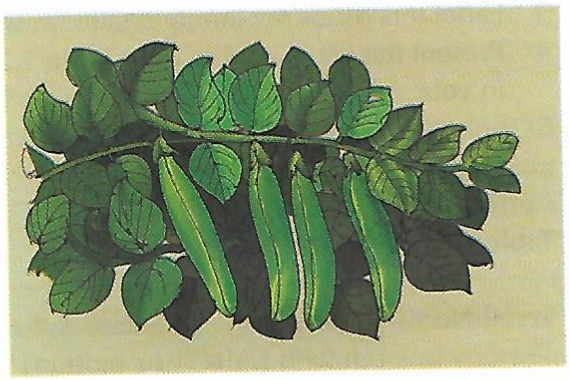


Fig. 1.2 Garden pea plant (commonly found in Plateau State of Nigeria)

Reasons for using the garden pea for experiments

Mendel chose the garden pea plant of all plants to carry out his experiment because:

1 he had observed that the garden pea plant shows seven pairs of contrasting traits such as:
   a) tall or short stem heights;
   b) yellow or green seed colour;
   c) purple or white flower colour;
   d) round or wrinkled seed shape;
   e) constricted or smooth pod;
   f) terminal or axial flower position on leaf; and

g) green or yellow cotyledon colour.

2 He observed that the growth period of the garden pea plant was short, such that experiments with the plant could be repeated with confirmatory results within a short period of time.

3 He observed that the plant grew in large quantities such that he could use large numbers for each experiment to enable detailed and accurate observations. He was able to experiment with one trait after the other.

4 He also observed that the plant is normally self-pollinated, so if you wish to do the pollination by yourself, you would be sure of the types you have crossed.

Mendel's experiment on height traits

Mendel picked the tall and short-stemmed varieties of the garden pea plant. He planted the seeds of tall-stemmed plants and the short-stemmed plants separately. When they flowered, he artificially cross-pollinated them.

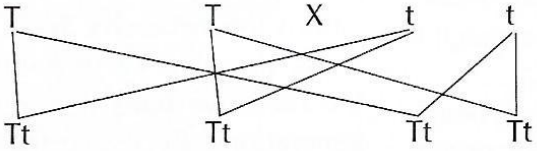
To do this, he took pollen grains from flowers of the short-stemmed variety and put on the tall-stemmed variety and vice versa. The pollinated flowers produced seeds. He allowed the seeds to ripen. He then collected the seeds from both varieties and stored them. During the next planting season, he planted all the seeds from the cross-pollination.

He observed that the plants that resulted from the cross-pollination of tall and short varieties were all tall. He inferred that the trait for tallness overshadowed the trait for shortness. He went further and planted all the seeds from the cross–pollinated generation.

He again cross-pollinated them and observed that ¾ of the plants that resulted were tall while ¼ were short. In other words, the trait of shortness reappeared in the 3rd generation. He inferred that in the garden pea plant, the trait for shortness was suppressed in earlier generations. When the short-stemmed plants in the 3rd generation were cross-pollinated, the resulting plants were all short-stemmed.

Step 1:

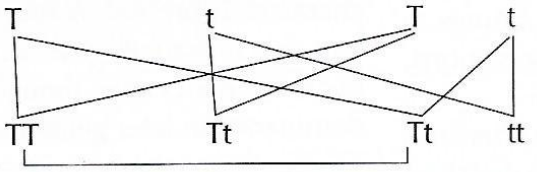
Tall-stemmed and short-stemmed cross-pollinated



All tall-stemmed offspring are produced.

Step 2:

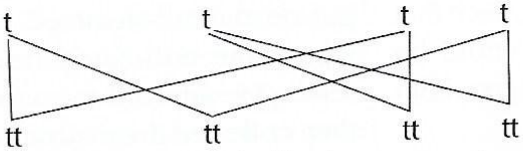
All tall stemmed from 2nd generation cross-pollinated



¾ tall-stemmed offspring ¼ short-stemmed offspring

Step 3a:

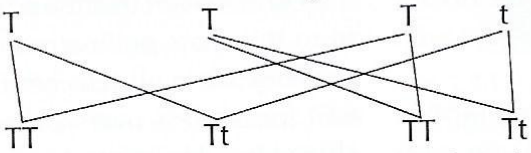
Short-stemmed from 3rd generation cross-pollinated



All short-stemmed offspring are produced

Step 3b:

Tall-stemmed from 3rd generation cross-pollinated



All tall-stemmed offspring are produced

Mendel continued his experiments with the garden pea plant focusing on other contrasting traits one after the other. His results were so good and convincing that today, he is regarded by scientists as the father of modern day genetics.

Mendel wisely used the garden pea plant for his experiments and made his observations within a short period of time. Today, scientists use many other organisms such as short-leaved plants, rats, rabbits, chickens and dogs for genetic experiments through cross-breeding.

To do genetic experiments with human beings takes time and the person conducting the experiment may not live long enough to get confirmatory results.

Experimental crossing of human beings is unethical. This is to promote peace, harmony and morality. Cross-breeding in human beings should be based on love and tradition and not by experiment. However, inheritance of traits in human beings is effectively studied through observations, family records and family history.

In human beings, many characteristics do not have simple patterns such as tall or short characteristics in the pea or plant. Many human characteristics show continuous variations from one form to the other, e.g. intelligence is not assessed by being very bright or very dull because some people fall in-between.

Dominant and recessive traits

Mendel in his experiments observed that the trait for tallness overshadowed the trait for shortness. In genetics, when one trait overshadows the other in the offspring, the overshadowing trait is called the **dominant trait** while the one that is suppressed is called the **recessive trait**. The dominant traits show in early generations, while the recessive traits may resurface in later generations. Recessive traits appear when both parents show the trait.

A dominant trait is a trait that shows its presence even though the contrasting character is present. A recessive trait is the trait that is actually present in an offspring but is not noticeable, though it may assume dominance in later generations.

Dominant characteristics are controlled by dominant genes and recessive

characteristics by recessive genes. For example, if organisms with contrasting characteristics are crossed and the resulting offspring show one of the characteristics without the influence of the contrasting characteristic, then the characteristic seen is said to be the dominant characteristic.

Phenotype

A phenotype is the composite of an organism's observable characteristics or traits such as its morphology development and physiological properties. A phenotype results from the expression of an organism's genes as well as the influence of environmental factors and the interactions between the two.

Genotype

The genotype of an organism is the inherited instructions or the sum total of the genes inherited from both parents. Not all organisms with the same genotype look or act the same way because appearance and behaviour are modified by environmental and developmental conditions.

Likewise, not all organisms that look alike necessarily have the same genotype. Genotype is expressed with capital and small letters when present in a given trait, e.g. 'B' for Black and 'b' for white.

Activity 1.5 Identifying dominant and recessive traits in your community

Materials required

Your science notebook, biro

Procedure (group activity)

1 Work in groups of 5 students.
2 Observe the people in your community.
3 Complete Table 1.5.
4 Discuss your entries in the group.
5 Submit your report to your teacher.

Table 1.5 Dominant and recessive traits

Serial No.	Trait	Dominant	Recessive
1	Height (tall/short)		
2	Skin colour (dark/light)		
3	Size (large/small)		
4	Strength (strong/weak)		
5	Mass (fat/slender)		
6	Sanity (normal/abnormal)		
7	Number of fingers (five/six)		
8	Hair colour (black/brown)		
9	Tongue rolling (ability to roll/inability to roll)		

Activity 1.6 Identifying dominant and recessive traits in your family

Materials required

Your science notebook, biro

Procedure (individual work)

1. List the dominant and recessive traits in your family. To do this, you select a trait in your father, select the same trait in your mother and identify which one is expressed in you and in your siblings, e.g. height of father and height of mother and height of the children.
2. Summarise your observations in a table indicating the dominant and recessive traits as in Table 1.1.
3. Present your table to your teacher.

What determines our traits?

Our genes give the instruction that defines our traits. Each of us has thousands of genes which are tiny units of life that reside in our chromosomes. The environment we live in helps determine and modify our traits. For example, while a person's gene may specify a certain hair colour, environmental factors such as exposure to sunlight or chemicals may change the hair colour. Scientific knowledge has shown that the way family traits appear in individuals depends on two factors: the gene and the environment.

How traits are transmitted in human beings

Human beings have two complete sets of 23 chromosomes, i.e. 23 pairs of chromosomes ($2 \times 23 = 46$). When chromosomes are found in the cells of the body, all the cells of the body carry 23 pairs of chromosomes except the egg and sperm cells which carry 1 set of 23 chromosomes ($1 \times 23 = 23$).

At the conception of a new individual, the egg carrying 23 chromosomes joins with the sperm carrying 23 chromosomes to form a single cell called **zygote**. This zygote carries 2 sets of 23 chromosomes. When the zygote divides, it ultimately develops into a child. This way, every child receives half of its chromosomes from the mother and the other half from the father. This transfer takes place at conception. The rule is that each child must receive exactly one of each chromosome.

Also at conception, parents contribute chromosomes randomly. Every child inherits a complete set of chromosomes from both parents (23 + 23 chromosomes). As a result, every child has a unique combination of traits. Some will resemble the mother and some will resemble the father while others will combine to produce a unique product. When the child grows up, the child will pass his own combination of chromosomes to his own children. This way, some traits are passed through many generations. An example is the bunion trait. If your parents have it, then you stand the chance of having it. A **bunion** is a bony, lumpy feature of the joint at the base of the big toe.

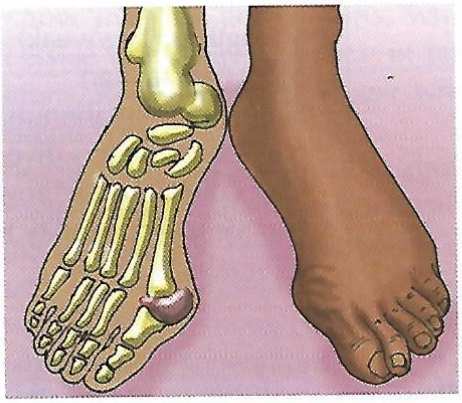
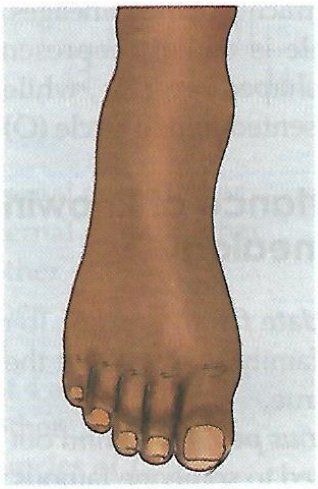


Fig. 1.3 Feet bunions

The medical name for bunion is *Hallux valgus*. Some people have bunions on the big toe, making the big toe point towards the other toes on the foot while some people have straight big toes. Which type of big toe do you have? Scientists describe the set of genetic information for each of us as an **allele**. We can describe the straight big toe with **allele 'B'** and describe the bunion big toe with **allele 'b'**.

a)



b)

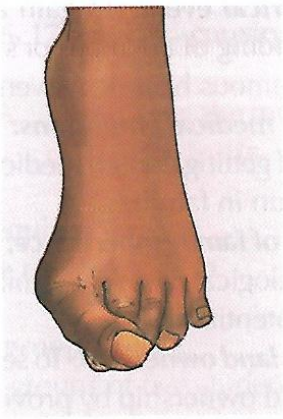
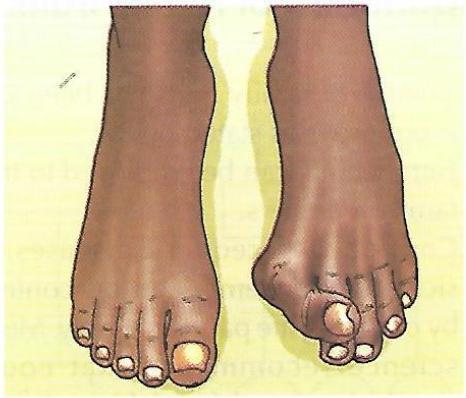


Fig. 1.4(a) *'B' straight big toe*
(b) *'b' bunion big toe*

Each of us has two alleles for bunion. As a result, we all have one of these combinations.



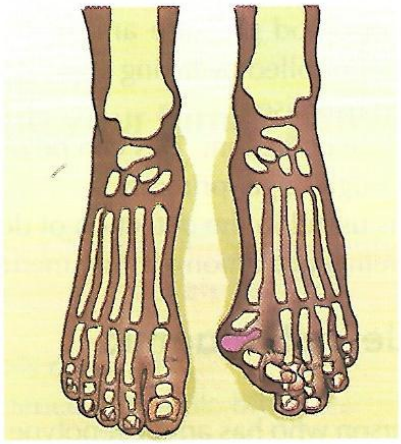


Fig. 1.5 Combination of bunion and straight big toe

Some people may have two of the same allele. Those with *'BB'* will have straight big toes while those with *'bb'* will have bunions. Scientists use the word **homozygote** to describe having the same allele for a trait. Some other people may have the two different alleles for a trait. They are described as heterozygotes. In the case where two different alleles interact, the dominant trait will appear while the recessive trait is suppressed.

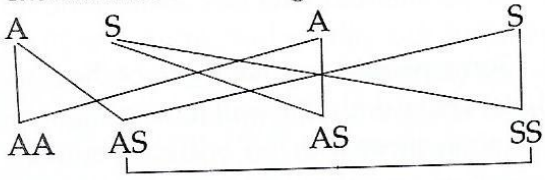
Importance of family traits

Knowledge of family traits has been useful in several ways as stated below.

1 Family traits can be employed to trace family members.
2 Control of hereditary diseases, e.g. sickle cell anaemia can be controlled by choosing life partners wisely. Medical science recommends that couples should be tested for sickle cell before marriage. Again, health problems like high blood pressure and diabetes can be controlled by taking appropriate diet and exercises.
3 Crime detection: This can be done through finger printing.
4 It is useful in the detection of degree of intelligence among family members.

Sickle cell anaemia

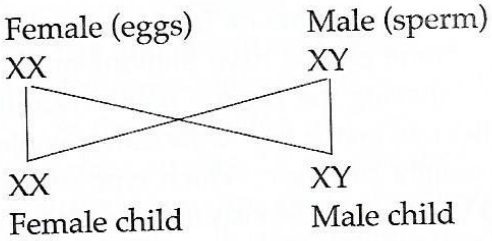
If a person who has an AS genotype marries another AS genotype, there is a 25% (¼) chance that a full fledged sickler is born.



That is why it is not advisable for two 'AS' genotype partners to marry each other.

Sex determination

It is to be noted that only the male partner or donor determines the final sex of the child or offspring. This is because the female has only the XX chromosome while the male has the variated XY chromosome. Only the fusion of X and Y chromosomes brings up the male child.



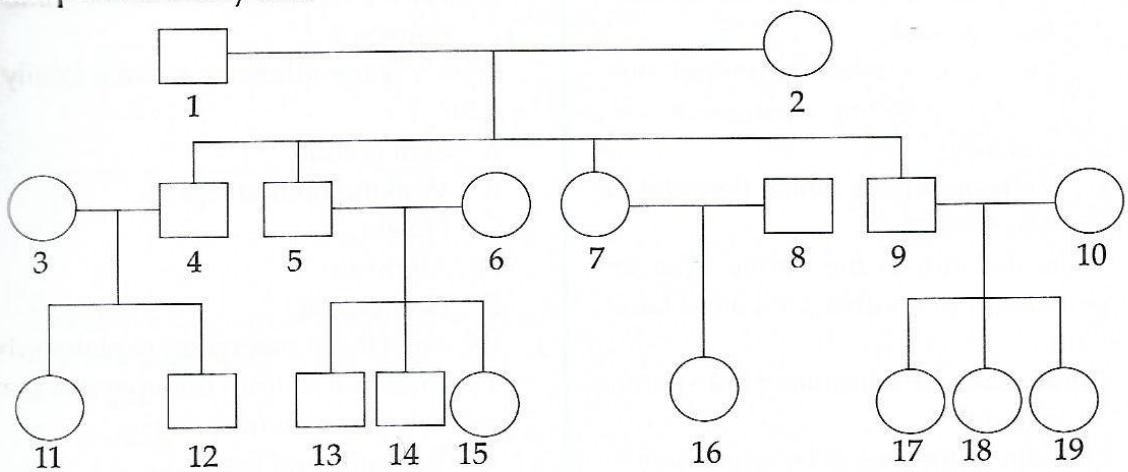
Family genealogy

Family genealogy is the study of families and the tracing of their lineages and history. The male is usually represented with a square shaped box (□) , while the female is represented with a circle (O).

Importance of knowing family genealogy

1 ***Validate family stories:*** To determine if the family stories about their ancestors are true.
2 ***Famous people:*** To find out if one is related to someone famous.
3 ***Historical event:*** To gain a better understanding of an ancestor's involvement in a famous historical event.
4 ***Trace medical conditions:*** To assess the risk of getting certain medical conditions that run in families.
5 ***Trace of family inheritance:*** To determine genealogical proof of a family connection for potential heirs.
6 ***Trace land ownership:*** To settle questions of land ownership by providing proof of descent.
7 ***Find birth parents:*** To determine the birth parents of an adopted child. Alternatively, to find children given up for adoption.
8 ***Community history:*** To document a community's history by understanding the families that founded and influenced the community.

Example of a family tree



1 → paternal grandfather
2 → paternal grandmother
3 → mother
4 → father
11 → self
Children of 4 are 11 and 12.
12 → brother
5 and 9 → uncles of 11
7 → aunt of 11
13, 14, 15, 16, 17, 18, 19 → cousins of 11

Activity 1.6 Discussing the importance of family traits

Materials required
Your science notebook, biro

Procedure (group work)
1 Work in groups of five students.
2 Discuss the importance of family traits.
3 List the points.
4 Submit your science notebook to your teacher.

Tracing your family genealogy

Activity 1.7 Tracing your family genealogy

Materials required
Your science notebook, biro

Procedure (individual work)
1 Start by putting down your name, followed by your father's name, your grandfather's name and so on.
2 Interview your father and mother to get the names of your fore relations.
3 Trace your family from your father's side down to the community.
4 Trace your family from your mother's side.
5 Submit your record to your teacher.

Summary

1 Traits are the qualities that make us unique.
2 There are 3 major types of traits:

a) Physical traits which describe the way we look.
b) Health traits which determine one's chance of getting a particular disease.
c) Behaviour traits which describe the way we act.

3 Traits that run in the family from one generation to another are called family traits.
4 Family traits are transmitted from parents to offspring.
5 Heredity is the means by which parents transmit traits to offspring.
6 Genetics is the study of heredity and variations.
7 Gregor Mendel is the *father* of modern genetics.
8 Dominant traits are the traits that over-shadow the other traits. The suppressed traits are called recessive traits.
9 Traits are determined by genes and the environment.
10 Family traits are important in tracing family members, control of inherited diseases, and crime detection.
11 Family genealogy is the study of families and the tracing of their lineages and history.

Revision questions 1

1 Which of these statements is not correct about family traits?
A Family traits could be dominant or recessive.
B Family traits are transmitted from sibling to sibling.
C Family traits can be used to trace family members.
D Family traits are transmitted from parents to offspring.
E Family traits can be used in crime detection.

2 Which of the following is not a family trait?
A Skin colour
B Walking on two legs
C Height
D Albinism
E Hair colour

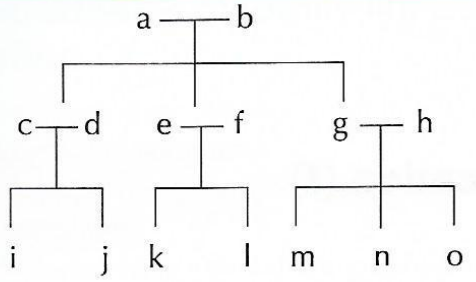
3 Which of these statements explains why a particular trait from both parents may not be seen in an offspring?
A The trait is recessive.
B The trait is lost.
C The trait has been altered.
D All the above statements.
E None of the above statements.

4 A notable scientist that carried out experiments on transfer of traits from parents to offspring is _____.
A Gregor Mendel
B J. J. Thompson
C Lord Rutherford
D Michael Faraday
E Prince Maxwell

5 Which structure in the chromosome transmits characteristics from parents to offspring?
A Allele
B Gamete
C Gene
D Genotype
E Phenotype

6 Which one of these disorders or abnormalities is not genetic?
A Albinism
B Colour blindness
C Haemophilia
D Leukaemia
E Sickle cell

7



The above diagram of a family tree show that m's aunties are _____.

A a and b
B i and j
C d and f
D n and o
E c and d

8 State two (2) differences between dominant and recessive traits.

9 State three (3) uses of family traits.

10 Draw your family tree from your father to the community as much as you can trace.

Chapter 2 Family life education (I)

Introduction

Family life education is an aspect of learning that focuses on the healthy functioning of the family system. It provides an innovative approach to the skills and knowledge of typical human development, good decision making skills, positive self-esteem and healthy personal relationships.

The goal of family life education is to:

1 teach and foster knowledge that will enable individuals and families to function properly;
2 enrich and improve the quality of individual and family life; and
3 minimise problems such as substance abuse, domestic violence, child abuse, unemployment and teenage pregnancy.

Objectives

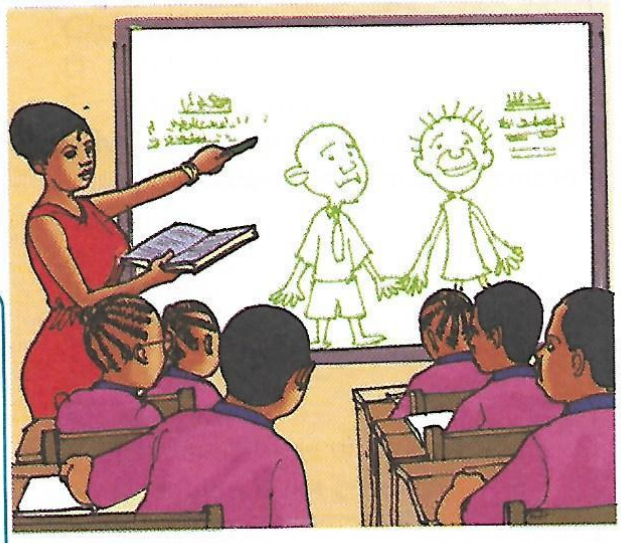
By the end of this chapter, you will be able to:

1 define family life education;
2 state the importance of family life education;
3 define teenage pregnancy;
4 state the causes of teenage pregnancy;
5 state the consequences of teenage pregnancy; and
6 highlight the care needed during pregnancy.

Meaning of family life education

Family life education is an educational process that helps in developing the physical, social, emotional and moral character of people in relation to the socio-cultural aspects of their society.

Family life education provides this information through an educational approach, often in a classroom, through printed materials or other educational materials.



Importance of family life education

The following are the benefits or importance of family life education.

1 It helps young people to solve family problems.
2 It helps the youth in their growing stage to know about the social, emotional and physical changes that take place at their various ages.
3 It develops knowledge about different role functions and importance of the family.
4 It teaches how to maintain good relationships among the members of the family and other people in the society. It helps to make the family happy and prosperous.
5 It develops the knowledge, values and skills which are necessary for adulthood, marriage and parenthood, as well as for participation in community life.
6 It helps the adolescent to deal with the changes that affect lives in the society.
7 It helps family members to make wise decisions and communicate effectively with others about matters concerning social behaviour.
8 It makes adolescents become aware that they are becoming sexually mature, thereby making them understand sexual attitude and behaviours.

Teenage pregnancy

Teenage pregnancy is pregnancy in human females who are under the age of twenty (20) as at the time of delivery. Worldwide, there is an increase in the rate of teenage pregnancy which most teenage girls do not plan for. Teenage pregnancy constitutes an extra health risk to the mother and the baby. Teenagers have a higher risk of pregnancy-related high blood pressure and its complications when they do not have access to early prenatal care. The risks for the baby include premature birth and low birth weight.

Causes of teenage pregnancy

For some adolescents, pregnancy and childbirth are planned and wanted, but for many they are not. Unwanted adolescent pregnancies are more prominent in poor, uneducated and rural communities. Below are some of the causes of teenage pregnancy:

1 There is social pressure to marry, and once married, to have children. This is what operates in some African cultures.
2 Some girls do not know how to avoid getting pregnant, i.e. sex education is lacking in many countries.
3 Contraception services may be too expensive or not widely or legally available.
4 Girls may be unable to refuse unwanted sex or resist coerced sex which tends to be unprotected, e.g. rape.
5 Poverty is also associated with increased rates of teenage pregnancy. Economically poor countries have far more teenage mothers compared with economically rich countries.

Checking adolescent pregnancy and delivery

The following steps can be taken to check adolescent pregnancy and delivery:

1 Reduce or stop marriage before age 19.
2 Increase the use of contraceptives by adolescents at risk of unintended pregnancy.

3 Reduce unsafe abortion among adolescents.
4 Increase use of skilled antenatal, childbirth and postnatal care among adolescents.

Consequences of adolescent pregnancy and delivery

The consequences of adolescent pregnancy and delivery can be in the form of:
a) health effects.
b) economic and social consequences.

a) Health effects
i) Pregnancy and childbirth complications are the second highest cause of death among 15 to 19 year olds globally. This contributes to maternal deaths and long-lasting health problems.
ii) Early childbearing increases the risks for both mothers and their newborn babies. Babies born to mothers under 20 years of age face a high risk of being stillborn or dying later.
iii) Low birth weight is another likely health consequence of adolescent pregnancy and delivery.
iv) Infection during abortion, incomplete abortion and injuries to genital organs usually occur.

b) Economic and social consequences
i) Many girls who become pregnant have to drop out of school. This increases the rate of illiteracy in society.
ii) A girl with little or no education has fewer skills and opportunities to find a job. This contributes to unemployment in society.
iii) It also disrupts life plans and career goals of such girls.
iv) It can lead to forced marriage which may in turn lead to divorce.

Care needed during pregnancy

Becoming pregnant as a teenager, especially if the pregnancy is not wanted, can put enormous stress on young women and their families.

However, once it has happened, there is no way to go back. So the important thing to do is to support the young woman and ask her to make the wisest choice by:
1 going for a pregnancy test as soon as she misses her period.
2 confiding in someone she trusts about the pregnancy. It could be her partner or a close relative.
3 starting antenatal check-ups with a registered medical centre.
4 adhering strictly to all medical instructions given by the medical practitioner during antenatal visits.
5 not using unprescribed drugs or herbs.
6 eating balanced and well nourishing diet. Food rich in calcium, folic acid, iodine, iron and protein should be given high preference.
7 avoiding alcohol and cigarettes.
8 getting adequate rest and relaxation.
9 not carrying heavy objects/loads.
10 maintaining a high degree of hygiene.

Handling teenage pregnancy

This is a very difficult time for a young woman/girl who has only a short time to make a major decision. There is no easy way out. The choices available are:
1 continue keeping the pregnancy and keep the baby after birth.

2 giving the baby up for adoption after delivery.
3 termination or abortion of the pregnancy.

In making these choices, some factors to take into consideration are:
1 the age of the girl in question.
2 the family's personal beliefs.
3 the access to services and support.
4 how the young woman got the pregnancy.
5 how far the pregnancy has progressed.

The decision to be taken should be the best possible. She needs to be able to look back and know that the decision she made was the best she could make at that time.

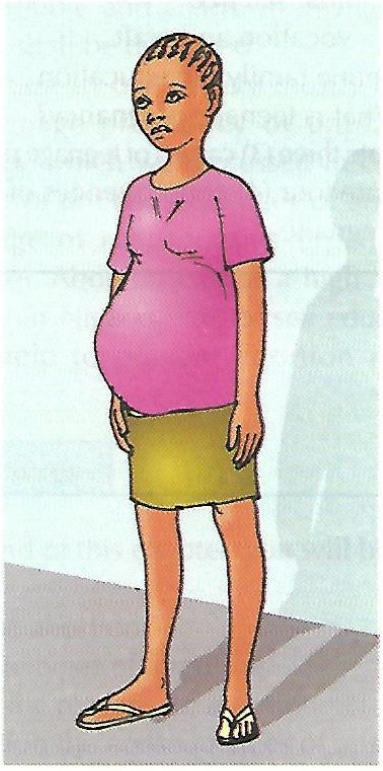


Fig. 2.2 A pregnant teenager

Myths and facts about pregnancy

Myths are things people believe, but which do not exist in reality. They are actually false; while facts are things known to be true and have been proven to be true.

Myths about pregnancy
1 All pregnant women have morning sickness.
2 If I urinate after sexual intercourse, I cannot get pregnant.
3 If I washed my vagina after sex, I would not get pregnant.
4 Only pregnant women miss their period.
5 All pregnant women spit a lot.

Facts about pregnancy
1 Pregnant women may experience some bleeding and yet be pregnant.
2 You may be pregnant and still be menstruating.
3 A pregnancy can be more than 9 months before delivery.
4 Urinating after sexual intercourse does not prevent pregnacy.
5 Washing one's body and cleaning up after sex would not prevent pregnacy.

Summary

1 Family life education helps to enrich and improve the quality of individual and family life.
2 Teenage pregnancy is pregnancy in human females under the age of 20 at the time that the pregnancy ends.
3 Some causes of teenage pregnancy are societal belief, lack of sexual education, and ignorance about contraception and poverty.

4 The consequences of adolescent pregnancy and delivery include:
   i) termination of education.
   ii) poverty.
   iii) forced marriage and divorce.
   iv) health risks.
5 A pregnant teenager needs all the care and support she can get to carry the pregnancy and give birth safely.

Revision questions 2

1 Which of the following people need to take folic acid?
   A Athletes
   B Caterers
   C Drivers
   D Pregnant women
   E Carpenters
2 One of the following is a benefit of family life education.
   A Helps young people to solve family problems.
   B Makes young people fight in the family.
   C Does not develop the knowledge about different roles.
   D Makes adolescents sexually active.
   E None of the above.
3 A sixteen-year old that is pregnant is a/an _____.
   A adolescent
   B adult
   C teenager
   D youth
   E Toddler
4 _____ pregnancy is more prominent in poor, uneducated and rural communities.
   A Unwanted
   B Adult
   C Contraception
   D Wanted
   E Solicited
5 _____ is associated with increased rate of teenage pregnancy.
   A Education
   B Wealth
   C Poverty
   D Health
   E Weather
6 There are _____ and _____ consequences of adolescent pregnancy and delivery.
   A health, peace
   B economic, social
   C psychomotor, physiology
   D arts, science
   E vocation and craft
7 Define family life education.
8 What is teenage pregnancy?
9 State three (3) causes of teenage pregnancy.
10 State four (4) consequences of teenage pregnancy.

Chapter 3 Family life education (II)

Introduction

Family life is the interaction and activities that go on in a family. It could be pleasant or not depending on how close the family is. When there is a good relationship in a family, every member of the family enjoys, but when the family is not united, there is always trouble and chaos. In this chapter, abortion shall be discussed.

Abortion in our society mostly results from teenage pregnancy or unplanned pregnancy which we discussed in chapter two. Part of the consequences of abortion is damage of reproductive organs and also death. Abortion causes a high rate of mortality in Nigeria. Proper sex education would help to prevent abortion in our society.

Objectives

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

1 define abortion;
2 list the types of abortion;
3 state the reasons for abortion;
4 mention the consequences of unsafe abortion;
5 identify the ways of preventing abortion; and
6 state reasons why one must seek counselling over unwanted pregnancy from a certified medical practioner.

Abortion

Abortion is the process of ending a pregnancy at an early stage by medical surgery or taking medication.

It is sometimes known as termination. It involves ending the life of a foetus before it is born.

Types of abortion

There are two types of abortion:

1 Medical abortion which involves the use of abortion pills to end a pregnancy.
2 Surgical abortion which is a minor surgical procedure to remove or end a pregnancy. There are two types of surgical abortion:
   a) Dilative curettage (D and C) which is a surgical means used to terminate pregnancy that is up to 16 weeks.
   b) Dilation and evacuation (D and E) which is a surgical abortion procedure used to terminate a pregnancy after 16 weeks.

Reasons for abortion

There are different reasons for deciding to go through abortion procedures. Some of these reasons are:

1 **Birth control**

A family that has decided to have four

children would not allow any pregnancy to stay after the fourth child is born. Any other pregnancy would be terminated.

2 **To terminate unwanted pregnancy**
Pregnancy that is not planned for is usually aborted, especially teenage pregnancy.

3 **Pregnancy resulting from rape or incest**
This type of pregnancy is usually terminated because the girl involved would be ashamed to move around with the pregnancy. The fear of what people and family members will say may also be the major deciding factor or force for her to abort the pregnancy.

4 **Inability to support or care for a child**
A family may decide to terminate a pregnancy if the finances to take care of the baby are not available. For example, if the wife or husband loses their job, they may reason that it will be difficult for them to take care of the new baby.

5 **To prevent birth of retarded babies**
Whenever a mother goes through a scan and it is discovered that the baby will be retarded or deformed or cannot make it through the pregnancy period, she will be advised to terminate the pregnancy.

4 **To forestall risks**
If a pregnancy serves as a threat to the life of a mother, the pregnancy will be removed to save the life of the mother.

