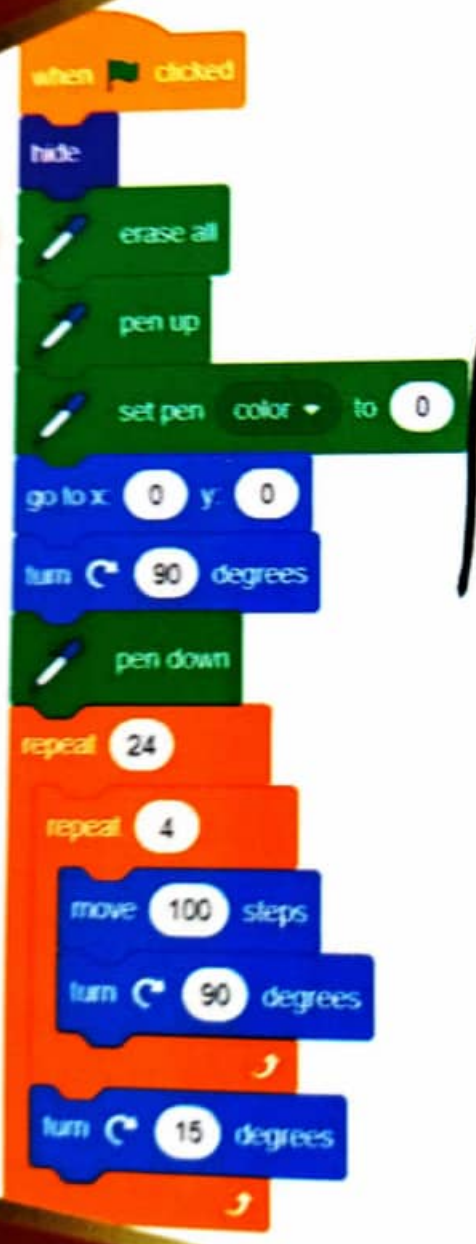
Science

Pupil's Book

Standard Five





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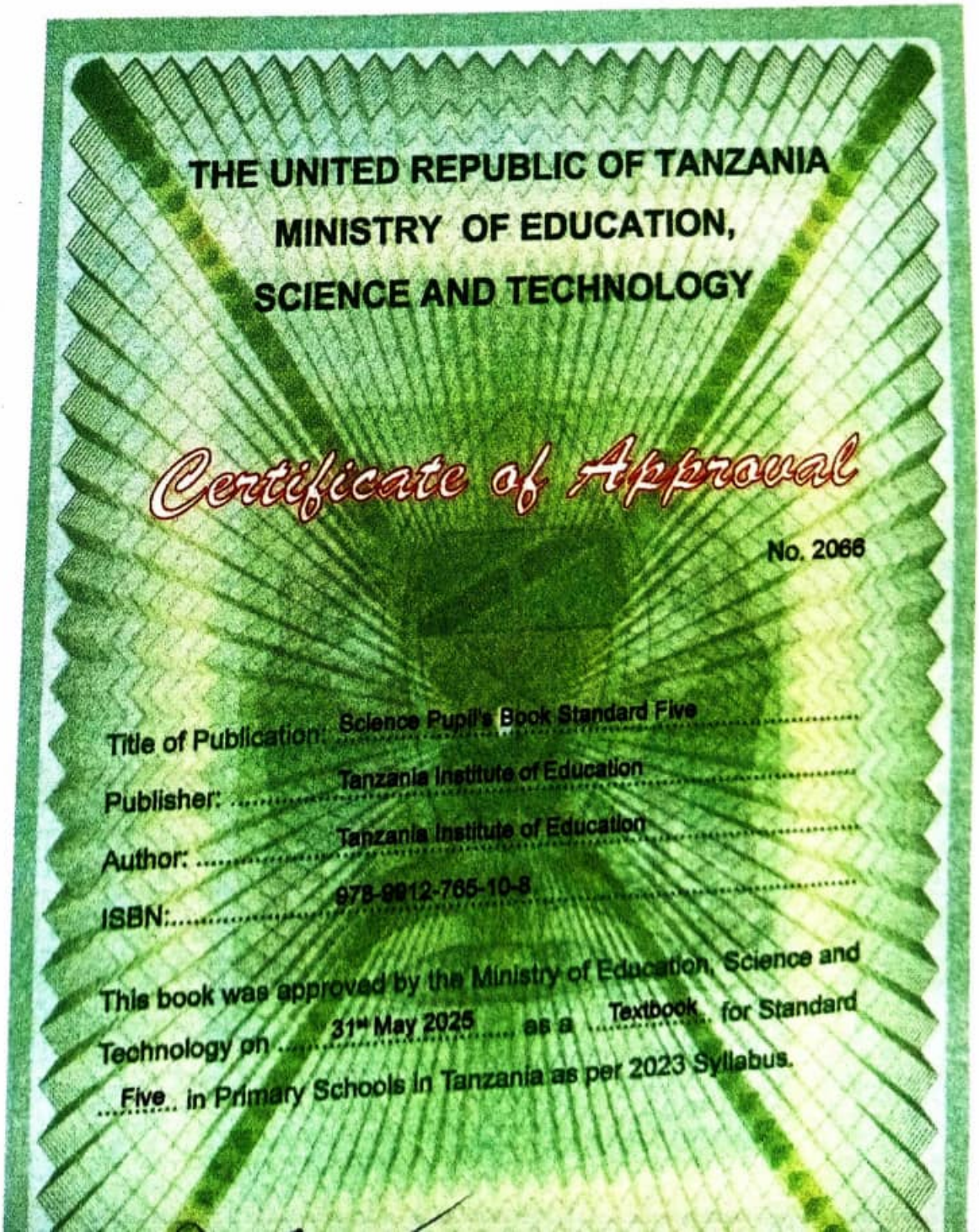

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Dr Aneth A. Komba
Director General
Tanzania Institute of Education

Introduction

The Science Pupil's Textbook Standard Five has been prepared in line with the 2023 Science Syllabus for Primary Schools Standard III–VI, issued by the Ministry of Education, Science and Technology. Some content in this book has been adapted from Science and Technology for Standards Five and Six textbooks, published in 2018 in accordance with the 2016 curriculum and syllabus.

This textbook has five chapters, namely; Digestive system, Growth and development in plants and animals, Reproductive system, Magnetism and Computer coding. The content in this book has been presented through text, activities, experiments, exercises and illustrations. This has been done to enable you to develop the required competencies in each chapter. Each chapter has exercises to enable you assess your understanding of the respective content. Thus, you are required to do all activities, experiments, questions and exercises on your own or in collaboration with your peers. Moreover, consult your teachers, parents or guardians when searching for information from the library, the internet and other sources.

Additional learning resources are available in TIE e-Library at *https://ol.tie.go.tz* or *ol.tie.go.tz*



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Chapter One

Digestive system

Introduction

The digestive system is essential for the health and well-being of the body. In this chapter, you will learn about the concept and parts of the digestive system in human beings. You will also learn about the functions of each part of the digestive system, as well as some disorders in the digestive system and how to prevent them. The competencies developed will enable you to describe how the body obtains nutrients from food. You will also analyse the importance of maintaining a well-functioning digestive system.



Think The importance of the digestive system to human beings.

Concept of the digestive system

Activity 1

Search for information about the importance of the digestive system in maintaining the well-being of the human body from the library or reliable online resources.

Digestion is the biological process by which food is broken down into smaller particles which provide nutrients that can be absorbed by the body. These nutrients are used by the body for growth, repair, production of energy and protection against diseases. For the body to obtain these nutrients, food must be broken down into small particles that can be absorbed by the body. Digestion takes place within the digestive system.

The digestive system is a collection of organs that are responsible for breaking down food into small particles that can be absorbed and used

It is important to eat a balanced diet, drink sufficient amount of water and avoid foods high in fat or sugar to keep the digestive system healthy. Apart from human beings, other animals also have digestive systems suited to the type of food they eat.

Exercise 1

1. Explain the meaning of digestion.
2. Why is the digestion process important to human beings?
3. What is the relationship between the digestive system and the energy used by the body for daily activities?
4. Why does eating a balanced diet contribute to the well-functioning of the human digestive system?

Parts of the digestive system

Activity 2

Search for information about parts of the digestive system and their functions in the human body from the library or reliable online resources.

The digestive system consists of various organs that work together to facilitate the breakdown of food. The human digestive system begins in the mouth and ends at the anus. It includes the digestive tract, organs and glands that work together. The main parts of the digestive tract are the mouth cavity, pharynx, oesophagus, stomach, small intestine and large intestine, as shown in the Figure. The small intestine consists of the duodenum and ileum, while the large intestine includes the colon, rectum and anus. The organs that make up the digestive system include the tongue, liver, pancreas and gallbladder. The digestive system is also composed of salivary and gastric or stomach glands. Other organs of the digestive system such as the liver, pancreas and gallbladder, also contain glands that produce digestive enzymes which break down food.

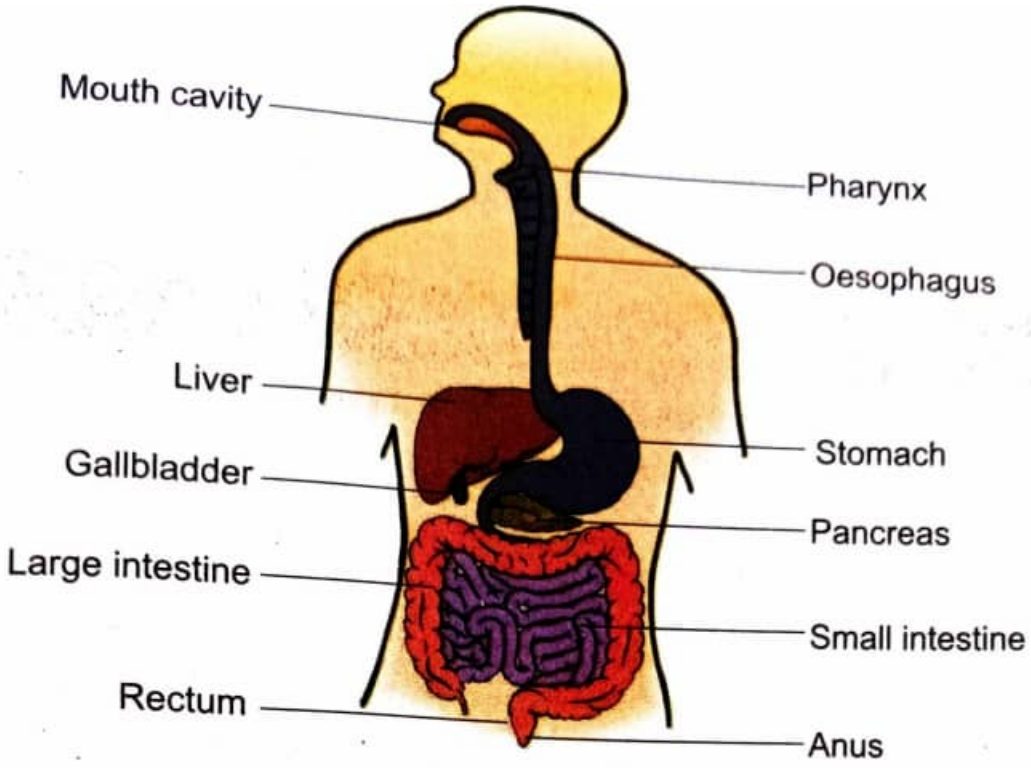


Figure: *The digestive system*

Mouth cavity

The digestion process starts in the mouth cavity, where food is chewed using teeth and mixed with saliva. Foods rich in starch begin digestion in the mouth cavity and are thereafter transported through the oesophagus into the stomach.

Pharynx

The pharynx is a part of the digestive system located between the mouth and the oesophagus. Its function is to direct food from the mouth cavity to the oesophagus. A flap called the epiglottis prevents food from entering the airway by closing the windpipe during swallowing.

Oesophagus

The oesophagus is a muscular tube that connects the pharynx to the upper part of the stomach. Food moves through the oesophagus in a series of muscle contractions and relaxation in the walls. This movement helps to move food to the stomach.

Stomach

Upon reaching the stomach, food is broken down with the help of acid and digestive enzymes, which are produced there. The acid and enzymes digest proteins, starch and fats, converting them into a semi-liquid paste

called chyme. The chyme then moves to the small intestine for further digestion and absorption.

Small intestine

This part is located between the stomach and the large intestine. The first part of the small intestine where digestion occurs is called the duodenum. The duodenum receives enzymes from the pancreas and bile from the gall bladder which breaks down food. The main foods broken down in this part are fats, proteins and carbohydrates.

The ileum is the last part of the small intestine where the digestion process is completed. When partially digested food reaches the ileum, it stimulates the intestinal walls to release digestive enzymes. These enzymes complete the breakdown of proteins, carbohydrates and fats. The small intestine then absorbs nutrients from digested food and allows the body to utilize them for various bodily functions.

Large intestine

The large intestine is located after the small intestine. Its function is to absorb water and minerals from undigested food into the body. It also uses the remaining undigested food to form faeces which are then eliminated from the body. Also, it contains beneficial bacteria that help to break down food remains and produce certain vitamins. The colon, rectum and anus are parts of the large intestine.

Colon

This is the first part of the large intestine responsible for reabsorption of water from the digested food into the body. It is also the section where some nutrients, such as vitamins, are produced by bacteria found in this part. The colon also serves to store faeces before they are eliminated from the body.

Rectum

The rectum is the second part of the large intestine, where faeces are stored temporarily before being expelled from the body during defecation. It controls the removal of the faeces from the body.

Anus

This is the last section of the digestive system that is responsible for allowing faeces to pass to the outside of the body. Faeces are the remains

of food that were not digested and absorbed by the digestive system.

Activity 3

(a) Watch an online video showing how digestion of food occurs, then write a brief explanation on the digestion process in the human body.

(b) Observe the displayed digestive system of a mouse, then answer the questions that follow:

Questions

1. Identify the organs of the digestive system of the mouse that are also found in humans. State the function of each organ.
2. Describe four (4) parts of the digestive tract of the mouse that are also found in humans. State the function of each part.
3. Which glands observed in the digestive system of the mouse are also found in humans?

Exercise 2

1. Explain the role of the mouth in the digestion process.
2. Describe the functions of the stomach and small intestine in the process of food digestion.
3. Write a short story describing the process of food digestion through the digestive system, explaining the changes that occur at each stage.
4. Why is it important to chew food thoroughly before swallowing?
5. Explain the importance of saliva in the digestion process.

Disorders in the digestive system

Activity 4

Search for information about the disorders in the digestive system from the library or online sources.

The digestive system can be affected by ... its efficiency in food digestion or nutrient absorption. A digestive system disorder is a condition that affects the normal functioning of the digestive tract, making it difficult for the body to properly digest and absorb food. These disorders can be congenital, inherited or caused by lifestyle factors and poor nutrition. Some of the disorders in the digestive system include:

Constipation

This is a disorder of the digestive system that causes a person to have difficulty in passing faeces or to have hard, dry faeces. This problem can be caused by eating foods with low fibre content, not drinking enough water, and lack of physical exercises. In addition, health issues such as poor functioning of the large intestine can also cause constipation.

Prevention methods

Constipation can be prevented by eating foods rich in fibre such as fruits and vegetables, drinking enough water and carrying out physical exercises regularly.

Bloating

This is a condition where the stomach feels full, tight or swollen, often due to a building up of gas in the stomach. It can result from overeating, eating too fast, food intolerance or consuming gas-producing foods. Symptoms of bloating include stomach pain, a feeling of fullness and burping. Sometimes, the gas can have a strong, unpleasant odour.

Prevention methods

To prevent bloating, it is important to eat food in moderate amounts and chew it slowly to reduce the amount of swallowed air. Also, drink enough water to aid digestion in the stomach. Limit intake of gas-producing foods such as beans and carbonated beverages. Eating fibre-rich fruits and vegetables also prevent bloating.

Heartburn

This is a condition that occurs when acid from the stomach rises into the oesophagus, causing pain or a burning sensation in the throat. Symptoms of heartburn include a burning feeling in the chest, frequent burping and

These foods take longer to be digested and can increase stomach acid production. Another cause of heartburn is eating large amounts of acidic foods, such as lemons and limes. Beverages like soda, coffee and alcohol can also cause heartburn. Eating just before sleeping can also lead to heartburn.

Prevention methods

Heartburn can be prevented by eating slowly, allowing the digestive process to occur effectively. Also, eating smaller amounts of food more frequently and avoiding foods that cause heartburn. High intake of acidic foods, such as oranges, lime, tangerine, potatoes, beans and tomatoes, and foods with a lot of spices or fat should be avoided. After eating, rest for two to three hours before lying down or going to bed. Additionally, exercise or strenuous activity shortly after eating should be avoided. If heartburn persists, it is advisable to seek medical advice.

Stomach ulcers

This is a condition resulting from erosion of the lining of the stomach wall. Stomach ulcers can be caused by eating foods that are high in acid or having a bacterial infection that erodes the walls of the stomach lining. Sometimes, stomach ulcers can be caused by prolonged periods of hunger. When the acid and enzymes in the stomach come into contact with the eroded walls, they cause sores. This is because acid burns the stomach wall, creating ulcers or sores. Stomach ulcers cause severe pain in the abdomen. When the ulcers are large, they may cause heavy bleeding. Symptoms of stomach ulcers include intense pain, such as a burning sensation in the stomach. Other symptoms include vomiting blood and passing stool mixed with blood.

Prevention methods

Stomach ulcers can be prevented by eating at regular intervals and reducing the intake of highly acidic foods. Additionally, avoiding smoking and alcohol can help to prevent ulcers.

Proper eating habits

Maintaining proper eating habits is important for good health and for preventing problems in the digestive system. A healthy diet should consist of balanced meals that include all essential nutrients in appropriate

proportions. These essential nutrients include carbohydrates, proteins, fats, vitamins, minerals, and water. It is also important to have regular mealtimes and reduce the intake of unhealthy foods and snacks that lack essential nutrients.

It is advisable to consume whole grains and drink sufficient amounts of water to ensure proper functioning of the digestive system. Drinking water half an hour before and after a meal is important for effective digestion and nutrient absorption. You can improve the body health and protect from disorders in the digestive system by following these habits.

Activity 5

Conduct a thorough search for proper eating habits from various sources of information, such as the internet, books, reliable educational videos, and interviews.

Revision exercise

Section A: Choose the correct answer.

1. In which of the following parts of the digestive system does absorption of the nutrients take place?
   (a) Stomach
   (b) Small intestine
   (c) Oesophagus
   (d) Large intestine
2. Which of the following parts of the digestive system prevents food from entering the windpipe?
   (a) Stomach
   (b) Colon
   (c) Epiglottis
   (d) Oesophagus
3. In which of the following parts of the digestive system does the preparation of faeces for elimination from the body take place?

