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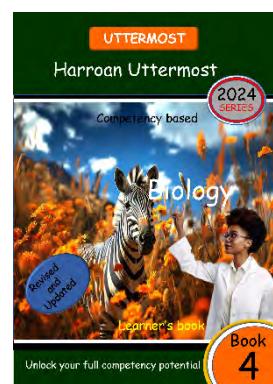
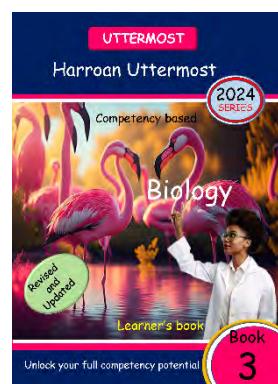
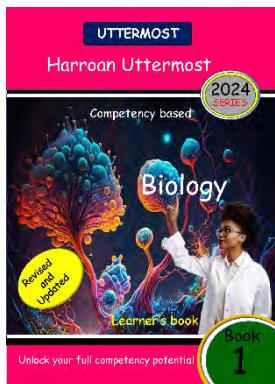
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Chapter **1**

Asexual Reproduction



By the end of this Chapter, you should be able to;

- Understand the concept of asexual reproduction and its significance in the life cycles of different organisms.
- Identify and describe various methods of asexual reproduction, such as binary fission, budding, fragmentation, spore formation, and vegetative propagation.
- Explore the advantages and disadvantages of asexual reproduction compared to sexual reproduction.
- Describe the different adaptations and mechanisms that organisms have evolved for successful asexual reproduction.
- Examine real-life examples of asexual reproduction in plants, animals, and microorganisms and their ecological implications.

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1.1 Asexual reproduction in lower organisms

Introduction to Reproduction

Reproduction biology, although it may seem distant from our day-to-day lives, actually plays a crucial role in shaping the world around us. From the birth of a new baby to the growth of plants in our gardens, the wonders of reproduction surround us in our daily lives. By understanding the fundamentals of reproductive processes, we gain a deeper appreciation for the miracles of life and the integral role reproduction plays in sustaining our existence.

Reproduction is a fundamental process by which biologically matured living organisms produce offsprings that are genetically similar to them. It is the ability of an organism to produce new individuals of the same species. Reproduction ensures survival and continuity of different types of individuals in the population. The new individuals produced undergo growth and development before they reach the period of being capable to reproduce.

Importance of Reproduction in Daily Life

1. Human Life existence: Reproduction is fundamental to the existence of the human race. It is through reproduction that new generations are born, ensuring the survival and diversity of our species. The birth of a child is a momentous event in the lives of individuals and families, highlighting the significance of reproduction in our daily lives.

2. Food Production: Reproduction is essential in the domain of agriculture and food production. Plants reproduce through processes such as pollination and seed formation, which are responsible for the growth and propagation of crops. Without reproduction, we would not have a sustained supply of food to meet our daily nutritional



Reproduction ensures survival & continuity of organisms

3. Economic Impact: Reproduction has significant economic implications. Livestock and poultry industries rely on successful reproduction for the production of meat, milk, eggs, and other animal-based products. It also underpins industries related to plant breeding, where new varieties are developed to enhance crop yields, disease resistance, and other desirable traits.

Challenger

- Imagine a world without reproduction. How do you think this would impact human existence and the continuation of our species?
- Consider a scenario where plants no longer reproduce. What consequences might this have on food production and the availability of fresh fruits and vegetables in our daily lives?

Use the answer sheet template



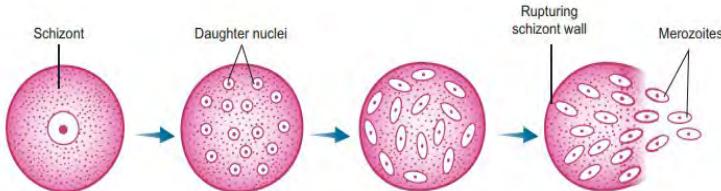
Key question: Define asexual reproduction & describe the different types of asexual reproduction

While the overarching goal of reproduction is the same, the methods and mechanisms can vary widely among different species. Understanding the different types of reproduction is essential for comprehending the diversity and complexity of life on our planet. From asexual reproduction to sexual reproduction, each method has its unique characteristics and advantages.

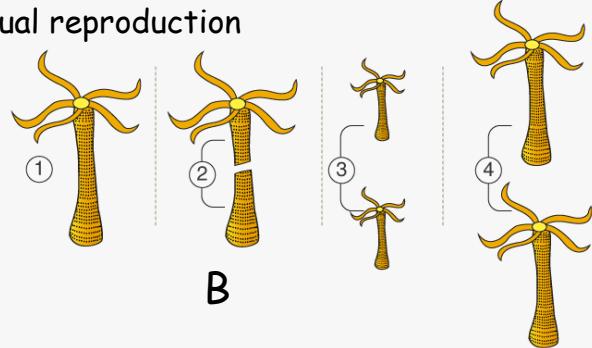
Group activity:

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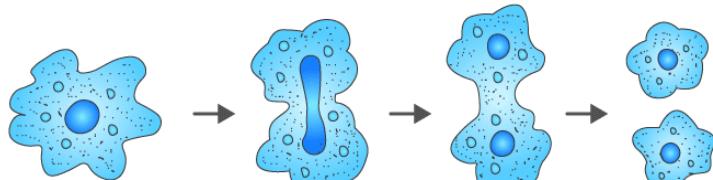
- The figures below show the different types of asexual reproduction in lower organisms. For each, identify the type of asexual reproduction, describe how it occurs & outline examples of organisms which have that type of asexual reproduction
- identify common characteristics in all the types and hence derive the meaning of the term asexual reproduction



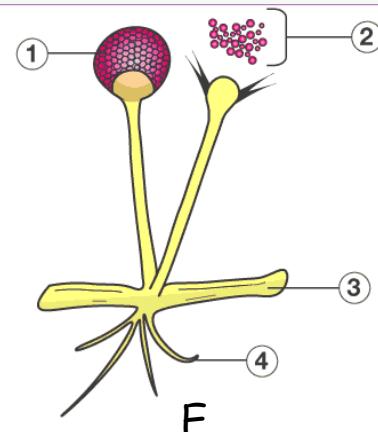
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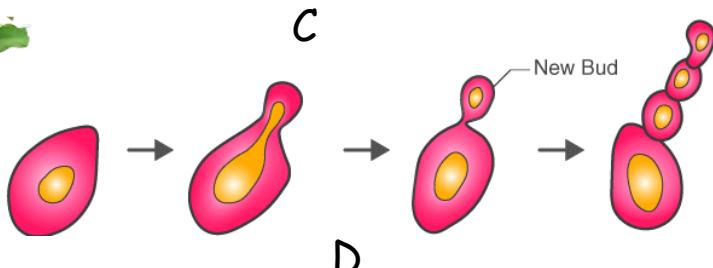
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C



E



D



Use your brain power!