Consequences of unsafe abortion

Unsafe abortion is the removal of pregnancy by unqualified persons. This usually occurs in places or cases where experienced medical personnel are not available, or when their bills are too high for an average person to afford. It also usually occurs in countries where abortion is illegal, for example in Nigeria.

The consequences of unsafe abortion include:

1 Damage to reproductive organs such as the womb or uterus. A fake doctor can damage the womb of a woman in the name of carrying out an abortion. Such women may not be able to get pregnant again, and the womb might also be infected.
2 The urinary tract can be infected when instruments that are not properly sterilised are used in the abortion procedure in quack hospitals.
3 Unsafe abortion can lead to infertility. The woman might not be able to get pregnant again.
4 The fallopian tube could be blocked due to infection from unsafe abortion. Mostly when infections are not properly treated, they can block the fallopian tube after some years, thereby making the person infertile.
5 Excessive bleeding or haemorrhage can be a result of unsafe abortion. The person can bleed to death if the bleeding is not stopped on time.
6 Unsafe abortion can lead to death as a result of negligence on the part of the 'unsafe' doctor handling the procedure, or the use of harmful drugs to terminate pregnancy.

Fig. 3.1 A pregnant woman

Ways of preventing abortion

There are two ways to prevent abortion. Firstly, when unwanted pregnancy is prevented, abortion is not necessary. Secondly, when pregnancy occurs, the pregnant woman will be advised not to think of abortion but to think of taking care of the baby.

The ways of preventing abortion are through:

1 Adequate sex education: This prevents unwanted pregnancy, which eventually prevents abortion because when there is no unwanted pregnancy, there is no need for abortion. Every young girl should have sex education to avoid unwanted pregnancy.

2 Abstinence: This is the best and safest way of preventing abortion, although it demands discipline. Abstinence is a deliberate decision not to have sex before marriage. It also prevents teenage pregnancy or unwanted pregnancy.

3 Every married couple must have a plan on when to have a baby so as to avoid unwanted pregnancy.

4 Use of contraceptives: Contraceptives are drugs that prevent pregnancy. There are two types: long-term and short-term contraceptives. Long term contraceptives include IUD which is planted close to the womb to prevent pregnancy.

The short term type is the use of oral pills or birth control pills to prevent pregnancy. All these release certain hormones which prevent pregnancy in women.

5 Condoms can also be used to prevent pregnancy. There are two types: male and female condoms. These would not allow sperm to get to the womb and so pregnancy is prevented.

6 In case pregnancy has been confirmed, the pregnant lady should be advised against abortion but to consider taking care of the baby herself. This is known as parenting.

7 Adoption: This is another option to abortion. The pregnant girl or woman is advised to give up the child for adoption immediately the child is born. This will prevent abortion.

8 Another way of preventing abortion is to advise the individual to keep the baby and ask for support from parents, family members and, friends.

This is possible in cases where the pregnant woman does not have the financial means to take care of the baby.

Fig. 3.2 A pregnant woman with a counsellor

9 Talk to your partner if you decide to keep the pregnancy and let him understand the reason for your decision.

Activity **Discussing teenage pregnancy**

Materials required

Your science notebook, biro

Procedure

1 Arrange the students into two groups.
2 The students should debate on the topic 'Teenage pregnancy is the major cause of abortion in Nigeria.'
3 A group will be for the topic while the other group will be against it.
4 Write down your points and present it to your teacher for further discussion.

Summary

1 Abortion is the process of ending a pregnancy at an early stage through the use of medication or by medical surgery.
2 There are two types of abortion. They are medical abortion and surgical abortion.
3 There are various reasons for abortion; for birth control, to remove unwanted pregnancy, and to remove pregnancy from rape or incest.
4 The consequences of unsafe abortion are damage to reproductive organs such as the womb, fallopian tube, etc.
5 Abortion can be prevented by having adequate sex education, abstinence, use of condoms, contraceptives, etc.
6 The need to seek counselling over unwanted pregnancy is to help the mother and her partner make a decision that they will not regret in future.

Revision questions 3

1 Abortion is the process of ending a _____ at an early age.
   A pregnancy
   B film
   C party
   D class
   E adult stage
2 The two types of abortion are _____.
   A drugs and water
   B plastic surgery and burns
   C medical and surgical abortion
   D good and bad abortion
   E slow and fast abortion
3 The following are reasons for abortion except _____.
   A birth control
   B to terminate unwanted pregnancy
   C to terminate pregnancy resulting

from incest or rape

D to prevent birth of medically unfit babies

E to have a robust baby

4 One of these is the consequences of unsafe abortion.

A Damaged womb/uterus

B Damaged lungs

C Kidney failure

D Mouth cancer

E Cholera

5 Seeking advice from counsellors over unwanted pregnancy is to help the mother to _____.

A make a decision that she will not regret in future

B make a wrong decision

C abort the baby

D kill the partner

E kill herself

6 a) What is abortion?

b) List the two types of abortion.

7 Give three (3) reasons why abortion is carried out.

8 State five (5) consequences of unsafe abortion.

9 Identify three (3) ways of preventing abortion.

10 State two (2) reasons why one has to seek a counsellor over unwanted pregnancy.

Chapter 4 Reproductive health

Introduction

In Book 1 of this course, you learnt about diseases such as HIV/AIDS and the danger it has posed to human populations. You have important roles to play in ensuring the health and well-being of your reproductive organs through good habits. The health and well-being of the reproductive organs and issues relating to reproduction are referred to as **reproductive health**.

In this chapter, you will learn about reproductive health, its meaning and importance, care and protection of the reproductive system, some infections of the reproductive system and their consequences, and some coping skills for preserving our reproductive health.

Objectives

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

1 explain the meaning of reproductive health;
2 explain the significance of reproductive health;
3 state ways of caring for and protecting your reproductive system;
4 mention some sexually transmitted infections;
5 state the adverse consequences of infection to one's life; and
6 demonstrate skills for self-preservation against sexual abuse.

Reproductive health

Health is the fitness of the body. The body is described as healthy when all the parts are in good condition and performing their functions properly and effectively.

Reproductive health is an important part of the general health of the body. It is globally referred to as a state of complete physical, mental and social well-being of an individual in all matters relating to the reproductive system. It is not merely the absence of disease or infirmity in this area.

Reproductive health describes the capability of people to have a safe sexual relationship; and the capability of people to produce healthy children, take decisions on whether to have children, when to have children, the number of children to have and what family planning methods to adopt.

Reproductive health is beyond the absence of diseases but include personal relationships and all issues relating to the reproductive system. This is because anything that affects the reproductive system usually leads not only to serious physical

consequences but also serious mental, social and economic consequences, as we shall discuss later in this chapter.

Importance of reproductive health

Reproductive health encourages both men and women to have free access to safe, effective, affordable and acceptable family planning methods of their choice. It encourages access to health care services that enhance safety in pregnancy and childbirth.

Only healthy reproductive organs can perform their reproductive functions successfully. The importance of reproductive health is as follows:

1 It encourages individuals to experience healthy sexual development and maturation.

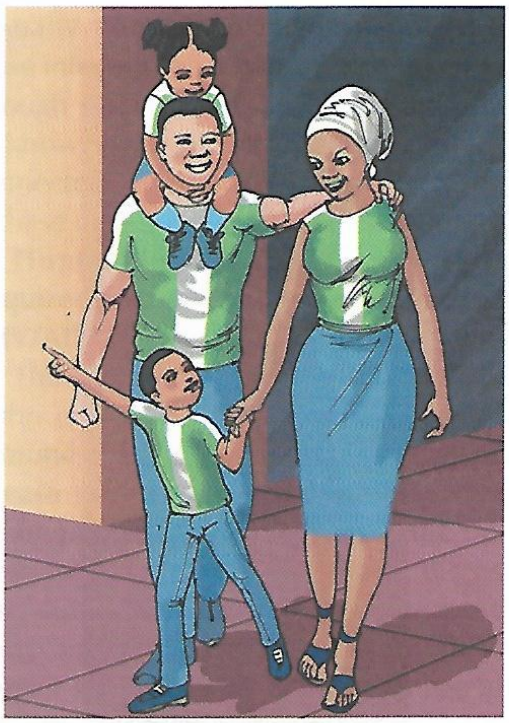


Fig. 4.1 A happy family

2 It ensures that people have responsible relationships and sexual fulfilment.
3 It ensures that people have children safely, when they decide to.
4 It enhances the avoidance of illnesses, diseases and disabilities related to sex and reproduction.
5 It encourages freedom from violence and other harmful practices that are related to sex and reproduction.
6 It improves people's access to basic and reproductive health information, so that individuals are better informed about their reproductive system and how it functions.
7 It reduces the incidence of early marriage and unwanted childbearing.
8 It improves the protection of teenagers against HIV/AIDS and other sexually transmitted infections (STIs).
9 It improves sexual responsibility.
10 It promotes family happiness.

Activity 4.1 Importance of reproductive health

Materials required

Pictures of infected reproductive organs provided by the teacher.

Procedure (group work)

1 Study the photographs of the infected reproductive organs.
2 Discuss the causes of such conditions.
3 What did the infected people do wrong?
4 Discuss the importance of reproductive health.

Care and protection of the reproductive system

The human reproductive organs, particularly the penis and vagina, are open to the outside environment. Therefore, micro organisms can easily find their way into the reproductive pathways, if these organs are not protected. For instance, little children while playing in the sand and on dirty floors without wearing pants or protective clothes, can easily be infected through their reproductive organs. People can also be infected through the use of dirty toilets.

Also, dirty pubic hair in both males and females can allow the growth of pubic lice, which cause itching and scratching that opens the skin to further infections. It is important that we take care of the reproductive organs and protect them from infections.

Activity 4.2 Care and protection of the reproductive organs

Material required

Your science notebook, biro

Procedure (group discussion)

1 Each group should elect a secretary.
2 Each member of the group should suggest two things he/she will do to care for and protect his/her reproductive organ.
3 The group should accept or reject the suggestions.
4 The secretary records all the accepted suggestions.
5 Present the group work to the teacher.

You can ensure that your reproductive organs are well cared for and protected in the following ways:

1 By washing the openings and surroundings of reproductive organs regularly with clean water.
2 By wearing clean pants and clothes to protect the organs from contact with dirty surfaces.
3 By keeping the toilets clean.
4 By keeping your pubic areas clean through regular washing and shaving.
5 By abstaining from sex before marriage.
6 By abstinence from sex with casual partners.
7 By being faithful to your partner.
8 By attending postnatal clinics after child birth.
9 By keeping away from abortion.
10 By avoiding mutilation (circumcision) of the female reproductive organs.
11 By keeping away from self-medication when infected.

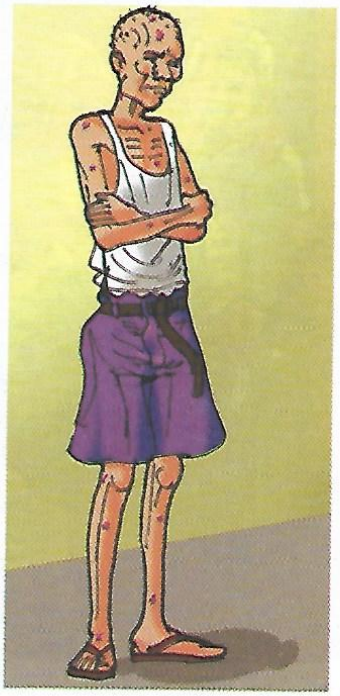


Fig. 4.2(a) An STI patient

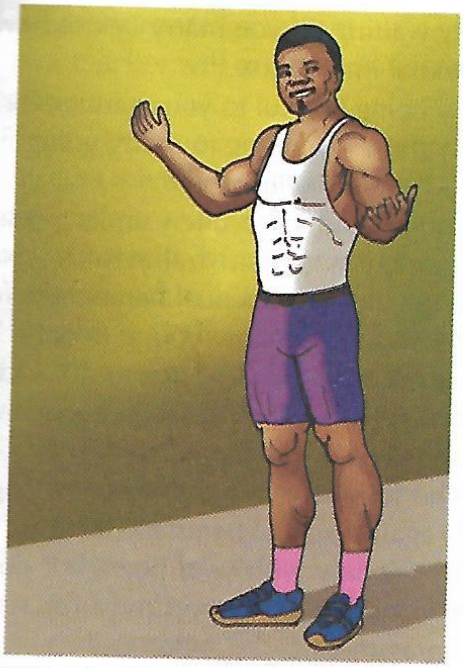


Fig. 4.2(b) A healthy person

Sexually transmitted infections (STIs)

Sexually transmitted infections (STIs) are those infections that human beings contract through sexual intercourse. It is important to know some of the infections that are connected with sexual intercourse. Some of these infections are explained as follows:

1 **Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome (HIV/AIDS)**

The human immunodeficiency virus is the organism that destroys the natural immune system that should fight against disease germs that enter the body. When the immune system is damaged, the body becomes easily infected by most diseases that should have been suppressed. At a point, any disease organism that comes in contact with the body causes damage and the individual becomes bedridden. At this stage, the person is said to have **full blown AIDS.**

As you have learnt in Book 1 of this course, the most common way of contracting HIV is through unprotected sexual intercourse with an infected person. This can, therefore, be prevented by abstinence (not having casual sex).

2 **Gonorrhoea:** This is a disease caused by a small round bacterium called *Neisseria gonorrhoeae*. It affects the urinary and reproductive tracts because the two tracts are very close to each other. Gonorrhoea causes painful discharge of thick milk fluid from the reproductive and urinary tracts. Gonorrhoea can cause sterility in both male and female human beings, if not treated. It can also be transferred to the eyes and cause blindness in children born of infected parents.

3 **Syphilis:** This is another common STI caused by a wavy bacterium called *Treponema pallidum*. The disease starts as a 'local' sore on the reproductive organs and spread with painful itching. If not properly treated, it may cause serious deadly diseases of the heart, the blood vessels and the nervous system.

Consequences of STIs

Sexually transmitted infections have serious consequences. Some of these are:

1 severe damage to parts or the entire sex organs;
2 serious pains and discomfort that come with the infection;
3 likely infertility and sterility;
4 waste of resources such as money in treatment, time in visiting hospital and energy of those attending to the infected persons;

5 loss of valuable manpower leading to reduced productivity in the society and family; and
6 bad image in the society for sufferers.

Activity 4.3 Consequences of STIs in national development

Materials required
Health centre, data, science notebook, biro

Procedure
1 Visit a health care centre in your community.
2 Obtain data on the number of people that are HIV positive.
3 Obtain from your teacher data on the number of people suffering from STIs in the state and the country.
4 Discuss in your group the consequences of these infections on our national life such as the:
   i) economy;
   ii) workforce; and
   iii) leadership.
5 Prepare a report of your discussion and submit to your teacher.

Coping skills for preserving reproductive health

Our reproductive health status is a pointer to our sexual behaviour. Generally, STIs are contracted through sexual intercourse with infected persons. Since it is not easy to identify infected persons by merely looking at their faces, STIs can be prevented by adopting the following healthy sexual behaviours:
1 By avoiding sexual intercourse with casual partners.
2 By waiting till you marry before having sexual intercourse.
3 By being faithful to your partner.
4 By those intending to marry going first for HIV screening.

Young adults are often under pressure for unhealthy sexual behaviours. Some often fall victims to sexual harassment from adults and their fellow young people. This is not because they choose to fall victims but because they lack the skills to cope with situations of sexual harassment.

The following are some of the coping skills against sexual harassment:
1 Be friendly with your peers but do not give them the opportunity for sexual harassment.
2 Be polite but firm in saying **no** to sex.
3 Give reasons to the person harassing you. For example,
   i) I want to complete my studies.
   ii) I am very busy today.
   iii) I have some assignments to do.
4 Quickly take your leave, if you find yourself alone with someone that might ask you for sex.
5 Manage your resources well to avoid a situation where you run out of resources and someone entices you with the things you lack.
6 Wear clothes that do not expose your body, that is, be modest in your dressing.
7 Avoid bad company.
8 Avoid drinking to the extent of getting drunk.

Activity 4.4 Coping skills against sexual harassment

Materials required
Your science notebook, biro.

Procedure: (group discussion)

1 Your teacher will organise you into groups.
2 Elect a group recording secretary.
3 Discuss the following questions in your group:
   i) What will you do if you find yourself alone in a room with a classmate who is likely to ask you for sex?
   ii) What will you do if someone you love asks you for sex before marriage?
   iii) What reasons will you give to reject a very senior and rich person who asks you for sex?
   iv) How will you relate with your male and female peers without sexual relationship?
5 The recording secretary prepares a record of the group's responses to all the questions.
6 The recording secretary presents the record/report to the whole class.

Summary

1 Reproductive health education is a crucial aspect of general health. It is a state of complete physical, mental and social well-being of an individual in all matters relating to the reproductive system and not merely the absence of diseases or infirmity.
2 Reproductive health education is important because it prepares individuals to:
   i) experience healthy sexual development and maturity;
   ii) achieve their desired number of children safely and in good health;
   iii) avoid illness, disease and disability associated with sexuality and reproduction; and
   iv) be free from violence and other harmful practices related to sexuality and reproduction.
3 It is important to care adequately for our reproductive organs by observing proper hygiene of the reproductive organs and adopting positive reproductive health habits/behaviour.
4 Sexually transmitted infections include: HIV/AIDS, gonorrhoea and syphilis. These infections can be prevented by positive reproductive health behaviours.
5 STIs have some consequences such as pain and discomfort to the victim, waste of resources in treatment and care for the victim, change of family and national focus to curtail spread of diseases, economic wastage, and bad image.
6 There are coping skills for preserving our reproductive health.

Revision questions 4

1 Which of these is **not** an STI? _____.
   A Gonorrhoea
   B Syphilis
   C HIV
   D *Tuberculosis*
   E Malaria
2 Which of these diseases is sexually transmitted? _____.
   A Malaria
   B Diarrhoea
   C Gonorrhea
   D Anaemia
   E Typhoid
3 Infections can occur through _____.
   A use of dirty toilets
   B shouting

C sleeping on a clean bed
D drinking of unexpired drinks
E running

4 STIs are contracted through _____.
A eating of raw foods
B beating
C unprotected sexual intercourse with an infected person
D wound from knife cuts
E talking

5 HIV can be prevented by _____.
A not sharing the same food with an infected person
B not talking to an infected person
C not going outside to work
D abstinence
E None of the above

6 Syphilis is caused by _____.
A a virus
B bacteria
C whooping cough
D crying
E Mosquito

7 List four (4) coping skills against sexual harassment.

8 Define reproductive health.

9 List five (5) ways in which reproductive health is important.

10 List four (4) ways to care for and protect our reproductive organs.

Chapter 5 Environmental hazard I (Soil erosion and flooding)

Introduction

Environmental hazard is a situation that threatens the surrounding natural environment and may adversely affect people's health. Wherever you live in Nigeria, you are likely to see daily, many trucks that carry white sand to block-moulding industries or to building sites. Where does the white river sand come from? You may say: from the river. If you say so, another question would arise: How does the sand get to the river? You are likely to have also seen tippers carrying sand collected from un-tarred roadsides or from gutters. This type of sand has the brown colour of soil but is also used for building. Where does this sand come from?

Both river sand and local sand from gutters are products of the wearing away of the soil. Rain drops which fall through the atmosphere possess kinetic energy. When they strike the soil surface, they loosen soil particles. The rain drops that fall on the ground collect into flowing water. Such flowing water has a force, with which it wears away soil particles and carries them away as it flows into streams and rivers. Streams and rivers continue the process of wearing away the surface of the soil and carrying the worn out soil particles into the sea. As the stream or river flows, sand in the flowing water is deposited at the bottom of the stream or river, where the slope of the ground is small or the force of moving water is small. This is how river sand settles, and is later collected by people whose business it is to do so. It is difficult to estimate the quantity of river sand collected and used in a country each year. It must be enormous. This shows you that erosion is a serious issue.

In dry areas of the world, especially in desert or semi-desert areas, erosion is caused by wind rather than by rain. The wearing away and transportation of the soil surface by water or wind is called **erosion**. Normally, after the rain, the rain water sinks into the ground. Two or three hours after rain, there is normally no standing water on the ground except on clayey soil. In some exceptional situations, standing water remains on the soil surface for days. This is called **flooding**.

Erosion and flooding are harmful to the environment which in turn harm human beings; hence, they are called **environmental hazards**. Erosion reduces soil fertility and the yield of crops. Severe erosion may create deep gutters or even valleys, thereby causing nearby buildings to collapse. Residents in such areas may migrate. Flooding may also cause loss of buildings and lives.

In this chapter, you will learn about erosion and flooding, their causes and effects, and methods of controlling them.

Objectives

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

1 explain soil erosion;
2 identify human activities that cause soil erosion;
3 describe methods of controlling soil erosion;
4 explain practical methods of controlling soil erosion on farmland;
5 describe different types of drainage patterns in your communities;
6 state the causes of flooding;
7 describe how flooding can be prevented; and
8 discuss effects of flooding.

Soil

The soil which functions as a covering to the earth is a mixture of minerals, organic matter, gases, liquids and some organism that act as support to life on earth.

It took millions of years to form the soil, called **ground stone** (pedolith). It is formed every 100 to 400 years at the rate of 1 cm while the non-renewable one is destroyed. To build enough soil to form productive land, it takes about 3 000 to 12 000 years.

Soil is where plants grow, and the habitation for some insects and animals, while minerals such as petrochemicals and gold are also found in it.

Soil erosion

Definition

Erosion is the wearing away and transportation of the surface of the soil, by which soil or rock material is removed from one part of the earth to another, through the action of wind and water.

Types of soil erosion

There are three types of erosion, namely sheet erosion, gully erosion and rill erosion.

1 ***Sheet erosion:*** This occurs when a large area is worn away fairly uniformly at the surface. This type of erosion occurs sometimes in a playing field.

Fig. 5.1 Sheet eroded land

2 ***Gully erosion:*** This occurs when a channel is worn out more severely than the surrounding areas, thus forming a big gap/hole in the soil, called gully or valley or trench.

Fig. 5.2 Gully eroded land

3 ***Rill erosion:*** This happens when the narrow and shallow channels are gradually worn away into unprotected soil by hill slope run-off. Since soil is regularly left bare during agricultural operations, rills may form on farmlands during these periods. Rills are fairly visible when first done, so they are often the first indication of an ongoing erosion problem.

Fig. 5.3 Rill eroded land

Agents of soil erosion

In the tropical areas of the world, there are two main agents of erosion, namely water and wind.

a) ***Water:*** This includes rain drops that fall through the atmosphere and flood water that flows on the surface of the soil. Water loosens and transports soil particles from one place to another.

b) ***Wind:*** In the desert and semi-desert areas, vegetation is scanty, and as a result, the soil is exposed. The wind is the main agent of erosion here. When the wind blows, it carries large quantities of soil from the soil surface sometimes as sand storms, from one place to another.

Causes of soil erosion

This can be as a result of human activities or the nature of the land and soil itself.

Human activities that cause erosion

Human activities that cause erosion are as follows:

i) ***Bush burning:*** Bush burning destroys the vegetation cover of the soil and exposes the soil surface to direct action of rain drops, and rain floods, which loosen the soil particles and carry them away.

ii) ***Overgrazing and overstocking:*** Allowing farm animals to eat up all the plants on a given piece of land is called overgrazing. Overgrazing exposes the soil to erosion. Also, livestock trample and break up the soil, thereby making the soil loose and more prone to soil erosion.

iii) ***Soil tillage and cultivation:*** When a farm land is tilled and cultivated, the soil is softened and exposed to wind, rain drops and rain floods. These conditions promote erosion.

iv) ***Farming on steep slopes:*** Before planting crops, farmers usually clear the ground (of vegetation) or till the ground and make mounds or ridges. In this process, they remove the vegetation cover of the soil and soften the surface soil.

When this is done on a steep slope, it causes rain floods to flow vigorously down the slope, thereby causing a quick wearing away of the soil surface.

v) ***Making ridges run in the direction of the slope:*** When ridges in a farm run in the direction of the slope of the land, rain floods move fast and can easily erode the soil surface, and carry surface soil particles away.

vi) ***Housing development:*** In any city today, the number of houses is more than the number in the same city fifty years ago. When buildings are few in an area, there are many fallow areas of land, covered by plants. When it rains, rain water easily sinks in the fallow areas, thereby making rain flood flow from one area to another. As more and more houses are built, more and more roofs collect rain water, and release flood water on the small un-built areas. Some people further use floor tiles to cover their compounds, thereby reducing the water that sinks into the ground, and so increasing the quantity of flood water and erosion in the area.

vi) ***Vehicle traffic on un-tarred roads:*** Vehicle traffic on un-tarred roads, especially heavy vehicles, break up the ground surface into fine particles, and allow wind to carry the soil particles away as dust.

vii) ***Poor irrigation practices:*** More rapid run-off of rain water results in soil erosion. This can remove the top soil and leave the ground unsuitable for growing crops.

ix) ***Deforestation:*** This is the removal of trees whose leaves provide canopies which protect the soil from the direct impact of rainfall, thereby making the land more susceptible to erosion.

Factors affecting erodibility

The following factors determine the erodibility of the soil (that is, how easily the soil can be eroded or experience erosion).

i) ***Slope:*** The steeper the slope, the greater the erosion as a result of the increased velocity of water flow. The length of the slope is very important because the greater the size of the sloping area, the greater the concentration of the flood water.

ii) ***Soil texture:*** This is the distribution of soil particles by size. The size of particles never changes. The three main soil particles are sand, silt and clay. The more sandy the soil, the easier it will erode.

iii) ***Soil structure:*** This is the grouping or arrangement of soil particles. Over-cultivation and compactness cause the soil to lose its structure and cohesion (ability to stick together) making it erode more easily.

iv) ***Organic material:*** This is the glue that binds the soil particles together and plays an important role in preventing soil erosion. Organic matter is the main source of energy for soil organisms, plant and animal. It also influences the infiltration capacity of the soil, therefore reducing run off.

Methods of controlling soil erosion

Some methods of controlling erosion are described below.

1 **Planting grass**

Universities, colleges, schools, individuals, offices and factories plant selected grass types in their play grounds or lawns. The roots of grass bind soil particles so that they are not easily carried away by flood water.

2 **Planting of trees**

Certain trees are planted to check erosion. Such trees have been selected because they have extensive root systems that bind soil

particles, and still do well in sandy soils. In large areas of Enugu State, cashew trees have been planted to check erosion on sandy soils. The leaves of the cashew trees break the force of rain drops on the soil. The roots of the cashew plants bind soil particles and prevent easy washing out of the soil particles by rain floods. On the other hand, the cashew plants produce edible fruits and seeds.

3 **Making ridges at right angles to the slope**

If ridges in a farm are made to run at right angles to the slope of the land, they help to reduce erosion.

4 **Building concrete drainage**

Building concrete drainage to move flood waters in a town or city reduces the amount of soil eroded by the flood water.

5 **Terracing**

Terracing means creating steps along a slope of land. The steps break the speed of flood water and, hence, reduce the rate of erosion of the soil as the water flows down the slope.

Fig. 5.4 Terracing

6 **Surfacing roads with bitumen**

When roads are tarred (covered with bitumen), the bitumen reduces the wearing away of the soil by rain water or vehicles.

7 **Strip farming**

In a farm, erosion can be reduced by planting crops that require clearing of the vegetation (such as yam or cassava, or maize or millet) in alternate strips with those that do not require cleaning of the vegetation (such as oranges, mangoes, guava). In this way, water flood from the cleared strips will be stopped in the un-cleared strips.

8 **Avoiding overgrazing**

This is done by moving animals to other pieces of land to eat plants in order to provide sufficient time for the grazed lands to recover their loss in terms of nutrients, and regrow.

Practical methods of preventing erosion on a given farmland

1 **Zero tillage**

The Ministry of Agriculture has found that it is not necessary to till the ground for every crop. Maize can be planted on cleared farmland without tilling the soil. This practice is called **zero tillage**. It has the advantage of checking erosion.

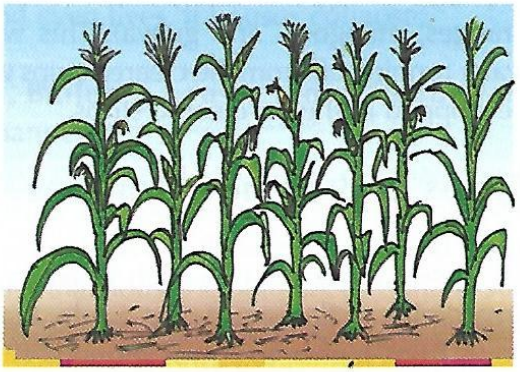


Fig. 5.5 Maize plant on land that has no tilling or ridges

2 **Cross bars**

When cross bars are made in the furrows between two ridges. the cross bars force flowing water in the farm to slow down and sink into the soil instead of flowing through unchecked, and eroding the farm.

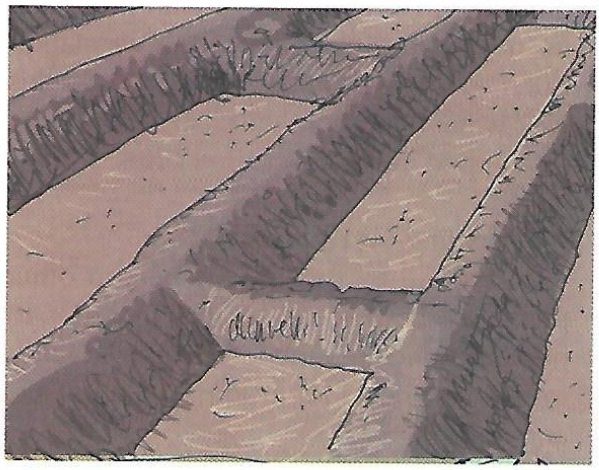


Fig. 5.6 Cross bars between two ridges

3 **Avoiding water drainage channels**

On a given farm land, the farmer should avoid planting along water channels to avoid plant growth retardation.

4 **Strip farming**

In a farm, erosion can be reduced by planting crops that require clearing of the vegetation (such as yam or cassava, or maize or millet) in alternate strips with those that do not require clearing of the vegetation (such as oranges, mangoes, and guava). This way, water running off from the cleared strips will be stopped in the un-cleared strips.

Types of drainage patterns

This refers to means by which water in an area drains or flows away. As a rule, water flows from higher to lower ground. Thus, water will flow from a hill into a valley along the hillsides.

A good drainage pattern allows free flow of water, while a bad or poor drainage pattern will not pave the way for free flow of water. This results in blocked drainage.

In planned cities, drainage channels are designed to run along slopes, from higher to lower ground. Often there is a stream in the valley, such that water from the land (higher ground) flows into a stream, the stream flows into a river, and the river eventually flows into the sea. As water flows from the land into a stream, some of the water sinks into the soil. Only a part of the rain water that reaches the soil flows as surface flood into streams.

A well designed drainage system is made of concrete and is designed by competent engineers.

Some examples of drainage patterns are as follows:

1 Pinnate drainage pattern.
2 Parallel drainage pattern.
3 Barbed drainage pattern.
4 Herring bone drainage pattern.
5 Dendrictic drainage pattern.
6 Centripetal drainage pattern.
7 Rectangular drainage pattern.
8 Annular drainage pattern.
9 Radial drainage pattern.
10 Deranged/contorted drainage pattern.

Activity 5. 1 Describing different kinds of drainage patterns that you have observed in your community.

Materials required

Your science notebook, biro.

Procedure

1. Write down the types of drainage patterns that you have observed in your area.
2. In your report, include answers to the following questions:
   a) Is there concrete or earth or no drainage in your community?
   b) Does water flow along roads and footpaths in your area? If so, does water erode the roads?
   c) Is there any hazard caused by erosion in your community?

Flooding

When a body of water, such as a stream or a river, overflows its banks, and enters land that is normally free from water, the land is said to be **flooded**, while the overflowing of the water is called *flooding*. A **flood** is an overflow of water that submerges land which is usually dry.

Causes of flooding

1 **Unusually high rainfall**

In 2012, there was flooding in the riverine areas along River Niger and River Benue. Most people who were adults in 2012 had never seen such a thing in their lives before. The cause was an unusually high annual rainfall. The rainfall was so much that the valleys of the River Niger and River Benue were filled up and the level of the water kept rising for about 5 km after Lokoja, on the way to Abuja. The road was flooded and became unusable. Vehicles that normally carry passengers through the road diverted to other roads. Some buildings in the valley of River Niger or River Benue were covered with water up to their roofs or nearly so. Such buildings were abandoned by the residents.

In Anambra West Local Government Area, towns such as Nzam, Inoma and others were completely abandoned. The inhabitants migrated to Onitsha, Awka, Enugu or wherever they had relations or friends. Some churches in Onitsha accommodated them as refugees for a period of about three months, when eventually the level of water receded to normal. The level of water had risen so high that bungalows were swallowed by the water. Memories of this flood will remain fresh in the minds of eyewitnesses. The cause of that natural disaster was unusual rainfall.