(a) Anus
(b) Large intestine
(c) Stomach
(d) Small intestine

4. What is the name of the part of the digestive system where the breakdown of food begins?
   (a) Mouth cavity
   (b) Oesophagus
   (c) Stomach
   (d) Small intestine

Section B: Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

5. Anyone can experience problems in the digestive system if dietary guidelines are not followed properly.
6. Constipation is caused by consuming large amounts of fatty foods
7. A balanced diet cannot harm the digestive system.
8. The only cause of stomach ulcers is eating acidic foods.
9. Stomach ulcers result in difficulties in producing or passing of hard and dry stool.

Section C: Short answer questions.

10. How does eating a balanced diet help to prevent disorders in the digestive system?
11. What are the causes of constipation?
12. What should be done to avoid bloating? Give two points.
13. Suggest three (3) ways to prevent heartburn.
14. Name two (2) eating habits that can cause problems in the digestive system.
15. Explain the importance of having a specific meal schedule and avoiding skipping meals.
16. Explain the effects of eating too much of fatty foods on the digestive system.

Vocabulary	
Absorption	the process by which digested food molecules pass into the blood or lymph
Chyme	semi-fluid mixture of partially digested food, water, stomach acid (hydrochloric) and digestive enzymes formed in the stomach, which passes into small intestine for further digestion and nutrient absorption
Digestive Enzymes	chemicals that aid in the digestion of food in the digestive system
Gland	an organ in the human or animal body that secretes hormones for specific body functions
Nutrients	substances in food that provide energy and materials for growth, repair, and maintenance

Chapter Two

Growth and development in plants and animals

Introduction

Growth is among the characteristics of living things. Plants and animals pass through different stages of growth before reaching adult stage. In this chapter, you will learn about the concept of growth and development in plants and animals. You will also learn about the essential requirements for plant and animal growth and development. Additionally, you will explore the different stages of plant and human growth and development, along with the changes that occur at each stage. The competencies developed will enable you to describe the growth and development stages in plants and animals and properly care for them. You will also be able to appreciate and manage your physical and emotional changes that occur during growth and development.



Think Essential requirements for plant and animal growth.

Concept of plant and animal growth and development

Activity 1

Search for information about the concept of growth in plants and animals from the library or reliable online resources.

Growth in living things is the increase in body size (height and width) and weight. It is an irreversible change that occurs in plants and animals as a result of cell division, cell elongation and cell differentiation. Plant growth involves the increase in height of a plant, which occurs at the tips of roots and shoots. Also, plants grow by increasing the width or thickness of the plant stem. Like plants, animals also grow by increasing in height and weight. Plants and animals grow through different stages. The changes

through which plants and animals undergo throughout their life cycle are called development. In plants, development involves germination, the occurrence of new leaves, roots and other parts such as flowers, and seeds or fruits. Development in animals includes changes in body structure and function. Examples of development in animals include a caterpillar becoming a butterfly and a baby growing into an adult. Development in plants and animals involves physical and behavioral changes.

Growth and development in plants

Plant growth and development refers to the series of changes a plant undergoes throughout its life cycle. Plant growth and development involves different stages. Each stage of development plays a vital role and has distinct features. These stages include seed germination, seedling, vegetative stage, reproduction stage, and senescence. See Figure 1.



Figure 1: *Stages of plant growth and development*

(a) Seed germination

Seed germination is the process by which a seed develops into a new plant. A seed germinates when it has matured and has received

root of the plant. Another part called the plumule also emerge, it is the embryonic shoot of the plant. It begins to grow upwards, eventually forming the stem and leaves of the plant. During this stage, food stored in the seed is used as a source of energy for germination.

(b) Seedling stage

Seedling is the stage that follows after seed germination. At this stage, the seedling develops few leaves. Its roots continue to grow into the soil to absorb water and nutrients. During this stage food storage is minimal, hence the seedling begins to manufacture its own food through photosynthesis.

(c) Vegetative stage

In this stage, the plant continues to grow and develops more leaves. It increases the production of its own food through photosynthesis. The roots, stems and branches continue to grow and become strong.

(d) Reproductive stage

This is the stage whereby the plant matures and develops from the vegetative stage to the reproductive stage. During this stage, flowering plants begin to form buds, which gradually develop into flowers that contain reproductive structures. Flowers facilitate pollination and fertilisation, leading to the formation of fruits or seeds. Fruits contain seeds for growing new plants. Plants such as watermelon, orange, tomato, avocado, maize and bean produce seed-bearing fruits. Some plants do not form flowers but produce seeds, which may germinate into new plants.

(e) Senescence stage

Senescence is the natural process of aging in plants, during which cell division stops making the tissues, or whole organs gradually lose their function and eventually die. Senescence of different plant parts such as leaves and flowers occurs throughout the plant life, although its rate increases as the plant gets older or after producing seeds. However, unlike in annual plants, in perennial plants senescence occurs in specific organs like leaves and flowers, allowing the plant to survive and grow for many years.

Experiment 1: *Investigating the stages of plant growth and development*

Aim: To identify the stages of plant growth and development

Materials: Bean or cowpea seeds, containers with holes at the bottom, fertile soil, water, a pen and a notebook

Procedure

1. Fill a container with fertile soil.
2. Sow one or two seeds in the soil and water the soil.
3. Place the container containing sowed seeds in a spot with sunlight.
4. Water it daily.
5. Observe and record changes daily. Use the following table to track your plants' growth.

Day	Changes that occur
1-5	
6-10	
11-15	
16-20	
21+	

Results: Write down the observations from your experiment.

Conclusion: Summarise what you have learnt from the experiment.

Essential requirements for plant growth

Plants grow well when they get their essential requirements. Figure 2, shows some of the essential requirements for plant growth.

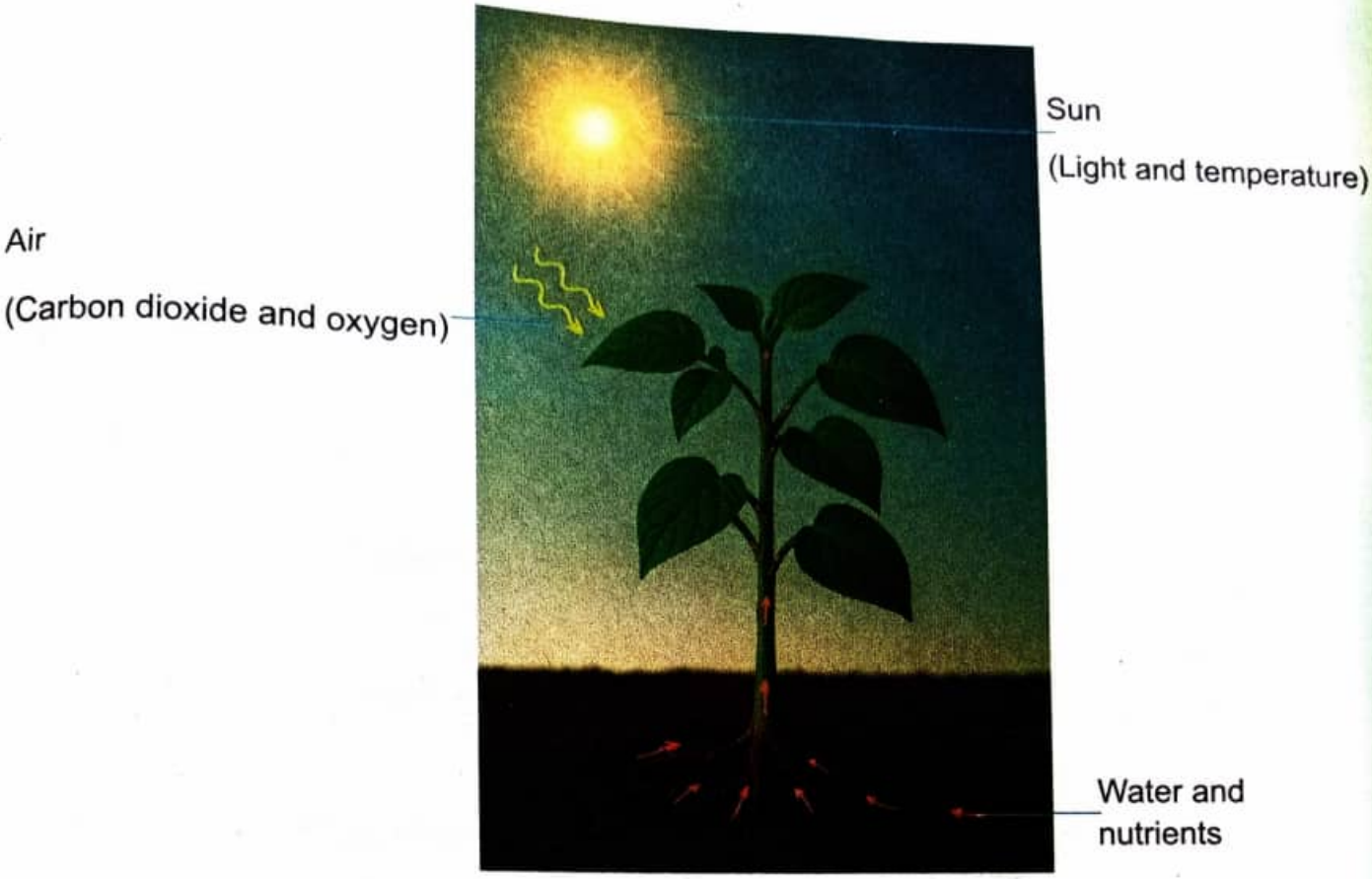


Figure 2: *Essential requirements for plant growth*

Plant growth depends on the availability of essential requirements including sunlight, air, water, nutrients, and optimum temperature to grow well. The absence of any of these requirements can affect plant growth. For example, a plant may receive enough sunlight, but if it lacks water or sufficient nutrients, its growth will be affected. The essential requirements for plant growth are as follows:

Sunlight

Sunlight helps plants to grow by providing both light and heat energy. Plants use light energy to make their own food. Plant leaves contain a green pigment called chlorophyll, that absorbs sunlight and enables plants to make their own food through photosynthesis. Without adequate light, plants cannot grow well due to a lack of food.

Air

Plants use carbon dioxide gas to make their own food through the photosynthesis process. Carbon dioxide gas enters the plant through small openings on the leaves called stomata. The stomata open to allow carbon dioxide gas to enter, enabling photosynthesis to take place. Insufficient

amount of carbon dioxide reduces the ability of the plant ... its own food. Plants also need oxygen for their growth. Oxygen helps to burn food to produce the energy required for plant growth.

Experiment 2: *Investigating the importance of air in plant growth*

Aim: To prove that air is important for plant growth

Materials: Bean or amaranth seeds, two containers with fertile soil, water, a plastic cover or glass, a ruler, a notebook and a pen

Procedure

1. Sow two seeds in two separate containers, labelled A and B.
2. Water both containers daily.
3. Place the first container (A) in an area with sunlight and sufficient air as seen in Figure 3.
4. Cover the second container (B) tightly with plastic or glass as seen in Figure 3 and place in an area with sunlight.



Figure 3: *An experiment to investigate the importance of air in plant growth*

5. Observe and measure the height of the plants in both containers daily for fourteen days.
6. Compare the growth of the plants in the two containers.

Water

Water is important for the survival of plants. Water supports proper growth and plays an important role in photosynthesis. Plants absorb water from the soil through root hairs by osmosis. The water then moves through the root and the stem until it reaches the leaves. Water helps the plant to:

(a) Dissolve soil nutrients, making it easier for plants to absorb them. These nutrients support plant growth and development.

(b) Transport food from the leaves to other parts of the plant.

(c) Regulate the temperature of the plant.

(d) Keep the plant firm when there is enough water inside the cells.

(e) Help plants produce their own food during the photosynthesis process.

Nutrients

Plants need various nutrients, such as minerals and vitamins for growth. Nutrients like nitrogen, phosphorus and potassium are essential for plant growth and development. These nutrients are absorbed through the plant roots. Plants obtain nutrients from the soil or any other medium where they are grown. Root hairs absorb water and nutrients through osmosis. Once absorbed, the nutrients are transported through the main root, the stem and finally reach different parts of the plant.

Temperature

Plants need an optimum temperature for growth. Temperature is essential for seed germination and photosynthesis. However, if the temperature is too high, plants dry out due to excessive water loss. Very low temperatures can prevent plants from making their own food, seeds from germinating, and can even cause the plant death.

Experiment 3: *Investigating the importance of water and sunlight in plant growth*

Aim: To determine the importance of water and sunlight in plant growth

Materials: Bean seedlings planted in three containers, labelled A, B and C, each with holes at the bottom, water and boxes that prevent light from passing

Procedure

1. Place the seedling planted in a container (A) in a spot with sunlight and water it. See figure 4.
2. Place the seedling planted in container (B) in a box that does not allow light to pass through and water it.
3. Place the seedling planted in a container (C) in a box that does not allow light to pass through without watering it.

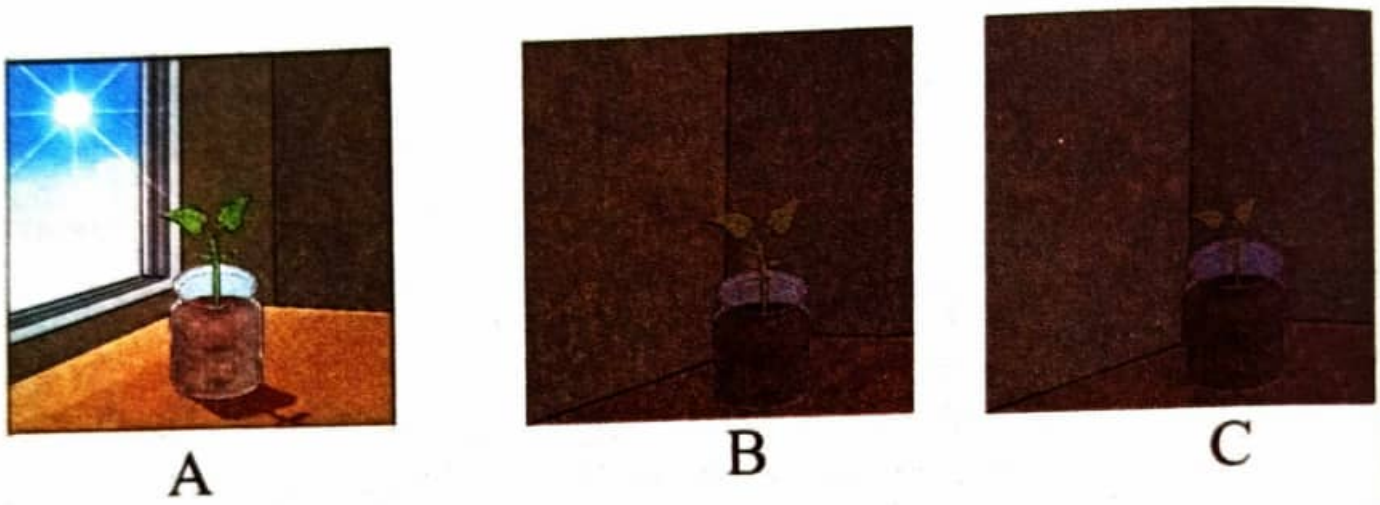


Figure 4: *An experiment to investigate the importance of water and sunlight for plant growth*

4. Observe the growth of plants for two weeks and record the results.

Results: With reasons, describe what happened to each plant.

Conclusion: Write the conclusion of your experiment.

Exercise 1

1. Why is sunlight important for plant growth?
2. Explain three (3) essential requirements for plant growth.
3. Suppose plants in your area show signs of stunted growth. What factors would you examine to determine the cause of the problem?
4. How can low levels of carbon dioxide in the atmosphere affect plant growth?

Growth in animals

Activity 2

Watch an online video that shows growth in animals. Then, write a brief description of animal growth.

Growth and development in animals depends on the availability of the factors such as weather and climatic conditions, nutrition and availability of water.

Nutrition

Animals require a balanced diet containing all essential nutrients. Lack of nutrients, such as proteins, carbohydrates, fats, vitamins, or minerals in their food can result in poor growth and development.

Environmental condition

Animals are affected by their surroundings. Unfavourable environmental conditions such as heat, cold, or poor air quality and space can stress animals and reduce their growth rate. Animals need optimum temperature to make the body function properly. Also, animals respond to optimum amount of light in their environment. In some species, proper lighting stimulates appetite and hormone production, improving growth and productivity.

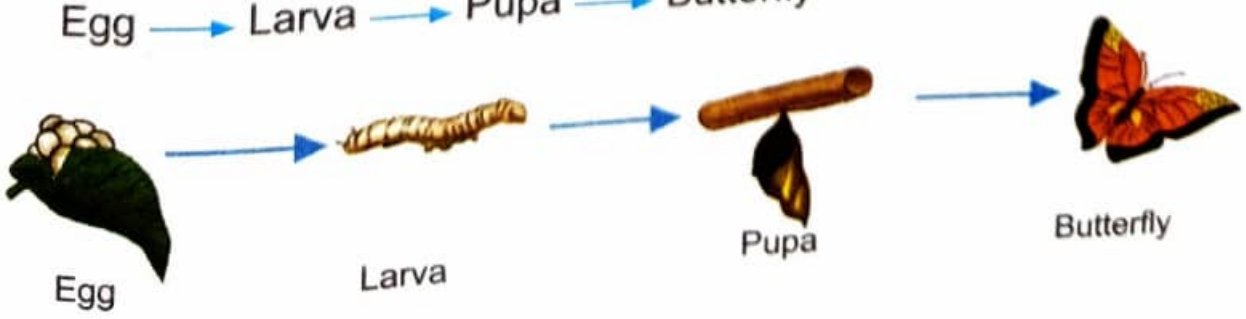
Water availability

Animals require constant access to clean and safe water. Water is essential for digestion, control of the body temperature, and transportation of nutrients, all of which are important for growth.