2. Imagine you are studying a species of bacteria that reproduces through binary fission. Describe how this method of reproduction contributes to the rapid growth and spread of bacterial populations.
3. Imagine you are studying a population of bacteria in a lab. Suddenly, one bacterium starts dividing into two identical daughter cells through binary fission every 20 minutes. How many bacteria will you have after 3 hours?
4. In your garden, you accidentally break a leaf from a succulent plant. To your surprise, the leaf falls on the soil and starts developing roots and new shoots. Explain how fragmentation helps succulent plants multiply and create new individuals.

My notes

Answer template

My notes

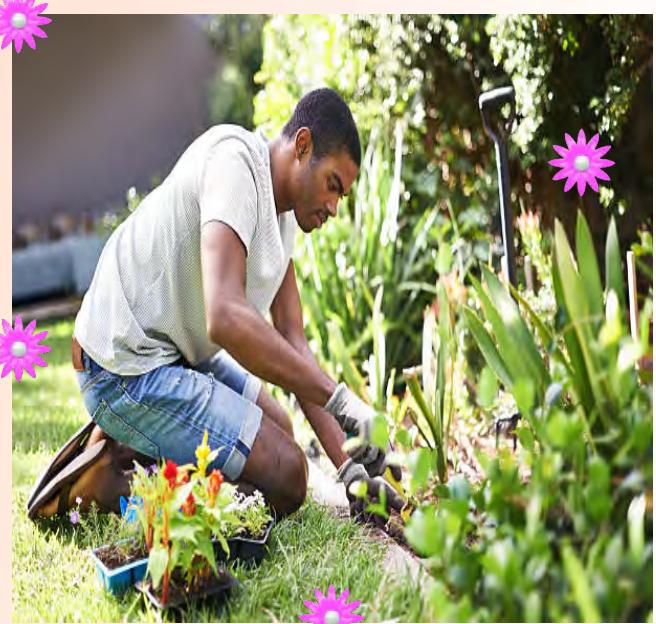
Answer template

1.2 Asexual Reproduction in Plants

 Key question: Identify and describe the mechanisms of natural vegetative propagation

Guide notes

Asexual reproduction in plants is a fascinating process that allows plants to reproduce and multiply without the involvement of seeds or the need for pollinators. Through various methods, plants are capable of producing new individuals using vegetative structures of the parent plant. This ability to reproduce asexually has significant implications for plant survival, propagation, and human activities. In plants, asexual (vegetative) reproduction involves the growth of a new plant from other parts of plant such as a stem, leaf or root but not from the seed. People use vegetative reproduction to grow new plants from a root, stem or leaf. This is what is referred to as vegetative propagation.



Imagine you have a beautiful flowering plant in your garden that you want to share with your friend. Instead of collecting seeds or waiting for flowers to produce fruits, you can use natural vegetative propagation methods to create new plants. By taking stem cuttings, dividing bulbs, or separating baby plantlets from the parent plant, you can easily generate genetically identical replicas of the original plant. This allows you to propagate your favorite plants quickly and share them with others, enhancing biodiversity in gardens and fostering a sense of connection and exchange among plant enthusiasts.

Vegetative propagation is any form of asexual reproduction in plants in which a new plant grows from a fragment of a parent plant and not from seeds. Similar to other types of asexual reproduction this form of reproduction does not involve **gamete formation** and **fertilisation**. Vegetative propagation uses parts of the original plant such as **stems, leaves and roots** to initiate a new plant. Plants such as **bananas, sweet potatoes, cassava and pineapples** have the ability to reproduce by vegetative propagation. Vegetative propagation is also known as vegetative reproduction or vegetative multiplication. Many plants can reproduce by vegetative propagation either naturally or by artificial means. **Natural propagation** occurs without human intervention. Artificial vegetative reproduction is the propagation which occurs as a result of human intervention and manipulation.