2 **Poor sanitation**

Poor sanitation may cause flooding. This occurs when people drink table water and throw away the empty bottles or sachets anywhere and when household refuse is thrown into the drainage. Also, soil eroded by rain floods sediment in concrete gutters constructed on both sides of major roads. The refuse and the soil sediment will eventually fill up the drainage and during heavy rains, floods overflow into adjacent land areas. Such flood water may cause flooding of private houses; causing damage to property and even lives, if houses collapse.

3 **Building houses along flood water channels**

When planning cities, the Department of Urban and Regional Planning indicates areas which are flood channels and makes rules that houses should not be built on such areas. Some people, however, in defiance of the rules choose to build in such places.

Once there is heavy rain, houses are flooded, and people incur loss of their property and/or lives.

4 **Natural disasters**
Major infrastructure failure such as the collapse of a dam or damage such as that sustained in an earthquake or volcanic eruption can cause catastrophic flooding.

Effects of flooding on communities and farmland

1 **Loss of personal property**
In the 2012 flood earlier discussed, people affected by the flood lost clothes, money, food, domestic animals and other property which they could not evacuate.

2 **Loss of crops**
Rice and yam crops, which were almost due for harvesting, but had not been harvested, were covered by that flood and destroyed. Flood waters damage farmland, making the land unworkable and preventing crops from being planted or harvested. This leads to shortage of food for humans and farm animals.

3 **Loss of buildings**
Buildings which do not have strong foundations or cement walls collapse in floods.

4 **Loss of lives**
If flood occurs at night, without any warning signs, lives may be lost. Lives are also lost when people, wading (walking) through floods mistakenly enter into unseen gulleys or large drainage.

5 **Displacement from home**
Floods fill houses and drive people away from their homes. Anyone displaced from home by a natural disaster cannot carry all the necessities of life along. Such a person suffers in many ways. Even drinking water can be a problem, and so medical help is sought in case of sickness.

6 **Shortage of consumable water**
There is shortage of drinking water or severe water contamination and an increase in the risk of water borne diseases.

7 **Psychological damage**
Psychological damage is involved where deaths, serious injuries and loss of property occur.

8 **Loss of health**
Urban flooding can lead to badly wet houses, which are linked to an increase in respiratory problems and other illness.

Prevention of flooding

1 **Building houses on safe high ground**
People should build their houses on safe high ground, where there is no danger of flooding.
2 **Good sanitation**
Good sanitation will prevent over-flooding of flood water from gutters to residential or other buildings.
3 **Urban planning**
Avoid building houses along flood channels. People should not build houses along flood channels to avoid flooding of their houses and possible damage to property and loss of lives.

Summary

1 Soil erosion is the wearing away of the surface of the soil and the transportation

of the worn out material from one place to another.

2 The types of erosion are sheet erosion, rill and gully erosion.

3 The agents of erosion are water and wind.

4 The effects of erosion include loss of soil fertility, reduction of crop yield, loss of valuable land to gully erosion, threat to life and property, and migration of people away from land threatened by gully erosion.

5 Soil erosion may be controlled by planting grass, planting cashew or other trees (e.g. bamboo trees), making ridges at right angles to the slope of the land, terracing, strip farming, tarring of roads, and making concrete gutters to carry flood water.

6 Flooding is the overflow of water from a stream or river or flood channel onto land that is normally dry and free of water.

7 Causes of flooding may be natural, like unusually high rainfall or a result of human activities such as blocking of gutters and flood channels by poor sanitation, or wrong location of buildings.

8 Flooding can be prevented by location of buildings on safe high ground, good sanitation and location of buildings away from flood channels.

9 Flooding has harmful effects on communities and farm lands. Examples are damage to buildings and property, loss of lives, displacement of people from their homes, damage to crops in flooded farms, and hardship of living somewhere else as refugees.

Revision questions 5

1 Erosion is _____.
   A the wearing away of the surface soil
   B transportation of soil materials
   C water
   D wind
   E all of the above

2 The following promote erosion except _____.
   A bush fires
   B cross bars
   C movement of heavy vehicles
   D cultivation of the soil
   E making ridges in the same direction as slope of land

3 Which of the following is not a method of controlling erosion?
   A Bush clearing
   B Strip farming
   C Planting trees
   D Terracing
   E Planting grass

4 Flooding means _____.
   A increase in volume of water in a river
   B flow of water along a wide valley
   C outflow of water from nearby land
   D inflow of water from nearby land
   E overflow of water to normally dry land

5 In a desert environment the main agent of erosion is _____.

6 Water normally flows from high to _____ land.

7 Describe two (2) methods of controlling erosion.

8 State two (2) causes of flooding in your community.

9 Describe two (2) ways of preventing flooding.

10 State the effects of flooding on the environment.

Chapter 6 Environmental hazard II (Bush burning and deforestation)

Introduction

Bushes and forests are useful to human beings in many ways, some of which are listed below. Bushes and forests provide:

1 firewood.
2 grass for cattle, goats, sheep, birds, monkeys, and rats.
3 edible fruits for human beings e.g. walnuts.
4 shelter for pedestrians, and animals.
5 medical leaves, barks and roots.
6 rubber.
7 timber for building, furniture and roofing.
8 home for birds and other animals.
9 leaves that break the impact of falling rain drops and thus reduce erosion.
10 roots that bind soil particles and reduce erosion.
11 a means of carrying out photosynthesis by taking up carbon dioxide from the air and giving out oxygen, thereby replacing the oxygen in air that has been used by human beings and animals.
12 rainfall by absorbing water from the soil and transpiring it into the atmosphere where it condenses and falls again as rain.

For the reasons given above, bush burning and deforestation are harmful to the environment and, hence, are considered environmental hazards. In this chapter, you will learn the causes of bush burning and deforestation, their harmful effects and their control.

Objectives

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

1 mention social, economic and agricultural practices influencing bush burning;
2 discuss the effects of bush burning;
3 suggest regulations against bush burning;
4 list reasons for deforestation;
5 state different effects of deforestation on plant and animal populations; and
6 list and explain government regulations against deforestation.

Bush burning

Bush burning occurs when an area of vegetation is set on fire. Such bush normally contains grass that may be a small part or a major part of the vegetation. Bush burning occurs mainly in the dry season when grass has become dry and inflammable. A bush fire normally continues until it is stopped by a stream or river or green, fresh forest.

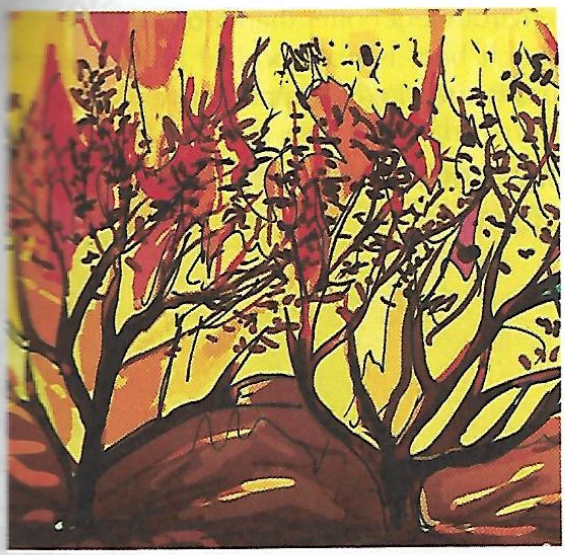


Fig. 6.1 A burning bush

Practices influencing bush burning

1 **Natural causes of bush burning**

A natural cause of bush fire is lightning. Before, or during a rain, there may be thunder and lightning flashes. The lightning may set fire to a tree, or an area of dry grass. Beginning from one starting point, the fire may spread and cover a large area.

2 **Human practices that affect bush burning**

i) *Smoking of cigarettes:* A cigarette smoker may smoke a cigarette and throw away the burning stub into a bush at the roadside along which he or she is going. If the cigarette stub accidentally falls on dry grass, it may begin a small fire that may grow into a big bush fire.

ii) *Hunting:* In some communities, the youth practise hunting in the middle of the dry season. They deliberately set fire on one side of a large bush area. This fire causes wild animals in the bush area to run towards the other end of the bush area for safety. The hunters line up along the expected escape route of the animals and try to catch the animals using sticks, cutlasses or other devices. Sometimes such fire, expected to cover a small area, to scare animals, spread to a large area or a big forest.

iii) *Cattle herdsmen:* Towards the end of the dry season, cattle herdsmen intentionally set fire to areas that contain much grass. The herdsmen have known that when the grass is burnt, it grows back better than if the grass is not burnt. In this way, the cattle herdsmen have fresh green grass for their cattle in advance of the approaching rainy season, when ordinarily the new grass will grow. This is probably an ancient pastoral practice which has survived till today.

iv) *Farming:* Some farmers believe setting fire on their farmland is a cheaper and faster method of land clearing instead of employing people to clear the farmland for agricultural purposes. Some farmers also believe bush burning enhances soil productivity.

Effects of bush burning

Bush burning has many adverse effects, some of which are described as follows:

1 **Burning of humus**

When a bush is burning, the humus which is on the soil surface is also burnt. By so doing, that humus that is burnt does not contribute

to soil fertility. It is wasted and lost.

2 **Killing of beneficial soil micro organisms**
Some soil organisms such as ants, bacteria, earthworm and fungi are useful. They help humus to decay and provide nutrients for plants. Earthworms also aerate the soil (i.e. create holes to allow air in the soil), they chew humus and, thereby, help the humus to decay. Bush burning kills useful soil insects thereby making soil infertile.

3 **Air pollution**
Bush burning produces carbon dioxide and smoke which pollute the air.

4 **Promotion of erosion**
Bush burning promotes erosion by removing the vegetation cover over the soil. The leaves of the plants, after bush burning, are no longer available to reduce the impact of falling rain drops on the soil. The soil is now exposed to the full power of rain drops and rain floods that erode the soil.

5 **Destruction of forest resources**
Bush burning destroys forest resources such as firewood, wild fruits, edible leaves, and medicinal plant materials.

6 **Carbon cycle**
Normally human beings and animals breathe out carbon dioxide and breathe in oxygen. These processes keep the carbon dioxide to oxygen ratio in the atmosphere fairly constant. When a bush is burnt, the role of plants in restoring oxygen in the atmosphere is hindered.

7 **Bush burning reduces rainfall**
Plants absorb water which has sunk into the soil and transpires it as water vapour into the atmosphere. The water vapour rises in the air, cools and falls again as rain. When bushes are burnt, this water cycle is hindered.

8 **Heat pollution**
Bush burning generates heat, making the environment hotter than it ought to be. Too much heat is not good; it makes people easily tired and less productive.

Regulations against bush burning

1 Federal, state and local governments make laws and bylaws against bush burning. Among other harmful effects already listed above, a bush fire may extend into a village and cause damage to life and property. For these reasons, laws against bush burning are enforced and offenders if caught, are punished in accordance with the law.

2 Many agencies, ministries and even local governments are concerned about bush burning. They therefore help to enforce laws and regulations against burning of bush. The agencies include:
   i) **FEPA** — Federal Environmental Protection Agency.
   ii) **EPA** of different states (Environmental Protection Agency), e.g. **LASEPA** (Lagos State Environmental Protection Agency).
   iii) **NAFCON** (The National Forest Conservation Council of Nigeria).
   iv) **FRIN** (Forestry Research Institute of Nigeria).

Other efforts to control bush burning include:

3 Provision of support that enables poor farmers have access to modern tools and machinery for land clearing.

4 Encouraging the use of traps when hunting for animals instead of bush burning.

Deforestation

Deforestation is the destruction or removal of forests or stands of trees where the land is thereafter converted to non-forest use.

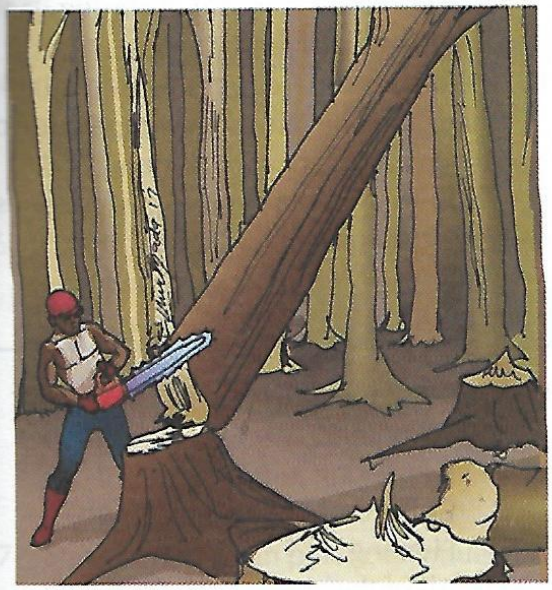


Fig. 6.2 Forest trees being felled

Reasons for deforestation

Reasons for the destruction of forests include the following:

1 *Firewood:* People cut stems and branches of forest trees which they use as firewood.
2 *Commercial charcoal:* Stems and branches of trees and shrubs are cut and processed to produce commercial charcoal which is used for domestic purposes and for export.
3 *Lumbering:* Trunks of big trees are cut, sawn into timber and used for building and roofing houses, construction of furniture and other purposes. The rate of the use of forest trees is greater than the rate of forest re-growth. Many European countries have laws that makes it mandatory that when you cut one tree, you plant another. So their forests are always re-growing. In Nigeria there is no such law yet, hence our forests are disappearing.
4 *Road Construction:* Road construction contributes to deforestation because forests are cut down to make way for new roads or for expansion of old roads.
5 *Farming:* Farming often begins with bush or forest clearing. Trees are cut down before crops are planted so as to prevent shading of the crops by trees. In this way, farming promotes deforestation.
6 *War:* Trees are used in war to hide from the enemy and also cover vital resources.

Effects of deforestation

The following are among the effects of deforestation:

1 Deforestation promotes erosion.
2 It promotes quick decay and loss of humus from the soil.
3 It removes the shade provided by trees and makes the environment hot.
4 It reduces rainfall.
5 Deforestation causes climate change.
6 It affects the carbon dioxide and oxygen balance in the atmosphere.
7 It causes loss of habitat for millions of species.
8 Deforestation makes the soil more prone to flooding and land slides because the soil is now more exposed.

Regulations against defores-tation

The Federal, State and Local Governments, have laws against deforestation. These laws are enforced by the Forestry Department. A

law is also needed to promote planting of trees in place of those harvested.

Factors that encourage deforestation

1 Disregard or ignorance of the value such forests possess.
2 Lack of forest management.
3 Deficient/weak environmental laws and failure in their enforcement.

Control of deforestation

The following can be introduced to control deforestation:

1 Reforestation.
2 Afforestation.
3 Introduction of an alternative source of heat to reduce the use of firewood.
4 Recycling of paper to avoid the use of soft wood.
5 Adoption of modern methods of cattle rearing.
6 Elimination of clear felling of trees to make sure that the forest environment is kept intact. Any felling that does occur should be balanced by the planting of enough young trees to replace the older one felled in any given forest.

Summary

1 Bush burning means setting bushes on fire.
2 Bush burning is caused by lightning (a natural factor) or by human factors such as smoking, hunting or cattle herdsmen's practice of burning grass so as to hasten the re-growth of grass.
3 Bush burning depletes forest resources (firewood, medicinal plant materials, vegetables, and fruits).
4 Bush burning increases heat in the environment, affects carbon dioxide and oxygen in the atmosphere, reduces rainfall, promotes erosion and destroys beneficial soil organisms and humus.
5 The reasons for deforestation include sourcing of firewood, processing of commercial charcoal, farming, and construction of roads.
6 Deforestation reduces the available shade, and increases the temperature of the environment and erosion.
7 There are government regulations against deforestation.

Revision questions 6

1 Which of the following is a reason for bush burning?
   A Lumbering
   B Collection of medicinal herbs
   C Hunting
   D All of the above
   E None of the above
2 Which of these is a beneficial effect of deforestation?
   A Reduction of medicinal plant products
   B Exposure of land surface
   C Reduction of shade
   D Reduction of rainfall
   E None of the above
3 One of the following is an effect of bush burning and deforestation on the environment.
   A Protection of the environment
   B Good government
   C Erosion
   D None of the above
   F All of the above
4 Which of the following encourages deforestation?
   A Road construction
   B Farming

C Lumbering
D Commercial production of charcoal
E All of the above

5 Which of these activities of man has the greatest effect on the number of wild life in Nigeria?
A Industrialisation
B Urbanisation
C Farming
D Deforestation
E Overgrazing

6 Which of the following activities does not contribute to the destruction of West African forests?
A Afforestation
B Building
C Deforestation
D Industrialisation
E Lumbering

7 State three human practices influencing bush burning.

8 State two adverse effects of bush burning on the environment.

9 Explain four adverse effects of deforestation on plants and animals.

10 State two government regulations prohibiting deforestation.

Chapter 7 Environmental hazard III (Desertification and ozone layer depletion)

Introduction

A **desert** is a region rendered barren or partially barren by extreme environmental conditions, particularly low rainfall. No part of Nigeria has been classified by geographers as a desert. The Sahara desert extends southwards only as far as the northern part of Niger, which is Nigeria's northern neighbour. The closest type of vegetation to a desert in Nigeria is called **Sahel Savanna** which exists at the northeastern tip of Nigeria (especially in Yobe and Borno states). Sahel Savanna contains scanty grass and stunted trees.

The Sahel Savanna lies in the main Savanna vegetation belt. It covers a wider area than any other type of vegetation. Grass species are dominant (that is, there are more grasses than trees or shrubs). The sizes of grasses and trees or shrubs diminish as the latitude increases (towards the north) in Nigeria. Also, the vegetation decreases in size progressively from Guinea Savanna, to Sudan Savanna to Sahel Savanna.

Desertification is a type of land degradation in which a relatively dry land region becomes increasingly arid, typically losing its bodies of water as well as vegetation and wild life.

In Sokoto, Katsina, Kano, Jigawa, Yobe and Borno States, the grassland is relatively thin when compared with the grassland in Niger State. In these northern states, close to the northern border, if the grassland is misused, it will degenerate to a condition that looks like a semi-desert.

Desertification is also defined as a change in the vegetation of an area over time which makes the vegetation look more like a desert. These changes are as follows:

1 Reduction in the size of vegetation.
2 Reduction in the number of plants.
3 Increase in the number and sizes of barren patches.
4 Increase in drought and decrease in productivity.

The **ozone layer** is a layer in the atmosphere that is useful to human beings and plants because it shields both from harmful ultraviolet rays from the sun caused by human activities that deplete (reduce) the ozone layer.

Desertification and depletion of the ozone layer are environmental hazards. As a result of human activity, a savanna area can be turned into a desert and when the inhabitants can no longer feed themselves there, they migrate. If, as a result of human activities the ozone layer is depleted (made smaller), more human beings, animals and plants will suffer from ultraviolet radiation, which will result in cancer and other health problems. In this chapter, you will learn about desertification and depletion of the ozone layer, their causes, their effects and how to control them.

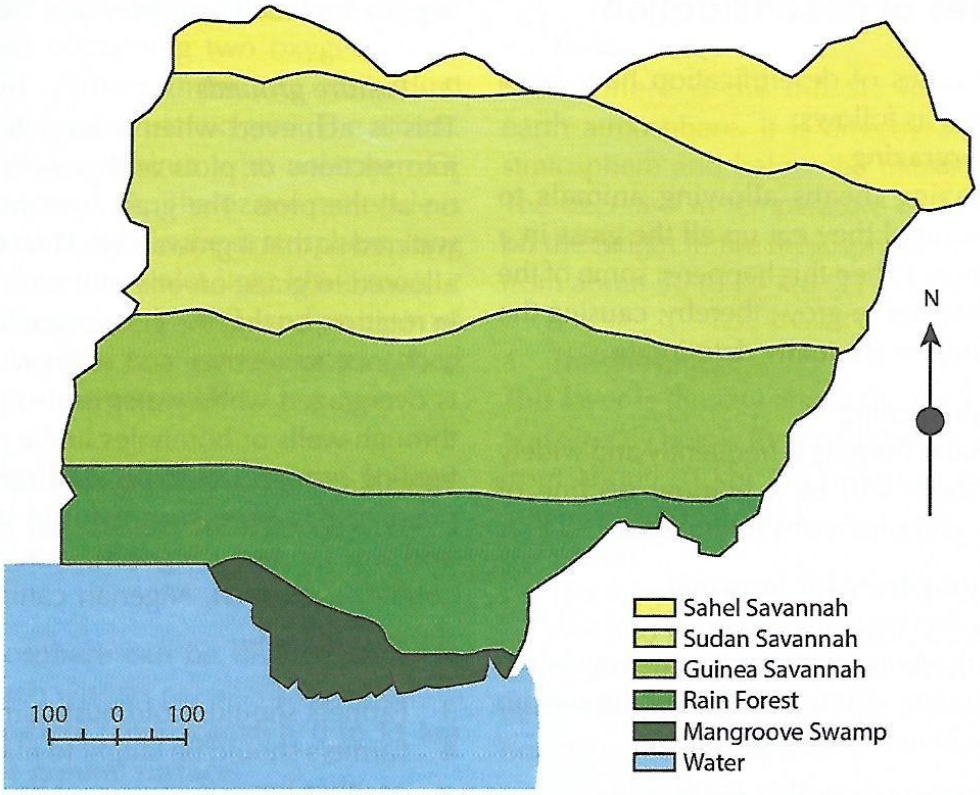


Fig. 7.1 Vegetation map of Nigeria

Objectives

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

1 define desertification;
2 state the geographical area where desertification occurs;
3 state the causes of desertification;
4 describe the ozone layer and its location in the atmosphere;
5 explain the importance of the ozone layer;
6 describe the effects of the depletion of the ozone layer; and
7 describe measures that will control depletion of ozone layer.

Desertification

Desertification is the process by which an area covered with vegetation changes to one in which vegetation is scanty or absent (partially like a desert). Desertification is a major global ecological and environmental problem.

Geographical areas where desertification is taking place in Nigeria

Desertification is taking place along the northern border of Nigeria, specifically in the extreme northern parts of Sokoto, Katsina, Kano, Jigawa, Yobe and Borno States.

Causes of desertification

Some causes of desertification have been identified as follows:

1 **Overgrazing**

Overgrazing means allowing animals to eat grass until they eat up all the grass in a vegetation. When this happens, some of the grass may not re-grow, thereby, causing the vegetation to gradually deteriorate.

2 **Bush burning**

When bush burning is frequently and widely done, there will be a gradual decline of grasses and organisms in the area.

3 **Cutting trees for firewood**

If trees are regularly cut for firewood, the trees will after some time die. The vegetation will become scanty or empty if there is no replacement (replanting).

4 **Clearing vegetation for farming**

If the vegetation is cleared for farming, in due course, the plants will die.

5 **Natural causes of desertification**

These include:

i Drought: The absence of rainfall or unusually low rainfall for several years.

ii Erosion, which reduces fertility of soil and its ability to support healthy vegetation.

Control of desertification

1 ***Afforestation***

Afforestation means deliberate planting of trees. The deliberate planting of trees in several states in Northern Nigeria started some years ago and is still going on. Species of trees selected are hardy and can survive harsh environmental conditions. Some trees which are now used for afforestation in Nigeria include *Eucalyptus* and *Neem*.

2 ***Pasture grounds***

This is achieved when a land is divided into sections or plots and grass is planted on all the plots. The grass is manured and watered so that it grows well. Then cattle are allowed to graze on one plot after another, in rotation, so that the grass in each plot has a chance to recover and re-grow. No plot is overgrazed while water is also provided through wells or boreholes in the plot. This feeding ground is known as a **ranch**. This practice has been successful in the USA, and the United Kingdom, among other countries. As such, Nigerian cattle owners should adopt it.

3 Farmers should avoid bush burning.

4 Farmers should be taught to plant cassia or other trees as sources of firewood.

5 Crop rotation, in which a leguminous cover crop is used to protect the fallow plot, will help to conserve the soil.

6 Public enlightenment by government agencies will help illiterate farmers to learn how to conserve the soil.

Ozone

What is an ozone? Ozone is a molecule that contains three atoms of oxygen (O_3).

The ozone layer is a layer of the stratosphere where ozone is formed in a large quantity, protecting the earth from the sun's ultraviolet radiation.

The ozone layer is the natural blanket which accumulates from excess oxygen released into the atmosphere by green plants, and it protects the earth from the direct heat of the sun.

Ozone in the earth's stratosphere is

created by ultraviolet light, striking oxygen molecules containing two oxygen atoms (O_2), and splitting them into individual oxygen atoms (atomic oxygen). The atomic oxygen then combines with unbroken O_2 to create ozone, O_3. The ozone molecule is unstable (although, in the stratosphere, long lived). When ultraviolet light hits ozone, it splits into a molecule of O_2 and an atom of atomic oxygen, a continuing process called the **ozone – oxygen cycle**.

Description of the ozone layer and its location in the atmosphere

The atmosphere can be divided into five layers, each with its peculiar properties.

1 **Troposhere (approximately 0 to 11 km above the ground surface)**

The layer of the atmosphere that is closest to the ground is called the **troposphere.** It extends from zero to about 11km altitude. The clouds, rain, lightning, wind, dust, moisture and other features of weather occur in the troposphere. In this layer, there is a fall in temperature of 6.5°C for every 1km rise in altitude. At the top of the troposphere, the temperature is about -60°C. The decrease of temperature stops with a rise in altitude.

2 **Stratosphere (approximately 14 km to 48 km from ground surface)**

At the bottom of this layer, temperature remains constant with increase in altitude, but later the temperature begins to increase with increase in height. Air is denser at the bottom than at the top of this layer. This layer lacks moisture or dust or turbulence and is good for flying aircraft. The maximum temperature in this layer is 10°C.

3 **Mesosphere**

Mesosphere is the middle layer of the earth atmosphere. It is directly above the stratosphere and below the thermosphere. The decrease in temperature is dependent on the height in the mesosphere. It extends from about 50 to 85 km (31 – 53 miles).

4 **Thermosphere**

This layer is directly above the mesosphere and directly below the exosphere. It extends from about 90 km (56 miles) to between 500 and 1000 km (311 – 621 miles) above our planet.

The temperature in this layer can reach up to 4 500°C. But because of its nearness to vacuum, contact with few atoms of gas that transfers heat is hampered, warmth is not felt while cold is felt.

Also, low earth orbit satellites are usually found in this layer.

5 **Exosphere**

This is the uppermost layer of the earth's atmosphere. It is almost airless, that is air, is very thin. Its altitude starts at about 500 km to 10 000 km.

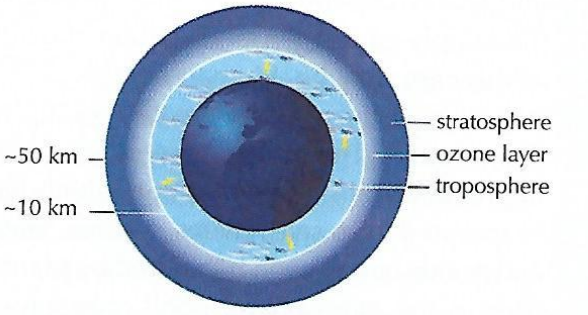


Fig. 7.2 Location of the ozone layer in the atmosphere

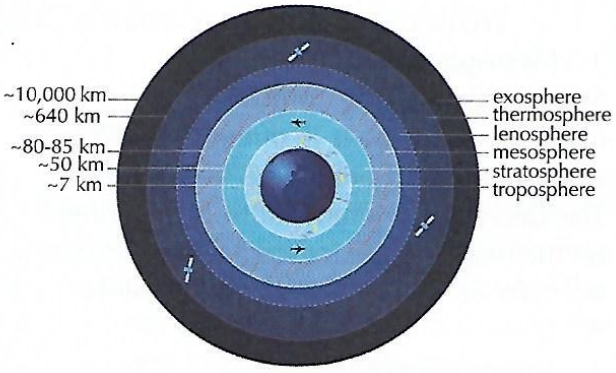


Fig. 7.3 Layers of the atmosphere

The ozone layer is located in the stratosphere, between 10 km and 80 km above the ground surface, with its highest concentration at about 25 km above the ground.

Ozone is related to oxygen. While one molecule of oxygen has two atoms of oxygen (formula O_2), one molecule of ozone has three atoms of oxygen (formula O_3).

Ozone	—	O_3
Oxygen molecule	—	O_2
Oxygen atom	—	O

Depletion of the ozone layer

The atmosphere is an important part of our environment. Human beings, animals and plants depend on the atmosphere for the supply of oxygen and carbon dioxide as the case may be. Human beings cannot stay alive if they fail to breathe for up to five minutes. The atmosphere plays a part in giving us rain. Water vapour, which has evaporated from seas, rivers, streams, lakes and ponds or has been transpired by plants, rises in the atmosphere, cools, condenses and falls again as rain. The ozone layer, which will now be discussed, is yet another way in which the atmosphere is useful to us.

Importance of the ozone layer

The sun emits (gives out) different kinds of energy radiations which include:

1 Heat (thermal) radiations which keep us, our environment, plants and animals warm.
2 Visible light rays, which enable us to see, and plants to photosynthesise.
3 Ultraviolet rays, which are high energy rays that are not visible to the human eyes. Ultraviolet rays have so much energy that they are harmful to living things. Exposure to ultraviolet rays can cause:
   i) cancer of the human skin,
   ii) damage of the eyes,
   iii) reduction of crop yield,
   iv) harm or death of small water plants which fish and other aquatic animals use as food.

The ozone layer is important to all living things on earth because it forms a shield that absorbs ultraviolet rays emitted by the sun as they pass through the atmosphere, and hence protect living things on earth from harmful ultraviolet radiations. Without the ozone layer, the amount of ultraviolet radiations reaching the earth's surface would cause much harm.

Usefulness of ozone

1 Ozone can be used as a bleaching agent and for killing bacteria.
2 In municipal drinking water system treatment, ozone is used to sterilise water instead of the more common chlorine which forms organo-chlorine compounds and remain in the water after treatment.

3 Ozone is used to clean and bleach fabrics as well as deodorise air and objects such as after fire incidents.
4 Ozonated water is used to wash fresh fruits and vegetables to kill bacteria.
5 Many hospitals in developed countries around the world use large ozone generators to decontaminate operating rooms before surgeries.

How ozone shields ultraviolet rays

Under normal conditions, ozone shields living things on earth from ultraviolet radiations through the process of **ozone formation** and destruction called the **ozone cycle**. This is shown in the steps above.

Then the ozone cycle begins all over again with oxygen. In step 3, ozone performs its critical function of absorbing ultraviolet radiations and preventing the harmful radiations from reaching the earth.

Causes of depletion of the ozone layer

Scientists have observed an ongoing depletion (reduction in the thickness) of the ozone layer of the atmosphere. This would mean that the protective shield which the ozone provides is being destroyed. In effect, more people will in future suffer from skin cancer, eye problems and other sicknesses caused by ultraviolet radiation than before.

The main cause of the depletion of the ozone layer is the accumulation (building up) of chlorofluorocarbons (CFCs) such as Freon chemical in the ozone layer. This is used for refrigeration, and as propellants in aerosols such as insecticide, deodorant, paint, polish and perfume sprays.

When chlorofluorocarbons get into the atmosphere, they rise until they reach the ozone layer. There, the chlorofluorocarbon reacts with ozone as shown below.

Step 1: O_2 (oxygen) + UV (ultraviolet rays) ⟶ O (oxygen atom) + O (oxygen atom)

Step 2: O_2 (Oxygen) + O (Oxygen atom) + NM (Neutral molecule) ⟶ O_3 (Ozone) + NM (Neutral molecule)

Step 3: O_3 (ozone) + UV (ultraviolet rays) ⟶ O_2 (oxygen) + O (oxygen atom)

Step 4: O (oxygen atom) + O_3 (ozone) ⟶ $2O_2$ (oxygen)

Step 1 Chlorine from chlorofluorocarbon reacts with ozone forming chlorine monoxide (ClO) and oxygen.

CFC Chlorine from Chlorofluoro-carbon	+	O_3 ozone	——>	ClO Chlorine monoxide	+	O_2 oxygen

Step 2 Two chlorine monoxide molecules react together forming chlorine peroxide (Cl_2O_2).

ClO Chlorine monoxide	+	ClO chlorine monoxide	——>	Cl_2O_2 chlorine peroxide

Step 3 Sunlight causes chlorine peroxide to break down into oxygen and free chlorine atoms.

Cl_2O_2 Chlorine peroxide		sunlight ——>		2Cl chlorine atoms	+	O_2 oxygen

It can be seen that while the ozone cycle described earlier recycles ozone, the cycle induced by chlorofluorocarbons (CFCs) does not produce ozone. It uses up ozone, hence, it is depleting the ozone layer of the atmosphere.

Harmful effects of depletion of ozone layer

The harmful effects of the depletion of the ozone layer include the following:

1 Skin cancer, skin ageing, dry skin, wrinkled and leathery skin.
2 Eye problems such as cataracts.
3 Harmful effects on plants which will reduce yield and may eventually lead to famine if unchecked.
4 Death of aquatic plants eaten by fish and other aquatic animals.
5 The warming of the earth's surface and the lowest layer of the atmosphere could be caused by the presence of water vapour, carbondioxide, methane and some other gasses in the air due are to the deplation of ozone layer. This process is referred to as the geen house effect.
6 Ozone depletion also causes global warming. Decrease in the temperature at the stratosphere following ozone layer depletion increases atmospheric temperature due to the presence of some gases that trap sun rays.