The following are examples of changes during an animal's growth and development:

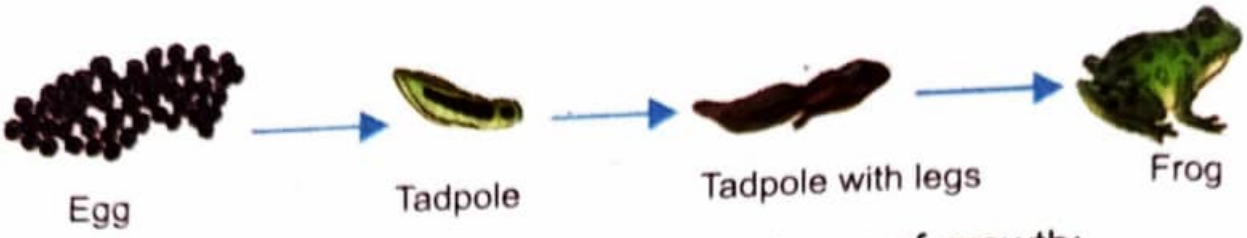
(a) Butterflies go through different developmental stages of growth namely:

Egg → Larva → Pupa → Butterfly



(b) Frogs go through the following stages of growth:

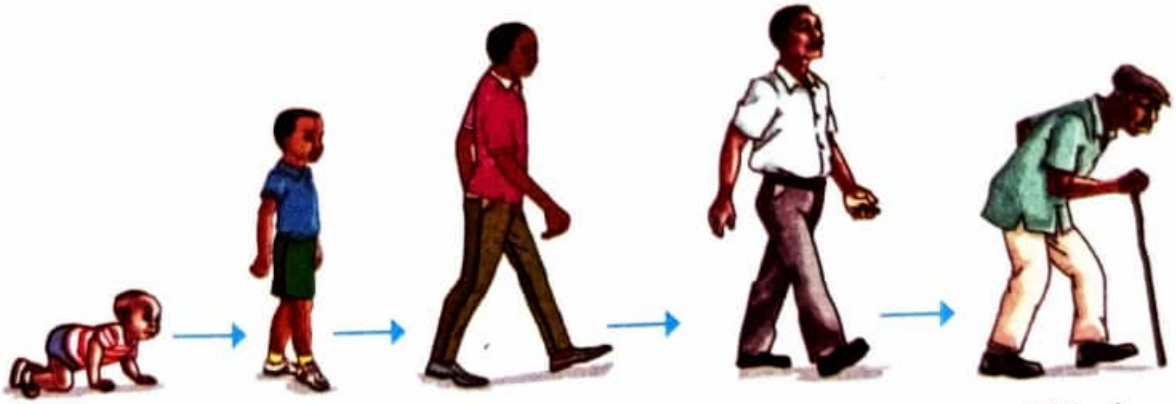
Eggs → Tadpole → Tadpole with legs → Frog



Egg Tadpole Tadpole with legs Frog

(c) Human passes through the following stages of growth:

Infancy → Childhood → Adolescence → Adulthood → Elderly



Infancy Childhood Adolescence Adulthood Elderly

Experiment 4: *Investigating the stages of growth in frog*

Aim: To identify the stages of growth in frog

Materials: A plastic container for storing eggs/tadpoles, a notebook, a pen and food for tadpoles (plant debris or specialised food)

Procedure

1. Visit a pond or a stagnant water area and look for frog eggs or tadpoles.
2. Carefully collect some eggs or tadpoles and place them in a container filled with clean water.
3. Feed them daily, observe and record changes in every three days for four (4) weeks.
4. Write down the observed changes, such as the emergence of tadpoles and their changes into young frog.
5. Draw and label different stages of growth in frog, from egg to frog.

Results: Write down the results of the experiment.

Conclusion: Write the conclusion of the experiment.

Stages of human growth and development

Humans pass through different stages of growth and development, including infancy, childhood, adolescence, adulthood and old age (Elderly). Each stage has unique changes that contribute to overall growth and development in humans.

(a) Infancy

This is the first stage of growth and development of a human being. Infancy stage covers the range of a period from birth to two (2) years. This is the time when the baby is born and starts early learning. During this period, a baby is learning things like touch, movement and emotion. Eventually, the baby is able to hold their head up, sit down, crawl, roll, walk a few steps without support and develops milk teeth. By the time a baby reaches two years of age, they can run and climb up and down without support. Increasing memory and speech sounds are observed during this period. A baby can also show anger, happiness, sadness and fear. Also, a baby learns how to recognise people around them and those who take care of them.

(b) Childhood

The childhood period ranges from the age of 2 years to 13 years. During this period, a child increases in height and weight, hence, a lot of changes in the body occur. During this stage the milk teeth are replaced by permanent teeth. The child develops skills in climbing, jumping, riding, running, self-feeding, drawing and colouring. The child learns social roles like dressing, eating and bathing on their own. During this period, the development of a child's skills with the help of parents or guardians is very important. Interactions among children themselves and their parents or adults are also important. Children need to be provided with a balanced diet, a conducive environment for playing, proper health services, regular cleanliness, shelter and clothing.

(c) Adolescence

Adolescence is a transition stage between childhood and adulthood. It is during this stage that puberty occurs. Puberty is defined as the phase where a child's physical and sexual characteristics start to mature into adult features. A child also undergoes physical, mental

and emotional changes which are driven by hormones. Puberty usually starts between the ages of 12 to 13 years in boys and 11 to 12 years in girls, though it can vary due to genetic, nutritional and environmental factors.

Physical changes during puberty

Both boys and girls undergo various changes during puberty.

(a) *Physical changes during puberty in girls*

In girls, these changes are as shown in Figure 5.

Activity 3

Examine Figure 5, then identify the physical changes that occur in girls during puberty.



Figure 5: *Physical changes in girls during puberty*

Physical changes in girls during puberty include:

(i) Growth and enlargement of breasts.

(ii) Increased activity of sweat glands.

(iii) Increased vaginal discharge.

(iv) Growth of hair under the armpits and around the pubic area.

(v) Increase in height and weight.

(vi) Voice becoming softer.

(vii) Appearance of pimples/Acne on the face in some girls.

(viii) Widening of hips.

(ix) Maturation of eggs and the beginning of menstruation.

Menstrual cycle

Menstruation is a natural biological process of discharging blood mixed with mucus from the break down of lining of the uterus through the vagina. The onset of menstruation is a key sign of puberty in girls. Menstruation usually occurs once every month forming a part of the menstrual cycle in which one or more egg matures.

The menstrual cycle refers to the period from the first day of menstruation to the day before the next period. It usually lasts 28 days as shown in Figure 6. However, some women have cycles that range between 21 to 35 days.

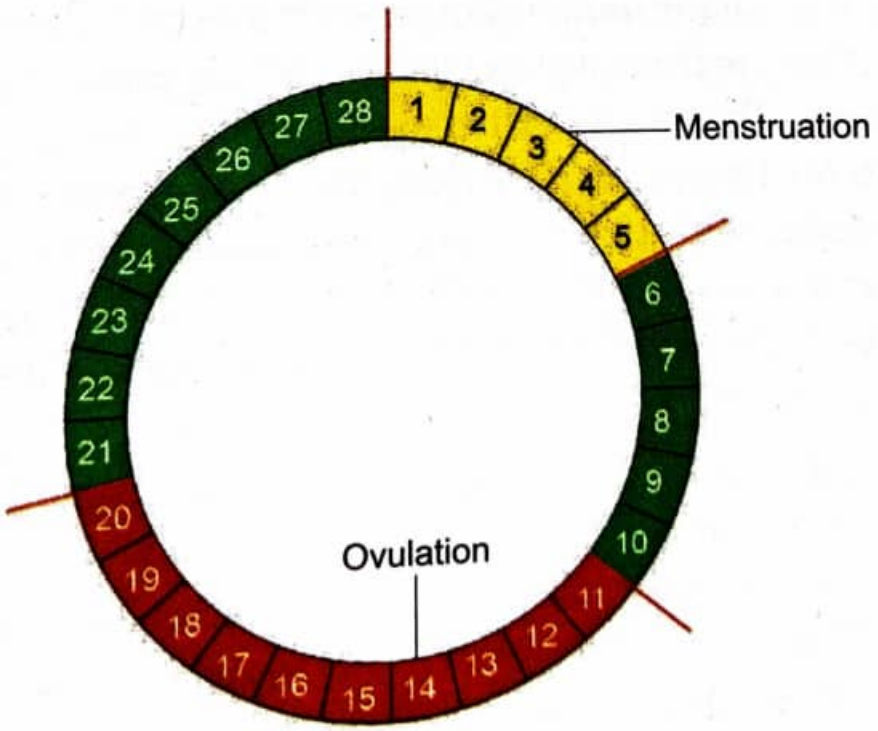


Figure 6: *Menstrual cycle*

Menstrual bleeding occurs when the uterine lining, which was built to prepare the uterus to receive a fertilised egg sheds off. The duration of menstruation varies from person to person. Typically, menstruation lasts between 3 to 5 days, though some women may have shorter periods, while others may experience longer periods of up to 7 days. During menstruation special materials called sanitary pads or sanitary napkins are used to absorb the blood that comes through the vagina. It is advised to use cotton-made pads. Pads are attached to the inside of underwear with adhesive strips or wings. It should be changed regularly typically after every 3 to 4 hours, in order to maintain hygiene and prevent effects that can rise like rashes or infections.

Activity 4

Draw a one-month menstrual cycle of 21, 28 and 32 days.

Disorders in the menstrual cycle

Sometimes, irregularities or disorders occur in the menstrual cycle. Some of these irregularities include discomfort during menstruation, lack of menstruation periods, severe menstrual pain, and prolonged or excessive bleeding during the menstruation period. These conditions may be caused by hormonal changes, stress, or underlying health issues.

Discomfort during menstruation: Some women experience discomfort during menstruation, making it difficult for them to perform their daily activities efficiently. The discomfort may last a few hours or several days, depending on the person. The symptoms may include depression, stomach pain, headaches, dizziness, rapid heartbeat, loss of appetite, and water retention in the feet, hands and fingers. To reduce the discomfort, it is advised to take physical exercises 3 to 5 times a week, eat a balanced diet and get enough sleep and rest.

Severe menstrual pain: Some women experience severe pain during menstruation. The pain may begin at puberty or later in life. The pain is often caused by uterine contractions due to hormonal imbalance. Other causes include infections in the cervix, uterine fibroids, and infections within the reproductive system. Any woman can experience pain during menstruation, however, those who smoke, consume alcohol, are overweight, or have experienced early puberty before age 11 are often at higher risk.

Excessive menstrual bleeding: Excessive menstrual bleeding occurs when a woman loses more blood than usual or has a longer menstruation period. This may result from a blood clotting disorder that prevents proper clotting of blood or hormonal imbalances that affect the menstrual cycle.

Activity 5

Read about safe menstruation from the library or reliable online materials. Write the findings on safe menstruation.

(b) *Physical changes during puberty in boys*

During puberty, boys develop physical characteristics as shown in Figure 7. The following changes occur:

(i) Enlargement of the testicles and penis.

(ii) Increased activity of sweat glands.

(iii) Growth of hair in the armpits, around the genitals, chest, abdomen, and beard (for some boys).

(iv) Increase in height and weight.

(v) Voice deepening.

(vi) Development of pimples/acne in the face.

(vii) Experiencing wet dreams.

(viii) Growth and broadening of muscles in the chest and arms.



Figure 7: Physical changes in boys during puberty

Exercise 2

1. (a) Explain the meaning of puberty.
   (b) Explain any five (5) physical changes that occur in girls and boys during puberty.
2. (a) Explain the meaning of menstruation?
   (b) Briefly describe what happens to a woman when she experiences menstruation.
3. Explain any two (2) disorders in the menstrual cycle.

Social changes during puberty

During puberty, boys and girls experience the following social changes:

(a) ***Self-awareness:*** During puberty, adolescents begin to explore and understand themselves better, recognising their identity as boys or girls and developing emotional connections.

(b) ***Desire for recognition:*** Adolescents at this stage seek recognition for their roles in society and the world. This desire is influenced by gender, peer groups, culture and family expectations.

(c) ***Desire for freedom:*** At this age, adolescents want to make their own decisions without interference from parents or guardians. This often leads to conflicts between them and their parents or guardians. While parents have a responsibility to guide their children, adolescents must also recognise the role of their parents and practise responsible freedom.

(d) ***Curiosity to learn new things:*** During puberty, boys and girls become curious and eager to try new experiences. This curiosity can sometimes lead to risky behaviours. For example, they may want to learn skills such as driving cars and riding motorcycles. Some may start smoking or using drugs. This urge can also lead to early sexual activity, which may result in unintended pregnancies or sexually transmitted infections like HIV.

Mental changes during puberty

During puberty, boys and girls experience mental changes that influence their behaviour. These changes include:

(a) Increased ability to understand reality in their surroundings.

(b) Improved problem-solving skills, even for complex and confusing issues.

(c) Enhanced ability to understand other people's thoughts and perspectives.

(d) Ignoring the consequences of some of their actions.

Changes in relationships during puberty

During puberty, boys and girls also show changes in their interactions with society, such as:

(a) ***Spending more time with friends than family:*** At this stage, adolescents feel that friends are more important than family. They believe that, peers understand them better because they share similar thoughts. As a result, they prefer spending more time with friends instead of family.

(b) ***Developing different opinions from adults:*** Adolescents start forming their own opinions and questioning what they see or hear. They feel confident in making decisions based on their beliefs. This can cause conflicts with parents, guardians, or older relatives. However, these disagreements are normal and do not harm family relationships.

(c) ***Desire to compete:*** Adolescents enjoy competing and comparing themselves with their peers in different aspects of life. They strive to be the best in everything they do, both at home and outside, and they want to be seen as role models.

Emotional changes during puberty

Adolescents experience significant emotional changes during puberty, including:

(a) ***Intense and fluctuating emotions:*** During puberty, emotions change quickly. A small event can make a teenager very happy, angry, or excited. They may cry or feel frustrated over minor issues. This is normal because their brain is still learning to manage emotions. If family and society do not understand this, conflicts may occur.

(b) ***Increased self-consciousness:*** Teenagers become highly aware of how they appear to others. They care about their physical appearance and fashion choices. They often compare their bodies to their peers

or celebrities. This is why many teenagers imitate the dressing styles, hairstyles, speaking and even walking styles of famous people they admire.

Ways to cope with changes during puberty

Activity 6

Observe the challenges that boys and girls face during puberty in your community. Then, suggest ways to manage them.

The changes during puberty in boys and girls cannot be avoided. However, following some strategies can help to reduce the challenges of these changes. To manage puberty effectively, the following are recommended:

Engaging in physical exercises: During puberty, adolescents grow quickly, gain weight, and develop more strength. Exercises improve blood circulation, keep the body active, reduce stress and promote happiness.

Getting sufficient sleep and eating a balanced diet: Sufficient sleep is essential for a growing body. It helps relieve tiredness and regulate energy levels. A balanced diet with essential nutrients supports healthy physical and mental development.

Avoiding alcohol, tobacco, and other substances: These substances affect the nervous system and impair decision-making abilities. Since puberty comes with challenges in making the right choices, avoiding substances and maintaining a healthy lifestyle is crucial. Respecting others also promotes good morals.

Sharing challenges with friends or family: Every adolescent experiences puberty differently. Sometimes, young people think they are the only ones facing these changes, leading to emotional distress, anxiety, and low self-esteem. Talking to others helps in getting the right guidance and support.

Seeking help from trusted individuals: Adolescents may face difficulties they cannot handle alone. It is important to seek advice from trusted people such as parents, guardians, teachers and other reliable adults.

Maintaining personal hygiene: Personal hygiene is crucial during puberty. This includes bathing regularly, washing clothes, ironing and keeping hair neat. For girls, changing sanitary pads or menstrual products on time during menstruation is essential for hygiene and comfort.

(d) Adulthood

Adulthood is a stage where physical growth slows down or stops, and the body focuses more on maintaining overall health rather than increasing in size. During this period, the rate of growth is minimal. This occurs in the age range of 18 - 65 years. This is the period when human beings mature with full physical and intellectual maturity. A person in this stage is self-confident and is more likely to make sound decisions and take responsibility. An adult person requires proper nutrition and should engage in regular physical exercises.

(e) Old age (Elderly)

Old age occurs normally at the age of 65 years and above. This is the period when the body systems and muscles become weak in comparison to those in the younger stages. Physical body strength decreases, body hair become grey and vision and hearing ability decrease. Skin loses elasticity and a person experiences a loss of memory. Elderly people require maintaining personal hygiene, eating a balanced diet and taking light physical exercises. Also, doing regular health checkups is important to maintain a good health status.

Revision exercise

Section A: Choose the correct answer

1. Which of the following are the essential requirements for plant growth?
   - (a) Sunlight, water, air, nutrients and appropriate temperature
   - (b) Water, sunlight, soil and appropriate temperature
   - (c) Air, soil, salt and seeds
   - (d) Sunlight, water, roots and air
2. The process by which plants make their own food using sunlight is called:
   - (a) Tropism
   - (b) Photosynthesis
   - (c) Production
   - (d) Chlorophyll

3. Extremely low temperatures can cause plan
   (a) Dry
   (b) Die
   (c) Transform
   (d) Lose all leaves
4. Puberty in boys usually begins between the ages of:
   (a) 8-10 years
   (b) 12-13 years
   (c) 16-18 years
   (d) 11-14 years
5. One of the changes that occurs in girls when they reach puberty is:
   (a) Voice deepening
   (b) Growing beard
   (c) Growing armpit hairs
   (d) Weight loss

Section B: Write **TRUE** for a correct sentence and **FALSE** for an incorrect sentence.

6. Plants need sunlight to make their own food.
7. Oxygen gas is used for photosynthesis in plants.
8. Men experience the menstrual cycle like women.
9. Puberty begins at the same age to both girls and boys.
10. Lack of essential nutrients can cause stunted growth in plants.

Section C: Short answer questions

11. Explain the meaning of growth in plants and animals.
12. Why can extreme heat affect the growth in plants?
13. Why do mature girls experience menstruation?
14. What effect does the shortage of carbon dioxide have on plant growth?
15. Explain four (4) effects of insufficient water on plant growth.

Vocabulary

Acne	small skin spots or pimples that appear during puberty due to increased oil production
Hormones	chemical substance produced by special group of cells to perform a specific function in the body
Life cycle	series of stages an organism goes through from birth to reproduction and death
Nutrient	substance that provides essential nourishment to living organisms, enabling growth, maintenance, and normal functioning
Pollination	the process by which pollen grains are transferred from the male part (anther) of a flower to the female part (stigma) of the same or another flower, enabling fertilization
Seedling	a young plant that emerges from a seed after germination.
Senescence	the process of aging or growing old in plants and animals
Stunted growth	a condition where a plant or an animal does not grow to its normal size because of lacking proper food, care, or is affected by diseases

Chapter Three

Reproductive system

Introduction

Reproduction is one of the characteristics of living organisms. Organisms reproduce to increase their population size. In this chapter, you will learn about the concept of the human reproductive system, the parts that make up the human reproductive system and their functions. Additionally, you will learn about some disorders in the human reproductive system. The competencies developed will enable you to care for your reproductive system and avoid challenges that may affect it.



Think Importance of caring for the reproductive system.

The concept of the reproductive system

Activity 1

Search for information about the meaning and importance of the reproductive system from the library or reliable online resources.

Reproduction is a biological process by which living organisms give rise to offspring. Reproduction ensures an increase in number of living things, and continuity of the species from one generation to another. There are two types of reproduction, namely, sexual and asexual reproduction. Sexual reproduction involves the fusion of reproductive cells (sperm and egg) to form an offspring. In humans and some plants, the reproductive cells are produced by two parents (male and female parents). However, in some flowering plants, only one parent can produce both reproductive cells. In contrast, asexual reproduction involves only one parent without the

need for fusion of the reproductive cells. Asexual reproduction produces offspring that are genetically identical to the parent.