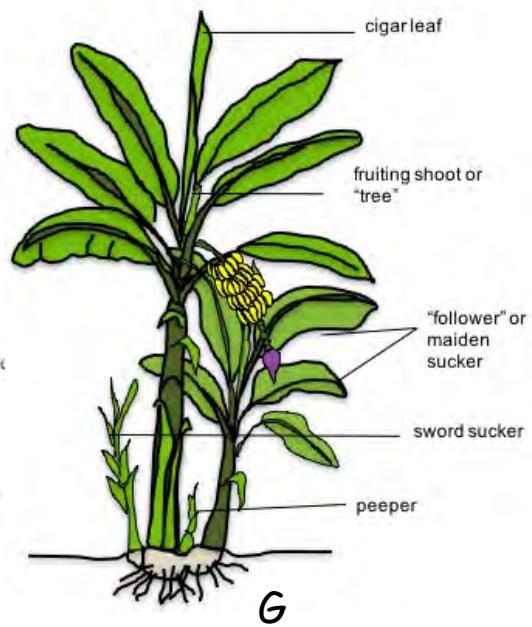
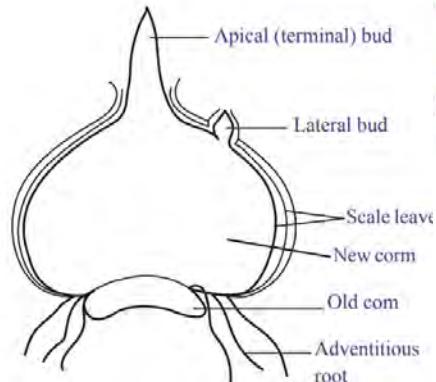
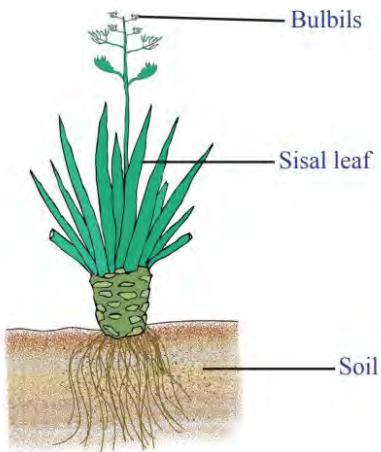
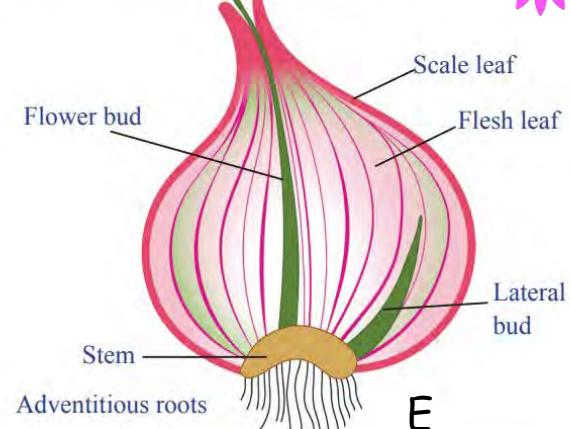
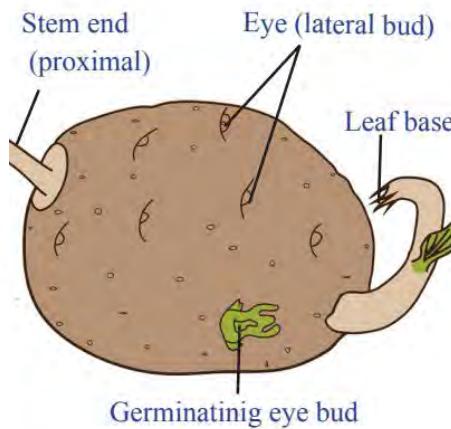
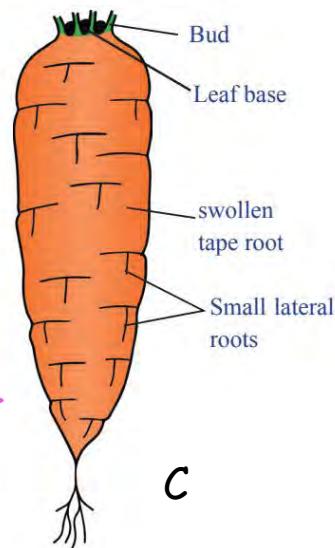
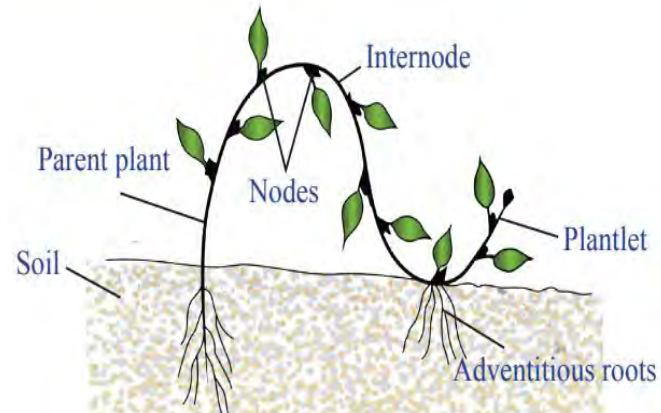
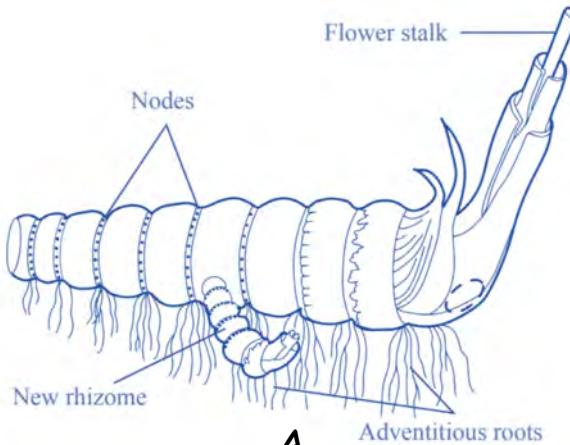
Natural vegetative propagation There are various plant structures through which natural vegetative propagation can occur. Vegetative structures that enable natural vegetation reproduction include rhizome, stolon, bulb, corm, tubers suckers, and bulbils.

Group activity:

Group activity:

Identifying & describing plant mechanisms of natural vegetative propagation

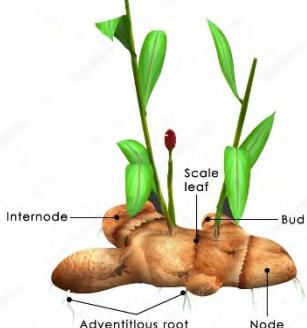
1 The figures below show the different mechanisms of natural vegetative propagation in plants. For each, identify the mechanism of natural vegetative propagation, describe how it leads to formation of new plants and outline examples of plants with that mechanism of vegetative propagation



2. You notice a plant in your garden that has spread and created a new plant through the growth of horizontal stems called runners. What method of natural vegetative propagation is this plant utilizing, and how does it benefit the plant?

Use your brain power!

1. You encounter a plant in a wetland area with underground stems called rhizomes.



Task: Identify the plant species and describe the role of rhizomes in its natural vegetative propagation. Discuss how rhizomes aid in the plant's adaptation to its environment and enhance its survival.

2. You attend a horticulture workshop and learn about a plant that produces miniature plantlets on its leaves.



Task: Identify the plant species and describe the process through which these miniature plantlets are formed. Discuss the significance of this method of natural vegetative propagation and how it contributes to the plant's ability to colonize new habitats.



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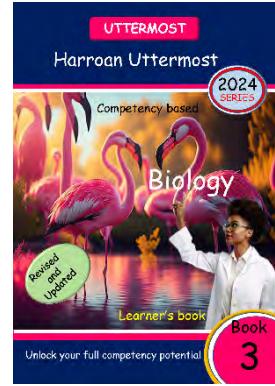
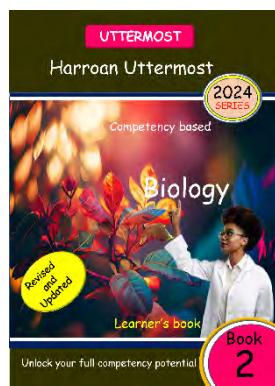
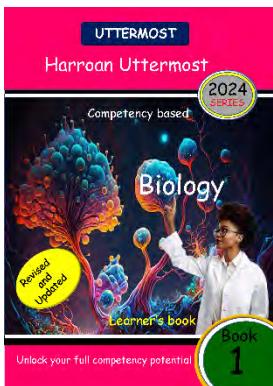