Control of depletion of the ozone layer

Many countries are now taking steps to control the depletion of the ozone layer of the atmosphere. Such steps include those listed below.

1 180 countries have signed the Montreal Protocol (1987) which called for the elimination of the use of chemicals that deplete the ozone layer.
2 Many nations have stopped manufacturing chlorofluorocarbons which deplete the ozone layer.

3 Substitute chemicals which do not deplete the ozone layer are being developed and used instead of chloro-*fluorocarbons*.
4 Again, the replacement of the ozone layer can be maintained by planting trees to ensure stable oxygen levels in the atmosphere, despite its removal by some processes.
5 Reduction of bush burning and control burning in household activities would also help to control depletion of the ozone layer

Summary

1 Desertification is the process whereby an area that is covered by vegetation changes to one in which vegetation is scanty or absent.
2 Desertification is taking place in the northernmost parts of Nigeria: Sokoto, Katsina, Kano, Jigawa, Yobe and Borno States.
3 Desertification is caused by drought, erosion, bush burning, overgrazing, firewood cutting, over cropping and so on.
4 Desertification can be controlled by enlightenment, aforestation, crop rotation, establishment of pasture grounds which are watered, fertilised and planted with grass.
5 The ozone layer is located in the stratosphere zone of the atmosphere. It extends from above the ground, but is most concentrated about 25 km above the ground surface.
6 The ozone layer is important because it forms a shield that absorbs ultraviolet rays from the sun, which, if it were not for the ozone shield, would cause harm to human beings, animals and plants on earth. Such harm includes cancer of the skin and eye problems such as cataracts, harmful changes in plants that retard yield, and death of microscopic aquatic plants.
7 The ozone layer is being depleted mainly by chlorofluorocarbons present in Freon, used for running refrigerators and propellants for insecticide, hair, perfumes, polish, paint and deodorant sprays.
8 Ozone layer depletion is now being controlled by the Montreal Protocol (1987) in which 180 countries signed to stop the use of CFCs, to develop substitutes for CFCs and to use other chemicals which do not deplete the ozone layer.
9 Tree planting campaigns should be maintained to ensure stable oxygen levels in the atmosphere, despite its removal by some processes.

Revision questions 7

1 Desertification is the change of a land covered with vegetation into a _____.
   A forest
   B savanna
   C thick bush
   D fresh water swamp forest
   E land with scanty vegetation
2 Which of the following is a natural cause of desertification?
   A Drought
   B Bush burning
   C Cutting of firewood
   D Overgrazing
   E None of the above

3 The ozone layer in the atmosphere shields living things from harm by _____.
   A X-rays
   B heat
   C ultraviolet rays
   D sunlight
   E chlorofluorocarbons
4 Which of the following causes depletion of the ozone layer?
   A Chlorofluorocarbons
   B Sunlight
   C Ultraviolet rays
   D Rainfall
   E High temperature
5 The ozone layer is located in the atmosphere between _____.
   A 0 and 10 km
   B 10 and 80 km
   C 80 and 150 km
   D 150 and 200 km
   E 200 and 250 km
6 State three (3) human activities that promote desertification.
7 List four (4) methods of controlling desertification.
8 Name one geographical area in Nigeria where desertification is occurring.
9 State three (3) hazards of depletion of the ozone layer of the atmosphere.
10 State two (2) control measures for reducing the rate of depletion of the ozone layer.

Chapter 8 Drug and substance abuse

Introduction

In Books 1 and 2, you learnt several things about drug and substance abuse. You learnt, for instance, that a drug is a substance that can be used to treat diseases and injuries, and/or to prevent sickness. Drug and substance abuse means the uses of drugs and substance wrongly, especially:

1 for wrong purposes (i.e. purposes not intended or recommended by medical professionals).
2 with the wrong doses (amounts).
3 in wrong frequencies.
4 in the wrong manner.
5 without medical prescription.
6 without medical supervision.

For instance, cocaine is used by the medical profession in the form of an injection, for the purpose of killing pain in a local area of the body, that is, as a local anaesthetic. Those who abuse cocaine use it to stimulate themselves (wrong purposes). They smoke, sniff or eat it (wrong method) in unmeasured amounts (wrong dosage). The aim of the person who abuses a drug is not to treat a disease. It may be to forget his problems. There is no limit to the quantity a person who abuses a drug may use.

Drug abuse is harmful to health as it may damage the brain or the senses. It may also have bad effects on other parts of the body such as the lungs. Unfortunately, a person that takes a drug feels like taking it again and again. In fact he or she does not feel comfortable unless he or she takes it repeatedly, whenever he or she has the urge to do so. At this stage, the person is said to be **addicted to**, or **dependent on** the drug.

Certain substances, which are not used for medical treatment, such as sugar and soft drinks, share some qualities with drugs. For instance, a person who drinks a particular soft drink, may develop an irresistible urge to take it frequently. For this reason, the term drug and substance abuse is used to cover the abuse of both drugs and other substances.

In this chapter, you will learn the effects of drug abuse, the prevention of drug abuse and the activities of drug control agencies. The misuse of herbal medicine will also be discussed.

Objectives

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

1 describe some effects of drug abuse on youths;
2 state strategies for a healthy, drug-free lifestyle;
3 describe the role and activities (including anti-counterfeiting activities) of national drug control agencies; and
4 describe what constitutes misuse of herbal medicine.

Effects of drug abuse

The effects of drug abuse are many. They vary with the drug being abused, the age of the person abusing the drug, the quantity of the drug taken and other factors. In Table 8.1, a summary of the effects of drug abuse on youths is presented.

Table 8.1 Summary of effects of drug abuse on youths

Drugs	Areas affected	Effects
Cocaine Heroin Marijuana Alcohol Amphetamines Cigarette (tobacco) Ketamine hydrochloride	Health	a) Stomach upset b) Damaged nostrils and lungs c) Skin rashes d) Injection abscess in those who administer injections of drugs on themselves e) Depression, anxiety, hallucination and euphoria
	Education	a) Loss of interest in education b) Poor performance in school c) Dropping out from school d) Rejection of good advice to return to school e) Aggression against parents
LSD (Lysergic Acid Diethylamide)	Social life Social behaviour	a) Aggression b) Roaming about c) Withdrawal from mates
	Discipline	a) Need for money leads to crime
	Future hope	b) None, because the individual is unwilling to go to school or learn a job.

Table 8.2: Effects of specific drugs

1 Cocaine	a)	Stimulates the central nervous system to make the abuser excitable and talkative.
	b)	Stimulation is followed by depression.
	c)	Abuser may have HIV infection through the sharing of injection needles with a sufferer.
	d)	Overdose causes death.
2 Heroin	a)	Abuser may have HIV infection by sharing injection needles with a sufferer.
	b)	Causes drowsiness, loss of the senses, hallucinations, after which one becomes helpless for hours.
3 Marijuana	a)	Alters the mind.
	b)	Slows down user's reaction.
	c)	Damages user's sense of reasoning and judgement.
	d)	Gives user distorted perception and emotion.
	e)	Alters the ability to separate facts from fantasy.
	f)	Creates illusion, delusion, hallucination depending on the dose of the drug taken.
	g)	Causes mental illness.
4 Alcohol	a)	Intoxication.
	b)	Loss of appetite.
	c)	Gradual damage of liver cells in chronic alcoholics.
	d)	Damaged sense of reasoning.
	e)	Aggression.
	f)	Under the influence of alcohol, one can become involved in sexual relationships that may result in HIV infection or unwanted pregnancy.
5 Cigarettes (Tobacco)	a)	Causes respiratory tract diseases, such as cough.
	b)	Causes cancer of the lungs.
	c)	Damages the nostrils and lungs.

General effects of drug abuse include:

1 Broken homes (probably due to waste of money on drugs and/or withdrawal from family).
2 Motor vehicle accidents when driving under the influence of alcohol.
3 Desire to commit suicide.
4 HIV infection, arising from sharing of injection needles.
5 Arrest by the police for being in possession of drugs.
6 Feeling of rejection, hostility, aggression, anxiety, depression and lack of confidence in self.
7 Problems at work place arising from lateness, carelessness and inefficiency.

Activity 8.1 Discussion of effects of drug abuse

Materials required

Your science notebook, biro

Procedure

1 Your teacher will divide the class into groups, with five students in each group.
2 In each group, each student will identify one person known to manifest effects of drug abuse.
3 Each student will report on the visible manifestations of drug abuse he or she has observed.
4 The group will put all the observations together in a report. The report should include the following:
   i) Sex of drug abuser (but not the name).
   ii) Name of drug abused.
   iii) Evidence of addiction or not.
   iv) Manifestations of ill health or other bad effects of drug abuse.
5 Present your report to your teacher for class discussion.

Strategy for a healthy, drug-free lifestyle (Prevention of drug abuse)

Schools, religious organisations, government, parents and everybody should be involved in the prevention of drug abuse. The roles of the different bodies mentioned above are explained below.

1 Schools
   i) Primary schools, secondary schools, tertiary institutions should teach pupils and students to say 'no' to drugs because they are harmful to health and well-being.
   ii) School rules should include a ban on drugs. Any student found using unprescribed drugs should be severely disciplined.
   iii) Schools (primary to tertiary) should involve pupils and students in positive interesting activities such as sports, drama, literary societies, debates, and hobbies (music, photography, gardening etc).

2 Religious organisations

Seminars and other educative activities should be planned for youths in school and youths out of school by religious organisations to shift the focus of youths from unbeneficial activities.

With respect to drug abuse, religious organisations should teach youths the dangers involved in drug abuse, and how to overcome temptations to join peers in drug abuse.

3 Government

Enlightenment campaigns to teach youths and adults to avoid drug abuse, stressing that the losers are the drug abusers themselves, should be carried out.

Also, government should further support the work of the national drug control agencies.

4 Parents

Parents should teach their children, oversee their activities and correct them whenever they join bad company, such as those involved in drug abuse.

5 Youths

Every youth should:
   i) set a high goal for himself or herself.
   ii) avoid bad company.

iii) live a clean life.
iv) set a high standard of morality and good behaviour for himself or herself.
v) study for success.
vi) say 'No' to drugs.
vii) learn from the failures they have seen in drug addicts.

6 Others are
i) inculating coping skills
ii) developing and maintaining positive social interactions
iii) living a healthy lifestyle

Drug control agencies

The two main drug control agencies in Nigeria are the National Agency for Food and Drug Administration and Control (NAFDAC) and the National Drug Law Enforcement Agency (NDLEA). The functions of these two agencies are stated below.

Functions of the National Agency for Food and Drug Administration and Control (NAFDAC)

1 To register all approved manufactured foods and drugs in Nigeria.
2 To prevent the manufacture, importation and distribution of fake, expired and substandard foods and drugs.
3 To identify, confiscate and destroy fake and expired foods and drugs in Nigeria.
4 To monitor the quality of drugs/products from pharmaceutical and food/drinks related industries.

Functions of the National Drug Law Enforcement Agency (NDLEA)

1 To apprehend traffickers of illegal drugs.
2 To arrest the sponsors of drug traffickers.
3 To control the use and sale of hard drugs such as marijuana.

Misuse of herbal medicine

Herbal medicine is the use of herbs for medical purposes. Herbs, in this context, mean plants, including their leaves, roots, stem, bark, flowers and fruits.

Many of the drugs used throughout the world are obtained from plants. Therefore, in principle, herbal medicine is not wrong. What is necessary is to ensure that makers of herbal medicinal products are not producing and selling fake drugs to the public.

Herbal medicines should by law be registered by the National Agency for Food and Drug Administration and Control (NAFDAC). Any such registered herbal medicine should have, displayed on the bottle, the NAFDAC number, the date of manufacture, the date of expiry, the direction for use, and the sickness it is intended to cure.

There is a dramatic increase in the manufacture and marketing of herbal medicines. It is important for all to be careful and buy only those herbal medicines approved by, and registered with the government agency empowered to do so.

Using unapproved, unregistered herbal medicine is an abuse of herbal medicine, while using a herbal medicine intended for a particular purpose for another purpose or using a herbal medicine for the right purpose but in the wrong dosage, is a misuse of herbal medicine.

Drug misuse

1 This is the use of a drug for a purpose or condition for which it is not suited and/or;

2 The use of a drug for an appropriate purpose but in an improper dosage.

Summary

1 A drug is a substance used for the treatment of a disease or injury or for prevention of sickness.
2 Drug abuse is the use of a drug:
   i) in the wrong dosage.
   ii) in the wrong manner.
   iii) in the wrong frequency.
   iv) without medical prescription.
   v) without medical supervision.
3 The effects of drug and substance abuse include:
   i) wrong stimulation.
   ii) depression.
   iii) hallucination.
   iv) damage to nostrils and lungs.
   v) brain damage.
   vi) mental (psychiatric) illness.
   vii) insanity.
   viii) skin rashes.
   ix) cancer of the lungs.
   x) premature death.
   xi) unconsciousness.
4 The strategies for a healthy, drug-free life-style include:
   i) Public enlightenment
   ii) Encouraging students and others to engage in useful activities such as sports, reading, music societies and religious programmes.
5 There are two drug control agencies in Nigeria, namely, National Agency for Food and Drug Administration and Control (NAFDAC) and National Drug Law Enforcement Agency (NDLEA).
6 Misuse of herbal medicine is the use of approved, registered herbal medicine in the wrong dosage or frequency.

Revision questions 8

1 Drug abuse means using a drug _____.
   A for the wrong purpose
   B in the wrong amount
   C in the wrong method
   D without medical supervision
   E all of the above
2 The harmful effects of drug abuse do not include _____.
   A depression
   B hallucination
   C damage to the lungs
   D normal blood pressure
   E mental illness
3 Misuse of herbal medicine means using herbal medicine _____.
   A for the right purpose but in the wrong dosage
   B in the wrong dose
   C in the wrong method
   D without medical supervision
   E none of the above
4 Which of the following should have responsibility for controlling drug abuse?
   A School
   B Religious organisations
   C Parents
   D Individuals themselves
   E All of the above
5 Describe the harmful effects of drug abuse on youths and the family.
6 Mention two (2) ways in which youths can maintain a drug free life.
7 Name two (2) national drug control agencies and describe their functions.
8 State two (2) misuses of herbal medicine.
9 What is drug abuse?
10 Why do people misuse drugs?

Chapter 9 Resources from living and non-living things

Introduction

Living and non-living things are the two major components of the environment. While living things are made up of plants and animals, non-living things are made up of chemicals and minerals which exist as solids, liquids and gases (the three states of matter). Living and non-living things in our environment have been found to be useful materials to man in different forms. Some serve as sources of food, e.g. cows for meat, plants for vegetables and fruits, and salt for taste. Most of the materials in our environment can be put to several uses. In this chapter, you will learn about resources from living and non-living things in our environment and their importance to human beings.

Objectives

By the end of this chapter you will be able to:

1 identify the resources from living and non-living things;
2 classify the resources identified into biotic and abiotic or renewable and non-renewable;
3 explain the importance of natural resources to yourself and the community or country;
4 list the importance and uses of soil;
5 list the importance and uses of solid minerals;
6 mention solid minerals and where they are found in Nigeria; and
7 identify the distribution of mineral deposits on a map of Nigeria.

Meaning of resources

In science and technology, resources are the raw materials provided by nature which are used by man in the production of finer materials for human survival and well being. Resources are supplies that can be readily drawn upon when needed. Through technology and scientific knowledge, most raw materials in nature can be processed into different kinds of products, e.g. cotton is a raw material provided naturally by plants that can be processed and used in the production of many kinds of clothing materials. Also, chemicals can be processed into drugs that cure many diseases.

Activity 9.1 Identifing natural resources from the community

Materials required

A local market, science notebook, biro

Procedure

1 Work in a group of five students.
2 Visit a local market in your community.
3 Make a list of the materials produced in the community.
4 Make a list of the raw materials used in

making the local products, e.g. local mats are made from animal skins such as cow, or goat. Brooms are made from palm fronds. Local soap is produced from palm oil.

5 Make a table with the two lists as in Table 9.1.

Table 9.1 Local products and their resources

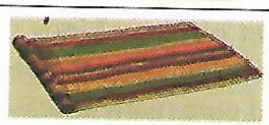
S/No.	Local products	Natural resources involved
1		
		
		

Fig. 9.1 Some local materials

Every man-made product is made up of natural resources to some degree. Natural resources consist of all things in the environment which do not come under man-made. They are things around us that take their course without the intervention of human beings. Examples are rivers, streams, mountains, precious stones and minerals. The earth is full of natural resources that were formed without human intervention. Natural resources may be listed as follows:

1 Forest
2 Aquatic (water)
3 Hydro resources
4 Animal (domesticated)
5 Microbial (those that are not seen by naked eyes)
6 Human resources (the human resources and intelligence)
7 Atmospheric resources (those that human beings cannot control, e.g. rain, wind, and sunlight)
8 Crop resources (agricultural growth)
9 Geological resources (naturally occurring formations, rocks and precious stones)
10 Edaphic resources (related to the soil and its properties)
11 Wildlife resources (lion, elephants, etc.)

There are many kinds of natural resources and they can be classified in different ways based on the origin of the resources or based on the renewability of the resources.

Based on **origin**, natural resources can be classified as biotic or abiotic.

Biotic resources are those resources that originate from living things or organic materials. Examples are forests (plants), animals, and the materials that originated from them such as coal, and petroleum formed from materials that were once living but have decayed).

Abiotic resources are those resources that come from non-living things or non-organic materials. Examples are land, fresh water, wind, sunlight and heavy metals such as iron, copper, silver, and gold.

Based on **renewability**, natural resources can also be classified as renewable or non-renewable resources.

Renewable resources are resources that can be renewed and are always in supply. Examples are sunlight, air, and wind. They

are continuously available and their quantity is not noticeably affected by human use. They are considered inexhaustible.

Non-renewable resources are those resources that are formed over a long period of time. They are non-renewable because their rate of consumption exceeds their rate of recovery or formation. Examples are fuels and other minerals. Most of the non-renewable natural resources are available in limited quantities and can easily be used up (exhausted) if they are not properly managed. Some natural resources are found everywhere and are referred to as ubiquitous resources, while most others occur in some small areas and are referred to as localised resources.

Resources from living things (Biotic/organic resources)

Living things serve as raw materials for the survival and welfare of man. They are called biotic or organic resources. Biotic resources could be plant or animal in origin.

Resources from plants

These include cash crops, food crops, medicinal plants (herbs) and ornamental plants. Cash crops are those plant products that are produced in large quantities and sold locally or exported. They bring money and create wealth for the farmers. For instance, the palm oil is a plant richly found in Nigeria especially in the southern zone of Nigeria. Palm fruits can be harvested and processed to extract the red oil which serves as raw materials for many products like soap, cream, and margarine. Examples of cash crops are cocoa, rubber, and cotton. The following are other examples of resources from plant sources.

1 Cocoa found in the South Western zone of Nigeria and in some West African countries like Ghana. Cocoa is the raw material for the production of beverages and chocolate drinks.
2 Dye obtained from two special plants called camwood and indigo which are found in all zones of Nigeria is used for colouring and making of patterns on textiles.
3 Cotton wool obtained from cotton plant which is found in the Northern zones of Nigeria is used in the textile industry.
4 Rubber from rubber plant which grows in the Southern zone of Nigeria when grown, the milk is drawn from it's stem and processed. The white milk is processed in industries for the manufacture of plastic materials like ball, chairs and tables.

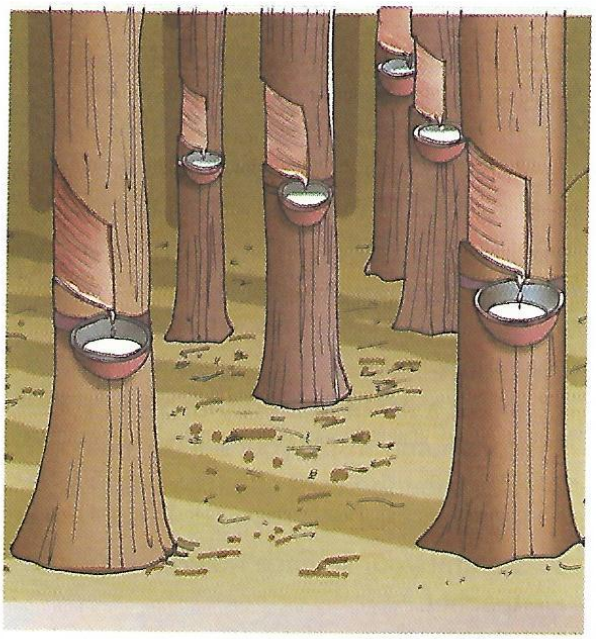


Fig. 9.2 Rubber tress

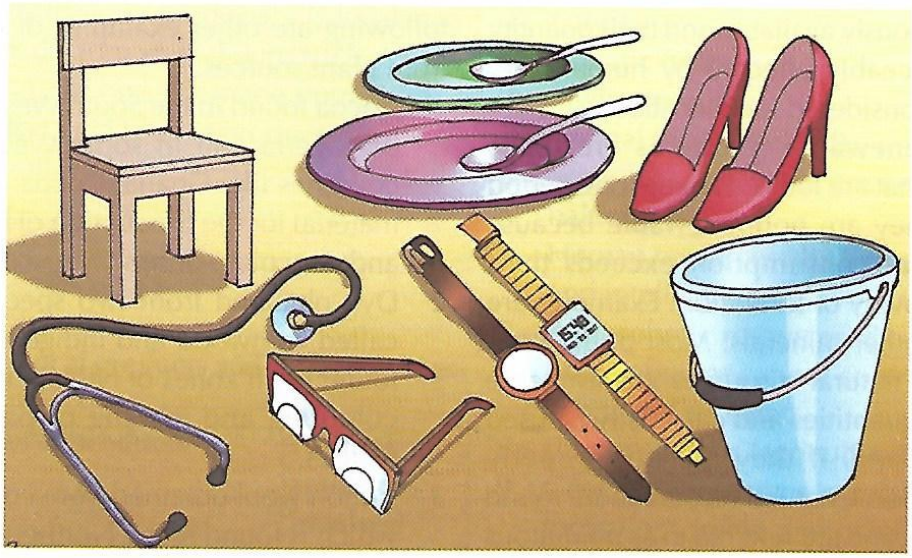


Fig. 9.3 Plastic products from rubber

Food crops are plants grown for food. Examples of food crops are yam, rice, beans, plantain, cassava, oranges, and mangoes. Uses of food include energy production, body building, body repair, growth, protection and prevention from ill health and maintenance of good health.

Medicinal crops are those plants which have chemicals that can help in the treatment of certain diseases.

Activity 9.2 Identifying plant resources

Materials required

Your science notebook, biro

Procedure

1 Make a list of plant resources in your community inside your science notebook.
2 Describe the uses of each resource identified.
3 Submit your science notebook to your teacher.

Resources from animals

Animals are important resources for cash, food, transportation and other uses. Examples of animal resources are:

1 Hides and skins which serve as leather used in the production of shoes, bags, and jackets. Conversion of hides and skin into leather is called tanning. The work-place where hides and skin are tanned is called tannery. Tanneries can be found in the northern zone of Nigeria.
2 Dairy products such as butter, cheese, yoghurt and milk.
3 Poultry products such as eggs, and chicken and turkey meat.
4 Transportation animals. These are animals used for transportation of man and goods, e.g. camels, horses and donkeys.
5 Horse tail which is a symbol of royalty for kings.
6 Elephant tusks, horns, feaathers of some birds are used in decoration/beautification works.
7 Wool from sheep used in making some clothing material.

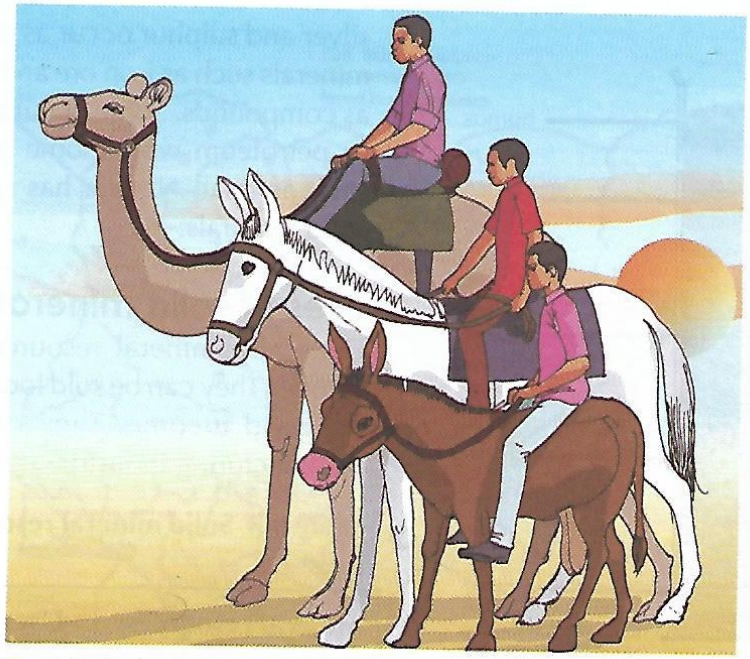


Fig. 9.4 Animals as resources for transportation

As living things die, they decay and gradually become transformed into materials that serve as useful resources to man and development. Dead materials transform into coal, fossil fuels petroleum or which can be extracted from the soil through exploration and drilling.

Resources from non-living things (Abiotic resources)

The non-living components of the environment include air, water, and minerals. These and most of the living things are found on or inside the soil. The soil alone is a form of natural resource which is important to human existence. Without the soil, food from animals and plants may be lacking. Soil is composed of humus, air, water, clay and silt. Other components of soil are fine sand, coarse sand and hard stones. These components occur in various proportions, depending on the type and location of the soil.

There are three major types of soil: sandy soil, loamy soil and clayey soil.

Sandy soil: This soil contains mainly sand and silt with a low percentage of clay. It makes for easy passage of water and air, but is poor in minerals.

Loamy soil: This is a good mixture of large and small particles of sand, clay silt and humus, i.e. decayed plant and animal remains. It is the best soil for the purpose of agriculture.

Clayey soil: This has more clay and silt particles than sand and as such high water retainability. It can be waterlogged and is not as good as loamy soil. Therefore, it is not good for agriculture.

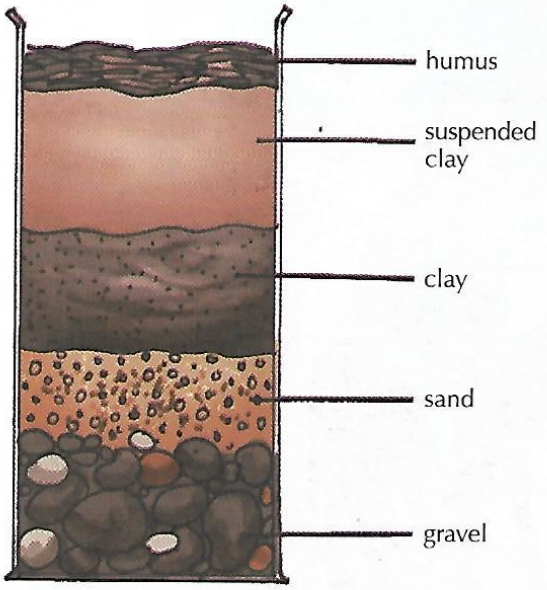


Fig. 9.5 Soil profile

Uses of soil

1 Soil is important for farming and grazing of animals.
2 Soil components are utilised in building to provide shelter.
3 Soil is the home of many plants and animals, particularly the micro organisms.
4 Soil is the building place of minerals.

Activity 9.3 Uses of soil in the community

Materials required
Your science notebook, biro

Procedure: (individual activity)
1 List the uses of soil in your community.
2 Submit your list to your teacher.

Mineral resources

Mineral resources are found under the earth's surface. Some minerals such as gold, silver and sulphur occur as elements. Some minerals such as iron ore and zinc ore occur as compounds. Some occur as liquids, such as petroleum while some occur as solids such as coal. Nigeria has rich deposits of solid minerals.

Uses of solid mineral resources

Generally, mineral resources are income earners. They can be sold locally or exported for good income. They can be used in manufacturing industries.

Table 9.3 Solid mineral resources and their uses

Mineral resources	Uses
Coal	for generating fuel and heat.
Lead	for making batteries.
Zinc	for making roofing sheets.
Limestone	for manufacturing cement.
Salt	for food and taste.

Activity 9.4 Locating mineral deposits in Nigeria

Materials required
Map of Nigeria, your science notebook, biro

Procedure: (individual work)
1 Study the map of Nigeria showing location of mineral deposits.
2 Identify the location of mineral deposits in Nigeria. For example, limestone is found in Makurdi, Abakaliki, Sokoto, Abeokuta etc.
3 Make a list of the mineral resources and their locations.

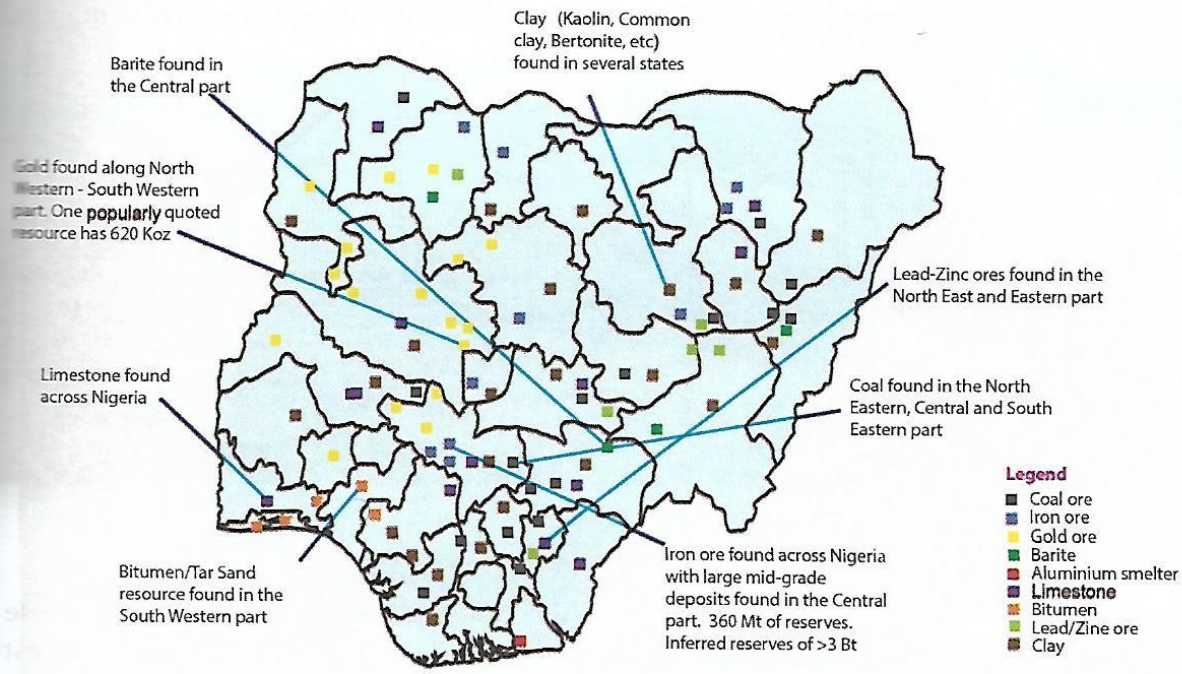
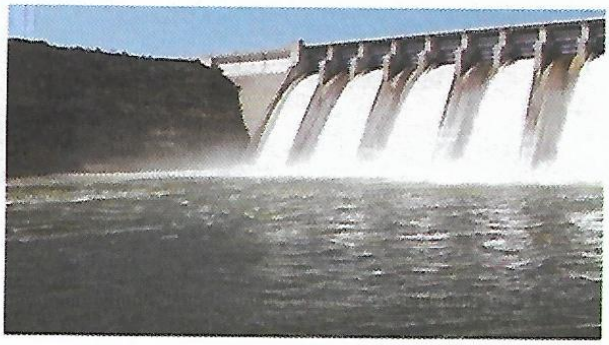


Fig. 9.6 Distribution of minerals in Nigeria

Water

Water is found everywhere in Nigeria. Only about 0.007% of earth's water is suitable for drinking. The rest is salt water or polluted water. Water bodies such as ocean, lake and rivers of the world can be used as means of transportation of goods and man. Water provides home for fishes which are valuable sources of food for man. Water is used for irrigation of crops especially in dry areas like the Northern zones of Nigeria. Water is used to generate electricity. For example, the Kainji dam and Gurara Water Falls which are involved in production of hydroelectricity. The water current is strong enough to turn the turbines that generate hydroelectricity.