Reproduction in humans biengs as in other organisms, occurs through the reproductive system. The reproductive system is a collection of organs and structures in living organisms responsible for the production of offspring. In humans beings, this system is divided into the male and female reproductive systems. Each system has specialised organs that work together to enable reproduction. Reproduction in humans is possible only after puberty. The reproduction in humans involves the production of reproductive or sex cells called gametes. The male gametes are called sperm and are produced in the testes, while the female gametes are called ova or eggs and are produced in the ovary.

Hormones, such as oestrogen, progesterone, and testosterone regulate the reproductive system. They control the growth of reproductive organs, the menstrual cycle, the production of gametes, and pregnancy.

The reproduction in human beings is important because it leads to an increase in population size. Therefore, it helps to ensure the continuity of generations. It allows them to pass on their traits and contribute to the ongoing existence of their kind. This is because reproduction involves the transfer of genetic material from one generation to the next.

Exercise 1

1. Why is reproduction important for the continuity of human generations?
2. Explain the meaning of reproduction.
3. Name any three (3) hormones that regulate the reproductive system in humans.
4. Differentiate between sexual and asexual reproduction. Give two points.

Activity 2

Watch an online video of the male and female reproductive systems. Then, write a brief description of all the organs that make up these systems and the function of each organ.

Male reproductive system

The male reproductive system consists of the external and internal structures. The external structures include the penis and testes. The internal structures consist of the sperm ducts, the urethra, the seminal vesicles, the prostate gland, and the Cowper's glands. Figure 1 shows different parts of the male reproductive system.

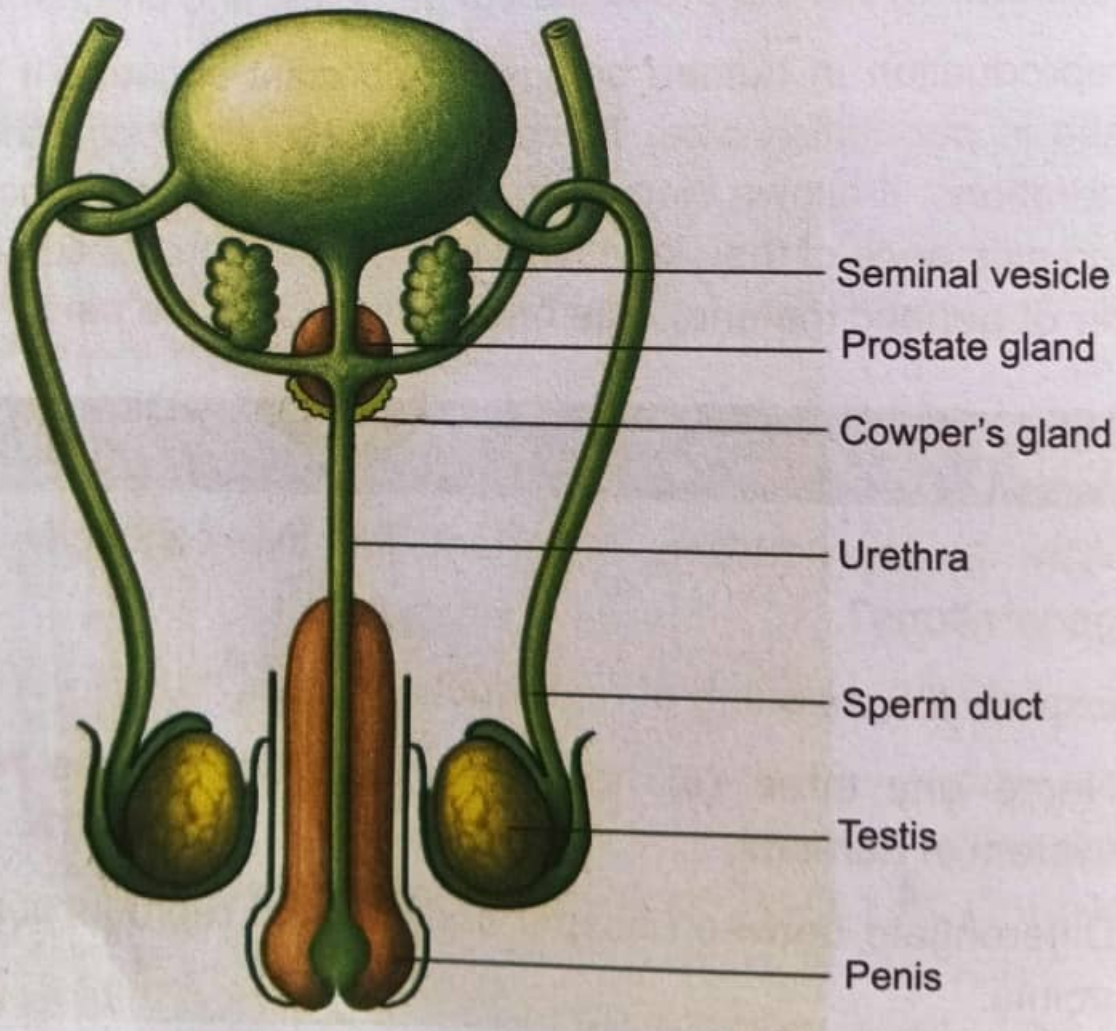


Figure 1: *Male reproductive system*

Table 1: *Parts of the male reproductive system and their functions*

No.	Structure	Description	Function(s)
1	Testes (singular: testis or testicle)	Are located inside a skin sac called the scrotum, which hangs behind the penis. Each male has two testes.	- To produce and store male gametes (sperms). - To produce the testosterone hormone, which is responsible for changes occurring during puberty such as beard growth, deepening of the voice, and increased muscle development.
2	Sperm ducts (Vasa deferentia)	Coiled tube connecting the testes and the urethra	To store and transport sperms from the testes to the urethra.
3	Penis	The external male reproductive organ located in front of the testes.	- To transport sperm into the female reproductive system. - To expel urine from the urinary bladder through the urethra.
4	Urethra	A narrow tube located inside the penis. It connects the urinary bladder and the penis.	- To tranport semen (sperm mixed with seminal fluid) out of the male body through the penis during ejaculation. - To transport urine from the urinary bladder out of the body.
5	Seminal vesicles	A pair of small glands located near the prostate gland, behind the urinary bladder.	To produce and secrete fluids that nourish the sperm and provide energy for the sperm to swim towards the egg.

No.	Structure	Description	Function(s)
6	Prostate gland	An organ located below the urinary bladder, surrounding the upper part of the urethra.	To produce a thick, slippery fluid that helps to protect and aid sperm movement.
7	Cowper's gland	A pea-sized gland located below the prostate gland	To produce a lubricating fluid that helps to neutralise acidity in the urethra, preparing it for the passage of sperms.

Female reproductive system

The female reproductive system is a specialised system responsible for production of eggs, secretion of hormones and provision of an environment for fertilisation and foetal development. This system consists of four main parts, namely the ovaries, fallopian tubes, uterus and vagina. Figure 2 shows different parts of the female reproductive system.

Additionally, the female reproductive system is regulated by oestrogen and progesterone hormones. These hormones control the menstrual cycle, pregnancy, and childbirth.

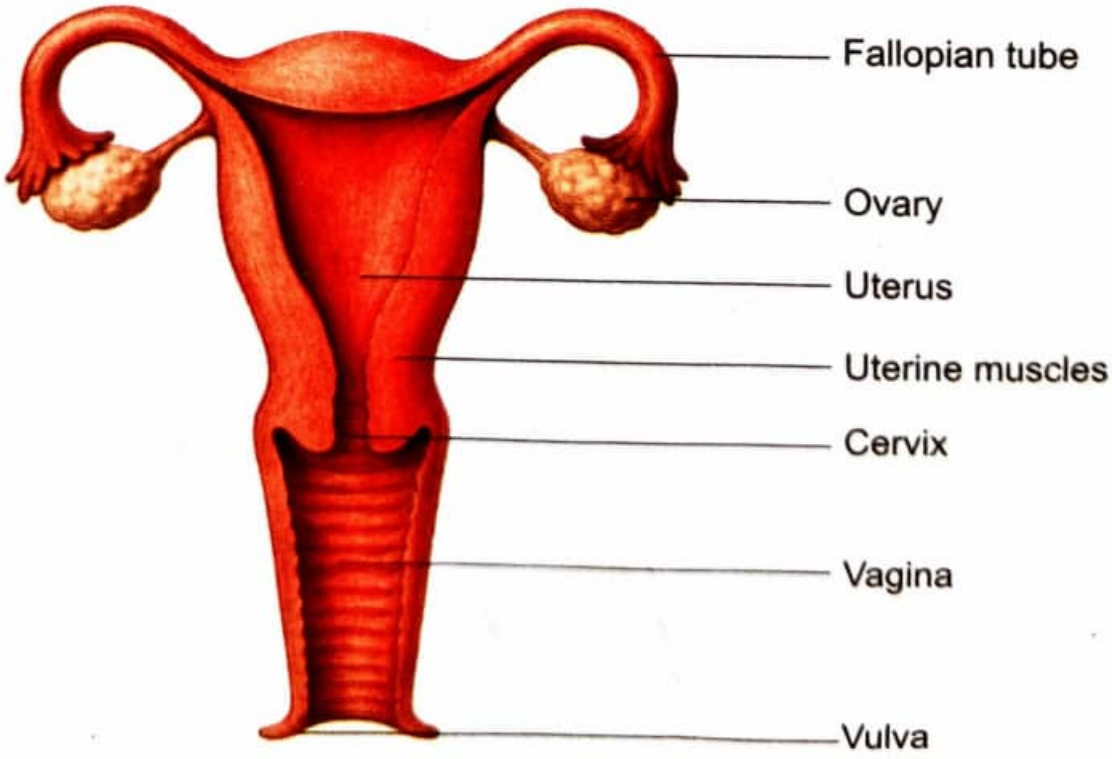


Figure 2: *Female reproductive system*

Table 2: *Parts of the female reproductive system and their functions*

No.	Structure	Description	Function(s)
1	**Ovaries**	These are a pair of reproductive glands on the left and right sides of the uterus.	- To produce and store female gametes (eggs). - To secrete essential hormones, such as oestrogen and progesterone, which help to regulate the menstrual cycle. The hormones also control various developmental changes that occur in women during puberty.
2	Fallopian tubes	A pair of tubes located on the left and right sides of the uterus connecting the ovaries to the uterus.	- To transport the egg from the ovaries to the uterus by capturing and directing the egg towards the uterus. - The place where fertilisation takes place.
3	Uterus (womb)	A muscular organ with thick muscular walls. During pregnancy, the foetus grows and develops inside the uterus until childbirth.	- Supports the implantation of the fertilised egg. - Forms the placenta that support foetal development during pregnancy.
4	Cervix	Is the lower part of the uterus that connects the uterus to the vagina.	- To regulate and allow the flow of blood during menstruation. - Allows passage of sperms into the uterus.

No.	Structure	Description	Function(s)
5	Vagina	The vagina is part of the female reproductive system located between the cervix and the external parts of the body.	- To receive sperm. - It serves as the passage for the baby during childbirth - It provides a route for menstrual blood to pass out of the body. - It protects other reproductive organs from infections by maintaining the acidic environment that prevents harmful pathogens.

Activity 3

Search for information about the parts of the human reproductive systems from the library or reliable online resources.

Exercise 2

1. What is the function of the reproductive system in humans?
2. Name any two (2) reproductive organs found in: (a) males (b) females
3. State any two (2) functions of each of the following:
   (a) Ovaries
   (b) Testes
4. Explain how the sperm cells are transported from the testes to the exterior of the body.
5. Name the parts of the female reproductive system that are involved in fertilisation process.
6. What is the role of the prostate gland in the male reproductive system?
7. What is the importance of the fallopian tube in the female reproductive system?

Activity 4

Search for information on the disorders in the human reproductive system from the library or reliable online sources.

Disorders in the reproductive system are various conditions that interfere with or impair the normal functioning of the reproductive system. These disorders can be structural or health related. The causes of disorders may include genetic inheritance, unhealthy lifestyle factors, poor nutrition, chronic diseases, or environmental influences, such as exposure to harmful chemicals or radiation. However, regular medical check-ups and early treatment can help prevent or correct reproductive system disorders in both males and females.

Disorders in the male reproductive system

Disorders in the male reproductive system refer to conditions that can interfere with the normal functioning of the male reproductive system. Some of these disorders include:

Infertility

This is a condition in which a male is unable to impregnate a female. Male infertility can be caused by various factors, including producing too few sperm resulting in reduced chances of fertilisation. It can also result from weak sperm that are unable to swim toward the egg. Additionally, sperm abnormalities such as missing tails, having two tails, lacking a head, or having an irregular shape can contribute to infertility.

Furthermore, the testes may fail to produce sperm due to diseases, poor nutrition or hormonal deficiencies. Another cause of infertility is blocked sperm ducts often resulting from sexually transmitted infections such as gonorrhoea and syphilis.

Prostate gland disorders

This refers to conditions in which the prostate gland is damaged or enlarged. This disorder can affect both the urinary and reproductive systems. Prostate enlargement may result from infections or cancer, causing blockage of the urethra leading to difficulty in urination.

Disorders in the female reproductive system

These are conditions that interfere with the normal functioning of the female reproductive system. Some of these abnormalities include:

Infertility

Infertility is the condition whereby the female egg cannot be fertilised. Infertility in women can be caused by various factors, including the failure of eggs to mature. This condition often results from hormonal imbalances whereby the ovaries may fail to produce sufficient oestrogen or progesterone.

Infertility in females may also be caused by sexually transmitted infections such as gonorrhoea, syphilis, and chlamydia. These infections can block the fallopian tube, hence preventing the egg from passing through to allow fertilisation.

Cervical disorders

The cervix can be damaged due to complications during childbirth or due to infections within the cervix. This may result in a deformed cervix.

Menstrual disorders

These are problems related to timing, flow, or discomfort associated with a woman's menstrual cycle. They include amenorrhea, which is a condition in which a matured female stops having her periods or misses them for a certain period of time without being pregnant. Menstrual disorders also include painful periods due cramps of uterine wall, a condition termed as dysmenorrhea. They can also include excessively heavy or prolonged menstrual flow, a condition known as menorrhagia. These disorders may be caused by hormonal imbalances, particularly a lack of oestrogen production, genetic abnormalities, chronic illnesses, and stress. These disorders can be treated, hence, it is important to seek medical advice.

Caring for the reproductive system

Activity 5

Search for information on the best ways to maintain the health of the human reproductive system from the library or reliable online sources. Then, write the suggestions on how to maintain a healthy reproductive system.

The reproductive system is important to our well-being. Therefore, it is important to care for it to prevent problems that can reduce its efficiency. Some of these problems include infections that can cause diseases in the reproductive parts. Examples of diseases that affect the reproductive organs include sexually transmitted diseases and other infections from fungi, bacteria or other germs. The following should be done to care for the reproductive system:

Observing cleanliness

It is important to keep our bodies clean by taking a bath with clean water and soap every day. It is also important to clean the genital parts with clean water after using the toilet. It is recommended to use a clean toilet and observe cleanliness in the toilet. Also, wear clean and dry underwear every day, and never share underwear with anyone else to avoid infections.

Eating a balanced diet and taking regular physical exercises

Eating a balanced diet and drinking enough water helps to keep your body and reproductive system healthy. Also, taking physical exercise regularly helps to make the body stronger and keeps the reproductive system healthy. It also helps to prevent excessive weight gain, which can harm the body and the reproductive system.

Avoiding risky behaviour

Some habits are dangerous to our body health. Using alcohol, cigarettes, and other harmful drugs can damage the body and reproductive system. It is best to avoid such habits to maintain a healthy reproductive system.

Revision exercise

Section A: Choose the correct answer.

1. Which of the following is not a part of the female reproductive system?
   (a) Urethra
   (b) Ovary
   (c) Fallopian tube
   (d) Uterus

2. Which of the following hormones is primarily responsible for changes during puberty in males?
   (a) Oestrogen
   (b) Progesterone
   (c) Testosterone
   (d) Prolactin
3. Which of the following parts of the female reproductive system produces eggs?
   (a) Uterus
   (b) Ovary
   (c) Fallopian tube
   (d) Urethra
4. Which of the following is a function of the uterus?
   (a) Nurturing the foetus
   (b) Producing sperm
   (c) Producing eggs
   (d) Producing hormones
5. Which of the following diseases affects the female reproductive system?
   (a) Pneumonia
   (b) Cervical cancer
   (c) Arthritis
   (d) Diabetes
6. One of the following is among the causes of amenorrhoea.
   (a) Increase in body weight
   (b) Frequent pregnancies
   (c) Hormonal imbalance
   (d) Consumption of natural foods
7. Which among the following are the causes of decreased sperm production in men?
   (a) Regular physical exercise
   (b) Smoking
   (c) Drinking enough water

(d) Eating enough fruits

8. Which of the following can help maintain a healthier reproductive system?

(a) Regular health check-ups
(b) Taking medication without doctor's advice
(c) Excessive alcohol consumption
(d) Smoking

Section B: Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

9. Infertility is a disorder in the reproductive systems of both males and females.
10. The testes are part of the female reproductive system responsible for producing sperm.
11. The vagina helps in transferring sperm from the testis to the urethra.
12. Sexually transmitted diseases are disorders in the male reproductive system.

Section C: Short answer questions.

13. What complications can occur if the man's prostate gland becomes enlarged?
14. Explain two (2) functions of the seminal vesicles in males.
15. Explain the significance of an acidic environment in the vagina of the human being.

Vocabulary

Foetus	the developing baby inside the uterus after the embryonic stage
Hormones	chemical substance produced by special group of cells to perform a specific function in the body
Implantation	the process by which a fertilised egg attaches to the lining of the uterus

Placenta	an organ that forms in the uterus during pregnancy to nourish the developing foetus
Puberty	the stage during which the body becomes capable of sexual reproduction.
Risky behaviour	actions that increase the likelihood of harmful consequences, including unprotected sex, substance abuse, or multiple sexual partners

Chapter Four

Magnetism

Introduction

A magnet is a device that is used in various applications. In this chapter, you will learn about the concept of magnetism. You will also conduct simple experiments to explore magnetism and identify the properties and uses of the magnets. In addition, you will learn how to store magnets. The competencies developed will enable you to use magnets in your everyday life.



Think The importance of magnetism in our daily life.