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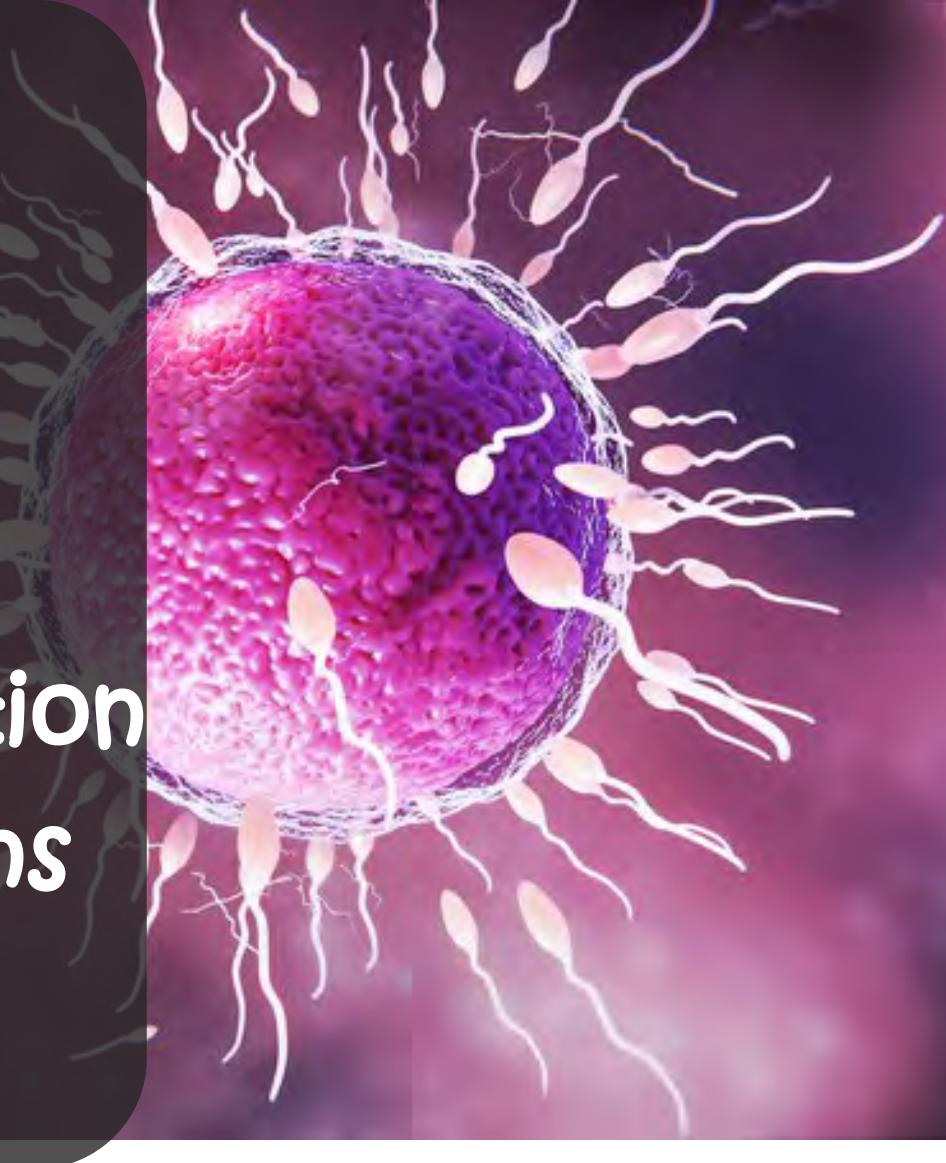
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Chapter 2

sexual Reproduction In Humans



By the end of this chapter, you should be able to;

- Define sexual reproduction and describe its importance in the life of organisms.
- Identify and label the reproductive organs and structures in both male and female organisms.
- Describe the functions of each reproductive structure in their respective roles in reproduction.
- Compare male and female gametes
- Describe the process of fertilization of an ovum and the developments of the zygote up to birth
- Describe the meaning and importance of antenatal medical care
- Outline health risks/complications associated with early/teenage pregnancy and abortion
- understand the common issues associated with reproductive systems
- analyse the challenges faced by people living with HIV/AIDS and how to overcome them.



2.1 Reproductive systems of humans.

Key question: identify the parts of reproductive systems and their functions

Reproductive systems in humans.

The continuity of a species is dependent on the increase in population through the process of sexual or asexual reproduction. Sexual reproduction involves the production of male and female gametes by individuals who have reached sexual maturity. This process is completed with the fertilisation of both gametes to create new life. The reproductive system in humans is a complex system responsible for the creation of new life. It is composed of organs and structures that work together to produce, transport, and nurture reproductive cells, as well as facilitate the union of sperm and egg for fertilization

Daily life connections

The knowledge of the reproductive system has practical implications in various aspects of daily life. It helps individuals understand their own bodies, reproductive health, and family planning. Additionally, it plays a crucial role in the fields of medicine, fertility treatments, sexual education, and reproductive technologies.



Description of Male Reproductive System

The male reproductive system consists of several organs that work together to produce and deliver sperm. The primary organs are the testes. **The testes** are the main reproductive organs. They are enclosed in a sac-like pouch called the scrotal sac or scrotum. They are oval in shape. They are found between the thighs, behind and below the penis. They hang outside the body to ensure that their temperature is lower than that of the body. Sperms develop better at a lower temperature than that of the body. Within the testes there are thousands of tube-like structures called seminiferous tubules. **Scrotal sac (scrotum)** is a poach like sac of skin that holds testis together. It hangs behind the penis. It is well supplied with nerves and blood vessels. Being outside it makes the temperature of the scrotum to be lower by about 2-3 degree centigrade compared to body temperature. This temperature is suitable for sperm production and storage.

Seminiferous tubules are small coiled tubules inside the testes. **Epididymis** is a long-coiled tube located at the back of each testicle. One end of epididymis is attached to the testis and the other to the sperm duct. The lining of the epididymis has cilia which propel the sperms forward. **Vas deferens** is long muscular tube also called the sperm duct. Vas deferens has a narrow lumen and muscular walls which contract during ejaculation, propelling sperms towards the urethra. **Penis** is a copulatory organ. The tissues of the penis are highly supplied with blood vessels. The penis has spongy tissues called erectile tissues in which the blood accumulates. When the spongy tissue is filled with blood, the penis becomes firm and erect. This enables the penis to penetrate into the vagina. The head of the penis is known as the glans which is very sensitive to stimulation. **The glans** is protected by the foreskin which is called prepuce. The foreskin is usually removed during circumcision to reduce the risk of STI's and STDs infection as well as for hygienic purposes.