(a) Gurara water falls



(b) Kainji dam

Fig. 9.7 (a - b) Hydroelectricity sources in Nigeria

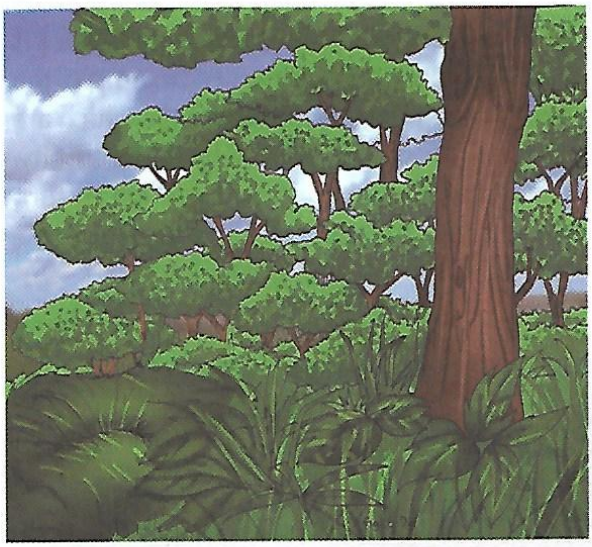
Wind

Wind has also been found resourceful in generating electricity through the use of windmills.

Fig. 9.8 Windmills generating electricity from the wind

Forests

Forests are important resources. They provide timber for humans, as well as food and shelter for plants and animals. There are different types of forests in Nigeria. These include the rainforest and savanna forest found in different parts of the country.



a) *Rainforest*

a) *Savanna forest*

Fig. 9.9 (a - b) Forests in Nigeria

Fig. 9.10 Timber from our forests

Importance of natural resources

The wealth of any nation often depends on the natural resources available. Learning about natural resources will provide a better understanding of the role of natural resources in wealth creation. It will help you to develop sustainable methods to manage resources and make sure that resources are maintained for future generations. Since most natural resources are available in limited quantities, efforts must be made to regulate their use. Depletion occurs when use is more than the quantity available. Government regulates the use of natural resources through permits, taxes, rules and monitoring. Some natural resources are essential for survival while others merely satisfy the needs of society.

Summary

1 Resources are raw materials provided by nature which are used by man in the production of finer materials for human survival and well-being.
2 Most raw materials in nature can be processed into different kinds of products.
3 Natural resources consist of all things in the environment which are not made by man.
4 Some natural resources are forest, water, animals, plants, minerals, and soil.
5 Based on their origin, natural resources can be classified as biotic (originating from living things) and abiotic (originating from non-living things).
6 Based on renewability, natural resources can be classified again as renewable (when availability is continuous) and non-renewable (when availability is limited).

7 Biotic or organic resources include plants and animals.
8 Plant resources include cash crops, medicinal crops, food crops and ornamental plants.
9 Abiotic resources include land, water, sunlight, wind, soil and minerals.
10 There are three types of soil: sandy, loamy and clayey soils.
11 Natural resources play important roles in wealth creation.

Revision questions 9

Choose from A–E to complete the sentences in questions 1-5.

A biotic
B transportation
C natural
D soil
E loamy

1 Resources are the _____ materials provided by nature and used by man in production of finer materials.
2 Examples of natural resources are forests, wind, _____, mountains.
3 Resources that originate from living things are referred to as _____.
4 One of the uses of animal resources is _____ soil.
5 The best type of soil for agriculture is _____ soil.
6 List three (3) uses of the soil.
7 List three (3) solid mineral resources and give their uses.
8 Draw a map of Nigeria and show the location of seven solid minerals.
9 What is the difference between renewable and non-renewable resources?
10 State two (2) importance or benefits of natural resources.

Chapter 10 Non-living things (Elements, compounds and mixtures)

Introduction

In Book 1, you learnt that there are many non-living things around us and some of them are quite useful. Some non-living things are elements, some are compounds while some others are mixtures. An example of elements is gold. Water and common salt are compounds, while air is a mixture.

In this chapter, you will learn about elements, compounds and mixtures and their properties as well as their uses. You will also learn about the symbols used to represent these non-living things.

Objectives

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

1 describe elements, compounds and mixtures with examples;
2 describe the properties and uses of elements, compounds and mixtures;
3 state the combining powers (valency) of elements;
4 explain the atomic models; and
5 write the symbols of common elements.

Elements, compounds and mixtures

An **element** is a simple chemical substance that cannot be split into simpler substances. Examples are oxygen, nitrogen, copper, silver and gold.

A **compound** is a substance that can be separated only by chemical means. Examples of chemical compounds are common (table) salt, water, carbon dioxide and ammonia.

A substance that can be separated into two or more substances by physical means is a **mixture**. An example is sea water. Sea water is a physical combination of water and salt, which can be separated into its constituents by heating. Another example is the salad that you eat. When prepared it is not chemically joined and all that is used in its preparation can be separated.

Some properties of elements, compounds and mixtures

Properties of elements are:

1 Elements consist of only one kind of atom.
2 An element cannot be separated into other substances.
3 Elements cannot be broken down into a simpler type of matter by either physical or chemical means.
4 Elements can exist as either atoms (e.g. argon) or molecules (e.g. nitrogen).

Properties of compounds

1 Compounds are non-flammable, for example water.
2 Compounds don't support combustion.
3 Compounds are chemically combined.

4 Compounds do not retain their own properties when combined, for example, combination of hydrogen (highly flammable) and oxygen (which supports combustion) to form water which is non-flammable.

Properties of mixtures

1 Components of mixtures are not chemically combined and so do not undergo changes in composition.
2 Components of mixtures can be separated by physical means, for example filtration, evaporation, and sublimation.
3 Mixtures can be homogeneous (having uniform composition of mass), for example, the combination of sugar and water.
4 Mixtures can be heterogeneous (having un-uniform composition of mass), for example, the combination of common salt and sand.
5 During the separation of mixtures, energy is neither given out nor absorbed.
6 Mixtures have no melting or boiling points.

Activity 10.1 Separation of sea water into its constituents

Materials required

Sea water, Bunsen burner, evaporating dish, science notebook, tripod stand, wire gauze, biro.

Procedure

1 Pour 10 cm^3 of sea water into an evaporating dish.
2 Place the dish on the Bunsen burner and heat it for some time.
3 Record your observation after the water has all turned into steam.
4 Put a little of what remains in the dish on your tongue. What does it taste like?
5 Submit your report to your teacher.

Result

You will discover that what remains in the evaporating dish is common salt. Water, which is physically combined with salt in the sea water, evaporated when heat was applied.

Uses of common elements, compounds and mixtures

Elements, compounds and mixtures are very useful in everyday life. Common elements used in everyday life include oxygen, gold, silver, copper and aluminium. Oxygen sustains life as we cannot live beyond five minutes without oxygen. It is used to resuscitate those who are dying. Gold and silver are used for making jewellery. Copper is a good conductor of both heat and electricity. As a result of the latter quality, electric cables are made of copper. Aluminium is now used for making roofing sheets.

Some of the constituents of a compound mentioned earlier are water and common salt. Water is needed for drinking and washing. These are two activities, which refresh human beings. Common salt is needed for making food tasty.

Mixtures like air, kaolin, and petroleum are also very useful. Air is a mixture of oxygen, nitrogen, carbon(IV) oxide, water vapour and rare gases. The importance of each component in the air is shown in Table 10.1.

Table 10.1 Importance of the components of air

Components of air	Importance
1 Oxygen	Supports life.
2 Nitrogen	Forms nitrogen compound in plants.
3 Carbon(IV) oxide	Used for photosynthesis in plants.
4 Water vapour	Cools into raindrops as it rises up in the atmosphere.
5 Rare gases (Neon)	Used in filling fluorescent tubes.

Atoms

Matter is anything which has mass and occupies space. About 400 BC, Greek philosophers were the first to develop the idea that matter is made up of minute (very small), indivisible particles, which they called atoms.

In 1806, John Dalton, a British scientist put forward a number of statements about atoms, which made up what was called Dalton's atomic theory. He stated his ideas as follows:

1 Matter is made up of minute, indivisible particles called atoms.
2 Atoms cannot be created or destroyed.
3 All atoms of an element are alike, and different from the atoms of all other elements.
4 Chemical combination takes place between small numbers of atoms of different elements.

Dalton's atomic theory has been modified over the years, in the light of new scientific knowledge. However, it did help scientists, and still helps us to understand what happens when substances react.

Earlier in this chapter, you learnt about elements, mixtures and compounds. As John Dalton stated, when elements react, it is the atoms of the elements that combine.

Atomic models

It is possible to represent atoms with models. For example if we represent one atom of hydrogen, one atom of carbon and one atom of oxygen with balls of different colours, then the models of the atoms would look as shown in Fig 10.1.

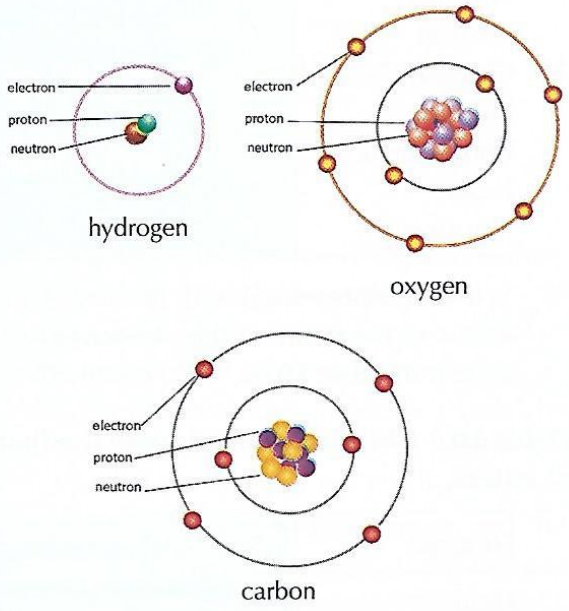


Fig. 10.1 Models of atoms of hydrogen, carbon and oxygen

Models of atoms are used in science laboratories to show how atoms are arranged in space. In order to record and describe in a brief form how elements react, the atoms of the reacting elements are represented with universally accepted symbols called chemical symbols.

Chemical symbols

A **chemical symbol** is an abbreviated form of the name of an element which represents an atom of the element. There are four different ways by which the symbols can be written. These are explained below.

1 Symbols represented with the first letter of the name of the element as shown in Table 10.2.

Table 10.2 Chemical symbols with the first letter

Element	Symbol
Hydrogen	H
Nitrogen	N
Carbon	C
Oxygen	O
Sulphur	S
Phosphorus	P
Iodine	I
Fluorine	F

2 Symbols represented with the first 2 letters of the name of the element as shown in Table 10.3.

Table 10.3 Chemical symbols with the first 2 letters.

Element	Symbol
Helium	He
Lithium	Li
Berylium	Be
Neon	Ne
Aluminium	Al
Calcium	Ca
Cobalt	Co
Bromine	Br

3 Symbols represented with the first letter and another letter in the name of the element as shown in Table 10.4.

Table 10.4 Chemical symbols with the first letter and another letter

Element	Symbol
Magnessium	Mg
Chlorine	Cl
Manganese	Mn
Zinc	Zn
Cadmium	Cd
Platinum	Pt

4 Symbols of elements derived from the Latin word as shown in Table 10.5.

Symbols derived from Latin names of elements

While many symbols are derived from English names of elements, some symbols are derived from Latin names of the elements.

Table 10.5 Chemical symbols derived from Latin words

Element	Symbol	Latin word
Sodium	Na	Natrium
Iron	Fe	Ferrum
Copper	Cu	Cuprum
Potassium	K	Kalium
Silver	Ag	Argentum
Gold	Au	Aurum
Lead	Pb	Plumbum
Mercury	Hg	Hydrargyrum

These elements are shown in Table 10.6.

Table 10.6 Names and symbols of the first 20 elements

S/No	Element	Symbol
1	Hydrogen	H
2	Helium	He
3	Lithium	Li
4	Beryllium	Be
5	Boron	B
6	Carbon	C
7	Nitrogen	N
8	Oxygen	O
9	Fluorine	F
10	Neon	Ne
11	Sodium	Na
12	Magnesium	Mg
13	Aluminium	Al
14	Silicon	Si
15	Phosphorus	P
16	Sulphur	S
17	Chlorine	Cl
18	Argon	Ar
19	Potassium	K
20	Calcium	Ca

Molecules

A molecule is the smallest group of combined atoms of either an element or a compound that can exist independently in nature. A molecule can be represented by a model.

Molecular model

This is the representation of molecules and their processes. Some molecular models are shown in Fig. 10.2. [Water H_2O, Sodium chloride (NaCl)]

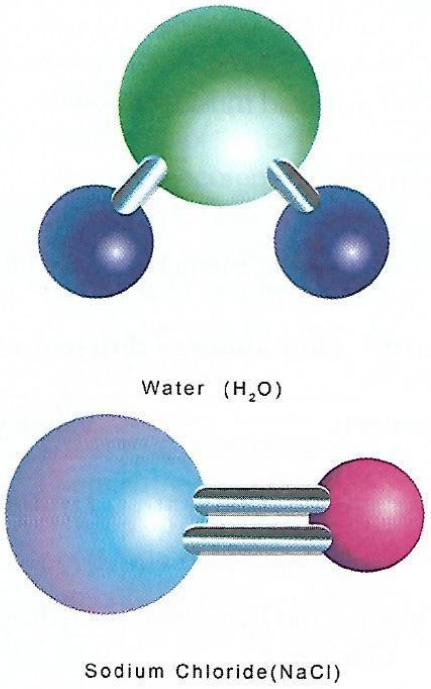


Fig. 10.2 Molecular models of some elements and compounds

Formulae

A **formulae** is a shorthand representation, which shows the number and kinds of atoms in one molecule of an element or compound. In the molecule of an element, the atoms are alike. For instance, one molecule of oxygen contains two atoms of oxygen. Therefore, the formula for oxygen is O_2. This formula consists of the symbol for oxygen and the number of atoms of oxygen in the oxygen molecule written as a subscript. Similarly, one molecule of nitrogen contains two atoms of nitrogen. Therefore, the formula for nitrogen is written as N_2. Many gases have molecules that contain two atoms e.g. H_2. However, one molecule of ozone contains three atoms of oxygen. The formula for ozone is therefore O_3.

In a compound, the atoms of two or more elements are chemically combined. In

order to write the formula of a compound, the combining powers of the atoms of the elements involved must be known.

Valency

Atoms of different elements have different combining powers or valencies. The valency of an element, is the number of hydrogen atoms that one atom of the element can combine with. How atoms of different valencies combine is shown in Table 10.7.

Table 10.7 How atoms of different valencies react

	Elements	Valency	Formula compound
1	Oxygen and hydrogen Oxygen 2	Hydrogen 1	H_2O
2	Chlorine and hydrogen Chlorine 1	Hydrogen 1	HCl
3	Sulphur and hydrogen Sulphur 2	Hydrogen 1	H_2S
4	Calcium and oxygen Calcium 2	Oxygen 2	CaO

Table 10.8 Valencies of some elements

Valency	Valency	Velency	Valency	Valency
1 H Na K Ca Fl Mg Cl Pb Br Mn I Zn	2 O S	3 Al Fe	4 C Si	5 N P

Summary

1 An element is a simple chemical substance that cannot be split into simpler substances.
2 A compound is a chemical substance made up of two or more substances chemically combined, which can only be separated into its constituent substances by chemical means.
3 A mixture is made up of two or more substances physically combined, which can be separated by physical means.
4 The number of atoms of the constituents of a compound depends on the combining powers (valency) of the atoms.
5 Chemical combination takes place between small numbers of atoms of different elements.
6 Symbols used are of different types:
   i) The first letter of names of the element are used.
   ii) When the first letters of two or more elements are similar, the second letters are included.
   In some cases, symbols are the first and second letters of their Latin names.
7 A formula is a brief representation showing the number and kinds of atoms in one molecule of an element or compound.

Revision questions 10

1 An element _____.
   A can be split into simpler substances
   B cannot be split into simpler substances
   C is made up of two or more substances chemically combined
   D is made up of two or more substances physically combined
   E None of the above
2 A compound _____.
   A is made up of two or more substances chemically combined
   B is made up of two or more substances physically combined
   C can be split by physical means
   D cannot be split by chemical means
   E cannot exist
3 A mixture _____.
   A is made up of two or more substances chemically combined
   B is made up of two or more substances physically combined
   C can only be split by chemical means
   D cannot be split by chemical means
   E is a name
4 The symbol for the element potassium is _____.
   A Po
   B P
   C K
   D Pu
   E Pm
5 Explain how symbols of elements are derived.
6 Name three (3) examples each of elements, compounds, and mixtures.
7 Define valency.
8 Write the symbols of four (4) common elements and the formulae of four (4) common compounds.
9 What is atomic model?
10 Mention four (4) uses each of elements, compounds, and mixtures.

Chapter 11 Metals and non-metals

Introduction

Elements may be classified as either metals or non-metals based on their properties. In this chapter, you will learn about the characteristics of metals and non-metals, the differences between them, extraction of some metals from their ores, and the uses of some of these metals.

Objectives

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

1 define metals and non-metals;
2 state the differences between metals and non-metals;
3 explain how tin and iron are extracted from their ores;
4 state the uses of some metals and non-metals; and
5 understand the activity series.

Metals

Metals are elements which react chemically in nature by **losing electrons** to form cations. They generally have less than four electrons in the outermost shells of their atoms. When two metals are mixed together, the product is an alloy.

Characteristics and properties of metals

1 They are lustrous (shiny) in nature.
2 They are good conductors of heat and electricity.
3 They have high melting points.
4 They have high density (heavy for their size).
5 They are malleable (can be hammered into sheets).
6 They are ductile (can be drawn into wires).
7 They are usually solid at room temperature (an exception is mercury).
8 They are opaque as a thin sheet (we cannot see through metals).
9 Metals are sonorous or make a bell-like sound when struck.
10 They have 1-3 electrons in the outer shell of each metal atom.
11 They corrode easily, e.g. damaged by oxidation such as tarnish or rust.

Non-metals

Non-metals are elements which react chemically by **gaining electrons** to form anions. Non-metals have more than four electrons in their outermost shells.

Characteristics of non-metals

1 They are generally poor conductors of heat and electricity.
2 Solid non-metals are generally brittle

with little or no metallic lustre.

3 Most non-metals have the ability to gain electrons easily.

Differences between metals and non-metals

Table 11.1 Differences between metals and non-metals

	Metals	Non-metals
1	They have metallic lustre i.e. they are shiny and can be polished.	They have no metallic lustre. They are not shiny and cannot be polished.
2	They are good conductors of heat and electricity.	They are non-conductors of heat and electricity and as such, they may be used as insulators.
3	They are malleable, i.e. they can be beaten or hammered into thin sheets.	They are very brittle and cannot be hammered.
4	They are ductile, i.e. they can be drawn into wires.	They cannot be drawn into wires.
5	They are generally strong and hard.	They are generally soft.

Differences in chemical properties between metals and non-metals

1 Metals burn in oxygen to give basic oxides (examples are shown below),
$4Na + O_2 \rightarrow 2Na_2O$
$Na_2O + H_2O \rightarrow 2NaOH$
while the oxides of non-metals are acidic.
$S + O_2 \rightarrow SO_2$
$SO_2 + H_2O \rightarrow H_2SO_3$

2 Metals above hydrogen in the activity series liberate hydrogen gas from water, e.g.
$2Na + 2H_2O \rightarrow 2NaOH + H_2$
while non-metals cannot liberate hydrogen gas from water.

Extraction of tin from its ores

Tin is one of the basic chemical elements. It is found in Jos, Plateau State, and in Kano State of Nigeria. The main tin ore is tin stone or cassiterite [Tin(IV) oxide]. When refined, it is a silvery-white metal known for its resistance to corrosion and its ability to coat other metals.

In addition to the ores themselves, several other materials are often used to process and refine tin. These include limestone, silica and salt. Carbon, in the form of coal or fuel oil, is also used. If high concentrations of certain chemicals are present in the ore, it may require the use of other materials.

The manufacturing process

The process of extracting tin from tin ore varies according to the source of the ore deposit and the amount of impurities found in the ore. Regardless of the source, each process consists of several steps in which the unwanted materials are physically or chemically removed, and the concentration of tin is progressively increased. Some of these steps are conducted at the mine site, while others may be conducted at separate facilities.

Steps used to process ore

The steps used in processing ore are listed and explained as follows:

1 Mining of the ore.
2 Concentrating the ore.
3 Smelting of the ore.
4 Refining and purification of the ore.

1 **Mining of the ore**

When the gravel deposits are located at or below the water level in the stream, they are brought up by a floating dredge, operating in an artificial pond created along the stream bed.

The dredge excavates the gravel using a long boom fitted either with chain-driven buckets or with a submerged rotating cutter head and suction pipe. The gravel passes through a series of revolving screens and shaker tables on board the dredge to separate the soil, sand and stones from the tin ore. The remaining ore is then collected and transferred ashore for further processing.

2 **The concentration of the ore**

The ore enters the cleaning or dressing shed adjacent to the mining operation. First, it passes through several vibrating screens to separate coarser foreign materials.

It may then pass through a classifying tank filled with water, where the ore sinks to the bottom while the very small silt particles are carried away. It may also pass through a floatation tank, where certain chemicals are added to make the tin particles rise to the surface and overflow into troughs.

Finally, the ore is dried, screened again, and passed through a magnetic separator to remove any iron particles. The resulting tin concentrate is now about 70-77% tin by weight and consists of almost pure cassiterite.

3 **Smelting of the ore**

This is carried out in the reverberatory furnace. In the furnace, the concentrated ore is heated with coke or anthracite at a temperature of 1200°C. This reduces the tin(IV) oxide to tin metal

$SnO_2 + 2C \rightarrow Sn + 2CO$

4 **Refining and purification of the ore**

The crude tin from the first furnace is placed in a low temperature furnace along with the crude tin recovered from the slag plus the hard head.

Since tin has a melting temperature much lower than most metals, it is possible to carefully raise the temperature of the furnace so that only the tin melts, leaving any other metals as solids. The melted tin runs down an inclined surface and is collected in a poling kettle, while the other materials remain behind. This process is called **liquidation** and it effectively removes much of the iron, arsenic, copper and antimony that may be present.

The molten tin in the poling kettle is grated with steam, compressed air, or poles of green wood. Most of the remaining impurities rise to the surface to form a scum, which is removed. The refined tin is now about 99.8% pure.

For applications requiring an even higher purity, the tin may be processed further in an electrolytic refining plant.

Uses of tin

1 It is made into tin foils or tin sheets used in wrapping.

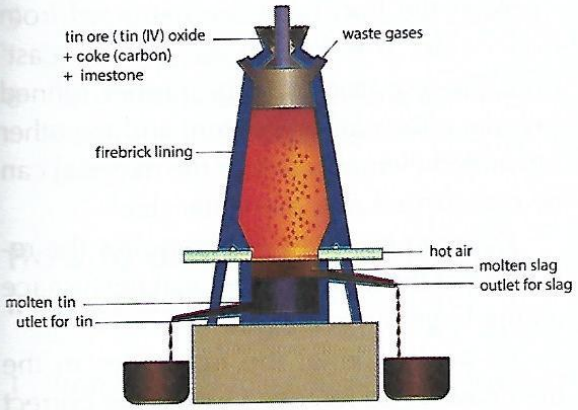


Fig. 11.1 Extraction of tin from its ore

2 It is used in making packaging cans.
3 It is used in electroplating.
4 It is used in making solder and fuse wires.
5 It is used in making a type of metal used in printing machines.
6 It is used in making ball-bearing metals which are used in machines.
7 A tin compound, stannous fluoride, is often added to toothpaste as a source of fluoride to prevent tooth decay.

Extraction of iron from its ores

Iron ores are rocks and minerals from which metallic iron can be economically extracted. The ores are usually rich in iron oxides and vary in colour from dark grey, bright yellow, deep purple to rusty red.

A large deposit of iron ore is found in the Itakpe hills near Okene in Kogi State. It is estimated at 300 000 000 tons. The basic raw materials used for the extraction of iron ore are:

Limestone → Calcium carbonate ($CaCO_3$)
Burnt magnetite → Iron(III) oxide (Fe_3O_4)
Fluorspar → Calcium fluoride (CaF_2)
Bentonite → Potassium(K), Sodium (Na), Calcium (Ca), and Aluminium(Al)
Coke (gas) → Oxygen gas

The magnetite (Fe_3O_4), limestone and coke are fed into the furnace from the top. A blast furnace of hot air at 800°C is blown into the furnace through the tuyeres located towards the base of the furnace. The hot air combines with red hot coke to form carbon monoxide. The carbon monoxide produced reduces the iron ore to molten iron.

$$Fe_3O_{4(s)} + 4CO \rightarrow 3Fe + 4CO_{2(g)}$$

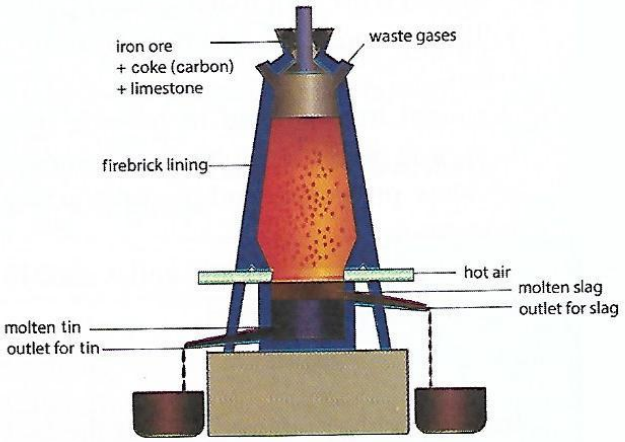


Fig. 11.2 A blast furnace (extraction of iron)

Removal of impurities

Limestone decomposes into calcium oxide and carbon(IV) oxide when heated

$$CaCO_3 \rightarrow CaO + CO_2$$

The main impurity in iron ore is sand, SiO_2 (Silicon(IV) oxide). The calcium oxide reacts with the silicon(IV) oxide to form calcium trioxosilicate(IV) ($CaSiO_3$) (slag).

The slag is lighter than the molten pure iron. The iron from the blast furnace is **pig iron**. Pig iron contains a high proportion of carbon and as a result, it is brittle but when it is melted and heated to reduce carbon contents, its quality is improved.

Cast iron is produced when pig iron is further heated and the carbon content is about 40%. It is used for making lamp posts and iron pipes. When cast iron is re-heated to reduce its carbon content, **wrought iron** is produced. Wrought iron is malleable and ductile. It is used for the construction of iron gates, window protectors and nails.

Uses of iron

1 Cast iron is used for making water pipes, railings, lamp posts and Bunsen burner bases.
2 Wrought iron is used in making iron nails, iron sheets, agricultural implements, window protectors and in constructing iron gates.
3 Pig iron is hard and brittle and is used in the manufacture of steel.

Note

1 Iron is highly preferred due to the fact that it is cheap and is abundantly available in our surroundings.
2 Iron can be moulded easily to create many forms. That is why it is used in many products that you often see around the house.

Manufacture of steel

Steel is a metal containing iron and a small percentage of carbon. The iron is extracted from iron ores, mined and then refined to remove the oxygen content.

After the iron has been extracted from iron oxide, it is known as 'pig' or 'cast' iron. The pig iron must be further refined to reduce the carbon content and the other unwanted elements before the material can be categorised as a particular steel.

Refining iron into steel requires the re-melting of the iron in a steel making furnace with a large oxygen input.

In steel making, the impurities in the melt have to be removed before the correct composition can be achieved. These include phosphorus and silicon (which make steel hard and induce brittleness), and sulphur (which can cause cracking in poured castings and welds). A fundamental distinguishing property of steel is its great strength which depends partly upon the carbon content.

Methods of varying the hardness of steel

The hardness of steel can be varied by the following:

1 Varying the percentage of carbon.
2 Tempering.
3 Alloying with other metals such as nickel, cobalt, manganese and chromium.

Types of steel

1 Stainless steel (chromium and nickel).
2 Armour steel (chromium and nickel).
3 Tool steel (chromium, tungsten or molybdenum).

Uses of steel

1 Steel is used in making crushing machines.
2 Steel is used in reinforcing concrete.
3 It is used in building bridges.
4 It is used in making cutlery and containers used in chemical and food processing industries. Stainless steel contains chromium and nickel.

5 Armour steel is used in making gears and armour plates.
6 Tool steel is used in making drilling and cutting tools, such as hammers and chisels.

How to distinguish between iron and steel

1 Iron is easily magnetised but it loses its magnetism easily. Steel on the other hand is not easily magnetised and does not lose its magnetism easily. This is why steel is used in making magnets.

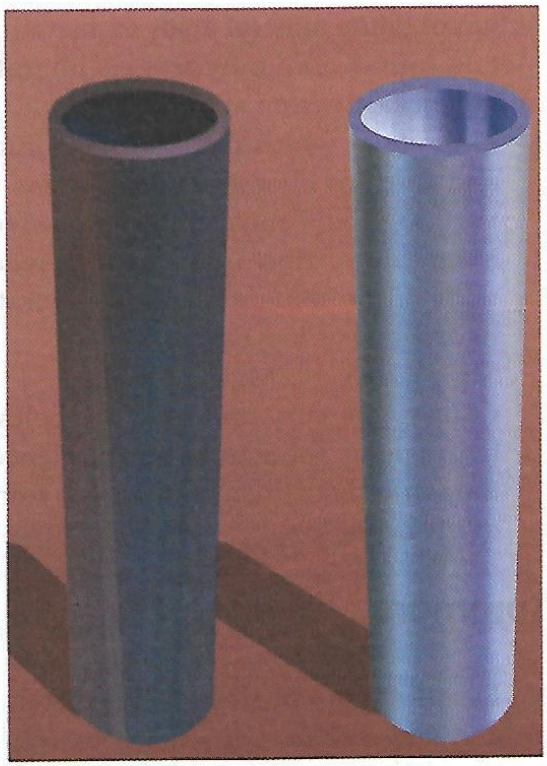


Fig. 11.3 Iron and steel products

2 Steel is more malleable and ductile than iron.
3 Steel is harder and tougher than iron.
4 Steel has a higher tensile strength than iron.

Electroplating

This is the coating or covering of a metal with another metal to prevent rusting or corrosion. It can be done by electrolysis, e.g. steel can be coated with chromium. This is found in bicycle and door handles. Steel can also be coated with nickel or chromium as in cutlery.

Activity series

An activity series is a list of substances ranked in order of relative reactivity. It is the arrangement of metals from the most reactive to the least reactive.

In the metal activity series, the most active metals appear on top, and the least active metals appear at the bottom.

Table 11.2 Most active metals in the activity series of metals

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

Hydrogen has a peculiar nature. It sometimes behaves like a metal in hydrochloric acid (HCl) and sometimes as non-metal in sodium hydroxide (NaOH).

For non-metals, they are usually arranged from the least reactive to the most reactive.

Table 11.3 Least active non-metals in the activity series of metal

Non-metal	Symbol
Carbon	C
Phosphorus	P
Sulphur	S
Oxygen	O
Chlorine	Cl
Fluorine	F

This means fluorine is the most reactive of the non-metals while carbon is the least reactive.

Metals are electro-positive while non-metals are electro-negative.

Electro-positivity means the ease with which atoms of metals give of the electrons in their outermost shell to attain the stable arrangement of eight or two electrons. Electro-negativity refers to the ease with which non-metal atoms accept electrons.

Just as some metals are more electro-positive than others, so also are some non-metals more electro-negative than others.

Action of metals on water

Metals above hydrogen in the activity series will liberate (displace) hydrogen from water. The rate also depends on metal position (distance) away from hydrogen.

1 Potassium, sodium and calcium will react with cold water to liberate hydrogen, e.g.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

2 Magnesium, iron, zinc and aluminium will react with less vigour, hence it requires steam and strong heating to liberate hydrogen from water.

$$Mg + H_2O \xrightarrow{\text{heat}} MgO + H_2.$$

D

3 Copper, mercury, silver and gold will not liberate hydrogen from water or steam because they are below hydrogen in the series.

Action of dilute mineral acids on metals

Metals found above hydrogen liberate hydrogen easily from acids:

1 The rate at which potassium, sodium and calcium liberate hydrogen gas is very high and most times explosive.

2 Magnesium, zinc, iron and lead react with dilute mineral acids to liberate hydrogen gas less easily.

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

3 Copper, mercury and gold are below hydrogen in the activity series. Hence, they would not liberate hydrogen from dilute acids.

Summary

1 Elements may be classified as metals and non-metals.

2 The differences between metals and non-metals are:

	Metals	Non-metals
a)	They are good conductors of heat and electricity.	They are poor conductors of heat and electricity.
b)	They have metallic lustre.	They have no metallic lustre.
c)	They are malleable.	They are not malleable.
d)	They are ductile.	They are not ductile.
e)	They have high densities.	They have low densities.

3 The main tin ore is cassiterite which is tin(IV) oxide (SnO_2).
4 Steel is an alloy of iron and carbon.
5 Steel is more suitable for making permanent magnets since it is not easily demagnetised whereas iron is used in making temporary magnets.
6 Electroplating is the coating or covering of a metal with another metal to prevent rust or corrosion.
7 The activity series is a list of substances ranked in order of relative reactivity.