The concept of magnetism

Activity 1: *Exploring the ability of a magnet to attract objects*

Materials: A magnet, pieces of chalks, iron paper clips, plastic pegs, pieces of paper, beverage bottle caps, water bottle caps, a pen, a pencil, pieces of wood, a pin and a razor blade

Procedure

1. Collect all the materials listed and put them on the table.
2. Take the magnet and pass it near the objects you have collected see Figure 1. What have you observed?



Figure 1: *The magnet attracting objects*

3. Prepare a table and list the names of the objects that were attracted and the names of the objects that were not attracted by a magnet.

Magnetism is the ability of magnet to attract or repel objects. The magnets use this ability to attract iron-related materials towards them. Thus, a magnet is a device that has the ability to attract objects made of iron-related materials. Each magnet has two poles. These poles are the North (N) and the South (S) poles. Magnets produce the magnetic field. The magnetic field is a region around the magnet where magnetic forces can be felt. The magnetic force is what causes materials to be attracted or repelled by a magnet. Therefore, magnetic force is the push or pull caused by magnetism. Also, magnetic force represented by imaginary lines called magnetic lines of force which can be visualised when you sprinkle iron filings around a bar magnet. The filings arrange themselves in a specific pattern and forming lines. .

Shapes of magnets

Activity 2: *Identifying the shapes of magnets*

Search for information about the shapes of magnets from the library or reliable online sources. Write down your findings.

Magnets have various shapes depending on their uses. These are horseshoe magnets, cylindrical magnets, U-shaped magnets, bar

magnets and ring magnets, as seen in Figure 2. Each shape affects how the magnet creates its magnetism. The magnets have different uses in devices depending on their shapes.

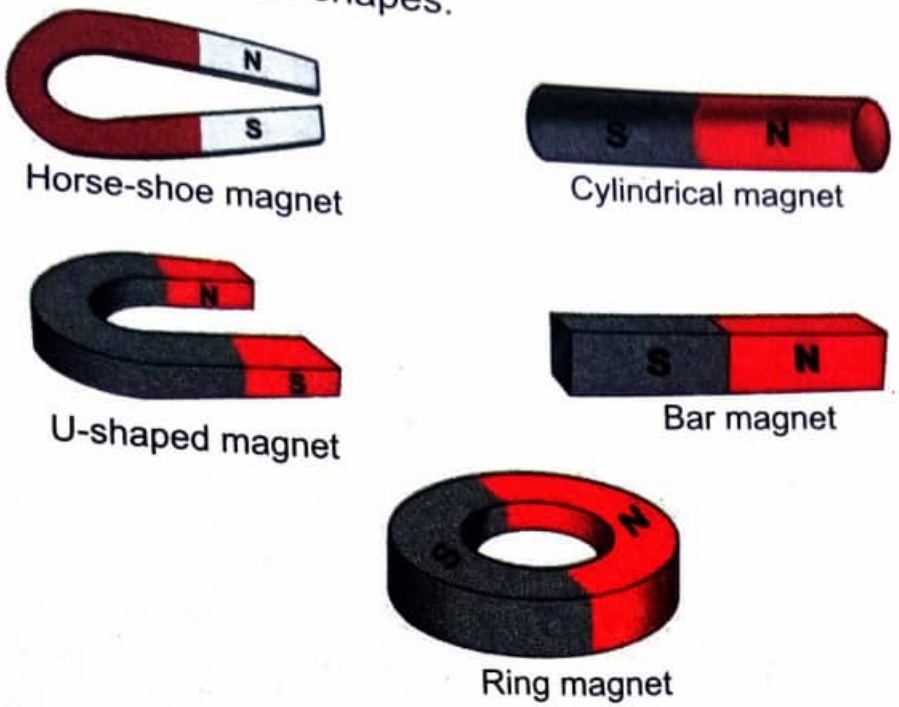


Figure 2: *Shapes of magnets*

Properties of magnets

Magnets show several essential properties that define their behaviour. Some of the properties are:

(a) Magnets attract things made of iron-related materials.

(b) The magnetic force is strongest at the poles.

(c) Like poles repel while unlike poles attract each other.

Activity 3: *Investigating the ability of a magnet to attract objects depending on its shape*

Materials: Bar magnet, ring magnet, horse-shoe magnet, U-shaped magnet, cylindrical magnet, pins or any kind of iron related objects and a table

Procedure

1. Take the pins or any kind of iron-related objects and place them on the table.
2. Take the bar magnet and move its N pole or S pole close to the pins or any kind of iron-related objects objects. What happened?

3. Move other parts of the bar magnet close to the pins or any kind of iron-related objects objects. What happened?
4. Repeat procedures 2 and 3 using magnets of different shapes. What happened when magnets of different shapes were used?

The shape of a magnet affects its ability to attract objects. Also, the poles of the magnet have the strongest force of attraction. Other parts of the magnets show a weaker force of attraction.

The law of magnetism

The basic law of magnetism states that; "*unlike poles of magnets attract each other, while like poles of magnets repel each other*".

Activity 4: *Observing the magnetic force between like and unlike poles of magnets*

Materials: Two bar magnets and a table

Procedure

1. Put one bar magnet on the table.
2. Bring the N pole of the other magnet close to the N pole of the first magnet on the table as seen in Figure 3. What do you observe?



Figure 3 (a): *Repulsion of magnetic poles*

3. Bring the S pole of the other magnet close to the N pole of the first magnet on the table. What do you observe?



Figure 3 (b): *Attraction of magnetic poles*

Like poles of magnets repel each other when brought closer together. This is because the magnetic forces are acting against each other. On the other hand, unlike poles of the magnets attract each other. This activity proves the law of magnetism.

Experiment 1: *Observing the existence of magnetic lines of force*

Aim: Identifying magnetic lines of force

Materials: Iron filings, white paper, bar magnet, U-shaped magnet and a table

Procedure

1. Spread the iron filings on the white paper placed on top of the table.
2. Put the bar magnet on top of the paper with iron filings.
3. Gently shake the paper. What do you observe?
4. Observe how the iron filings are aligned and compare them with the pattern shown in Figure 4.

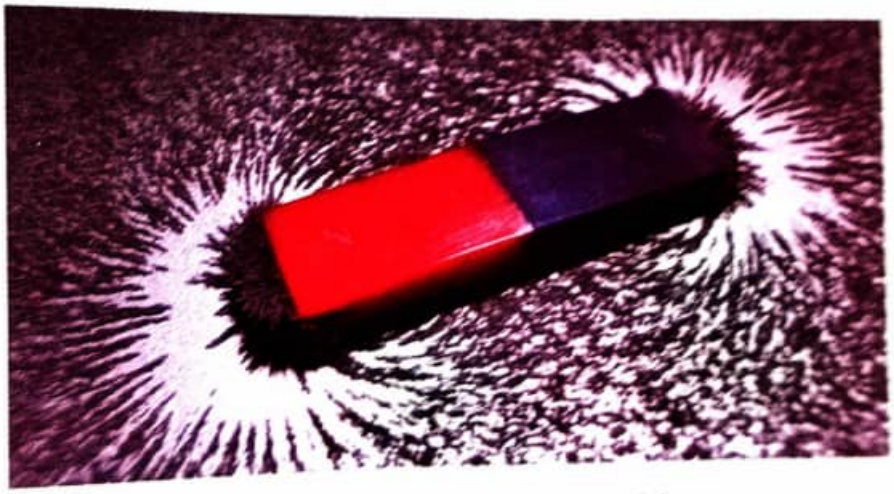


Figure 4: *Magnetic lines of force*

5. Using a U-shaped magnet, repeat procedure 1- 4.

Results: Write the results of the experiment you have conducted.

Conclusion: Write the conclusion of the experiment you have conducted.

Experiment 2: *Exploring the pattern of magnetic lines of force between like poles of magnets*

Aim: Investigating the pattern of magnetic lines of force between like poles of magnets

Materials: Two bar magnets, white paper, iron filings and a table

Procedure

1. Spread the iron filings on the white paper.
2. Put the two magnets on the paper with iron filings as seen in Figure 5. Make sure the two like poles of the magnets are facing each other at a close distance.
3. Move one magnet towards the other. What do you see?
4. Draw the pattern you have seen in your exercise book and compare it with the one shown in Figure 5.

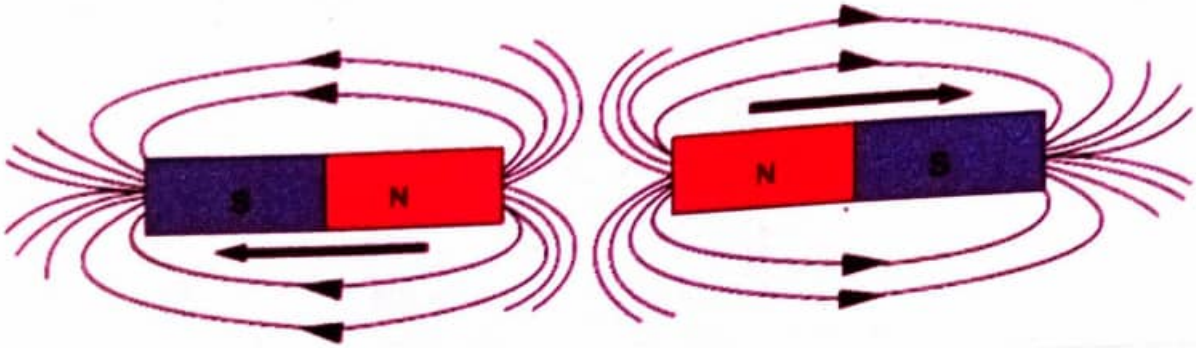


Figure 5: *Magnetic lines of forces between like poles of magnets*

Results: Write the results of the experiment you have conducted.

Conclusion: Write the conclusion of the experiment you have conducted.

Experiment 3: *Exploring the pattern of magnetic lines of force between unlike poles of magnets*

Aim: Investigating the pattern of magnetic lines of force between unlike poles of magnets

Materials: Two bar magnets, white paper, iron filings and a table

Procedure

1. Spread the iron filings on the white paper.
2. Set up the two magnets on the white paper with iron filings. Make sure the two unlike poles of the magnets are facing each other at a close distance.
3. Move one bar magnet towards the other. What do you see?

4. Draw the pattern you have seen and compare it with the one shown in Figure 6.

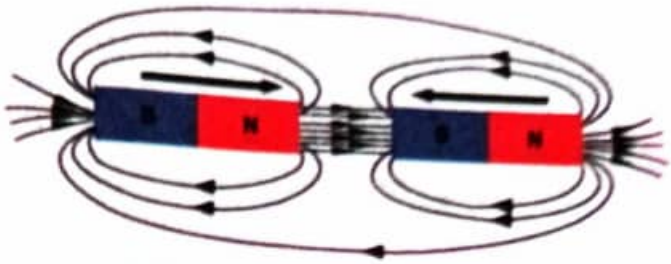


Figure 6: *Magnetic lines of force between unlike poles of magnets*

Results: Write the results of the experiment you have conducted.

Conclusion: Write the conclusion of the experiment you have conducted.

Activity 5: *Investigating the penetration of magnetic force through matter*

Materials: Water, two empty glasses, two nails and a bar magnet

Procedure

1. Put one nail in one empty glass.
2. Pour some water into the second glass.
3. Put the second nail in the glass containing the water as shown in Figure 7.
4. Dip the magnet slowly in the glass containing the water near the nail. What do you see?
5. Pass the magnet on the surface of the empty glass, near the nail. What do you see?

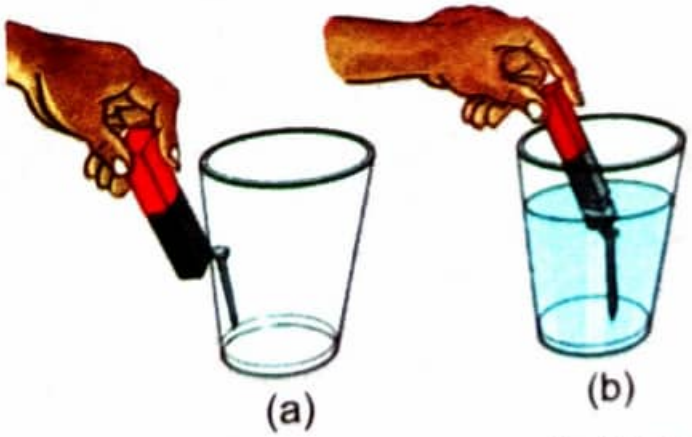


Figure 7: *The penetration of magnetic force in matter*

The magnet attracted the nail through the empty glass. See Figure 7(a).

Similarly, magnetic force penetrated into the water and pulled the nail in

the glass. See Figure 7(b). This shows that magnetic force can penetrate through different matters.

Exercise

1. You are given a bar magnet, a piece of iron, and a piece of plastic material of the same size and colour but with no labels. How would you test to determine which one is the magnet?
2. How can you conduct a simple activity to determine which objects in your home or school are attracted to a magnet?
3. Why do two magnets attract or repel each other when placed together?
4. Draw the pattern of magnetic field lines of force for the following situations:
   (a) Like poles brought close together.
   (b) Unlike poles brought close together.

Uses of magnets

Activity 6: *Search for information about different uses of magnets*

Search for information about uses of magnets from the library or reliable online sources. Write down your findings.

Magnets are used in various places such as homes, schools, hospitals and industries. The following are some of the uses of magnets.

Lifting heavy objects

Magnets are used to pick up objects made of iron-related materials, as seen in Figure 8. The objects can be moved by a magnet from one place to another. At the port, magnets are also used to load and unload cargo made of iron-related materials.



Figure 8: *Objects attracted to a magnet and lifted*

Maintenance of electronic devices

Mobile phone, radio and computer technicians use magnetic screwdrivers to attract small screws used to assemble phones, radios and computers. Figure 9 shows a screw attracted to a magnetic screwdriver.



Figure 9: *Screw is attracted to a magnetic screwdriver*

Making electric bell

Magnets are used to make an electric bell. When the switch button is pressed, an electric current produces a magnetic force. This magnetic force attracts an iron rod or striker causing it to strike a gong and produce a sound.

Identifying the cardinal directions

The compass is a device made up by using a magnet. It shows the direction of the North and South poles of the Earth as seen in Figure 10. The compass is used to guide people in identifying the cardinal directions. It is also used to guide captains and pilots to move in the correct direction.

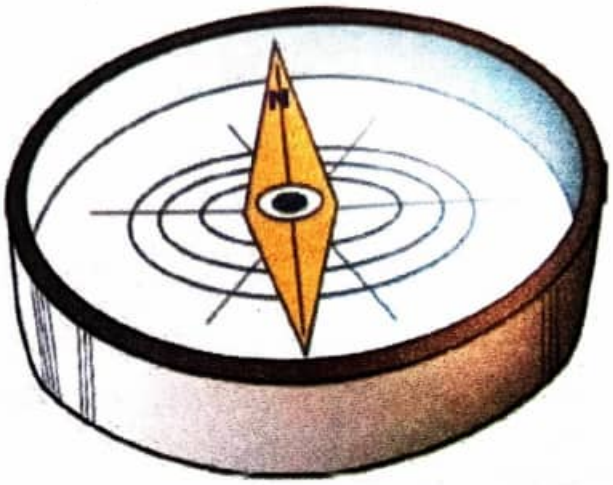


Figure 10: *The compass*

Experiment 4: *Investigating how to find direction using the magnet*

Aim: Identifying the south and north directions of the Earth

Materials: A bar magnet and a thread

Procedure

1. Tie the thread on the magnet and then suspend that magnet in the air, as shown in Figure 11.

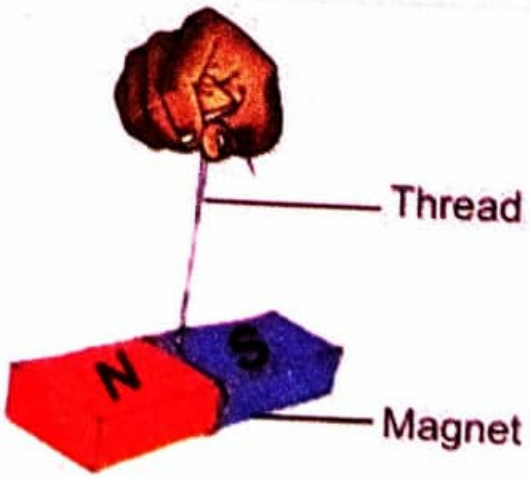


Figure 11: *Suspending a magnet in the air*

2. Wait until the magnet settles.

(a) In which direction of the Earth does the N pole of the magnet point?

(b) In which direction of the Earth does the South pole of the magnet point?

3. Push one pole of the magnet to make it rotate. Wait until it settles again. In which direction do the N pole and S pole point?

Results: Write the results of the experiment you have conducted.

Conclusion: Write the conclusion of the experiment you have conducted.

Electricity generation

The magnet is used in generating the electricity. For example, it is used in a bicycle dynamo. A bicycle dynamo has a magnet that is surrounded by a coil. See Figure 12. When the bicycle wheel rotates, it causes the magnet to rotate. Rotation of the magnet generates electricity in the coil. That electricity is then transmitted through a wire to the bulb, causing it to light up. When the wheels rotate fast, the electric current produced increases and the light from the lamp brightens. When the bicycle wheels rotate slowly, the electric current decreases and the light from the lamp becomes dim.

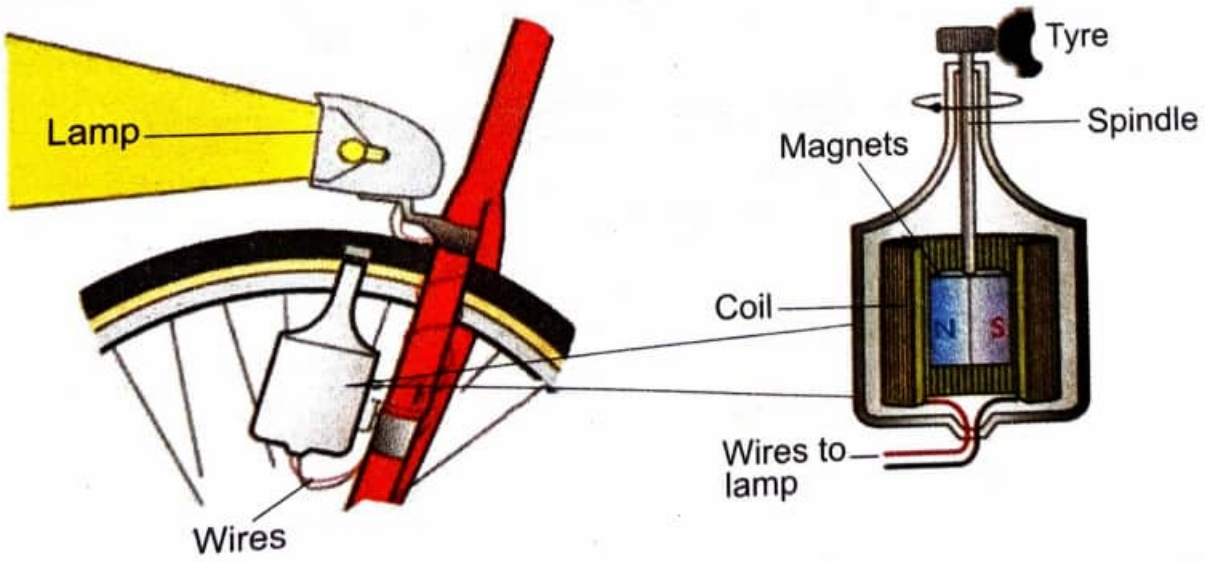


Figure 12: *Magnet inside a bicycle dynamo generating electricity*

Separation of objects

Experiment 5: *Investigating separation of materials made up of iron using a magnet*

Aim: Using a magnet to separate materials made of iron

Materials: Soil, a bar magnet, iron filings and a cardboard

Procedure

1. Put the soil on the cardboard.
2. Put the iron filings on the cardboard.
3. Mix the soil with the iron filings.
4. Pass the magnet above the mixture of the soil and the iron filings. What do you see?
5. Continue spreading the soil and iron filings mixture using a bar magnet. What do you observe.