Description of female Reproductive System

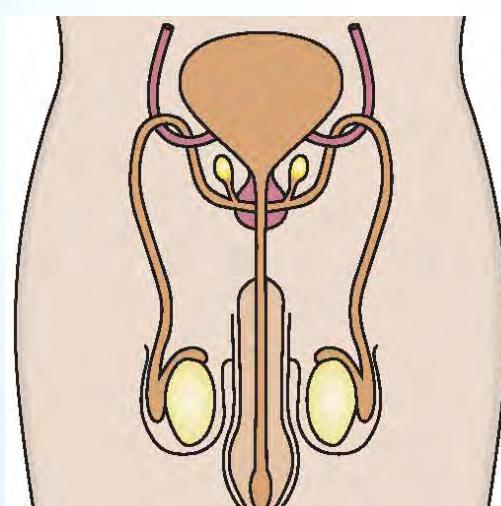
The female reproductive system includes organs that produce eggs (ova) and support fertilization, pregnancy, and childbirth. The main organs are the ovaries. They are oval-shaped cream-coloured organs found in the lower part of the abdominal cavity. There is one ovary on either side of the uterus. Ovaries are attached to the uterus by a membrane. Each ovary has two layers, an outer cortex and an inner medulla. The medulla has blood capillaries, nerve fibres and smooth muscles. The cortex has follicles. Each follicle consists of an immature ovum surrounded by epithelial cells. Fallopian tube (oviduct) is funnel-shaped at the end adjacent to the ovary. Uterus is a thick-walled muscular organ. The outer layer of the uterus is called myometrium and the inner layer is called endometrium. The uterus has elastic tissues that allow its expansion during development of foetus and can attain its original size after delivery. It is around 7.5 cm in length and 5 cm in width but it can enlarge four to five times of this size in order to accommodate the fully grown foetus. Cervix is a ring of muscles that closes the lower end of the uterus. Cervix separates the uterus from the vagina. The cervix is narrow to ensure that the embryo is not expelled from the uterus before the right time. During birth, the cervix expands to allow the baby to pass through into the vagina. Vagina is a muscular tubular structure that links the uterus to the outside of the body. Vagina is also called copulatory canal or birth canal. The vagina has elastic walls that stretch during sexual intercourse and during birth. The opening of the vagina is surrounded by flaps of tissue called labia which protect the vaginal opening. There are two sets namely labia majora and labia minora. Vulva is the external opening of the female genitalia that surrounds the opening to the vagina. Its walls contain vestibule glands.

Group activity:

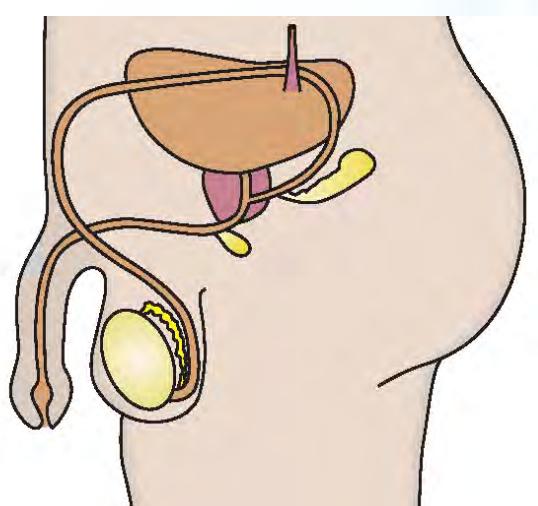
Group activity:

Identifying parts of a mammalian reproductive system

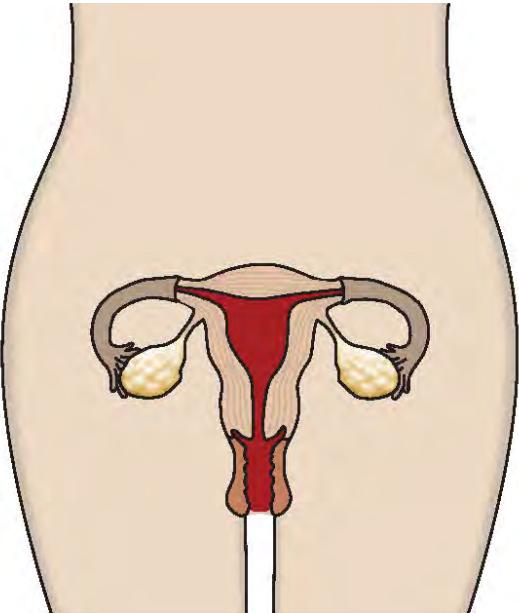
The figures below show the male and the female reproductive systems. For each, identify, label and name parts each stating their functions



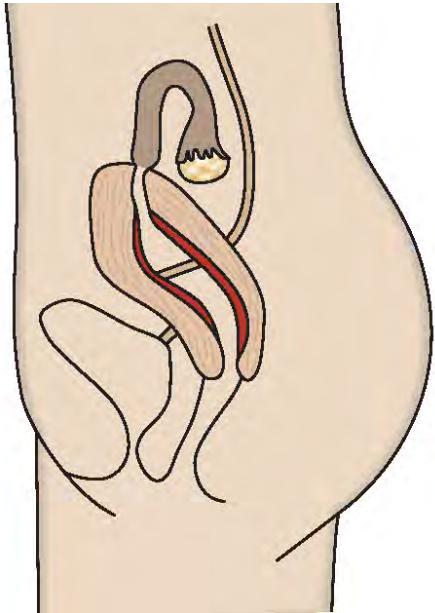
The front view of male reproductive system



The side view of male reproductive system



The front view of female reproductive system



The side view of female reproductive system



Use your brain power!

Jenni is a 30-year-old woman who wishes to conceive a child. She and her partner have been trying for several months without success. They are concerned about their reproductive health and want to understand the structure of the reproductive system. Sarah wants to know how the structure of the female reproductive system contributes to the process of fertilization and pregnancy. Discuss to Jenni the role of the ovaries, fallopian tubes, uterus, cervix, and vagina in the reproductive process and how they interact to support conception and pregnancy.



My notes

Answer template

This section is intended for you to write your answers in. It consists of 20 horizontal lines for notes or responses.



2.2 Menstrual Cycle

Key question: Describe the events which occur during menstruation period.

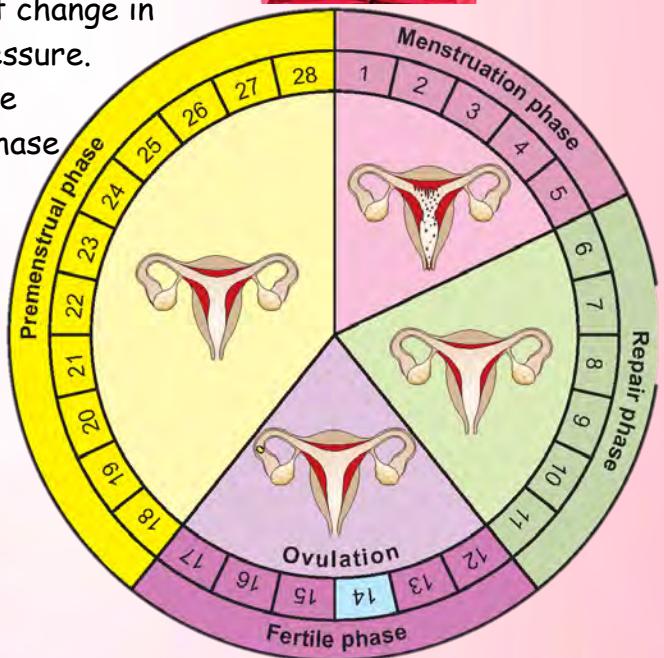
Menstrual cycle

The menstrual cycle is a natural process that occurs in females of reproductive age. It involves the monthly release of an egg (ovulation) and the shedding of the uterine lining (menstruation) in preparation for potential pregnancy. Understanding the menstrual cycle is important for reproductive health, family planning, and overall well-being. Women will undergo menstruation when they reach puberty. Menstruation marks the beginning of the menstrual cycle for each woman.