Revision questions 11

1 The following solids are conductors of electricity except _____.
A aluminium wire
B carbon rod
C copper rod
D wood
E Iron rod

2 Steel is used to make all the following except _____.
A as material to mould blocks
B building bridges
C making armoured plates
D reinforcing concrete
E cooking

3 Nigeria has her large iron ore deposits at _____.
A Argungu, Kebbi State
B Ilesa, Osun State
C Itakpe, Kogi State
D Umuahia, Abia State
E Ikeja, Lagos State

4 When two metals are mixed together, the product is called a/an _____.
A alkaline
B alloy
C slag
D solder
E A mix

5 Stainless steel is an alloy of _____.
A *iron and carbon*
B nickel and chromium
C tin and copper
D tin and lead
E Pig and cast iron

6 Metals are said to be malleable because they can be _____.
A beaten into sheets
B drawn into wires
C positively charged
D shiny and smooth
E cold

7 Alloys are made by mixing two or more _____ together.
A atoms
B compound
C metals
D non-metals
E chemicals

8 State four (4) physical differences between a metal and a non-metal.
9 List the three (3) types of steel.
10 What is electroplating?

You and energy

Chapter 12 Light energy

Introduction

You have learnt that there are many forms of energy and that energy can be transformed from one form to another. Some forms of energy have been mentioned in detail in Book 2. In this book, some other forms of energy such as light energy, sound energy, magnetism and electrical energy will be treated in detail. In this chapter you will learn about the reflection and refraction of light. You will also learn about vision as well as dispersion and the rainbow.

Objectives

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

1 explain the meaning of reflection and refraction;
2 describe the mechanism of vision;
3 explain eye defects and their remedies; and
4 explain the meaning of dispersion and use it to interpret the rainbow.

Light

The sense organ that responds to light is the eye. We are able to see an object because light from the object strikes the eye. Thus, when there is no light, we cannot see any object.

Rays of light

A light ray is the direction or path along which light energy travels. A collection of rays is called **beam**. There are three types of rays: an incident ray, reflected ray, and refracted ray. These are explained below.

1 ***An incident ray:*** This is a ray of light that strikes a surface. The angle between this ray and the perpendicular or normal to the surface is the **angle of incidence**.
2 ***The reflected ray:*** This is corresponding to a given incident ray. It is the ray that represents the light reflected by surface. The angle between the surface normal and the reflected ray is known as the **angle of reflection**.
3 ***The refracted ray:*** This is also called the transmitted ray. The refracted ray corresponding to a given incident ray, represents the light that is transmitted through the surface. The angle between refracted ray and the normal ray is known as the **angle of refraction**.

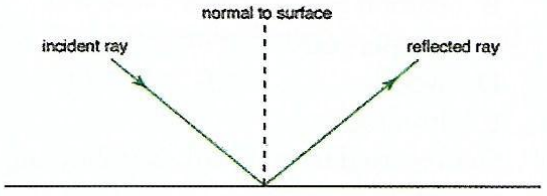


Fig. 12.1 Light rays

Beam of light

Beam

A beam occurs when the light energy radiating from a light source does so through directional projection. It is also the collection of parallel rays that are emitted from a luminous body or the sun.

A situation where there is a scattering of light from a beam resulting in a visible light beam from the side is called the Tyndall effect.

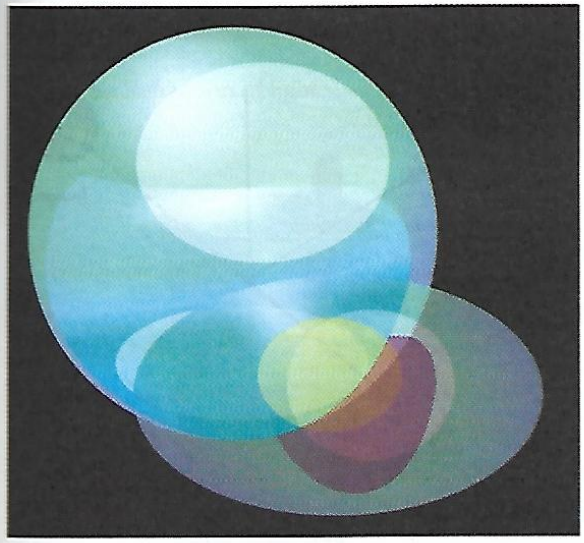


Fig. 12.2 The Tyndall effect

There are three types of beam as discussed below.

1 **Divergent beam**

A collection of rays/beam which spread from a point or source of light is called a divergent beam.

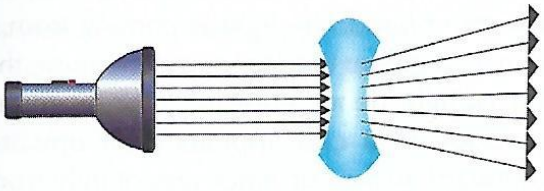


Fig. 12.3(a) Divergent beam

2 **A parallel beam**

This happens when the rays of light travel parallel to one another.

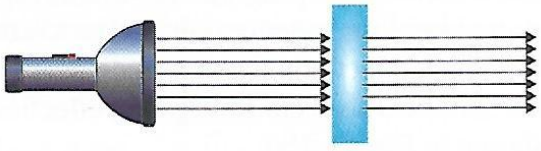


Fig. 12.3(b) Parallel beam

3 **Convergent beam**

This occurs when the rays of light coming from different directions meet at a point; the collection of such rays is termed a convergent beam of light.

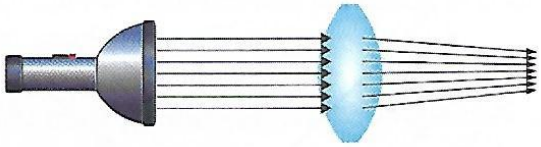


Fig. 12.3(c) Convergent beam

Light travels in a straight line

Light travelling in a straight line can be shown by making holes on point 1, point 2, and point 3 on screens. The light from a bulb is now placed in front of the screen in such a way as to allow the light go through the hole points made on the screen. Staying behind the screen, it can be observed that light travels in a straight line as long as the holes P_1, P_2 and P_3 lie in a straight line.

Reflection

Reflection of light is defined as the turning back of light when it meets an obstacle. If the obstacle is very regular, i.e. smooth and shiny-like glass, water or polished metal, the light will reflect at the same angle as it hits the surface. This is called **regular reflection**, shown in Fig. 12.4(a).

When light meets an obstacle that is not as smooth as the mirror, for example a sheet of paper or cloth, the reflection is diffused and the light reflects in lots of different directions (as shown in Fig. 12.4b). In regular reflection, all inadvertent rays are reflected at an angle to the angle of incidence. Most things are seen because light from a source has reflected off them.

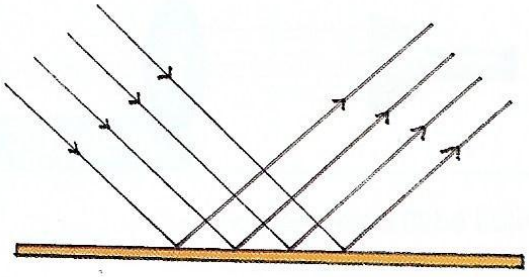


Fig. 12.4(a) Regular reflection of light

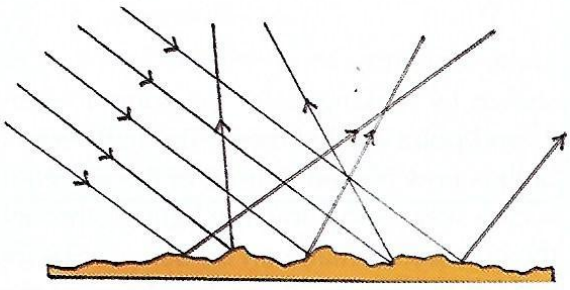


Fig. 12.4(b) Diffused reflection of light

In diffused reflection, the incident rays are reflected at different angles not equal to the angle of incidence. Fig.12.5 shows how the eye sees the image of an object in the mirror. When light rays from the object strike the mirror, the mirror reflects the rays to the eye. The reflected rays appear to be coming from behind the mirror. No ray actually exists behind the mirror. Thus the image of the object is in front of it.

The angle at which light hits a reflecting surface is called the angle of incidence, and the angle at which light bounces off a reflecting surface is called the angle of reflection.

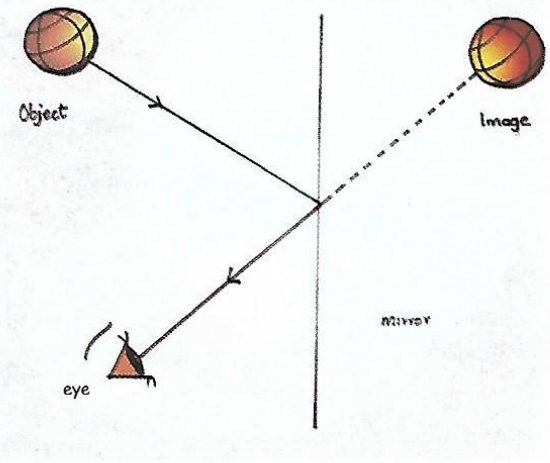


Fig. 12.5 Image in a mirror

Refraction

Refraction is the bending of light that occurs when it enters a medium other than the one it is coming from. If the first medium is less dense than the second one, the light rays bend inward in the second medium. If, on the other hand, the light is coming from a denser medium to a less dense medium, the ray of light bends outward. For example, a spoon in a cup appears bent upward (outward) in the cup since rays of light from

the part of spoon in the tea is passing from a denser medium (tea) to air (less) dense medium to the eye as shown in Fig. 12.6.

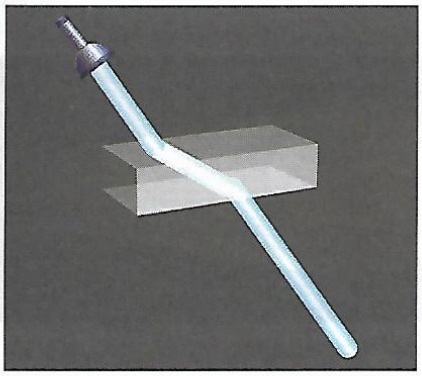


Fig. 12.6 Refraction of light

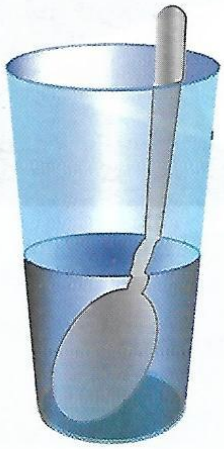


Fig. 12.7 A spoon appears bent in a cup of tea

Also a pool of water appears shallow when in actual fact it is not. This is due to the fact that the bottom of the pool appears raised up because rays of light from the bottom are refracted (bent) outward (i.e. upward) when passing from water (denser medium) to air (less dense medium).

Activity 12.1 Demonstrating refraction of light

Materials required

Rectangular glass block, a paper on which bold letters of the alphabet are written, your science notebook, biro.

Procedure

1 Place the paper with bold letters of the alphabet written on it, on your laboratory table.
2 Place the rectangular glass block on the paper.
3 View the printed letters from the top of the glass.
4 Record your observation into your science notebook.
5 Submit your science notebook to your teacher.

Result

You must have observed that the letters of the alphabet on the paper appear raised up. This is because the rays of light from them are refracted upward when they pass from glass (denser medium) through the air (less dense medium) to your eye. The fact that the bottom of a pool of water appears raised up poses some danger to those who are just learning to swim. Care must be taken in learning to swim.

Shadow formation

A **shadow** is an area where light from a light source is obstructed by an object. It occupies all of the space behind an opaque object with light in front of it. If narrow light rays are intercepted by a larger opaque object than the light source, a uniform dark shadow is formed.

This shadow is called a full shadow (**umbra**). If the light source is larger than the object, the shadow formed consists of an inner dark centre of full shadow and outer partial shadow called **penumbra**.

Sunlight causes many objects to have shadows at certain times of the day. An example is the angle of the sun, whose apparent height in the sky causes a change in the length of shadows. Low angles create longer shadows.

Currently, the only astronomical objects able to produce visible shadows on earth are the sun, the moon and in the right conditions, Venus or Jupiter.

Examples of shadow formations are the eclipse of the sun and the eclipse of the moon.

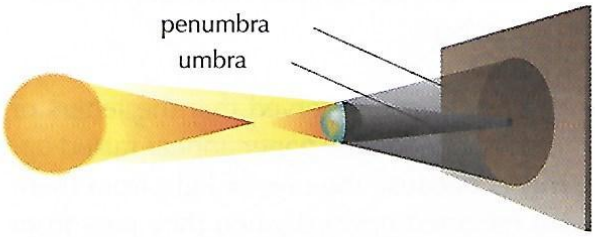


Fig. 12.6 The umbra and penumbra

Eclipse

An **eclipse** occurs when an object which is astronomical in nature is temporarily obscured as a result of another body passing between it and the viewers, or its passing into the shadow of another body.

An eclipse could either be a solar eclipse or a lunar eclipse. When the moon's shadow crosses the earth's surface, it is called **solar eclipse**; the moon, as an opaque object comes between the sun and the earth. When the moon moves into the earth's shadow, the earth comes between the sun and the moon; it is called **lunar eclipse**. Here, the earth is the opaque body that obstructs the passing of some of the light from the sun, from getting to the moon.

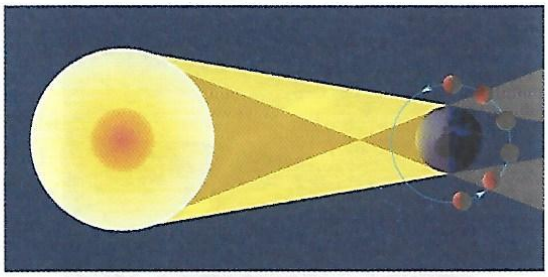


Fig. 12.8 Eclipse of the sun (Solar eclipse)

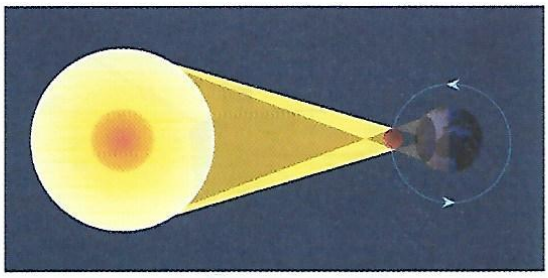


Fig. 12.9 Eclipse of the moon (Lunar eclipse)

Pinhole camera

This is a camera that has a small aperture and no lens called pinhole, i.e. a light-proof box that has a small hole on one side.

The light that passes through this small opening projects an image that is inverted on the opposite side of the box.

Light is obstructed, causing all the sides of the box, including the side where the point is created, to be completely dark.

Adjacent to the pinhole is a thin screen that looks like a projector sheet in-between the dark side.

The size of the aperture should mainly be 1/100 or less of the distance between it and the image projected. The smaller the hole,

the sharper the image, and the dimmer the image projected.

Usefulness of pinhole camera

1 The pinhole camera is used to capture the movement of the sun over a long period of time.
2 It ensures the safety of the eyes when viewing a solar eclipse by making the event to be observed indirectly as a result of diminished intensity of the pinhole image, thereby making it harmless compared with the full glare of the sun itself.

According to the principle of the pinhole camera, light rays from an object passes through a small hole to form an inverted image.

Vision

Vision is defined as the ability to see objects. The eye, the sense organ responsible for vision, forms the image of an object by the eye lens (i.e. eyeball) on the retina. The retina is the sensitive point of the eye situated at the back of the eye. Fig. 12.11 shows the different parts of the human eye.

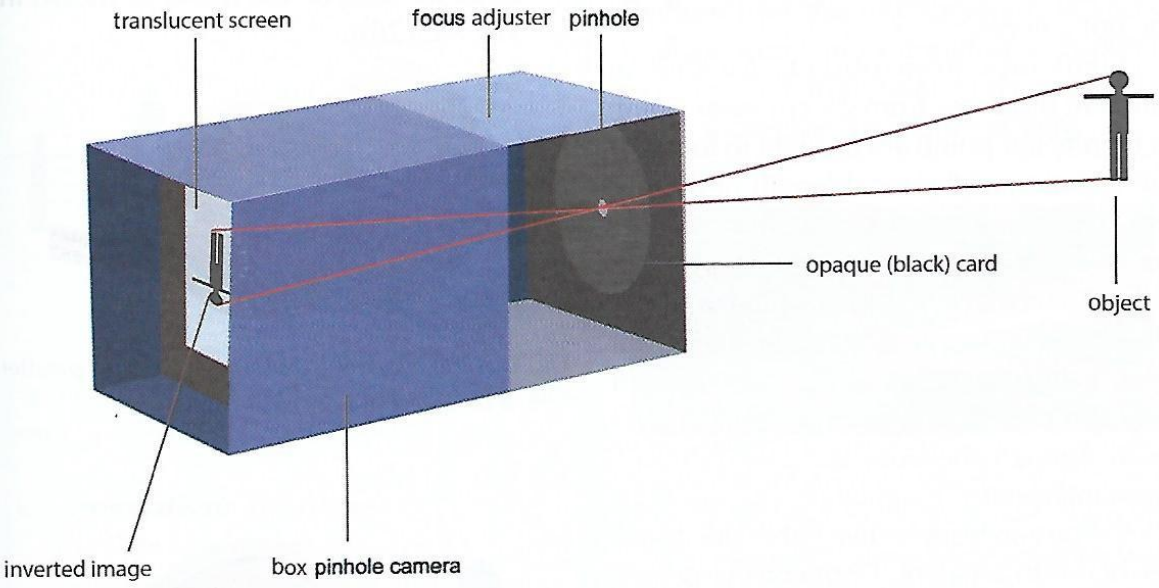


Fig. 12. 10 A pinhole camera

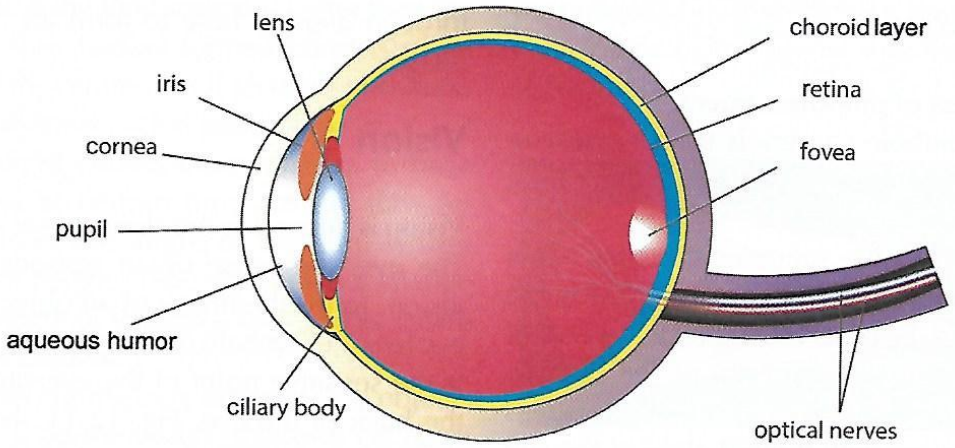


Fig. 12.11 The human eye

The eye lens forms an image by refracting rays of light from an object and bringing them to focus on the retina. The retina then transmits this message to the brain through the optic nerve.

Light rays from objects located at different distances from 25 cm (near point) to infinity (far point) are brought to focus by the variation of the focal length of the eye lens. The ciliary muscles make this possible. For example, if you look at a bird, light has reflected off that bird and travelled in nearly all directions. If some of that light enters your eyes, it hits the retina at the back of your eyes. An electrical signal is passed to your brain through the optical nerve and your brain interprets the signal as an image.

Vision can be defective either due to old age or due to accident. Common eye defects are explained below.

1 ***Short-sightedness (Myopia):*** A person who is short-sighted cannot see objects from afar. He can see only objects that are near. This is because his eye lens focuses on parallel rays from far objects in front of the retina. A diverging lens or concave lens worn by the person with the defect will correct the sight by causing the parallel rays from far objects to be focused on the retina as shown in Fig. 12.12(b).

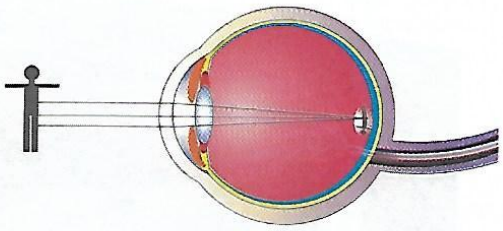


Fig. 12.12(a) Rays of light brought to focus parallel from a far object in front of the retina

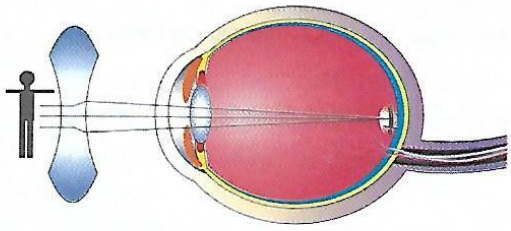


Fig. 12.12(b) Correction of short sight by diverging lens

2 ***Long-sightedness (Hypermetropia):*** A long-sighted person can see far objects but cannot see near objects, that is, his near point is farther than 25cm. For such a person, parallel rays of light are brought to focus behind the retina. This defect can be corrected by wearing a convex (converging) lens which helps to bring rays of light to focus on the retina as shown in Fig. 12.13(b).

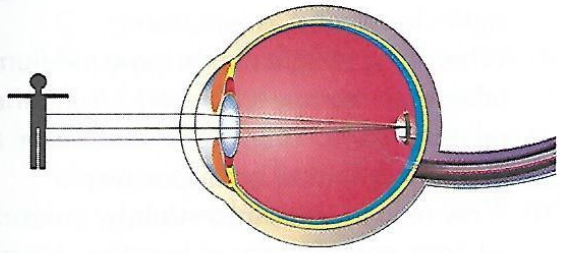


Fig. 12.13(a) Rays of light brought to focus behind retina

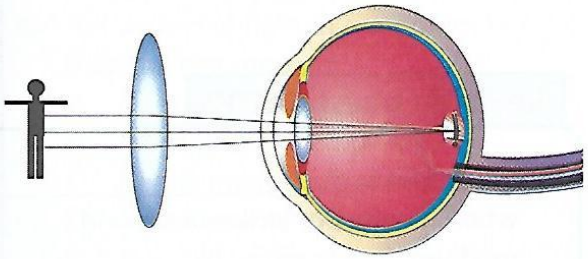


Fig. 12.13(b) Correction of long sight by converging lens

3 ***Astigmatism:*** This defect occurs when the light rays do not all come to a single focal point on the retina. Instead, some focus on the retina while some others focus in front of or behind it. This is usually caused by a non-uniform curvature of the cornea. A typical symptom of astigmatism is if you are looking at a pattern of lines placed at various angles and the lines running in one direction appear sharp whilst those in other directions appear blurred. Astigmatism can usually be corrected by using a special spherical cylindrical lens; this is placed in the out-of-focus axis. Other eye related problems are:

4 ***Cataract:*** A clouding of the lens which prevents a clear, sharp image being produced.

5 ***Glaucoma:*** An increasing dimness of vision.

6 Age-related macular degeneration (ARMD).

Dispersion and rainbow

When a ray of light enters some media, the ray splits into the colours of the rainbow. Such a medium is referred to as a **dispersive medium** and the phenomenon is known as **dispersion**. An example of a dispersive medium is a triangular glass prism. Fig. 12.14 shows the dispersion of light.

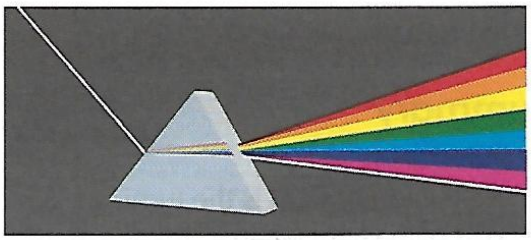


Fig. 12.14 Dispersion of light

For example, sometimes when we wash clothes with detergents, we see rainbow colours in the bubbles of the detergent solution. The rainbow colours are red, orange, yellow, green, blue, indigo and violet. The acronym ROYGBIV formed from the first letter of the alphabet of each colour helps us to remember the colours.

The colours of a rainbow are caused by refraction and dispersion of a ray of white light into a spectrum.

Activity 12.2 Demonstrating dispersion of light

Materials required

Source of light, triangular glass prism, your science notebook, biro

Procedure

1 Place the triangular glass prism behind the source of light.
2 Switch on the light.
3 Observe the light inside the prism.
4 Record your observation.

Can you see the seven colours of the rainbow inside the triangular glass prism? You must have observed these colours.

Light from the sun is also observed to disperse (i.e. to split) into the seven colours of the rainbow in the sky. This is sometimes seen during or immediately after rainfall. The rainwater droplets act as the dispersive medium to the sun rays.

Summary

1 Reflection of light is the turning back of part of the light when it strikes a medium other than the one from which it is coming.
2 Reflection is regular if the second medium is very smooth like a mirror.
3 Reflection is said to be diffused if the second medium is not very smooth, e.g. paper or cloth.
4 Refraction of light is the bending of light inside a second medium different from the one from which it is incident or coming.
5 The ray of light bends inward or downward if the second medium is denser than the first.
6 The ray of light bends outward or upward if the second medium is less dense than the first.
7 Vision is the ability to see and the eye is the sense organ used in seeing.
8 Vision can be defective and some of the defects are short-sightedness, long-sightedness, and astigmatism.
9 When a ray of light enters some medium other than the one it is coming from, the ray splits into many colours. Such a medium is said to be dispersive.
10 A ray of light splits into rainbow colours when it enters a triangular glass prism, rain droplets, soap bubbles etc.
11 Rainbow colours are red, orange, yellow, green, blue, indigo and violet.

Revision questions 12

1 Reflection is the _____ when it enters or strikes a second medium.
   A turning back of light
   B bending of light
   C propagation of light
   D none of the above
   E movement
2 Refraction is the _____ when it enters or strikes a second medium.
   A turning back of light
   B bending of light
   C propagation of light
   D none of the above
   E all of the above

3 Reflection is regular when light strikes a _____.
   A sheet of paper
   B cloth
   C mirror
   D stone
   E nothing
4 Reflection is diffused when light strikes _____.
   A paper
   B a mirror
   C silver
   D a polished surface
   E none of the above
5 Refraction of light in a medium is less dense when the first medium _____.
   A does not bend
   B bends inward (downward)
   C bends upward
   D inside
   E does all of the above
6 Refraction of light in a medium denser than the first medium _____.
   A does not bend
   B bends outward (upward)
   C bends inward (downward)
   D does none of the above
   E does all of the above
7 One of the following is an eye defect _____.
   A bad sight
   B slow sight
   C good sight
   D long sightedness
   E fast sight
8 One of the following is not a rainbow colour.
   A Brown
   B Red
   C Violet
   D Green
   E Yellow

9 i) Describe apparent depth.
   ii) State one danger of apparent depth to amateur swimmers.
10 Explain how we see objects with our eyes.
11 Explain dispersion.
12 Describe how the rainbow is formed.
13 Name three (3) important parts of the eye.

Chapter 13 Sound energy

Introduction

We are all familiar with sound. Sound is detected by the ear which is one of the five sense organs. How sound is produced and transmitted is what you are going to learn in this Chapter. You will also learn how sound wave is reflected as well as how sound is detected by the human ear.

Like any wave, a sound wave does not just stop when it reaches the end of the medium or when it encounters an obstacle in its path. Rather, a sound wave will undergo certain behaviours when it encounters the end of the medium or an obstacle: diffraction around the obstacle, and transmission (accompanied by refraction) into the obstacle or new medium. Furthermore, in this chapter, we will learn and investigate behaviours that have already been discussed in the previous chapter and apply them to reflection, diffraction and refraction of sound waves.

Objectives

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

1 use objects to produce sound as well as make them vibrate;
2 explain the production of sound from a vibrating medium;
3 indicate how sound is reflected and identify objects that reflect sound; and
4 explain how sound is heard by the ear.

Production of sound

Activity 13.1 Demonstrating production of sound

Materials required

Empty cans, empty bottles, whistle, tuning fork, stick, your science notebook, biro.

Procedure

1 Use the stick to hit the can, bottle and the tuning fork with the same force as much as possible.
2 Blow the whistle.
3 Which one produces the loudest sound?
4 Record your observation in your science notebook and submit to your teacher.

You should have observed that, though you used about the same force to strike the materials, they did not all produce the same sound. The material with the highest density (i.e. the heaviest) produced the lowest sound. For example the empty can produced the loudest sound being the lightest material. How loud the sound produced is, is dependent on the vibration of the material producing it. The medium that vibrates most produces the loudest sound. If that medium is hindered from vibrating, the sound produced will be weak. Try to hold the empty can down with your leg, for example, while you strike it. You will observe that the sound reduces in intensity. This is because its vibration has been hindered.

Transmission of sound

Activity 13.2 Demonstrating how sound travels

Materials required

Metre rules, clams, bucket of water, table, your science notebook and biro.

Procedure

1 Clamp the metre rule onto the laboratory table.
2 Put a bucket of water on a stool beside the table.
3 Tap the loose end (i.e. the end that is not clamped) such that the metre rule is made to vibrate fast.
4 Watch the surface of the water in the bucket.

You must have observed series of compressions and rarefactions of air, the medium through which sound is being transmitted. A medium is needed for transmission of sound. In a vacuum for instance, no sound can be heard no matter how hard the object vibrates. These compressions and rarefactions are seen more clearly as ripples on the surface of water in the bucket as shown in Fig. 13.1.

For compressions and rarefactions of air and ripples on the surface of water in the bucket, the vibration of the metre rule causes compression and rarefactions of air particles in its immediate surrounding. The compressions and rarefactions are then transmitted from one particle of air to another till the ear picks up the sound. Any vibrating object like the tuning fork will produce a similar effect which can then be transmitted through any medium like air and water.

Fig. 13.1 Compression and rarefactions of waves

Reflection of sound

Just as light is reflected as you have learnt in Chapter 12, sound is also reflected. Sound is reflected when it meets an obstacle or a barrier. The reflected sound is heard as an echo after a time interval which in most cases is not more than a few seconds. The amount of reflection is dependent upon the dissimilarity of the two media. For this reason, acoustically minded builders of auditoriums and concert halls avoid the use of hard, smooth materials in the construction of the inside of the halls. A hard material such as concrete is as dissimilar as can be to the air through which the sound moves; subsequently, most of the sound waves is reflected by the walls and little is absorbed. Walls and ceilings of concert halls are made of softer materials such as fibreglass and acoustic tiles. These materials are more similar to air than concrete and have a greater ability to absorb sound. This gives room for more pleasing acoustic properties.

Activity 13.3 Demonstrating reflection of sound

Materials required

School hall or laboratory, stopwatch and your science notebook, biro.

Procedure

1 Close all windows and doors of the hall.
2 Hold the stopwatch while getting ready to switch it on when you give a loud shout.
3 Give a loud shout and switch on the stopwatch simultaneously.
4 Stop the stopwatch when you hear the echo.
5 Record your observation.

You must have heard an echo (i.e. the reflection) of your shout. The sound you made was reflected by the wall at the other end of your school hall. The wall acts as a barrier or obstacle. This activity helps us to measure the speed of the sound. Speed is distance divided by time. The distance travelled by your shout is twice the length of your school hall since the sound travelled to and from the back of the hall. Divide this distance by the time you obtained in the activity. This should give you the speed of sound which is 330 m/s in air when the room temperature is about 0° Celsius. The speed of sound is affected by the density of the medium through which sound is transmitted. For instance, the speed of sound through an iron railing is about fifteen times its speed in air.

Hearing

The human ear which is the sense organ responsible for hearing is divided into three compartments: the outer ear, the middle ear and the inner ear. Each of these compartments has its function.

1 **The outer ear:** This consists of the ear lobe and a tube. It is through this tube that sound wave travels en route to the middle ear.
2 **The middle ear:** The bones in the middle ear vibrate by the sound waves.
3 **The inner ear:** The auditory nerves in the inner ear detect vibrations and send these messages to the brain. The messages are interpreted by the brain as sounds.

Different vibrations on the eardrum produce different sounds. The greater the vibration, the louder the sound detected by the brain.

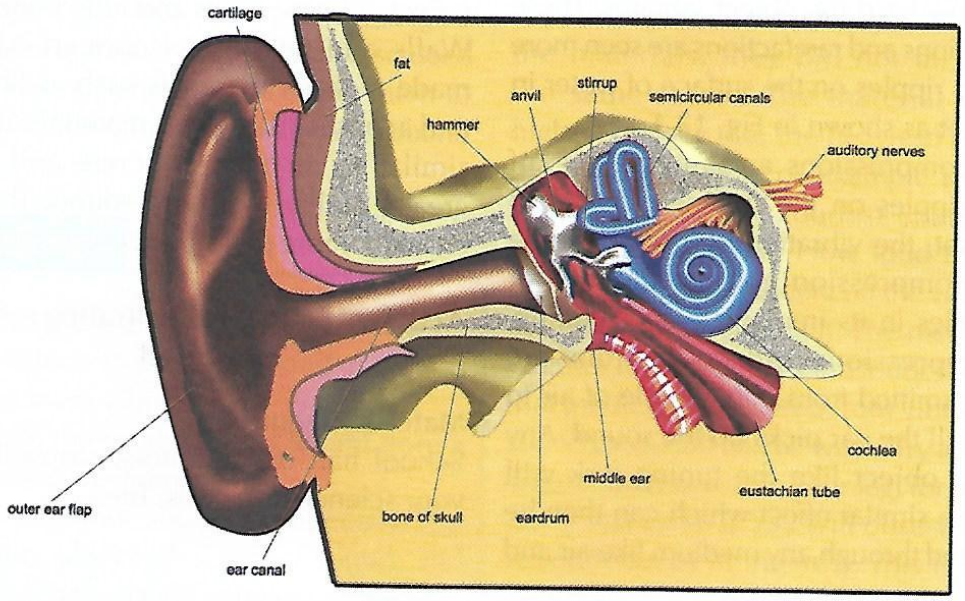


Fig. 13.2 The human ear

The ear is a very delicate organ. Thus any abuse to the ear will cause damage which can result in a hearing defect. How well people hear differs, perhaps because of hearing defects.