Results: Write the results of the experiment you have done.

Conclusion: Write the conclusion of the experiment you have done.

Magnets are used to separate iron related materials from non iron-related materials. This procedure is used in food industries to separate iron-related particles from food products. See Figure 13. This ensures safety and prevents food contamination.

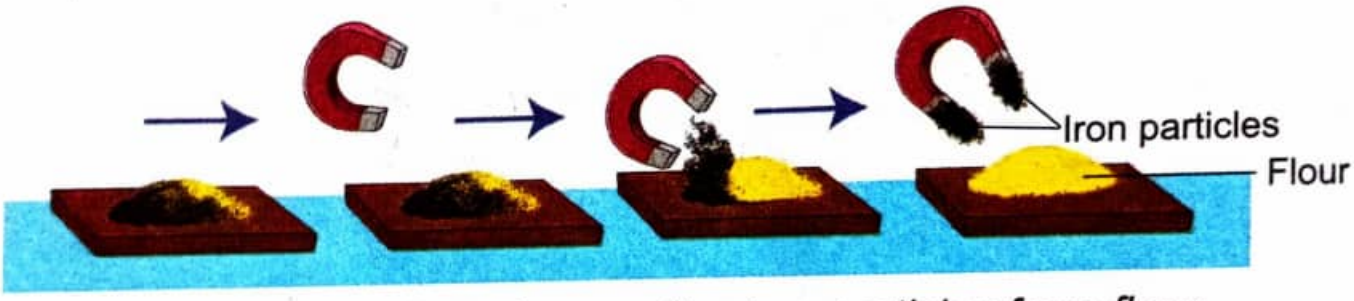


Figure 13: *Magnet separating iron particles from flour*

Magnets are also used in various electronic and technological devices. Examples include fridges, radios, phones, computers, generators, automated teller machine (ATM) cards, voice recorders and microphones.

Storing magnets

Activity 8: *Search for information on the proper ways of storing magnets*

Search for information about how to store magnets from the library or reliable online sources. Write down your findings.

Magnets become weak, if they are not stored properly. If you want magnets to maintain their magnetic strength, the following must be observed:

(a) Keep magnets away from things made of iron.

(b) Make sure like poles of different magnets are not facing each other.

(c) Do not burn magnets.

(d) Do not keep magnets close to objects with strong magnetism or electricity.

(e) Do not hit or hammer magnets.

Revision exercise

Section A: Choose the correct answer.

1. Which of the following is the purpose of fixing magnets on a freezer's door edges and some cabinets' doors?
   (a) Expel heat
   (b) Warm the region inside
   (c) Make the doors stick properly
   (d) Remove iron nature
2. One of the following is a property of a magnet when suspended in air.
   (a) Its North pole points towards the North of the Earth
   (b) Its North pole points towards the South of the Earth
   (c) The North pole and the South pole lack direction
   (d) It rotates all the time
3. If you want to pick up a nail from a bucket filled with water, which of the following is the best way?
   (a) dive into the bucket
   (b) drill a hole in the bucket
   (c) pull the nail from the bucket using an iron rod
   (d) dip a magnet tied to a long string into the bucket

Section B: Short answer questions.

4. List two (2) equipment found at home or school that contains magnets.

5. Explain what will happen, if you place a plastic cover, paper clips, stick and plastic rulers in contact with a magnet.
6. If you were given a bar magnet with unknown poles, how would you determine the North and South poles of the magnet?
7. You accidentally put iron particles into a basket containing maize flour. How can you separate those particles from the maize flour?
8. How would you design an experiment to demonstrate the presence of magnetic fields using available materials?
9. In what ways can you store a magnet without affecting its magnetic strength?

Vocabulary

Dynamo a device that uses magnetic principles to generate electricity from a rotating coil between magnets

Force is a push or pull of objects

Chapter Five

Computer coding

Introduction

Computer programs consist of a set of instructions, which are also known as statements. In a program, statements are organised in different control structures such as sequence, repetition and decision. The control structures enable a computer to accept data, perform calculations and show results. In this chapter, you will learn more about the sequence, repetition and decision control structures used to create simple games. In addition, you will learn about the concept of variables and operators in a program. The competencies acquired will enable you to create simple and interactive games.



Think Creating simple programs that can make decisions.

Sequence control structure

In a sequence control structure, program statements occur and are performed in a sequence. This means the first statement is performed first, followed by the second and so on. The statements are performed in this order until the last statement. This control structure is used when a task to be performed consists of steps that must be performed in a specific order.

A good example of a task that is performed in steps that follow a specific order is growing crops. In growing crops, the order of steps is:

1. Preparing the land;
2. Sowing seeds;
3. Weeding; and
4. Harvesting.

Notice that these steps must be performed in this order for the task to be completed. For example, you cannot begin with sowing seeds and then prepare the land; this will prevent the seeds from germinating.

This idea of performing tasks in sequence also applies to tasks performed by computer programs. In Scratch, sequence control structures command the order of execution, where code blocks are run one after another, from top to bottom, creating a sequential flow. Activity 1 demonstrates the use of the sequence control structure in the steps for drawing a rectangle shape (See Figure 1).

Activity 1: *Using the sequence control structure*

Draw a rectangle using sequential instructions.

Steps

1. Click the *Motion* block.
2. Choose the following blocks:
   (a) move (100) steps
   (b) turn (90) degrees
   (c) move (50) steps
   (d) turn (90) degrees
   (e) move (100) steps
   (f) turn (90) degrees
   (g) move (50) steps
   (h) turn (90) degrees

Code blocks

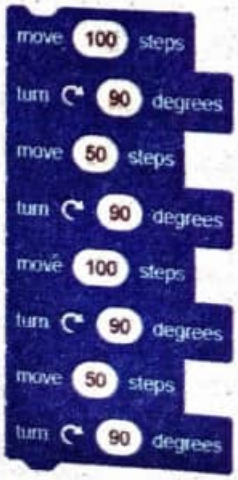


Figure 1: *Sequential instruction for drawing a rectangle*

Exercise 1

1. Identify three tasks in your everyday life that are done sequentially.
2. Explain the meaning of sequence in coding.
3. Create the sequential steps for drawing a triangle.

Variables and operators

Most computer programs that are used in our everyday lives perform various types of calculations. For example, computer programs used by banks and supermarkets perform numerous calculations involving numbers that represent money and groceries.

Suppose you go to a supermarket and buy three pens at 300/= shillings each, a ruler for 500/= shillings and two sweets at 100/= shillings each and pay using a 2000/= shillings note. The computer program at the supermarket shall calculate the total amount you have to pay for the items (that is, 1600/= shillings) and the change you should receive (that is, 400/= shillings). This shopping list is summarised in the table below.

Table: *Shopping list*

Item	Quantity	Unit price (shillings)	Sub-total (shillings)
Pen	3	300/=	900/=
Ruler	1	500/=	500/=
Sweet	2	100/=	200/=
Total			**1600/=**

In this example, each purchased item (pen, ruler and sweets) is associated with two numbers: the quantities bought and the price per item. In order for the computer program to perform this calculation, a way to represent these quantities is needed. The representation of these quantities in the program is done through variables.

A computer program can have any number of variables. Each variable is identified by a name and it can hold different values while the program is running. Examples of variables that we can create from the above example include *NumberOfPens* (value = 3), *PenPrice* (value = 300), and *RulerPrice* (value = 500). It is recommended that, name the variables

using names that remind you of what quantity the variable represents in our everyday lives.

Scratch program allows to create and use variables. Before you can use a variable in Scratch, you must create it. Once you are done with it you can delete it. Follow the steps in Activity 2 to learn how to create, rename, and delete variables in Scratch.

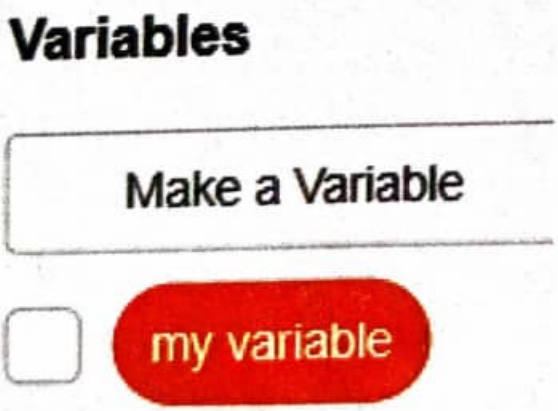
Activity 2: *Creating, renaming, and deleting variables in Scratch*

(a) Creating variables

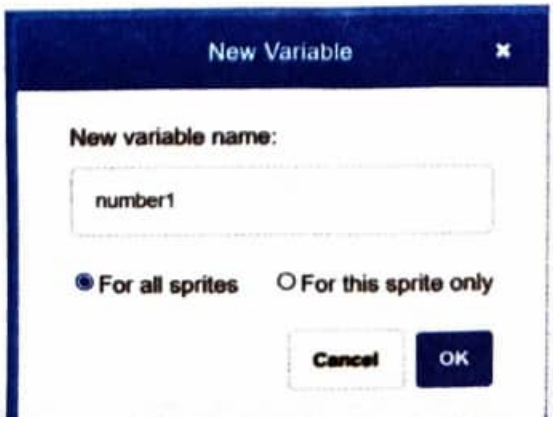
Steps

1. Go to the *Variables* block.
2. Click *Make a Variable*. See Figure 2 (a).
3. Enter the name of the variable in the dialog box that appears. Remember to give the variable a name that remind you of what quantity the variable represents. Example *number1*, *score*, *name*, *time*, *NumberOfPens* and *PenPrice*.
4. Choose whether the variable is for *all sprites* or *only for this sprite*. See Figure 2 (b).
5. Click *Ok* to create and save the variable. See Figure 2 (c).

(a)



(b)



(c) **Variables**

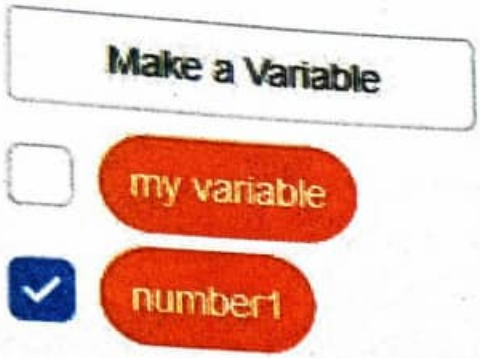


Figure 2: *Creating variables*

NOTE: You can click again the *Make a Variable* box to create other new variables as needed for your task.

(b) Renaming or deleting variables

Steps

1. Right click the variable you wish to rename or delete.
2. Select *Rename variable* and enter the new name to rename the variable.
3. Select *Delete the name of variable* to delete the variable. See Figure 3.

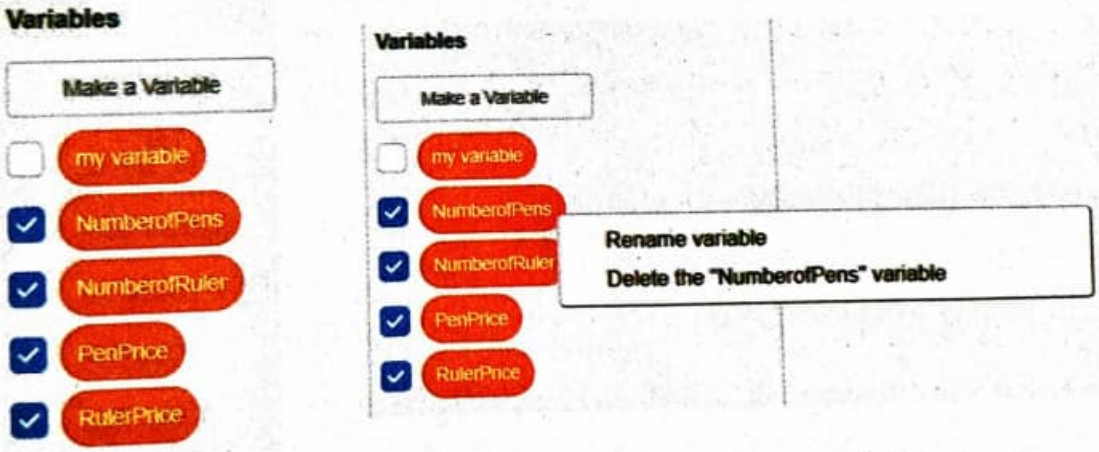


Figure 3: *Deleting and renaming variables*

Once a variable has been created, it can be used in different places in a program. Consider the previous example of a computer program used in supermarkets; Variables can be used in the calculation of the amount due for each item, the total price for all the items, and the change you are to receive. For example, when calculating the amount due for 3 pens, the calculation could be expressed as *PenPrice * NumberOfPens, where*

PenPrice and NumberOfPens represent the price of each pen (which is 300) and the number of pens purchased (which is 3), respectively.

Notice that in calculations, the arithmetic operator * is used to represent multiplication instead of × used in mathematics. Other arithmetic operators you can use include: addition (+), subtraction (–), division (/), and modulus (%). In addition to arithmetic operators, programs also use comparison operators such as less than (<), greater than (>), and equal to (=). There are also logical operators, including *and, or* and *not.*

The following activities demonstrate the use of variables and operators in performing calculations.

Activity 3: *Using variables and operators*

Create a Scratch program that calculates the subtotal for the purchase of pens from the previous example. You will need to create variables, get user input, perform the multiplication, and display the result. Here's a breakdown of the steps.

Steps

1. Create three variables, the first to store the number of pens (name it *NumberOfPens*), the second to store the price of each pen (name it *PenPrice*) and the last to store the product (subtotal) through the *Variables* block.
2. From *Sensing* block, choose *Ask ...* and *wait* block to get user input for the number of pens and price for each pen.
3. From the *Variables* block, choose the *set variable* block to store the input in the *NumberOfPens* and *PenPrice* variables.
4. Use the *multiplication* block inside the *set* block to calculate the *product/subtotal* by multiplying *NumberOfPens* and *PenPrice* and storing the result in the *product* variable.
5. From the *Looks* block, choose the *Say* ( ) block to display the *product/subtotal* to the user. See Figure 4.

Code blocks

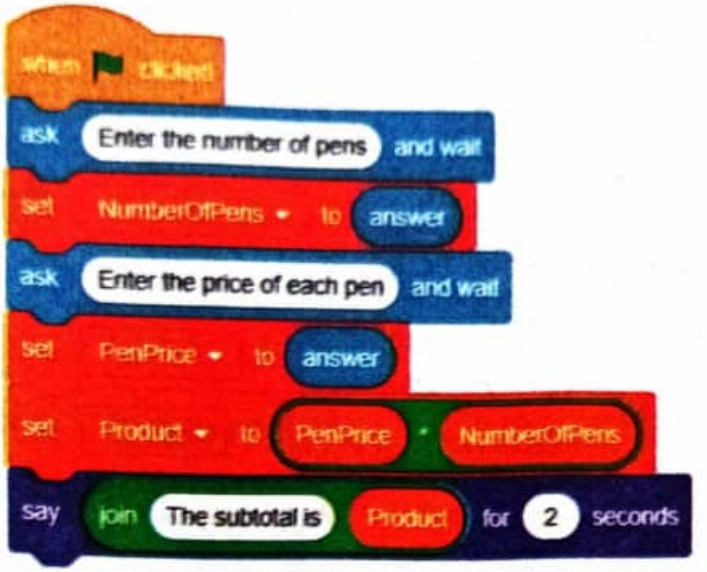


Figure 4: *Using variables and operators*

Activity 4: *Using variables and operators*

Create a program that adds two numbers with six-digits. Create variables, get user input, perform the addition, and display the result. Follow the steps below.

Steps

1. From the *Event* block, choose the *when green flag clicked* block.
2. Create variables for storing the first number, the second number, and the sum through the *Variables* block. Name the variables as *number1*, *number2* and *sum respectively*.
3. Get user input by using the *Sensing, Ask ... and wait* block. Store the input in the *number1* and *number2* variables.
4. Use the *addition* block inside the *set* ( ) to ( ) block to calculate the *sum* by adding *number1* and *number2* and storing the result in the *sum* variable.
5. Display the result by using the *Say* ( ) block to display the *sum* to the user. The coded blocks will appear as shown in Figure 5.

Code blocks

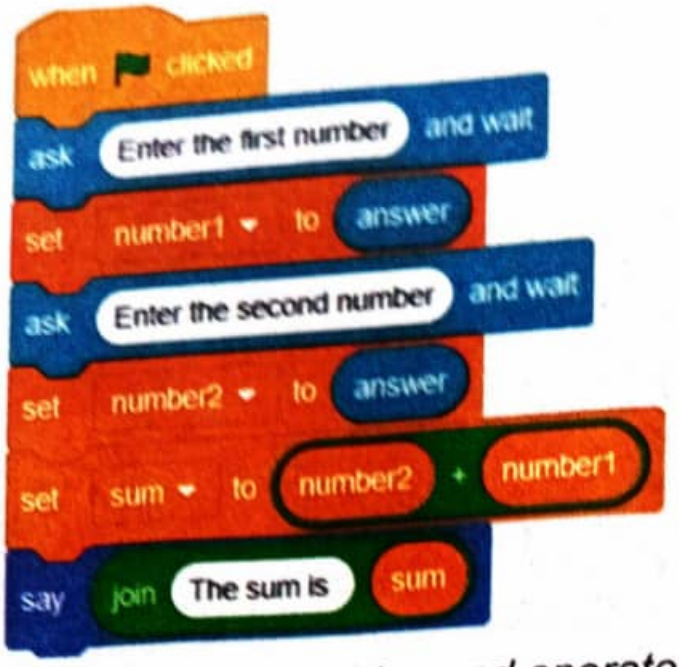


Figure 5: *Using variables and operators*

Exercise 2

1. Identify and list other variables in the example of the supermarket purchase.
2. What operators can be used to calculate the amount required to pay for the ruler and sweets in the example of the supermarket purchase?
3. What operators can be used to calculate the total cost of the given purchase list?
4. Name four (4) other activities that can be done in sequence at home or school?
5. Give two (2) examples of tasks whose steps can be performed in any order without affecting the final result.
6. Create a program by using Scratch that prompts the user to enter a number, store the number in a variable called *number* then display the square of that number.