Menstruation is the breakdown of the lining of the uterine wall and discharge of blood through the vagina.

Menstrual cycle refers to a series of changes that occurs in the uterine wall and the ovaries. Menstrual cycle also involves the formation and release of mature ovum. Menstrual cycle is controlled by the brain and endocrine system which secretes hormones. Normally, a menstrual cycle lasts for 28 days and it differs for each individual. There are various factors that affect the menstrual cycle such as nutrient intake, abrupt change in body weight, emotional changes and mental pressure.

The figure on the right shows the phases in the menstrual cycle which includes menstruation phase, repair phase, fertile phase and premenstrual phase.



The menstruation of a female will stop when she reaches menopause which is around 48 - 55 years old.

Daily life connections

The menstrual cycle has various connections to daily life. It helps individuals track their fertility, plan for pregnancy or contraception, and understand their reproductive health. Additionally, knowledge of the menstrual cycle promotes awareness and empathy towards those experiencing menstruation, fostering a supportive environment.

Role of hormones in menstruation

Follicle stimulating Hormone (FSH): Stimulates follicle growth in the ovary, stimulates the release of oestrogen.

Luteinizing hormone (LH): Stimulates ovulation, Causes the formation of the corpus luteum, Stimulates the release of progesterone.

Oestrogen: Repairs and stimulates the thickening of the endometrium, stimulates follicle growth until it matures, Stimulates FSH and LH release prior to ovulation.

Progesterone: Stimulates the thickening of the endometrium, making it thick, folded and rich in blood vessels to prepare for the implantation of embryo, Stops the release of FSH and LH to prevent follicle growth and ovulation.

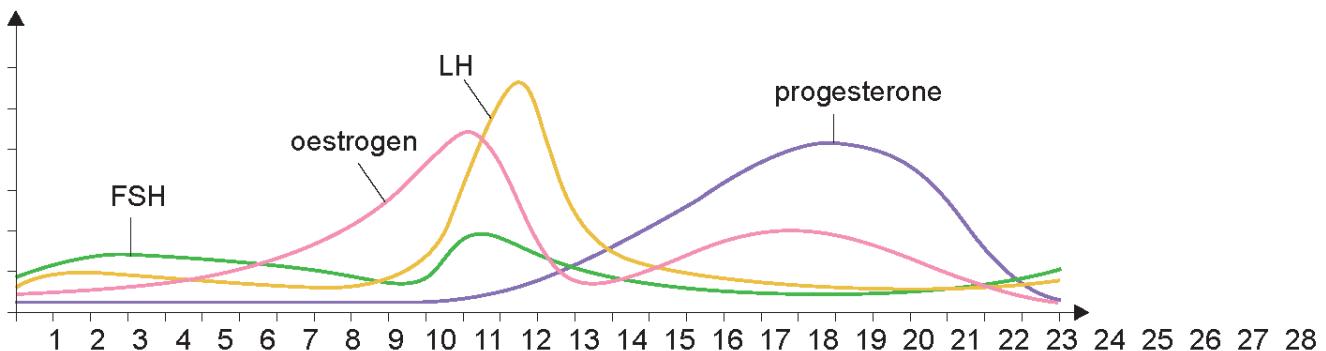
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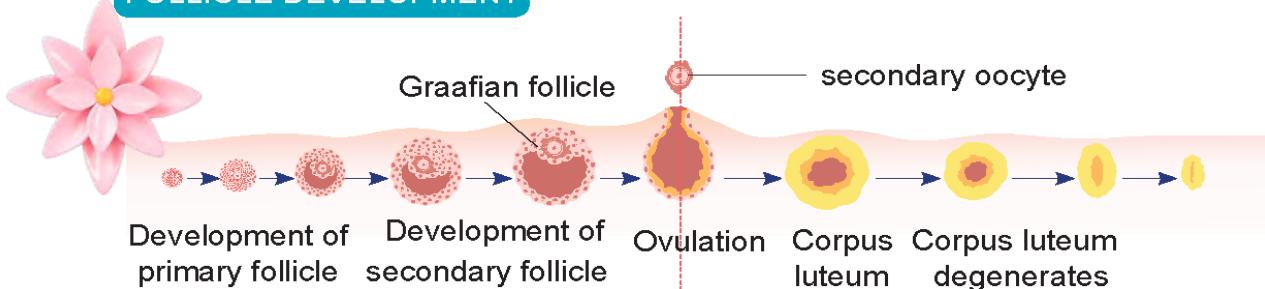
Describing the menstrual cycle events



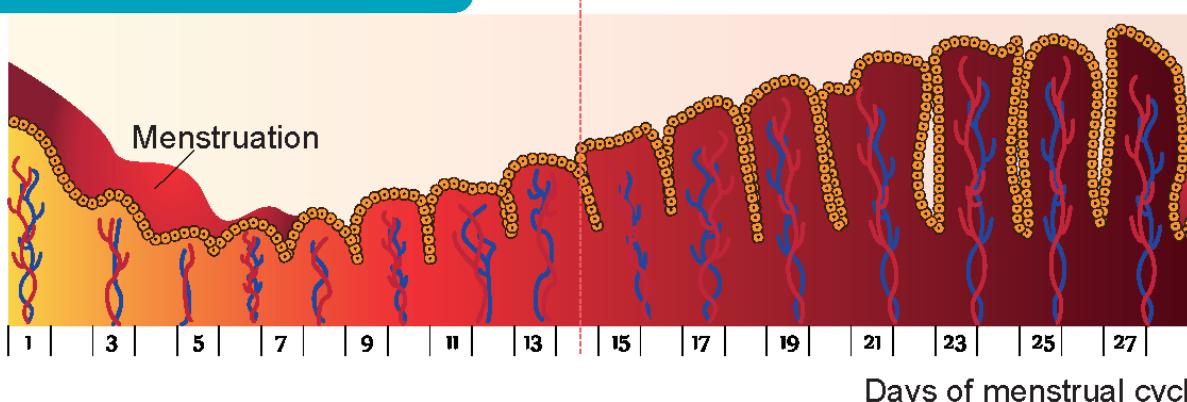
1. The graphs below show the events which occur during the menstrual cycle
- hormone level



FOLLICLE DEVELOPMENT



CHANGES IN ENDOMETRIAL THICKENING



1. Describe the events which occur during the menstrual cycle

Use your brain power!