Summary

1 Sound is produced when objects vibrate.
2 Sound waves can only be terminated through a medium.
3 When a sound wave meets a barrier, it is reflected; the reflected sound is known as echo.
4 The ear, the sense organ sensitive to sound waves, is divided into three parts, namely, inner part, middle part and outer part.
5 A hearing defect may be due to abuse of the ear.

Revision questions 13

1 Sound is produced when an object _____.
   A rotates
   B vibrates
   C translates
   D shines
   E does none of the above
2 The greater the intensity of motion the _____ the sound produced.
   A louder
   B lower
   C faster
   D slower
   E hotter
3 Another name for echo is _____ sound.
   A refracted
   B reflected
   C transmitted
   D triple
   E not any of the above
4 The speed of sound is _____ times greater in iron than in air.
   A 1
   B 10
   C 15
   D 20
5 The speed of sound in air is determined by _____ the length of a wall over the time interval of the echo from the other side of the wall.
   A once
   B twice
   C thrice
   D none
6 Echo is a phenomenon caused by _____.
   A deflection of light
   B deflection of sound
   C reflection of light
   D reflection of sound
   E refraction of sound
7 Explain the production of sound from a vibrating medium.
8 a) Describe how sound is reflected.
   b) Mention two (2) ways an echo can be produced.
9 Explain how sound is heard by the ear.
10 Mention the functions of the inner part, middle part and the outer part of the human ear.

Chapter 14 Magnetism

Introduction

Playing with magnets is one of the first bits of science most children discover. That is because magnets are easy, and fun to use, and they are safe. They are also quite surprising. Remember when you first discovered that two magnets could snap together and stick like a glue? Remember the force when you held two magnets close and felt them either attract (pull toward one another) or repel (push away)?

It is quite fascinating to observe that a certain kind of material from iron has the ability to attract small pieces of iron. This material known as **lodestone** or **magnetite** is what we will learn about in this chapter.

You will also learn about the laws of magnetism as well as the poles and fields of magnets. Finally, you will learn about how to take care of magnets.

Objectives

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

1 describe the lodestone as a naturally occurring magnet;
2 state the laws of magnetism;
3 illustrate magnetic poles and fields; and
4 explain how to care for a magnet.

Lodestone

Lodestone or magnetite was discovered around 600 BC to have the ability to attract pieces of iron. It can be referred to as a natural magnet or a naturally magnetised mineral. It was first discovered in Magnesia, hence the word magnetite. The word lodestone is an old English word for 'way'. This is because the lodestone was used in those days to find direction, like a compass. Lodestone is one of only two minerals that are found naturally magnetised; the other, pyrrhotite is only weakly magnetic.

Six important basic facts about how magnets behave

1 A magnet has two ends called **poles**, one of which is called a **north pole** or north-seeking pole, while the other is called a **south pole** or south-seeking pole.
2 The north pole of one magnet attracts the south pole of a second magnet, while the north pole of one magnet repels the other magnet's north pole. So we have the common saying: like poles repel, unlike poles attract.
3 A magnet creates an invisible area of magnetism all around it called a **magnetic field**.
4 The north pole of a magnet points roughly toward the earth's north pole. This is because the earth itself contains magnetic

materials and behaves like a gigantic magnet.

5 If you cut a bar magnet into two, it is a bit like cutting an earthworm into two. You get two brand new smaller magnets, each with its own north and south pole. (This is of course, a joke. You do not get two worms if you cut a worm in halves, but you do get two magnets if you cut one into two).

6 If you run a magnet a few times over an unmagnetised piece of a magnetic material (such as an iron nail), you can convert it into a magnet as well. This is called **magnetisation**.

Activity 14.1 Demonstrating the directional property of a magnet

Materials required

Three or more bar magnets, rope, your science notebook, biro.

Procedure

1 Tie the rope to each magnet in turn such that the magnet can be suspended freely and the rope does not slide, as in Fig. 14.1.

2 Observe the direction each magnet comes to rest after oscillating to and fro briefly.

3 Record your observations in your science notebook.

You must have observed that all the magnets come to rest in a particular direction. That direction is the north-south direction of the earth as shown in Fig. 14.1. By using a magnet, the north-south direction is determined and ships and aircraft are able to find their bearings.

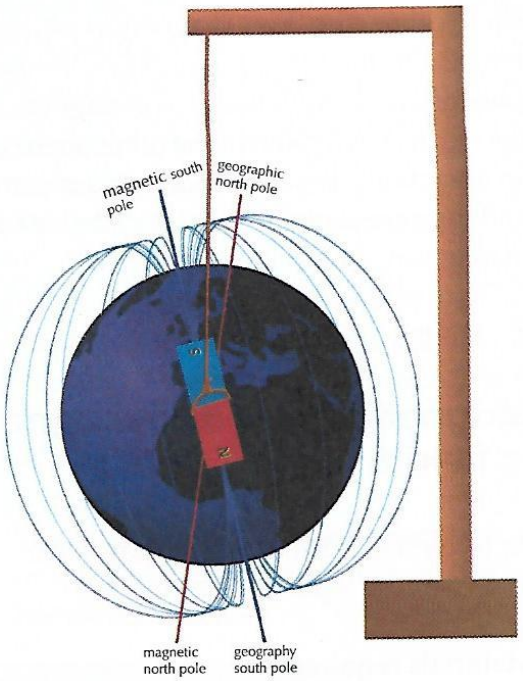


Fig. 14.1 A bar magnet suspended to show the north-south direction

Laws of magnetism

Activity 14.2 Demonstrating attraction and repulsion of magnets

Materials required

Two magnets with their poles clearly indicated, your science notebook, biro.

Procedure

1 Bring the two magnets near each other such that the north pole of one is beside the north of the other.

2 Now, bring another two magnets near each other such that the north pole of one is beside the south pole of the other.

3 Record your observation in your science notebook.

You must have observed that when the north poles of the two magnets are beside

each other, the two magnets repel each other. On the other hand, when the north pole of one of the other set of magnets was beside the south pole of the other, there was an attraction. These observations are correct and they are stated in what is called laws of magnetism. These laws are:

1 Like poles repel; and
2 Unlike or opposite poles attract.

Magnetic poles and magnetic fields

Activity 14.3 Identifying magnetic poles of a magnet

Materials required

Iron filings, bar magnet, cardboard, your science notebook, biro.

Procedure

1 Spread plenty iron filings on a cardboard.
2 Dip the whole bar magnet into the iron filings.
3 Record your observation in the science notebook.

You must have observed that there are two parts of the bar magnet where the iron filings cling the most. The two parts are the two ends of the bar magnet. Only a few, if any, of the iron filings are attracted to the middle part of the bar magnet. These two end points are referred to as magnetic poles of the magnet as shown in Fig. 14.2.

A standard bar magnet (i.e. one whose north and south poles are already identified) can then be used to identify the north (i.e. north-seeking) and the south (i.e. south-seeking) poles of the magnet, using the method of Activity 14.2.

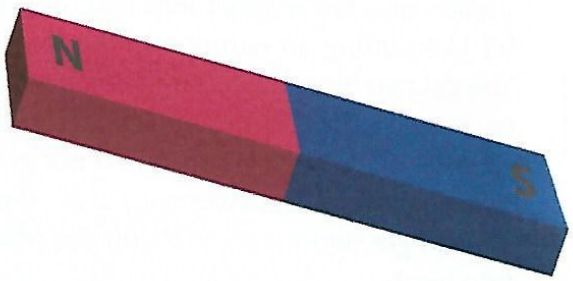


Fig. 14.2 Identifying the two poles of a magnet

Activity 14.4 Identifying the magnetic field of a magnet

Materials required

Iron filings, bar magnet, cardboard, science notebook, biro.

Procedure

1 Pour the iron filings on the cardboard.
2 Place the bar magnet under the cardboard.
3 Tap the cardboard gently with your biro.
4 Record your observation.

You must have observed that, on tapping the cardboard, the iron filings vibrate. They are then turned in the direction of the lines of the force of the magnet. Consequently, a pattern is formed known as the magnetic field of the magnet as shown in Fig. 14.3. The space surrounding a magnet in which magnetic force is exerted is referred to as magnetic field. The iron filings which have been magnetised by the magnet, only help to show the pattern of the field.

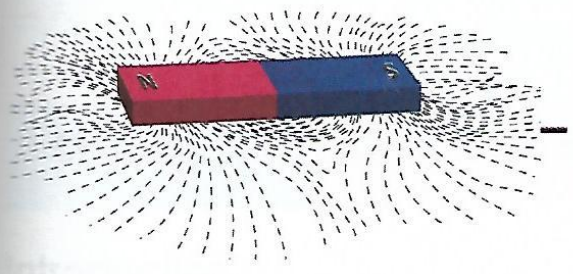


Fig. 14.3 Pattern of magnetic field formed by the iron filings

Care of magnets

The magnetic ability of a magnet can be lost under some situations, hence, the need to care for magnets. For instance, if a magnet is allowed to fall or if it is hammered while lying in the east-west direction, its magnetism is weakened. Also, if a magnet is withdrawn slowly to a distance of several metres in the east-west direction while current is still flowing in the solenoid inside which it is lying, its magnetism diminishes. A solenoid is a coil of copper, wound in a cylindrical form. A solenoid inside which a magnetised iron is lying is shown in Fig. 14.4.

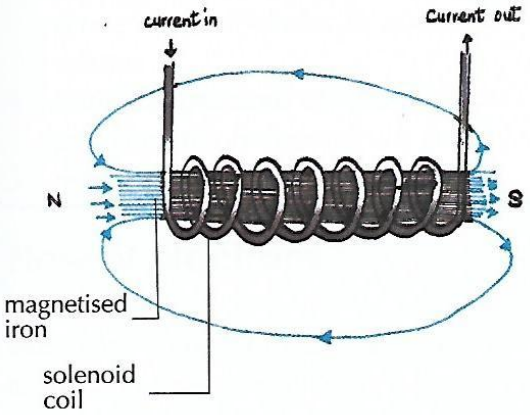


Fig. 14.4 A magnetised iron lying inside a solenoid

Summary

1 Lodestone or magnetite was discovered about 600 BC to have the ability to attract pieces of iron.
2 The laws of magnetism state that:
   i) like poles repel
   ii) unlike poles attract
3 The two poles of a magnet are the north (seeking) pole and the south (seeking) pole.
4 The space around a magnet is known as magnetic field where magnetic force is exerted.
5 The magnetism of a magnet can be lost or weakened; hence magnets should be handled with care.

Revision questions 14

1 The earliest mineral observed to show magnetic properties is called _____.
   A leadstone
   B lodestone
   C loadstone
   D none of the above
   E all of the above
2 Magnetism comes from the word _____.
   A Magnesia
   B Magnentia
   C Magnesium
   D Magenta
   E none of the above
3 Magnetised mineral ore was found in _____.
   A Africa
   B Australia
   C America
   D Magnesia
   E None of the above
4 When a magnet is suspended, it comes to rest in the _____ direction.
   A north-east

B north-west
C south-west
D north-south
E east-west

5 In which direction should a magnet not be hammered for it not to lose its magnetism?
A North-east
B North-south
C East-west
D South-west
E south-west

6 Which of these can be used to demonstrate the magnetic field pattern around a bar magnet?
A Ball bearings
B Charcoal
C Galvanometer
D Iron filings
E None of the above

7 Which of the following is a natural magnet?
A Aluminium
B Iron
C Lead
D Lodestone
E Rubber

8 State the laws of magnetism.

9 Explain how to show the magnetic fields around a magnet.

10 List two (2) methods of caring for a magnet.

Chapter 15 Electrical energy

Introduction

Energy has been defined as the ability to do work. Electricity, also known as electric current, has the ability to do work. Lifts or elevators in buildings of many storeys operate by electricity or electrical energy. This is just one example of the ability of electrical energy to do work. In this chapter you will learn about the flow of electrons in series, and parallel arrangement of resistors in electric circuits. You will also learn about fuses and circuit breakers as well as how the electric meter is read for billing.

Objectives

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

1 indicate the direction of electron flow in a circuit;
2 set up series and parallel circuits;
3 connect the ammeter and voltmeter to a series or parallel circuit and read their values;
4 state the functions of fuses and circuit breakers in a house circuit; and
5 read an electric meter for billing.

Flow of electrons

When an electric cell or battery is connected to a conducting wire, electrons are observed to flow. This flow of electrons or flow of electricity is referred to as **electric current**. Electricity or electrons flow from the positive terminal through the conducting or electric wires to the negative terminal of an electric cell.

The positive terminal is at a higher potential than the negative terminal, indicating that a potential difference exists between the two terminals. The potential difference can be regarded as the electrical condition that controls the direction of electron flow between two points in an electrical circuit as shown in Fig. 15.1 in a simple electric circuit.

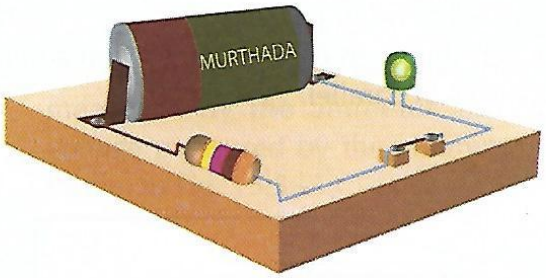


Fig. 15.1 A simple electric circuit consisting of an electric cell and resistor

This electric current flows from the higher point (taken as the positive terminal) to the lower point (taken as the negative terminal) just as it occurs in the flow of water or flow of heat.

The unit of electric current is **ampere**. 1 Ampere is the flow of 1 **coulomb** (unit of charge) of electricity in a time interval of 1

second. The relationship of current (I) and charge (Q) is given in the equation below.

$I = Q/t$

Where t is time interval,

I = current

Q = charge

Circuits: Series and parallel arrangements of resistors

A simple electric circuit consists of an electric cell, whose positive and negative terminals are connected to the ends of a resistor as shown in Fig. 15.1. More than one resistor can be connected to an electric cell. If two resistors or more are connected, such that the right end of the first resistor is connected to the left end of the second resistor as in Fig. 15.2(a), the resistors are said to be in **series**. If, on the other hand, the resistors are placed side by side such that their corresponding ends are connected together, the resistors are said to be in **parallel** as in Fig. 15.2(b) which shows an electric circuit containing resistors in parallel.

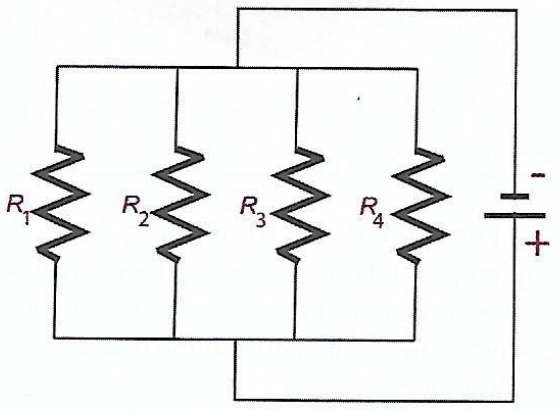


Fig. 15.2(a) Resistors in series

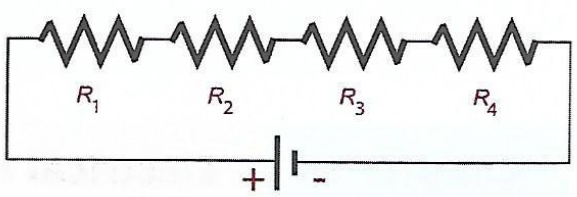


Fig. 15.2(b) Resistors in parallel

In a series arrangement of resistors, the same magnitude of current flows in each resistor, while in a parallel arrangement, the current divides between them in the ratio of the reciprocal of their resistance values. The potential difference across each resistor is different in resistors in series, but it is the same for resistors in parallel.

The net (total) resistance (R) for resistors in series is the direct sum of the resistance of each resistor, i.e.

$R_{total} = R_1 + R_2$

For resistors in parallel, the reciprocal of the net resistance (R) is the sum of the reciprocal of the resistance of each resistor i.e.

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$$

When parallel resistor R_1 and the total resistance R_{total} is given, then the formula below is used for the calculation of R_2.

$$R_2 = \frac{R_1 + R_{total}}{R_1 - R_{total}}$$

The current flowing in an electric circuit is measured by an **ammeter**, while the potential difference (voltage) across resistors is measured by a **voltmeter**. The unit of voltage is **volt** while the unit of resistance is **ohm**.

When a current of 1 ampere flows in a resistor of 1 ohm, the potential difference or voltage across the ends of the resistor is 1 volt.

Activity 15.1 Determining the net resistance of series and parallel arrangement of resistors.

Materials required

Electric cell, two resistors of different values, connecting wires, ammeter, voltmeter, your science notebook, biro

Procedure

1 Connect the resistors in series while making sure that the electric cell and the ammeter are also connected to the series.
2 Connect the terminals of the voltmeter to the left end of the first resistor and the right end of the second resistor i.e. the voltmeter should be connected to the resistors.
3 Take the readings on the ammeter and voltmeter.
4 Now connect the resistors in parallel while connecting the electric cell and ammeter in series with them and the voltmeter in parallel.
5 Take the readings on the ammeter and voltmeter.
6 Determine the ratio of voltage to current with the values of current and voltage in steps (3) and (4).

You should have observed that the ratio of voltage to current for series arrangement of resistors equals the sum of the resistances of the two resistors. For parallel arrangement of resistors, the reciprocal of the ratio of voltage to current equals the sum of the reciprocals of the resistances of the two resistors. Thus for a series arrangement of resistors,

$V/I = R = R_1 + R_2$

while for a parallel arrangement of resistors,

$$1/V/1 = \frac{1}{V} = \frac{1}{R_1} = \frac{1}{R_1} + \frac{1}{R_2}$$

Example

Given resistors $R_1 = 2$ and $R_2 = 4$

1 Connected in series. Find the current measured by the ammeter and the voltage by the voltmeter if a battery of 6 volts is connected as in Fig. 15.3(a).

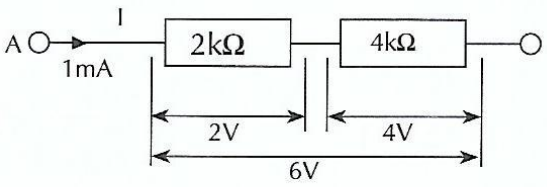


Fig. 15.3(a)

2 Connected in parallel. Find the current measured by the ammeter and the voltage measured by the voltmeter as shown in Fig. 15.3(b):

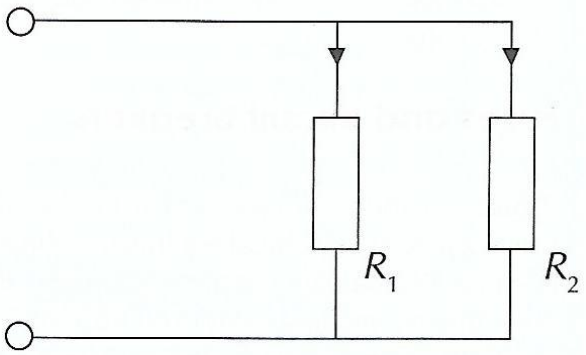


Fig. 15.3(b)

Solution

1 Net resistance $R = R_1 + R_2$

$R = 2 + 4 = 6$

$$\text{Current (I)} = \frac{\text{voltage (V)}}{\text{resistance (R)}} = \frac{6 \text{ volts}}{6}$$

$$= 1 \text{ ampere}$$

The current measured by the ammeter should be 1 Amp. If we neglect the internal resistance of the battery (you will learn about internal resistance in senior school), the voltmeter should read 6 volts, which is the voltage of the battery.

2 Net resistance R is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{4}$$

$$= \frac{2+4}{4} = \frac{1}{2}$$

$$R = \frac{4}{3} = 1\frac{1}{3}$$

$$\text{Current (I)} = \frac{\text{voltage (V)}}{\text{resistance (R)}} = \frac{6 \text{ volts}}{\frac{4}{3}}$$

$$= \frac{6 \times 3}{4} = 4\frac{1}{2} \text{ Amp}$$

The current measured by the ammeter should be $4\frac{1}{2}$ Ampere. 'Amp' or 'A' is the abbreviation of Ampere. Neglecting internal resistance, the voltmeter should read 6 volts.

Fuses and circuit breakers

A **fuse** is a short, thin piece of wire placed inside a piece of electrical equipment which prevents the damage of the equipment. It does this by melting when the current is greater than its capacity, thereby stopping the flow of current. The short thin wire is enclosed in a tube. Fig. 15.4 shows an example of a fuse. A fuse that has blown or melted can be replaced. However, it is important to find out the cause of the melting so as to prevent a recurrence. It may be necessary to invite an electrician who will then detect the fault and rectify it before replacing it.

Fig. 15.4 A fuse

A **circuit breaker** is a piece of equipment that stops electric current from reaching a machine if the machine has become faulty and has, therefore, become dangerous. It is a wire used for earthing the metal casing of a machine.

Electric meter reading and billing

An electric meter is normally installed in every house to measure the quantity of electrical energy consumed in that house. You learnt that the unit of energy is Joule. You also learnt that power, P, is the rate of energy, E, used i.e.

$$P = \frac{E}{t}$$

We can also write this equation as E = Pt

Since the S.I. unit of power is **watt** and that of time is **second**, another unit of energy is, thus, derived as watt per second.

A multiple of this unit is kilowatt per hour i.e. 1 000 watts of power dissipated during a time interval of 1 hour.

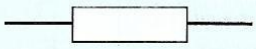
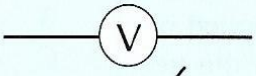
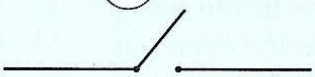
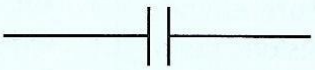
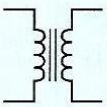
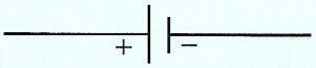
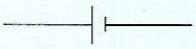
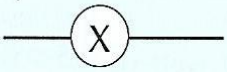
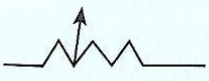
On a piece of electrical equipment, for example, an electric lamp, a rating of 240V 60W indicating that the working voltage is 240 volts and the power consumption is 60 watt, is usually found. If ten such lamps are used for 8 hours, the energy consumption is given by:

$10 \times 60 \times 8$ watt per hour.

This equals 4 800 watt per hour or 4.8 kilowat/hour.

Suppose electric energy costs ₦100 per unit of kilo per hour, the consumer will then have to pay $4.8 \times$ ₦100 or ₦480. The bill that will be sent to the consumer is ₦480 as current charges.

Table 15.1 Some electric components and their symbols

Electric components	Symbols
1 Resistors in parallel	
2 Ammeter (A) in circuit	
3 Voltmeter (V) in circuit	
4 Switch or key	
5 Capacitors	
6 Inductor	
7 Transformer	
8 Battery or dry cell	
9 Cells in series	
10 Cells in parallel	
11 Light bulb	
12 Resistor in series	
13 Fixed resistors	

Summary

1 Electron flow is the same as flow of electricity or electric current.
2 Electron or charge flows from the positive terminal to the negative terminal of a battery.
3 The positive terminal has a higher electric potential than the negative terminal.
4 In a series arrangement of resistors, the net or total resistance of the resistors is the sum of the resistance of the resistors.
5 In a parallel arrangement of resistors, the reciprocal of the net resistance of the resistors is the sum of the reciprocal of the resistance of each resistor.
6 The current flowing in a circuit is given by the ratio of the voltage supplied by the battery or electric cell to the net resistance of the resistors in the circuit.
7 In an electric circuit, ammeter is the equipment used to measure electric current, flowing in the resistors, connected in series to the resistors.
8 In an electric circuit, voltmeter, the equipment used to measure the voltage or potential difference across resistors is connected in parallel to the resistors.
9 Fuses and circuit breakers are devices that cut off electric current, thereby preventing damage to electrical equipment or appliances when there is excess current.
10 The unit of electrical energy consumed in homes is kilowatt per hour, i.e. 1 000 watt per hour.
11 1 kilowatt per hour is 1 000 watt of electrical power dissipated over 1 hour.
12 A rating of 240V 60 watt on an electrical appliance means that the working voltage of the equipment is 240 volts and that its power consumption is 60 watt.
13 The electric meter installed in homes is employed in reading (measuring) the quantity of electric energy consumed, the cost of which is then sent as electric bills to be paid by the consumers.

Revision questions 15

1 Electric current is the flow of _____ over a time interval.
   A energy
   B power
   C charge
   D none of the above
   E all of the above
2 The S.I. unit of electric current is _____.
   A volts
   B ohms
   C ampere
   D current
   E none
3 The arrangement of resistors **A** and **B** in series is by connecting _____.
   A left end of both **A** and **B** together.
   B right end of A to left end of **B**.
   C right end of both **A** and **B** together.
   D all of the above
   E none of the above.
4 The arrangement of resistors **A** and **B** in parallel is by connecting _____.
   A left end of both **A** and **B** together and their right ends together.
   B right end of **A** to left end of **B.**
   C left end of **A** to the right end of **B.**
   D **A** to **A**
   E none of the above.
5 The S.I. unit of resistance is _____.
   A volts
   B ohms
   C ampere
   D watt

E none of the above

6 The S.I. unit of voltage is _____.
A volts
B ohms
C ampere
D coulomb
E none of the above

7 _____ is used to measure current.
A Voltmeter
B Ohmmeter
C Ammeter
D Tester
E None of the above

8 _____ is used to measure voltage (potential difference).
A Voltmeter
B Ohmmeter
C Ammeter
D Current meter
E None of the above

9 Ammeter is connected in _____ in an electric circuit.
A series
B parallel
C perpendicular
D horizonal
E none of the above

10 Voltmeter is connected in _____ in an electric circuit.
A series
B parallel
C perpendicular
D hexagonal
E none of the above

11 Electric current flows from the _____ _____ in an electric circuit.
A positive terminal of a battery back to the negative terminal
B negative terminal to the positive terminal
C positive terminal back to the positive terminal
D negative terminal back to the negative terminal
E None of the above

12 A 12 volt electric cell or battery is connected to a resistor of resistance 2 ohms, which is then connected in series to a parallel arrangement of two resistors of resistance 3 ohms and 6 ohms. Calculate the current flowing in the circuit.

13 Describe the functions of:
a) fuses in electrical appliances
b) current breakers in house wiring.

14 In a house, ten 60-watt electric bulbs, a refrigerator rated at 200 watt, one electric kettle rated 220 V watt, one electric cooker rated 3 K watt and one television set rated 100 watt are all used for 10 hours in a day. Given that the cost for one kilowatt-hour (unit of electrical energy is $100), calculate:
a) the number of units that will be measured by the electric meter.
b) the cost of energy consumed.

Chapter 16 Radioactivity

Introduction

When a substance is used, it reduces in quantity. There are, however, some substances that reduce in quantity even when not used. Any of such substances is referred to as a **radioactive substance**. In this chapter, you will learn the meaning of radioactivity and radioactive elements. You will also learn about the types of radiation they emit and their properties as well as uses, and the dangers of radioactive rays.

Objectives

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

1 explain the meaning of radioactivity;
2 name some radioactive elements;
3 list the three types of radiation and state their properties;
4 state the uses of radiation; and
5 state the dangers in the use of radioactive rays.

Radioactivity

Radioactivity is the spontaneous disintegration or decay of some elements with the emission of alpha (α), beta (β) and gamma (γ) radiations. These elements are referred to as radioactive elements. When radioactive elements decay, other elements are formed which may also be radioactive. Thus there are two types of radioactivity. They are natural radioactivity and artificial radioactivity. Natural radioactivity is the decay of natural radioactive elements, while artificial radioactivity is the decay of artificial radioactive elements.

Radioactive elements

Radioactive elements are elements that disintegrate by emitting radiations capable of ionising air molecules or any matter through which they pass. There are two types of radioactive elements. They are the natural radioactive elements and the artificial radioactive elements. The natural radioactive elements include Uranium, Radium, Thorium, Plutonium. Artificial radioactive elements are Cobalt-60, Iodine-131 and Sulphur-35. These artificial radioactive elements are obtained by bombarding their normal atoms with protons and neutrons. The radiations emitted by both natural and artificial radioactive elements are alpha (α), beta (β) and gamma (γ) radiations. These radiations are discussed below.

All radioactive elements are found to have a definite rate of decay. This rate of disintegration is usually represented by the of the element. Half-life, indicated by $t_{1/2}$, is the time interval it takes a radioactive element to decay to half its original quantity. The half-life of radioactive elements ranges from a fraction of a second to several thousands of years. For instance the half-

life of Polonium is (Po – 210) 138 days. This is the time it takes for the radioactivity to decrease by half due to the process of radioactive decay.

Types of radiation and properties

The radiations emitted by radioactive elements are given as alpha (α), beta (β) and gamma (γ). The properties of these radiations are mentioned below.

Alpha radiation (α-radiation)
α-radiations are helium nuclei, i.e. helium atoms that have lost their electrons. As a result, α-radiations are positive ions. They are able to travel several centimetres in air but cannot penetrate paper or thin sheets or aluminum foil. They are deflected by a magnetic field.

Beta radiation (β-radiation)
β-radiations are streams of fast-moving electrons that are negatively charged. Their velocity is almost equal to that of light, i.e. 300 million metres per second. β-radiations travel farther in air than α-radiations. β-radiations are able to penetrate aluminum material of several millimetres thickness. In a magnetic field, they are deflected in a direction opposite to that of α-radiations.

Gamma radiation (γ-radiation)
γ-radiations are electromagnetic in nature. They are neither positively nor negatively charged. They travel farther than both α- and β-radiations and can penetrate a lead material of many centimetres thickness. γ-radiations are not deflected by magnetic fields. In Fig. 16.1, the deflections of α-, β-, γ-radiations by magnetic fields is shown. It is the most useful type of radiation for medical purposes, but at the same time, it is the most dangerous because of its ability to penetrate a large thickness of materials.

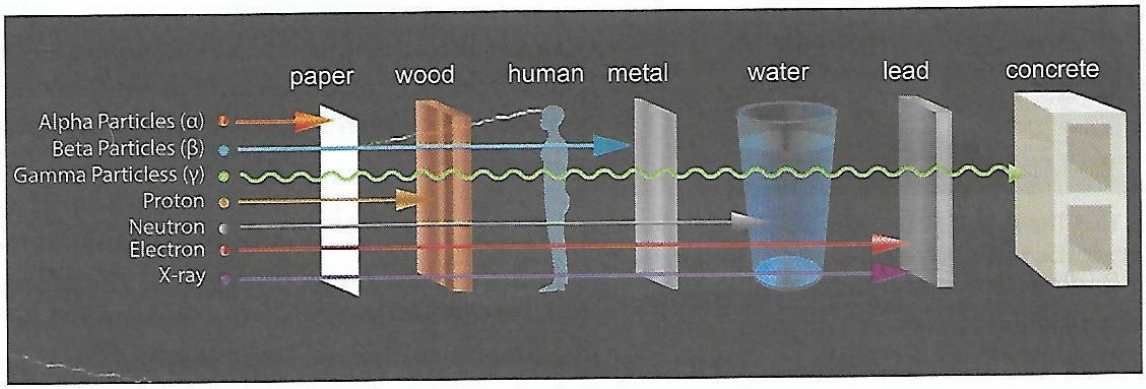


Fig 16.1 The alpha particles showing levels of penetration

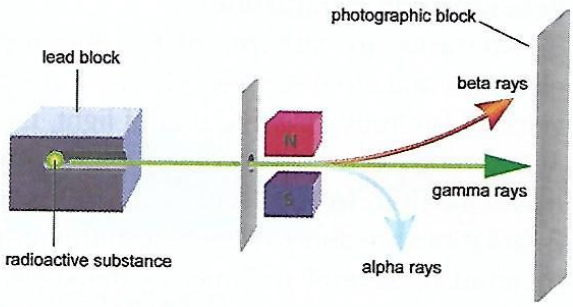


Fig. 16.2 Deflection of α-, β-, γ-radiations by a magnetic field

Uses of radioactivity

Artificial radioactive elements, e.g. cobalt isotope are sometimes used in place of *X*-rays or α-rays to treat cancer patients. This is because the use of cobalt isotope is simpler than using the α-rays or *X*-rays. α-rays and *X*-rays are actually similar in nature and properties. Radioactive rays are also used in fixing damaged bones. Use of radioactive rays in treating patients takes place in the radiology unit of a hospital.