Repetition control structure

Some tasks require a specific action to be performed repeatedly before the final result can be obtained. In coding, this is known as *repetition* or

looping. Consider the following tasks in a game:

(a) Moving a sprite to a location ten steps to the right.

(b) Moving a sprite to the right until it reaches the edge.

(c) Playing a sound while the game is playing.

All of these tasks require an action to be performed repeatedly before the final result can be obtained. To perform the first task, the sprite moves one step to the right (repeat this ten times) until it reaches the desired location. In the second task, the sprite moves to the right until it reaches the edge. In the third task, the action repeated is *play a sound*. The sprite plays the desired sound repeatedly until the game ends. So as long as the game is playing, the sound will play.

Notice that in the first task, the action is repeated a fixed number of times (ten times). In the second task, the action is repeated until a given condition is met (reaching the edge). On the other hand, in the third task, the action of playing a sound is repeated continuously until the game stops.

This means there are three kinds of repetition control structures, namely *repeat ( )* loop, *repeat until ( )* loop and *forever* loop. For the *repeat ( )* loop, the value in the brackets represents the number of times to repeat an action. For the *repeat until* loop, the value in the brackets represents the condition that makes the loop stop. The *forever* loop will run continuously until either you manually stop the program or use the *stop* block. In Scratch, these loops can be found in the Control block menu (see Figure 6).



Figure 6: *Types of loops in Scratch*

The *repeat ( )* loop is used when you want to do an action a certain number of times. The *repeat until ( ) loop* is used when you want to do an action until a certain condition is met. The *forever loop* is used when you want to do an action without stopping. Activities 5 to 7 demonstrate how to use repetition control structures in a program.

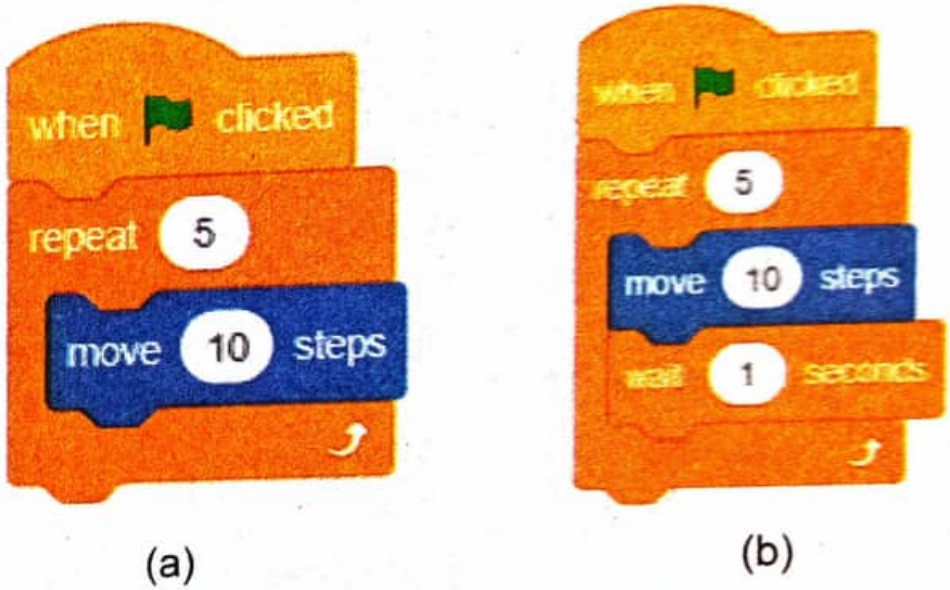
Activity 5: *Using a repeat ( ) loop in a program*

Create a program that moves a sprite 10 steps forward 5 times.

Steps

1. From the *Event* block, choose the *when green flag clicked* block.
2. From the *Control* block, choose the *repeat ( )* block.
3. Add the number of times the loop should repeat inside the brackets of the *repeat ( )* block.
4. Add the code to repeat inside the body of the *repeat ( )* block.
5. Click the green flag to start the program. You will observe the sprite move 10 steps forward five times. See Figure 7 (a).
6. Add a *wait (1) seconds* block to clearly observe the sprite movement. See Figure 7 (b).

Code blocks



(a) (b)

Figure 7: *Repeat ( ) loop in a program*

Activity 6: *Using a repeat until ( ) loop in a program*

Create a program that makes a sprite change the X-axis position by 10 until it touches the edge of the stage.

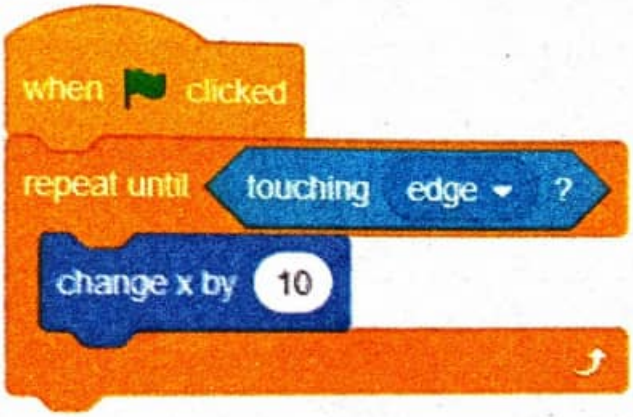
Steps

1. From the *Event* block, choose the *when green flag clicked* block.
2. From the *Control* block, choose the *repeat until ( )* block.

3. Add the condition to be met inside the brackets of the *repeat until ( )* block. In this case, choose the *touching edge?* block from the *Sensing* block.
4. Add the code to change the X-axis position of the sprite by 10 inside the body of the *repeat until ( )* block. To do that, choose *change X by (10)* from the *Motion* block.
5. Click the green flag to start the program. You will observe that the sprite will change the X-axis by 10 repeatedly until it touches the edge of the stage. See Figure 8(a)
6. Add a *wait (1) seconds* block to clearly observe how the sprite is changing position by 10 in X-axis. See Figure 8 (b).

Code blocks

(a)



(b)

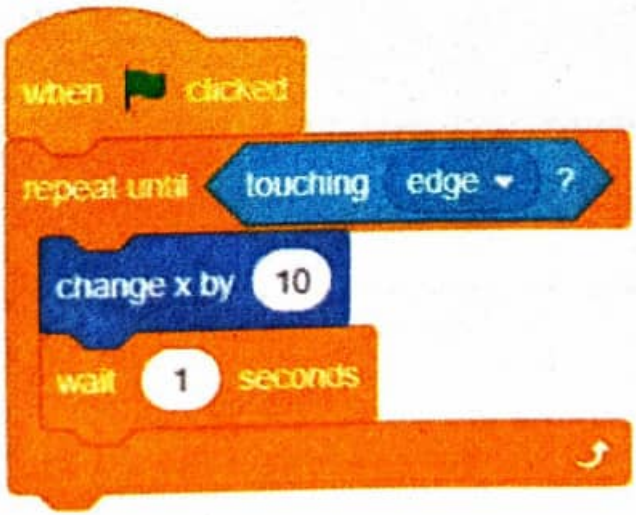


Figure 8: *Repeat until ( ) loop in a program*

Note: The *repeat until ( )* block is useful for situations where you don't know how many times the action has to repeat, but you know the condition required for the action to stop.

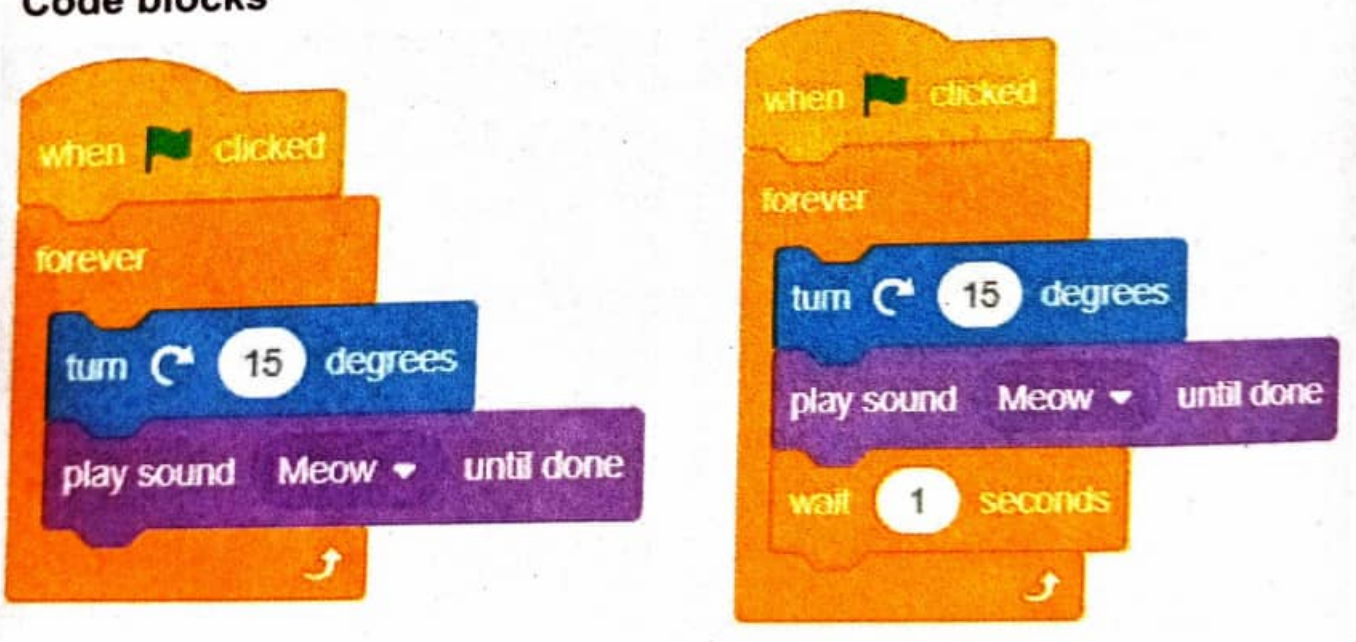
Activity 7: *Using a forever loop in a program*

Create a program that makes the sprite turn 15 degrees to the right while playing a sound in the background forever.

Steps

1. From the *Event* block, choose the *when green flag clicked* block.
2. From the *Control* block, choose the *forever* block.
3. Add the code to turn the sprite 15 degrees right inside the body of the *forever* block. To do that, choose the *turn right ( )* block from the *Motion* block, then add 15 in the brackets of the block. In addition, choose the *play sound ( ) until done* from the *Sound* block and add a sound of your choice.
4. Start the program by clicking the green flag. You will observe that the sprite will turn 15 degrees to the right continuously while the sound is playing. See Figure 9(a).
5. Add a *wait (1) seconds* block to clearly observe how the sprite turns 15 degrees right. See Figure 9 (b).

Code blocks



(a) (b)

Figure 9: *Forever loop in a program*

Note: The *forever* loop is designed to run forever as long as the program is running. To break out of the forever loop, you must either stop the program manually (by clicking the stop button) or programmatically using the "*stop*" block from "*Control*" block.

Exercise 3

1. Identify three tasks in your everyday life that involve repetition?
2. In the activities you have identified in question 1, identify the one that requires a *repeat*, *repeat until* or *forever* loops.
3. Create your own variations of the loops in activities 5 to 7 to perform some extra actions.
4. Create a program to count from 1 to 10:
   (a) Without using repeat loop
   (b) using repeat loop
   (c) Which approach between (a) or (b) is more efficient for counting the large numbers, such as 100 or 1000?

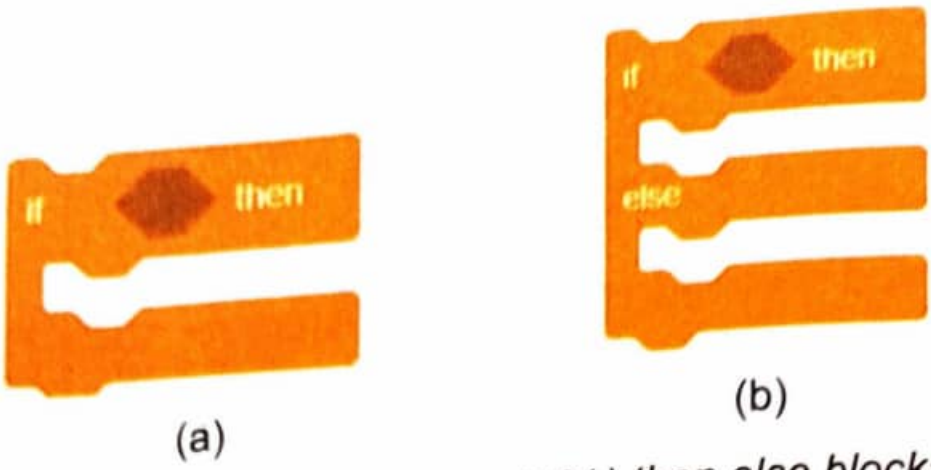
Decision control structure

Some tasks require a program to choose between different actions depending on a condition. In coding, this is known as *decision making* or *selection*. Consider the following tasks in a game:

(a) If the sprite touches *the edge of the stage*, it changes its *colour.*

(b) If the number is even, say *The number is even*, else say *The number is odd*

All these tasks require the program to make decisions. In the first task, the program has one choice to change its colour if the edge is touched. In the second task, the program has two choices, to either say *The number is even* or *The number is odd*. To make simple decisions in Scratch, the *if ( ) then block* is used. Similarly, to decide between two choices, the *if ( ) then else* block is used. These blocks are shown in Figure 10.



(a) (b)

Figure 10: *The if ( ) then and if ( ) then else blocks*

For a program to make a decision, it needs prior information. This information is known as a *condition* for the decision control structure and it is placed in the hexagon found at the upper part of the block.

Activity 8: *Using the decision control structure*

Create a program that makes the sprite move from right to left. If it touches the edge of the stage, it will change its colour, turn 180 degrees and then continue moving.

Steps

1. From the *Events* block, choose the *when green flag clicked*.
2. From the *Motion* block choose *set rotation style ( )*. Set the rotation style to *left-right*.
3. From the *Control* block, choose the *forever* block. Inside it, add a 10 steps motion block followed by an if () then block.
4. Choose the *touching* block from the *Sensing* blocks and set it to the edge. Thereafter, place it inside the condition area of the *if ( ) then* block in the script
5. Inside the body of the *if ( ) then* add the *change colour effect by (19)* and the *turn (180) degrees* blocks.
6. Start the program by clicking the green flag. See Figure 11.

Code blocks

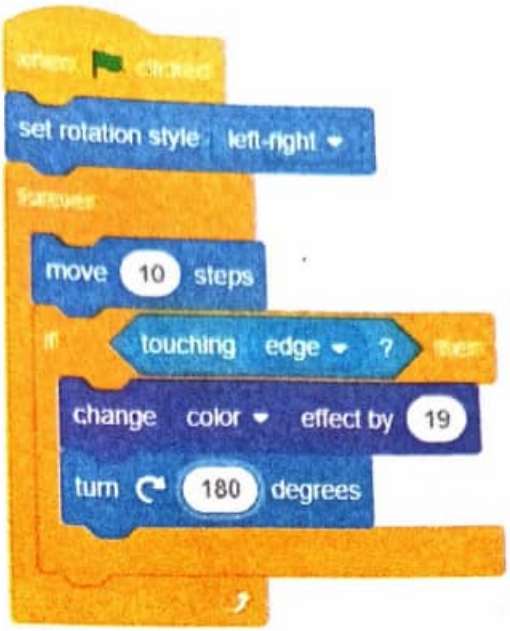


Figure 11: *Using the decision control structure*

Exercise 4

1. Suppose you are creating a game in which there are two balls that continuously move to a random position. The game ends whenever the balls touch or one of the balls touches the edges. Identify two decisions the game has to make.
2. (a) Give two examples of daily tasks that require you to make decisions.

   (b) What conditions guide you to make the decisions?
3. Write a program in Scratch to continuously prompt users to enter a number. If the number is even, say *Number X is even*, else say *Number X is odd*, where X is the number entered.

Activity 9: *Creating a number game*

Create a numbers game used in learning number patterns in a fun way through mathematics games and puzzles.

Steps

1. From the *Events* block, choose the *when green flag clicked* block.

2. From the *Looks* block, choose the *say ( ) for ( ) seconds* block.
3. From the *Sensing* block, choose the *ask ( ) and wait.*
4. From the *Control* block, choose the *if ( ) then ( ) else ( )*. Add the condition statement as shown in Figure 12.
5. Click the *Looks* block and choose *say ( ) for ( ) seconds*. Add appropriate messages as shown in Figure 12.

Code blocks

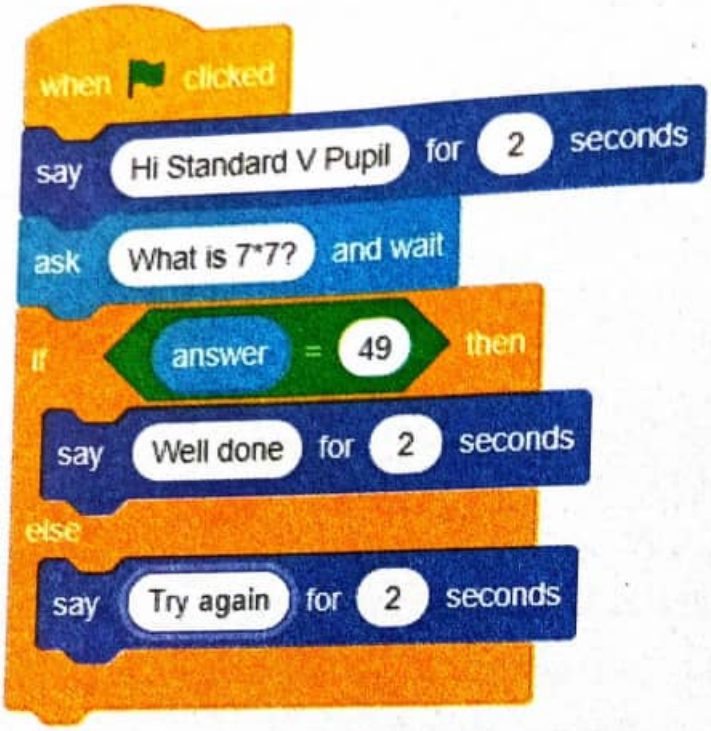


Figure 12: *Numbers game*

Note: You can add more questions by duplicating the blocks.