Shantel is a teenager who has recently started menstruating. She wants to understand the importance of personal hygiene during menstruation and consequences of poor personal hygiene during menstruation. Explain to Shantel the potential risks and precautions associated with poor personal hygiene during menstruation and provide her with practical ways she can keep a good personal hygiene during menstruation.



My notes

Answer template

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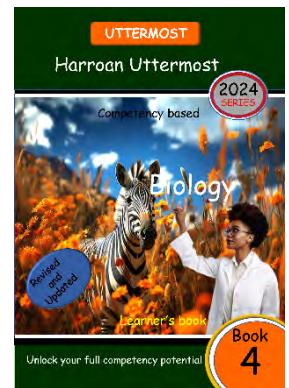
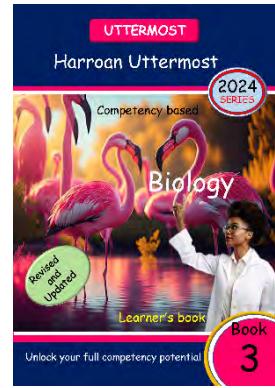
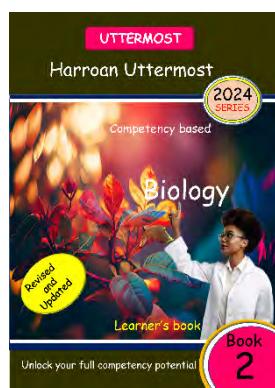
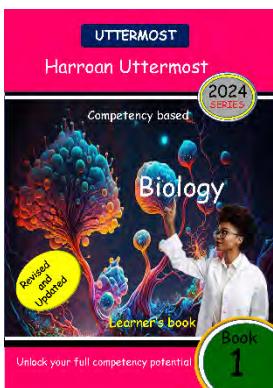


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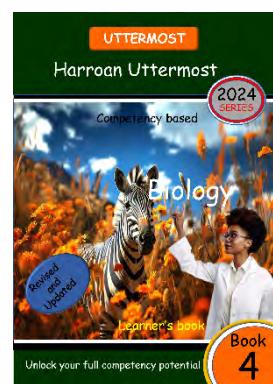
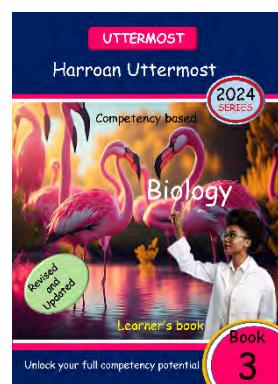
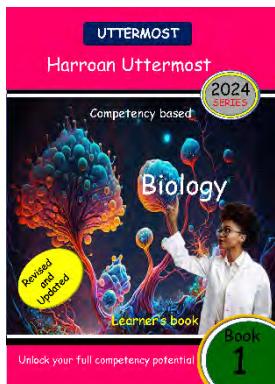
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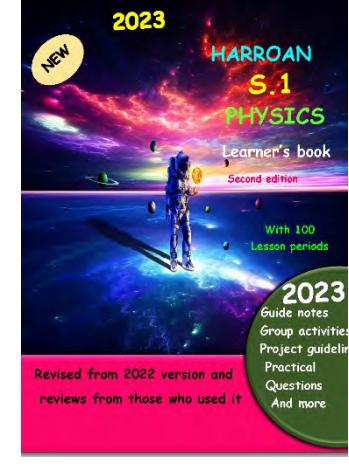
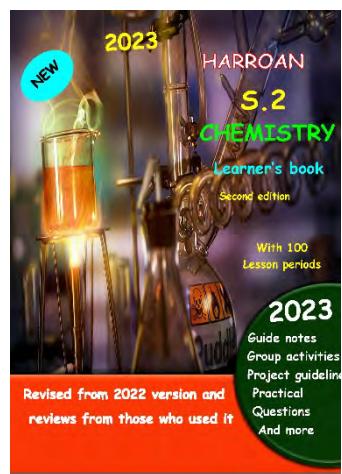
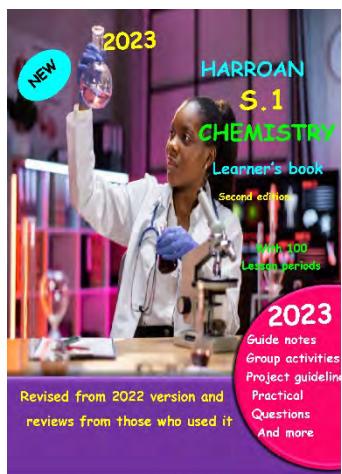
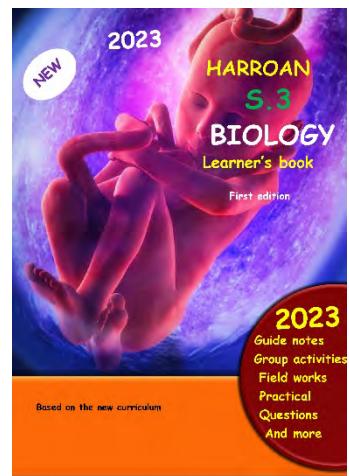
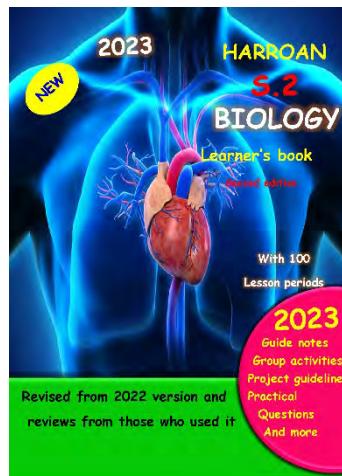


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Chapter

5

Genetics



By the end of this Chapter, you should be able to;

- Define genetics & common terms used in genetics
- Describe the importance of genetics in daily life
- Understand the concept of monohybrid inheritance
- Represent crosses in genetic diagrams
- Explain sex determination in humans
- Describe sex linkage in humans with relevant examples.
- Describe Mendel's laws of inheritance
- Explain the application of genetics in agriculture
- Explain the application of genetics in other industries.

5.2 Monohybrid inheritance

 Key question: Why did Mendel choose garden peas for his experiments?

Monohybrid inheritance

Monohybrid inheritance is the inheritance of single characteristic which is controlled by a single gene. Examples of this kind of inheritance include skin colour, hair texture or shape of an organism. Monohybrid inheritance results from monohybrid crossing. A monohybrid cross is a cross between two organisms with variations at one genetic locus of interest.