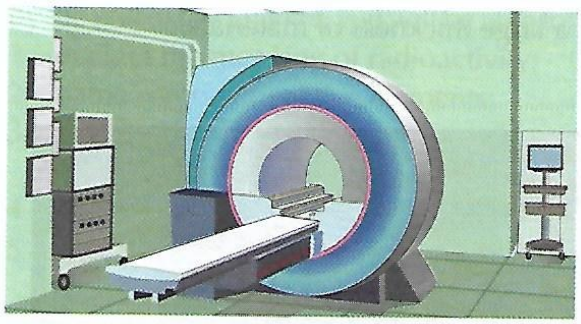


Fig. 16.3 The radiology unit of a hospital

Radioactive elements are also used in industry. Fruit drinks or water in bottles or cans are sterilised by passing γ-rays through them so as to remove germs. This method is less cumbersome than pasteurisation. In pasteurisation, the bottled or canned drinks have to be warmed to a temperature in which germs cannot survive. The same method of sterilisation by γ-rays is used to sterilise medical instruments and syringes.

γ-rays are used for the bombardment of radioactive elements by neutrons in fighting wars. This bombardment results in the split of the neutrons in a process called **nuclear fission**. The enormous nuclear energy can be harnessed to drive the turbines of an electrical power station. Thus another use of radioactivity is the production of electrical energy.

The ages of old objects buried in the ground over several years or objects in museums can be determined by the process called **carbon dating**. This process relates the radiation given out by the object in a time interval to the total radiation it has ever given. Both radiations are proportional and help in calculating the reduction in radiation which is used in determining the object's age.

Dangers of radioactive rays

Too much exposure to radioactive rays, especially *X*-rays which penetrate the moist area, may result in burns and destruction of living cells. It can also cause leukaemia, i.e. cancer of the blood. There is also the possibility of these diseases resulting from small doses of radiation from these elements accumulating in a human system over a long time.

Radiations from some radioactive elements used in nuclear bomb tests find their way into plants and, therefore, the food we eat, causing deformity. For example, during the Second World War, the hydrogen bomb thrown in Hiroshima caused deformities of foetuses in pregnant women.

Summary

1 Radioactivity is the disintegration or decay of radioactive elements with the

emission of alpha (α), beta (β) and gamma (γ) radiations.

2 Radioactive elements decay at a rate that can be represented by the half-life of the element.

3 The half-life is the time taken for half the atoms of a radioactive element to disintegrate.

4 There are both natural and artificial radioactive elements.

5 Alpha (α) radiations are helium nuclei (and positive ions) whose range of penetration in air is several centimetres and can be deflected by magnetic fields.

6 Beta (β) radiations are electrons (and therefore negative ions) whose range of penetration in aluminum is several millimetres and can be deflected by magnetic fields.

7 Gamma (γ) radiations are electromagnetic radiations (and therefore do not carry electric charge like α- and β-rays) whose range of penetration in lead is many centimetres, and are not deflected by magnetic field.

Revision questions 16

1 Radioactivity is not the _____ of a radioactive substance.
- A disintegration
- B decay
- C reduction
- D increase
- E same

2 One of these rays is not emitted in the disintegration of radioactive elements _____.
- A α
- B γ
- C β
- D X
- E None of the above

3 α-radiations are _____.
- A electrons
- B helium nuclei
- C electromagnetic waves
- D protons
- E electrodes

4 β-radiations are _____.
- A electrons
- B helium nuclei
- C electromagnetic waves
- D protons
- E ions

5 γ-radiations are _____.
- A electrons
- B helium nuclei
- C electromagnetic waves
- D protons
- E neutrons

6 $T_{1/2}$ of a radioactive element is _____.
- A half of the substance
- B half of the atoms
- C time for half of the substance to decay
- D none of the above
- E all of the above

7 One of these is a natural radioactive element: _____.
- A Uranium
- B Cobalt-60
- C Iodine-131
- D Sulphur
- E Magnesium

8 One of these is an artificial radioactive element: _____.
- A Radium
- B Uranium
- C Cobalt-60
- D Thorium
- E Iron

9 State two (2) uses of each of the radiations.

10 State three (3) dangers of α, β and γ-radiations.

Science and development

Chapter 17 Skill acquisition

Introduction

Every day, we are confronted with various problems in our environment. We may have such problems as broken chairs or damaged shoes that need to be fixed. We may need to cut or fix our hair or even trim our nails. These problems should be properly solved in order to sustain and maintain a good living environment. People solve problems by applying problem-solving procedures which involve the application of appropriate skills. Every work we do requires that we have certain skills in order to perform well with little or no waste of time, energy or resources. Skills enable greater output. Some individuals distinguish themselves in such services as carpentry, photography, hairdressing, and manicure. When services are needed in such areas, the people who have skills in the areas are sought. Skills are vital for rendering perfect service. Skills are acquired through learning and practice. Anyone wishing to acquire a new skill is faced with two options:

1 Learn like a baby through imitation or fumbling by trial and error.
2 Seek the help of an instructor or instructional manual.

The second option is more efficient, particularly for dangerous activities such as aircraft piloting and electrical work.

In this chapter, you will learn the meaning of skill acquisition, reasons for skill acquisition, types of skills and the importance of skill acquisition.

Objectives

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

1 explain the meaning of skill acquisition;
2 state at least three reasons for skill acquisition;
3 list at least ten types of skills; and
4 state the importance of skill acquisition.

Meaning of skill and skill acquisition

Skill is an act of doing something well. It is an ability to perform a special task with ease. Skills can be acquired by mental or manual means. Mental and manual skills include the following:

Mental skills: These include the intellectual skills we use in the classroom. They are as follows:

1 Listening skill: Ability to listen with understanding.
2 Reading skill: Ability to read well with understanding.
3 Speaking skill: Ability to speak well with meaning.
4 Writing skill: Ability to write well with meaning.
5 Mathematical skill: Ability to calculate and carry out mathematical operations

with ease and little error.

6 Science process skill: Ability to use scientific methods to identify and solve problems.

Manual skills: These include those skills that require body movements such as catching, throwing, running, holding and jumping.

The process of acquiring or learning a skill is called **skill acquisition**. Mental skills are acquired through education while manual skills are acquired through training and apprenticeship.

Mental and manual skills are developed through practice. 'Practice makes perfect.' With more practice, skill acquisition is improved. A skilled worker is a worker that possesses a recognised trade. An example is a carpenter who is skilled in roofing tasks. He may need the assistance of other workers who are not skilled. Unskilled workers usually act as labourers in roofing tasks.

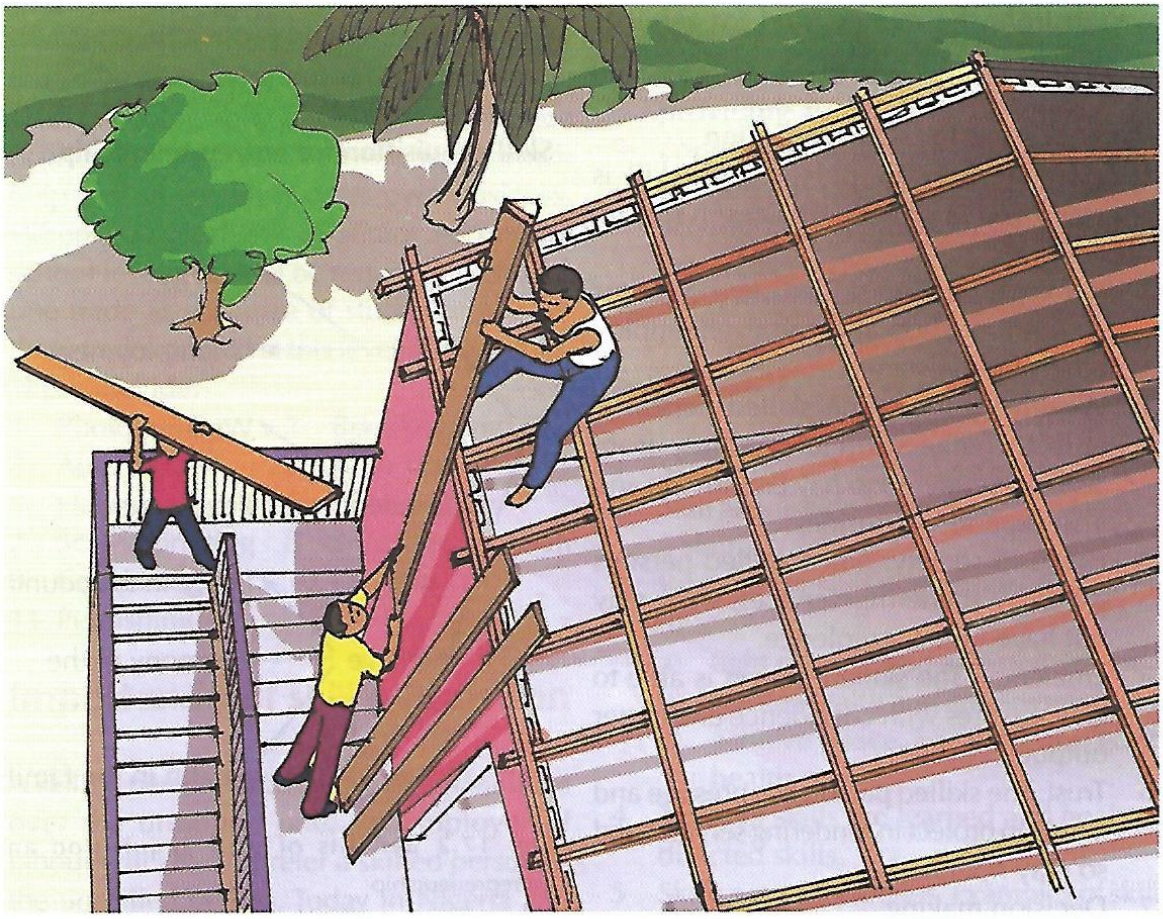


Fig. 17.1 A carpenter and his labourers

Reasons for skill acquisition

Skills are acquired in order to perform tasks better. A skilled person gives satisfactory service. An unskilled person causes more damage in the process of carrying out the work.

A skilled worker has initiatives and creativity such that he or she can find alternative ways of doing things better. With skill acquisition, there is more opportunity for employment.

Also, a skilled person is able to create wealth from the money paid for services rendered.

Major reasons for skill acquisition

1 Employment: The person with skill is employed to provide services in special areas.
2 Job creation: The skilled person opens an outfit or shop and can even employ others for assistance.
3 Wealth creation: The skilled person is able to make sufficient money from services rendered to pay employees and also expand the business.
4 Peace in society: Since skilled persons are busy rendering services, they may not have time for violence.
5 Efficiency: The skilled person is able to give services with confidence and better output.
6 Trust: The skilled person has prestige and image to protect in rendering services and so may not cheat.
7 Decision making
8 Emergency management
9 Ability to take risks
10 Survival strategy

A skilled person who is self-employed is called an **entrepreneur**.

Activity 17.1 Presenting reasons for skill acquisition

Materials required

A chart, science notebook, biro.

Procedure

1 Work in groups of five students.
2 Study the chart presented in Fig. 17.2.
3 Discuss the information in the chart.
4 Each member of the group should write an essay on the reasons for skills acquisition.
5 Members should present their essays to the group for further discussion.

Skill acquisition for entrepreneurship

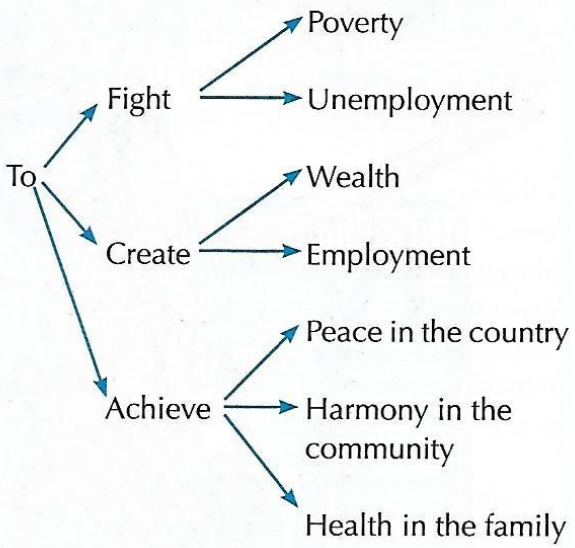


Fig. 17.2 Benefits of skill acquisition and entrepreneurship

Types of skills

There are two major types of skills: Learned skills and goal-directed skills.

Learned skills: These are the skills you must learn as a condition to perform a task. For example, you must learn the skill of throwing for you to be a good footballer.

Goal-directed skills: These are the skills you give yourself as a target to accomplish a task. In this case, you will perform such skills to a higher level because you want to hit your goal. You, therefore, follow instructions to the letter. The practice of skills is called trades. For instance, one who practises the skills of photography is said to be in the trade of photography. There are many trades which help one to establish one's own business. When you graduate to senior secondary school level, you will be required to choose one trade as a course of study out of over thirty trades offered at this level of education. These include:

1 Photography
2 Bookkeeping
3 Auto repair
4 Auto body repair
5 Hairdressing
6 Phone repair
7 Screen printing
8 Snacks production
9 Computing
10 Farming
11 Publishing

Importance of skill acquisition

A skilled person stands at a good advantage over the unskilled one. An employer of labour will always prefer a skilled person to the unskilled person. Today in Nigeria and most countries of the world, employment has become a problem. To be well prepared to face the challenges of survival after your education, it is right to acquire skills in at least one trade area. This will enable you to settle down happily and quickly either in the world of work or create wealth that will enable you to pursue further schooling. Skill acquisition is important as it enables one to:

1 secure employment;
2 improve our quality of life;
3 provide services to ourselves and others;
4 become proactive and relevant in the community;
5 demolish idleness and idle behaviour;
6 contribute to the economy of the country by payment of tax;
7 contribute to the economic growth of the family;
8 contribute to the family welfare by providing funds for their needs; and
9 contribute to the education of family members by paying their school fees and buying their school books and other materials.
10 appreciate human capability

Summary

1 Skill is the act of doing something well.
2 Skill acquisition is the process of learning a skill.
3 Reasons for skill acquisition are mainly to
   a) fight poverty and unemployment;
   b) create wealth and employment; and
   c) achieve peace, harmony and good health.
4 Types of skills are learned and goal directed skills.
5 Skills are called trades. Examples of skills are photography, and snacks production.
6 About thirty trade subjects are offered at the senior secondary school level.
7 Skill acquisition is important as skills enable one to become a proactive and relevant member of the community.

Revision questions 17

1 Which of these statements best explain the meaning of skill acquisition?
   A The act of doing a task well.
   B The ability to perform a task.
   C The process of learning to do a task well.
   D Parental training.
   E Repairing broken chairs.

2 Which of the following best describes the reason for skill acquisition?
   A Dependence on relations.
   B To keep poverty away from the family.
   C Freedom from good health.
   D Keep away from the family.
   E Take a risk.

3 The following activities can create wealth in the family except _____.
   A auto repairs
   B screen printing
   C video viewing
   D computer operation
   E snacks production

4 Skill acquisition is important in the community because _____.
   A it enables one to avoid employment
   B it provides opportunities for idleness
   C it keeps one away from paying tax to government
   D it enables one to become a relevant member of society
   E it is a way of life.

5 Which of these workers can be described as a skilled worker?
   A A worker who helps the carpenter to carry wood.
   B One who helps to carry blocks to the bricklayer.
   C One who helps in tidying the kitchen after snack production
   D One who lays the block in a building
   E One who guards the premises.

6 List eight (8) trades.

7 State two (2) reasons for skill acquisition.

8 Make three (3) statements to show the importance of skill acquisition.

9 Explain in your own words, the meaning of:
   a) skill.
   b) skill acquisition.

Chapter 18 Ethical issues in science and development

Introduction

Have you ever wondered why people use guns, bombs and nuclear weapons? Some unfortunate persons have lost their lives or have been wounded by accidental discharge of bullets. The issue of legalisation of abortion has become quite controversial in some countries. Many people are becoming concerned about the right and wrong application of science.

In this chapter, you will learn about the right and wrong applications of science, as well as the implications of wrong application of science. Such implications include the destruction of lives of individuals and its adverse effects on a country.

Objectives

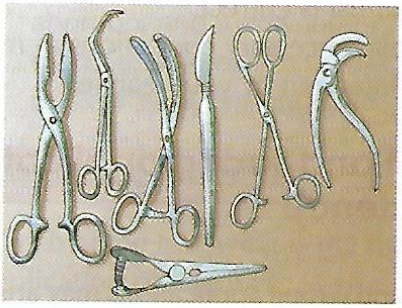
By the end of this chapter, you will be able to:

1 understand right and wrong applications of science;
2 list examples of good and wrong scientific practices;
3 explain the practices of science; and
4 discuss the implications of the application of science to the development of society.

Practices of science

Practices of science include production of fertiliser, poisonous gas, hydrogen bombs, insecticide and surgical equipment. Scientists also produce harvesters, grenades, aeroplanes, booby traps, cars and missiles. Other practices of science include purification of water and giving treatment and care to the sick.

Some of these practices may be described as good while others may be described as bad.



surgical equipment

aeroplane

harvester

Fig. 18.1 Some products of science

Activity 18.1 Separating the good practices of science from the bad ones

Materials required
Your science notebook, biro.

Procedure
1 Make a table with one column having the heading, 'Good practices of science' and another column 'Bad practices of science'.
2 Make a list of the good practices in the appropriate column.
3 Make a list of the bad practices in the other column.
4 Show your list to the teacher; ask her if your list is correct.
5 Make necessary corrections as may be pointed out by your teacher.

Right and wrong applications of science

Right and wrong applications may arise from good and bad practices of science.

There is no doubt that science has brought tremendous comfort, development, and ease of life for mankind. Nevertheless, when anything is good or advantageous, it can also be disadvantageous, if not well managed.

The right application of science is the application of science to better the lot of mankind. When the application of science however leads to destruction, it is the wrong application of science. Wrong application of science has resulted in human suffering and death.

Activity 18.2 Discussion on legalisation of abortion

Materials needed:
Your science notebook, biro.

Procedure
1 Your teacher will divide the class into two groups.
2 Let one group give reasons why abortion should be legalised.
3 Record these in your science notebook.
4 Let the other group give reasons why abortion should not be legalised.
5 Record also in your science notebook.
6 Let the class vote to indicate which side won.
7 Record the result of the vote in your science notebook.

Implications of right and wrong applications of science

The implications of the right application of science are many as shown below. The **right application of science** leads to:
1 the use of medical science to cure ailments.
2 ease of transportation by the use of motor vehicles and airplanes.
3 easy communication with any part of the world in a matter of seconds through information and communication technology (ICT).

On the other hand, **the wrong application of science** has led to destruction of innocent lives as discussed in the following examples:
1 **Abortion:** It is commonly believed by many that abortion is the killing of a human being. Others say that abortion may save the life of a mother, or limit the

size of a family to manageable proportions or save the career of a girl.

The decision on whether abortion is right or wrong is not taken by science, but by lawmakers. Science itself is not at fault. It is how individuals or governments use science that may be open to question. However, whichever way we look at it, abortion mainly involves destruction and not creation or construction.

2 **Mercy killing/Euthanasia:** Mercy killing is the use of medical science to terminate the life of a patient who is known to have a terminal disease. Those who support mercy killing hold that if someone is sure to die, why let the person continue suffering? Others say the individual may still one way or the other survive.

3 **War:** Science has produced weapons of destruction such as guns, grenades, and nuclear bombs. Governments, not scientists, decide when and if to use them. Individuals hold their personal views, and have the right to do so. Some adherents of particular faiths, for instance, do not participate in war. That is their own faith. What we should note is that the job of scientists is to investigate (carry out research) and bring out findings and discoveries. Ethical issues are left for those who make use of the scientific discoveries, like governments of nations, soldiers and legislators.

Summary

1 Just as science has had positive effects on mankind, it can also be applied wrongly.

2 The right application of science is in bringing development and comfort to humanity.

3 The wrong application of science is in its use as a means of destruction of humans.

4 The implications of the right application of science include:
   i) use of medical science to prevent disease and cure ailments;
   ii) use of agricultural science for bountiful harvests; and
   iii) employment of technology to produce computers, the Internet, cell phones, television, and washing machines.

5 The implications of the wrong application of science include:
   i) use of medical science to carry out abortion, and mercy killing; and
   ii) use of technology in producing nuclear weapons and guns.

Revision questions 18

1 Which of the following is the right application of science?
   A Bringing destruction to mankind.
   B Using science to kill our enemies.
   C Bringing development and comfort to humans.
   D Being used to annihilate people.
   E Abortion

2 Which of the following is the wrong application of science?
   A Bringing destruction to mankind.
   B Bringing ease and comfort.
   C Promoting development.
   D Providing comfort to humans.
   E None of the above

3 The practices of science are _____.
   A both good and bad
   B only good

C only bad
D neutral
E nothing

4 Right application of science _____ mankind.
A destroys
B better the lot of
C expires
D makes
E injures

5 _____ is one of the wrong applications of science.
A Medical cure
B Abortion
C Technological development
D Agricultural development
E communication technology

6 List two (2) examples of good scientific practices.

7 List two (2) examples of bad scientific practices.

8 What are the reasons given to justify the:
a) right application of science?
b) wrong application of science?

9 Explain the practices of science.

10 Briefly differentiate between the right and wrong application of information and communication technology (ICT).

Chapter 19 Simple machines

Introduction

Machines can be described as any devices that make work easier and more convenient for us to do. Many devices or tools that we use in doing work more conveniently at home are machines, although we do not think of them as machines because of their simplicity. Examples include the knife, broom, tin-cutter, hoe, cutlass, bottle opener, packer, screwdriver, and the hammer.

Some machines make work easier by reducing the amount of force that must be applied in order to move a load. Others make work more convenient by changing the direction of the force applied or increasing the speed or distance of movement.

Objectives

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

1 define machines and simple machines;
2 identify simple machines; and
3 list some simple machines and their uses

Types of machine

Machines can mainly be classified or grouped into simple machines and complex machines. Examples of simple machines are brooms, hoes, knives, axes, levers, the inclined plane, wedges, screws, wheel and axle, and the pulley.

Complex machines include the following: car jack, pump and sewing machines.

Meaning of simple machine

A **simple machine** is a device which uses a force applied at one point called **effort** to overcome another force called **load** at some other point. A simple machine enables a large load to be overcome by a small effort. Hence, a machine makes it possible for us to do work more easily. With a machine, a large load or resistance is overcome by a small effort. Simple machines are not as big and complicated as big ones. They are simple devices or tools that can be used in the home, offices, schools or other places. Examples include levers, pulleys, the wheel and axle, inclined planes, the hydraulic press and wedges.

Levers

Levers are collections of simple machines that are readily used in homes. Examples of simple machines that are commonly used in homes are the hoe, broom, cutlass, spoon, tin-cutter, hammer, the plier, and scissors. These are simple machines that are unique in the arrangement of their three most important components, which are **load**, **effort** and **pivot** or **fulcrum**.

1 **Load**: This is the point where work is overcome.
2 **Effort**: This is the point where force is applied.
3 **Fulcrum**: This is the turning point. It is also called **pivot**.

Classes of levers

The lever is of three classes, depending on the relative positions of the effort, load and fulcrum.

1 First class levers: These are simple machines in which their fulcrum is between the effort and load, e.g. scissors, and pliers.
2 Second class levers: The load is between the fulcrum and the effort, e.g. wheel-barrows, and nutcrackers.
3 Third class levers: The effort is between the load and the fulcrum, e.g. sugar tong, and the human forearm.

Uses and maintenance of simple machines

Machines are generally very useful in our daily activities, hence, they need to be maintained so that they will serve and be effective. Some uses and maintenance of simple machines are given in Table 19.1.

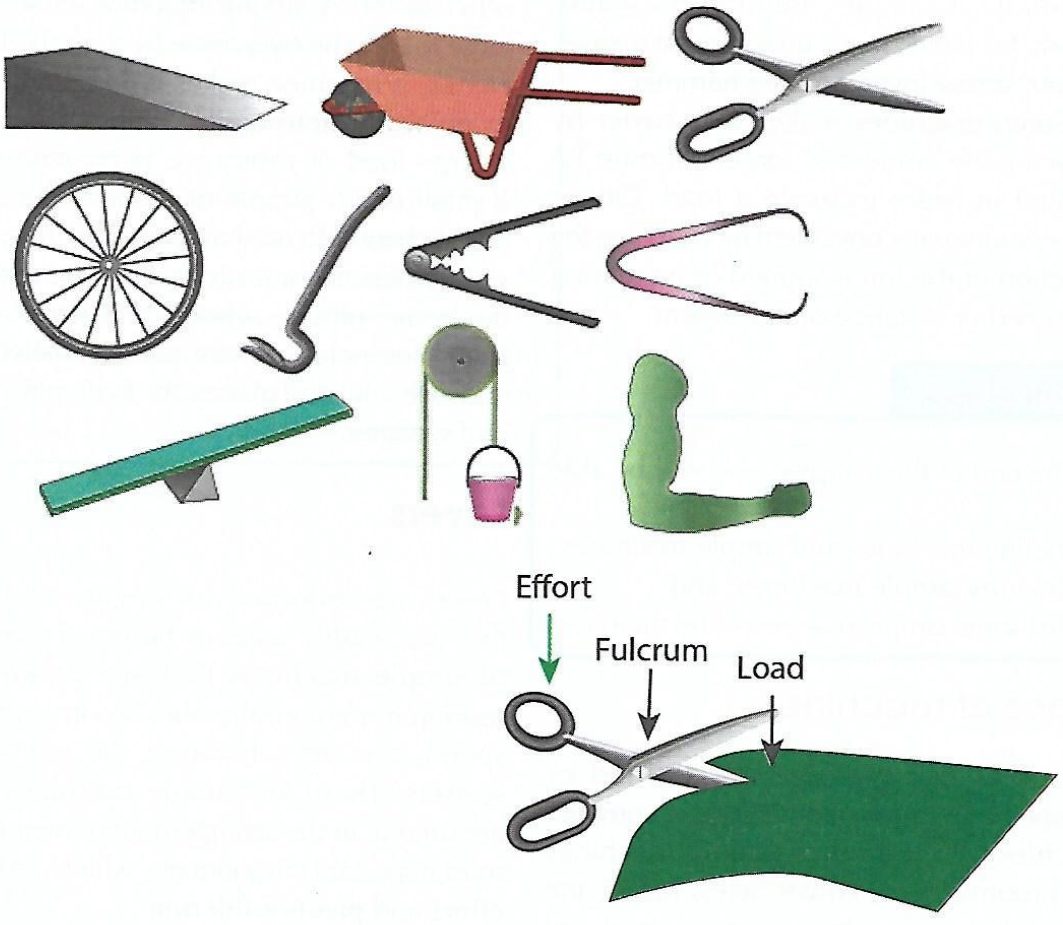


Fig. 19.1 A sample of simple machines

Table 19.1 Uses and maintenance of simple machines

S/N	Machine	Uses	Maintenance
1	Hoe	It is used in gardens and farms to weed grass or make heaps and ridges.	Wash and clean it when dirty especially after use.
2	Cutlass	This is used in cutting trees, bushes, and grass, at home or on the farm.	After use, it should be washed, wiped dry and filed to avoid being blunt.
3	Wheelbarrow	It is used in carrying loads, e.g. sand, domestic goods. Also, it is sometimes used in selling things in the market.	Wash thoroughly after use. Clean properly and keep dry. Lubricate the moving parts to reduce friction or rust.
4	Bottle opener	This is mainly used for opening bottle corks.	Keep in a dry, cool place when not in use. Also apply grease to prevent rust.
5	Knife	It is used mainly for cutting things like meat, vegetables, fruits, and bread.	Wash thoroughly and clean after use. Sharpen the blunt edges. Keep it in a dry and cool place.
6	Pliers	This is used in cutting materials, tightening of bolts and nuts, sometimes for breaking hard objects.	Always make sure it is clean and dry. Lubricate to reduce friction. Also, sharpen blunt cutting edges.

Activity · Identifying and arranging some devices into first, second and third class levers

Materials required

Charts showing different diagrams of simple machines, your science notebook, biro

Procedure (Individual work)

1 Identify different simple machines from the charts displayed before you.

2 Arrange the simple machines on the charts and complete the table as shown below.

Tool/Device	Lever arrangement	Lever class
Scissors	Fulcrum is between the hand and effort.	First class

Summary

1 A machine is any device that makes work easier and more convenient for us to do.
2 A simple machine enables a large load to be overcome by a small effort.
3 Load, effort and fulcrum are the important components in levers.
4 Simple machines or levers are grouped into three classes: first, second and third classes.
5 Machines are very useful for day-to-day activities; hence, they should be maintained.

Revision questions 19

1 Which of the following is not an example of simple machine?
   A Lever
   B Pulley
   C Bicycle
   D Wheel and axle
   E Wheel barrow
2 The arrangement of first class levers is _____.
   A load between screw and pivot
   B pivot between load and effort
   C effort between pivot and load
   D load between pivot and effort
   E none of the above
3 Simple machines make work _____.
   A harder
   B easier
   C longer
   D softer
   E bigger
4 The point where a lever rocks back and forth is the _____.
   A effort
   B load
   C work
   D fulcrum
   E joint
5 The following except one are examples of third class levers. _____
   A Sugar tong
   B Nutcracker
   C Human forearms
   D Fishing hook
   E None of the above
6 a) Define simple machines.
   b) Give four examples of simple machines.
7 a) What is a lever?
   b) Describe the three classes of lever.
8 a) List five (5) simple machines.
   b) Mention the uses and maintenance of the simple machines listed above.

Answers to objective revision questions

Chapter 1

1	B
2	B
3	A
4	A
5	C
6	D

Chapter 2

1	D
2	A
3	C
4	A
5	C
6	B

Chapter 3

1	A
2	C
3	E
4	A
5	A

Chapter 4

1	E
2	C
3	A
4	C
5	D
6	B

Chapter 5

1	A
2	B
3	A
4	E

Chapter 6

1	C
2	D
3	C
4	E
5	D
6	A

Chapter 7

1	E
2	A
3	C
4	A
5	B

Chapter 8

1	E
2	D
3	A
4	E

Chapter 9

1	C
2	D
3	A
4	B
5	E

Chapter 10

1	B
2	A
3	B
4	C

Chapter 11

1	C
2	E
3	C
4	B
5	B
6	A
7	C

Chapter 12

1	A
2	B
3	C
4	A
5	B
6	B
7	A
8	A

Chapter 13

1	B
2	B
3	B
4	C
5	B
6	D

Chapter 14

1	B
2	A
3	D
4	D
5	C
6	D
7	D

Chapter 15

1	C
2	C
3	B
4	A
5	B
6	A
7	C
8	A
9	A
10	B
11	B

Chapter 16

1	D
2	D
3	B
4	A
5	C
6	C
7	A
8	C

Chapter 17

1	A
2	B
3	C
4	D
5	D

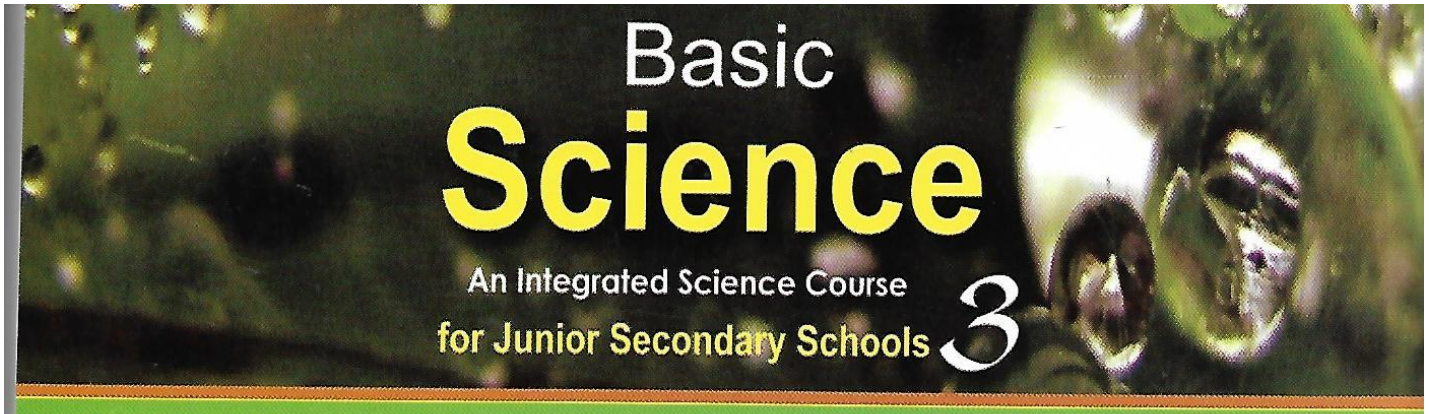
Chapter 18

1	C
2	A
3	A
4	B
5	B

Chapter 19

1	C
2	B
3	B
4	D
5	B

Index



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