Project

Create a quiz game that is fun and interactive for users to test their knowledge on numbers.

Note: The game should involve asking the user a question and provide feedback on whether the answer is correct or incorrect.

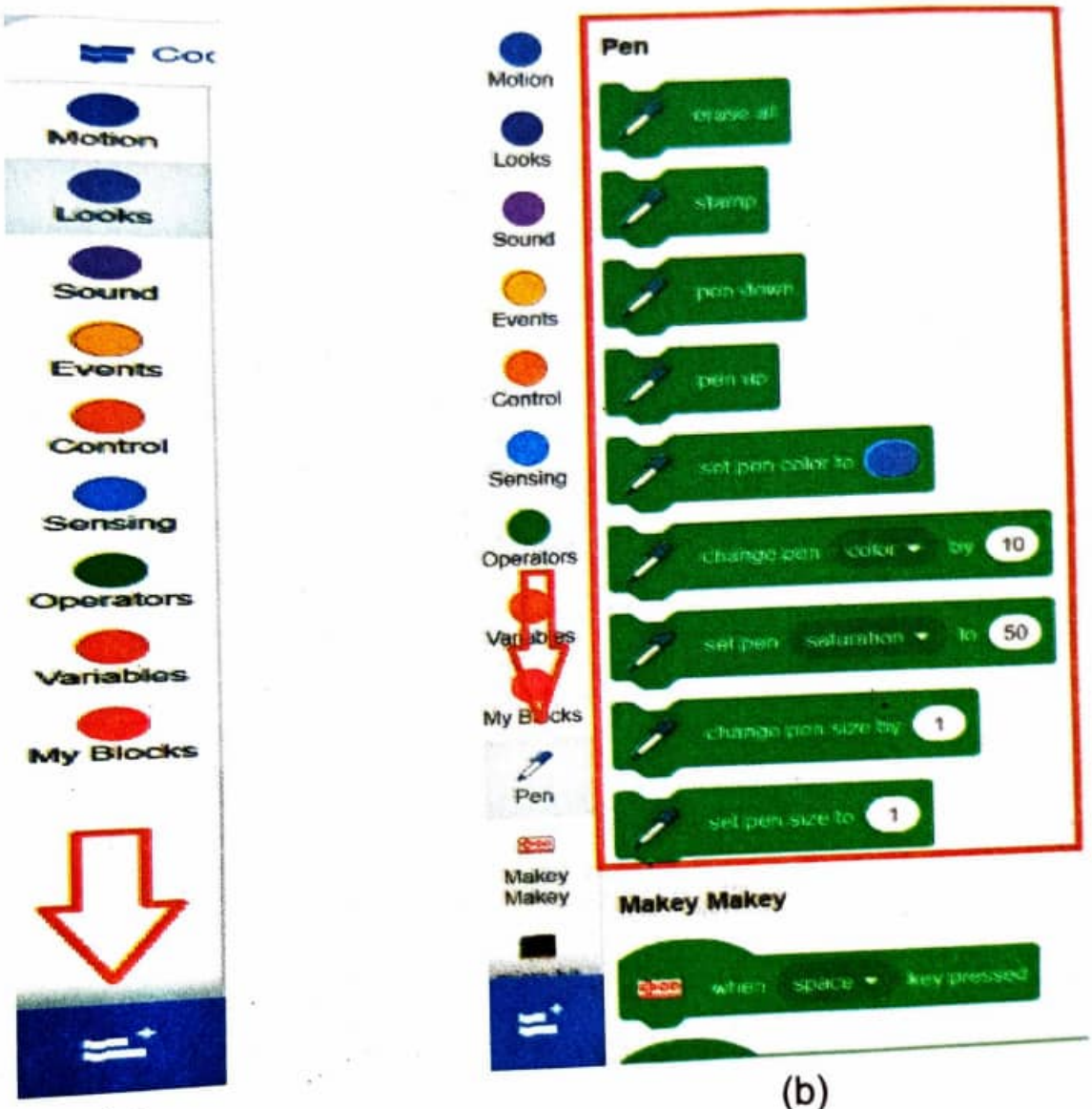
Drawing shapes in Scratch

Shapes are among the objects used to create simple and interactive games.

To draw shapes in Scratch, you have to add the Pen extension. To add the

Pen extension follow the following steps.

1. Click the *Add Extension* icon at the bottom left corner. See Figure 13 (a).
2. Click the *Pen extension* to add it to your programming palette. See Figure 13 (b).



(a) (b)

Figure 13: *Add Pen extension*

Examples of blocks from the *Pen extension* are:

(a) 

This allows your sprite to start drawing as it moves.

(b) 

This lifts the pen up so your sprite can move without drawing.

(c) 

This removes all marks made by the pen or stamping.

Activity 10: *Drawing a circle*

Create a circle by taking tiny steps and turning a little after each step. This activity illustrates how to make a circle by taking 1 step and turning 1 degree after each step.

Steps

1. Choose a sprite, for this case, choose a pencil from the sprites list.
2. From the *Events* block, choose the *when green flag clicked* block.
3. From the *Pen* block, choose the *pen down* block.
4. From the *Control* block, choose the *repeat ( )* block and place 360 in the condition area. This tells the program to repeat 360 times.
5. Inside the body of the *repeat ( )* block, add code to make the sprite move 1 step, and turn 1 degree after each step. See Figure 14.
6. Start the program by clicking the green flag. You will observe that, the sprite will make a small step and turn 1 degree until a full circle is drawn.

Code blocks

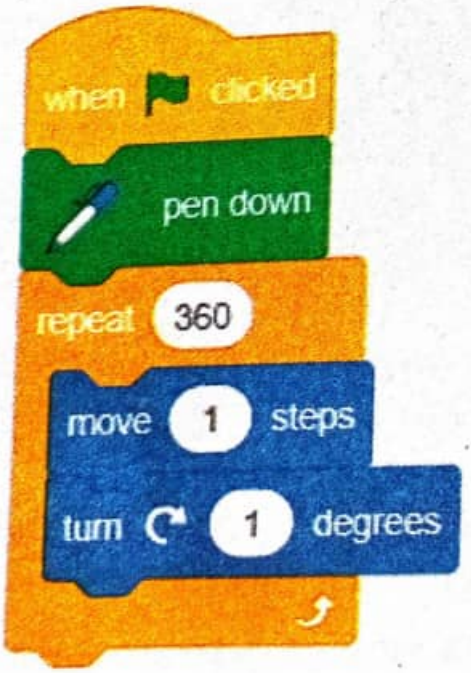


Figure 14: *Drawing a circle*

Note:

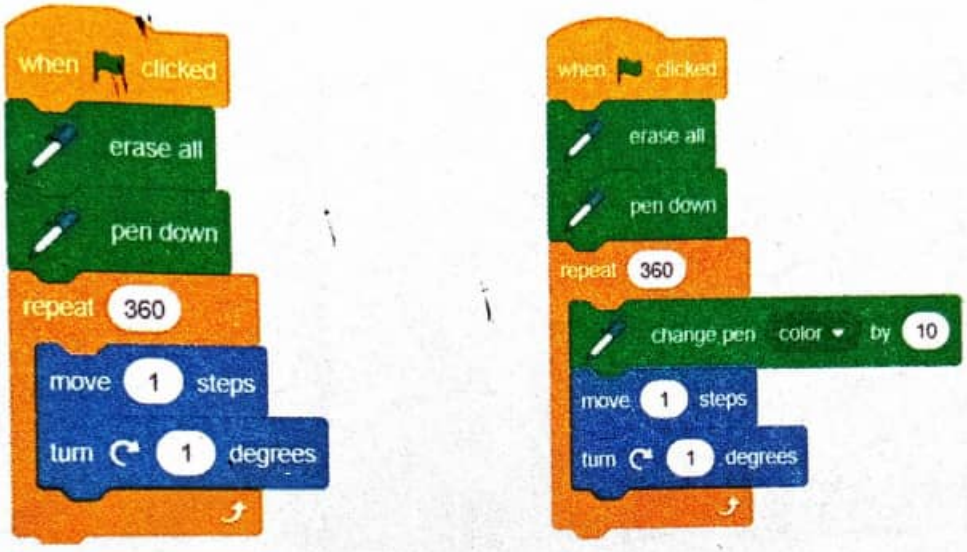
1. It's important to clear any old drawings from the stage before drawing a new shape. Refer to Figure 15(a).
2. A circle has 360 degrees.

(a) If you turn 1 degree each time, you need to repeat it 360 times to complete the circle.

(b) If you turn 2 degrees each time, repeat it 180 times.

(c) If you turn 3 degrees, repeat it 120 times, and so on.

3. Small steps make small circles and big steps make big circles.
4. For a colourful circle, you may add a *change pen color by ( )* block as shown in Figure 15 (b).



(a) (b)

Figure 15: *Drawing a circle with erase and colour changes*

Activity 11: *Drawing different shapes*

Draw any shape by specifying the number of sides and the length of each side of the shape.

Steps

1. Choose the pencil sprite from the list of sprites
2. From the *Variables* block, create two variables named *Length* and *Sides*.
3. From the *Controls* block, choose the *when green flag clicked* block
4. From the *Motion* block, use the *go to x (0) y (0)* to set the initial position of the sprite to centre (0,0).
5. From the *Pen* blocks, choose *erase all* and *pen down* blocks.

6. From the *Sensing* block, use the *ask ( ) and wait* block to prompt the user to enter the number of sides. Set the answer to the *Sides* variable using the *set ( ) to ( )* block from the *variables* block.

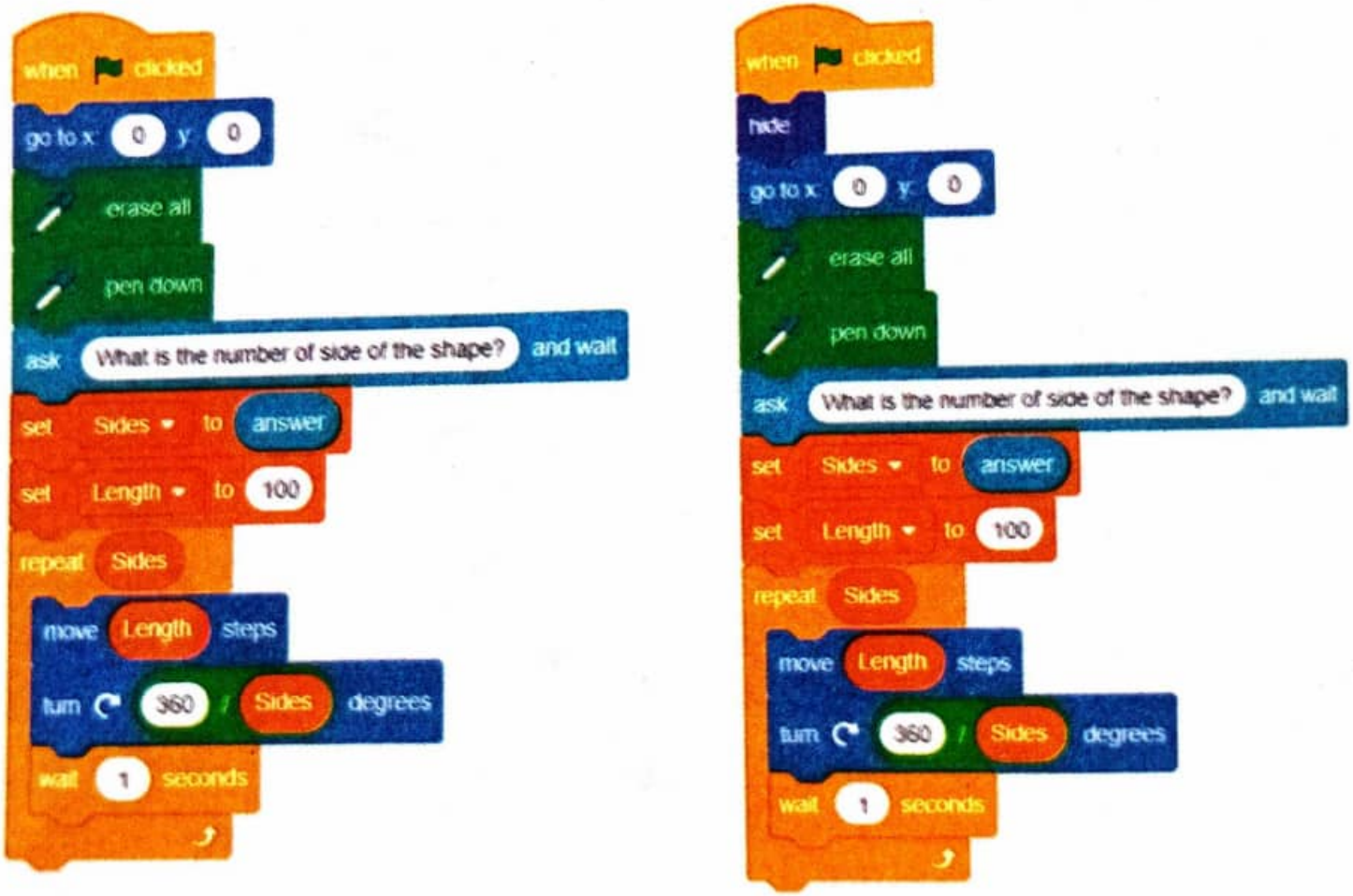
7. From the *Variables* block, choose the *set (variable name) to ( )* block and use it to set the length to 100.

8. From the *Controls* block, choose the *repeat ( )* block and add the *Sides* variable as the condition. Inside the body of the *repeat ( )* block, add a block to move the sprite to the desired length, and a block to turn the sprite as shown in Figure 16 (a).

9. Click the green flag to start the program. You will be prompted to enter the number of sides. Try entering number 3.

10. Add a *hide* block to improve visibility of how the shape is created. Refer to Figure 16 (b).

Code blocks



(a) (b)

Figure 16: *Drawing different shapes*

Revision exercise

Section A: Choose the correct answer.

1. What is the meaning of control structure in computer coding?
   (a) A game controller
   (b) A part of a computer mouse
   (c) A way to control how a program runs
   (d) A tool to draw lines and shapes
2. What does the sequence structure do in a program?
   (a) Makes random choices
   (b) Skips some steps
   (c) Repeats the same steps
   (d) Runs steps one after another in order
3. What is a repetition in coding?
   (a) Doing steps in order
   (b) Doing something again and again
   (c) Making a choice between two things
   (d) Ending the program
4. What does a decision structure do in a program?
   (a) Repeats a step
   (b) Runs steps randomly
   (c) Makes a choice based on a condition
   (d) Stops all actions
5. What kind of control structure is this: *If the score is more than 90, show a Well-done message*?
   (a) Sequence
   (b) Repetition
   (c) Decision
   (d) Loop

Section B: Answer the following questions.

6. Refer to Activity 11:

(a) Draw various shapes by varying the values of sides. Change the number of sides by entering 4, 5, 6, 7, and 8.

(b) Apart from changing the number of sides, what other modifications could you make to Activity 11?

(c) Write a Scratch program to draw a zigzag line.

7. (a) Choose the sprite of a boy from the existing sprites.

(b) Change the existing background to the background of a bedroom.

(c) Change the background to that of a birthday party.

8. Change the given script code into Scratch blocks.

When the green flag clicked,

ask *Enter the first number* and wait

set [*a*] to answer

ask *Enter the second number* and wait

set [*b*] to answer

say ([*a*] * [*b*])

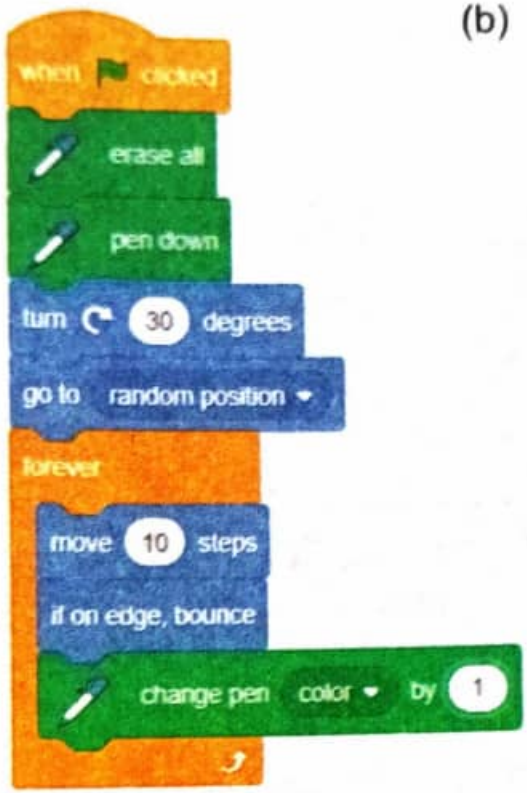
9. Make a variation of Activity 10. Use turns of 2, 3, 4 and 5 degrees to draw a circle.

10. Mashaka had 27 oranges. He shared the oranges equally among his three friends. Use the Scratch program to calculate the number of oranges that each of Mashaka's friends got. Create a simple project script that will perform the same task with variations in numbers.

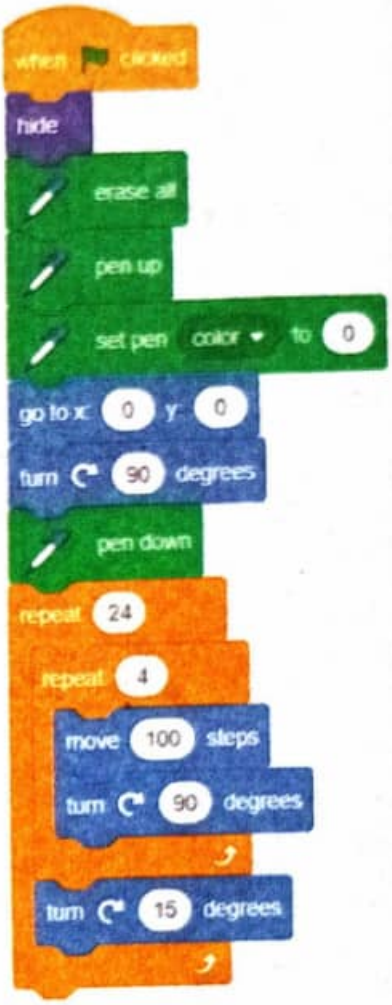
11. Create a quiz game that is fun and interactive for users to test their knowledge on any topic or subject. Thus, the game should involve asking a user a question and providing feedback on whether the answer is correct or incorrect.

12. What shapes presented by the following code blocks?

(a)



(b)



Glossary

Condition	an event that is used for controlling the decision and repetition control structures
Loop	a program control structure used for repeating actions
Modulus	is the remainder when you divide two (2) numbers
Operator	symbols that are used to represent mathematical calculations in a program, for example, addition (+)
Variable	a word that is used to represent the value of a quantity in a program