Mendel Experiments

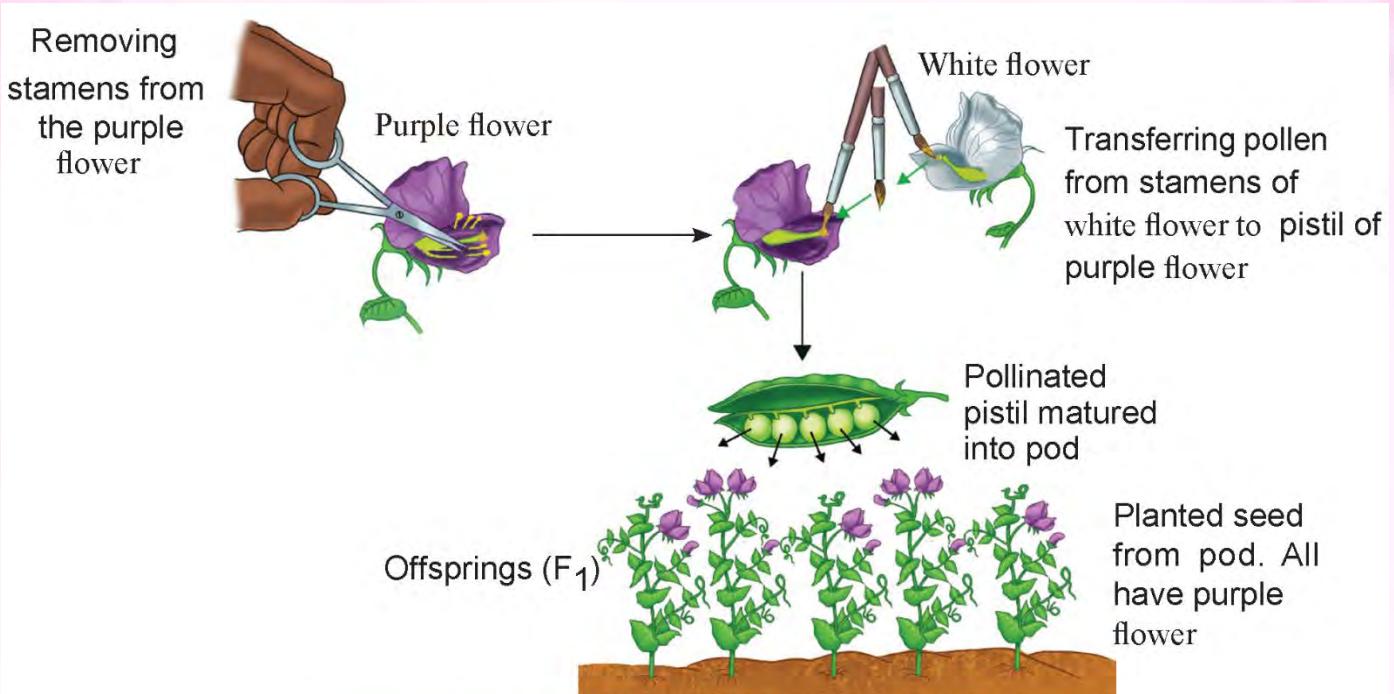
In 1856, Gregory Mendel began a series of experiments at the monastery to find out how traits are passed from one generation to next generation. At that time, it was thought that parents' traits were blended together in their offspring. Mendel discovered inheritance patterns by studying the common garden pea (*Pisum sativum*).

When doing his work, he selectively grew pea plants of different characteristics over many generations. He discovered that certain traits show up in offsprings without blending of parents' characteristics. Mendel demonstrated that heritable properties are transmitted in discrete units and are independently inherited. His experiments were based on seven distinct traits of peas. These were qualitative traits that could easily be measured and assigned value as dominant or recessive traits. These characteristics were visible and effectively used to study their effects in reproduction. The seven traits of the garden pea plants are shown in the picture below

	Flower color	Seed shape	Seed color	Pod color	Pod shape	Plant height	Flower position
DOMINANT							
RECESSIVE							

Mendel's procedure

In his experiments, Mendel chose pure line plants. He chose one trait to deal with at a time. He prevented self-pollination by wrapping or removing either the female or the male part of the flower, thus, leaving the possibility of cross-cross-pollination only. Peas can also be cross-pollinated by hand, by simply opening the flower buds to remove their pollen-producing stamen in order to prevent self-pollination and dusting pollen from one plant onto the stigma of another. In his experiment, Mendel opened the flower buds to remove stamen before they were ripe. He used pollen from another plant and dusted the pistil to effect crosspollination.



Mendel's procedures to carry out cross-pollination

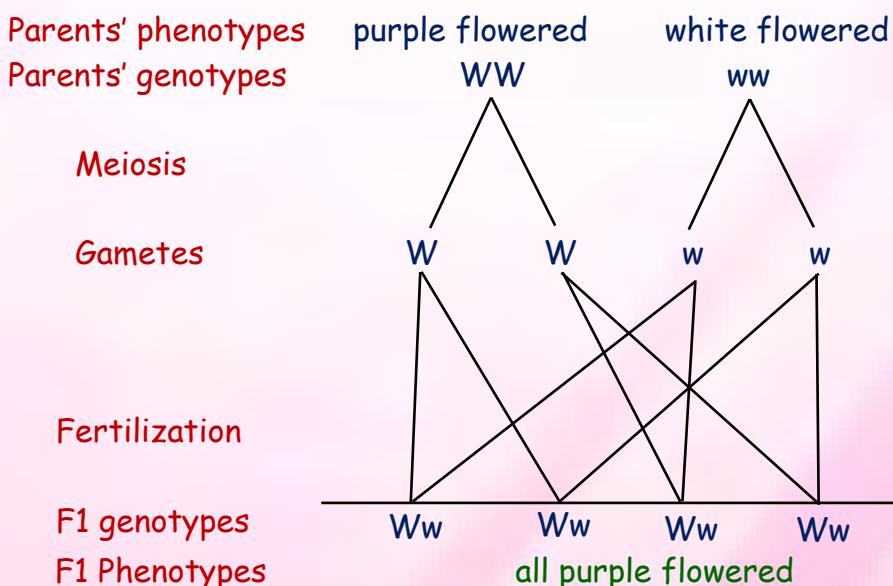
The result of his experiment showed that, only one character was phenotypically expressed in the first filial generation. When he allowed the F_1 generation to interbreed among themselves he obtained the F_2 generation which had a mixture of characters in the ratio of 3:1. Based on his experiments, Mendel recognized the phenomena of dominance and formulated the **principle of dominance**.

In the dominance principle, Mendel explained that in a pea plant with a pair of contrasting traits, its trait is determined by a **dominant inheritance factor** whereas another contrasting trait is determined by a **recessive inheritance factor**. The dominant inheritance factor suppresses the effect of the recessive inheritance factor. Hence, the recessive trait is not visible although its inheritance factor exists together with the dominant inheritance factor in a pea plant.

Constructing a cross to show the principle of dominance in crossing the purple flowered plants and white flowered plants shown in the picture above.

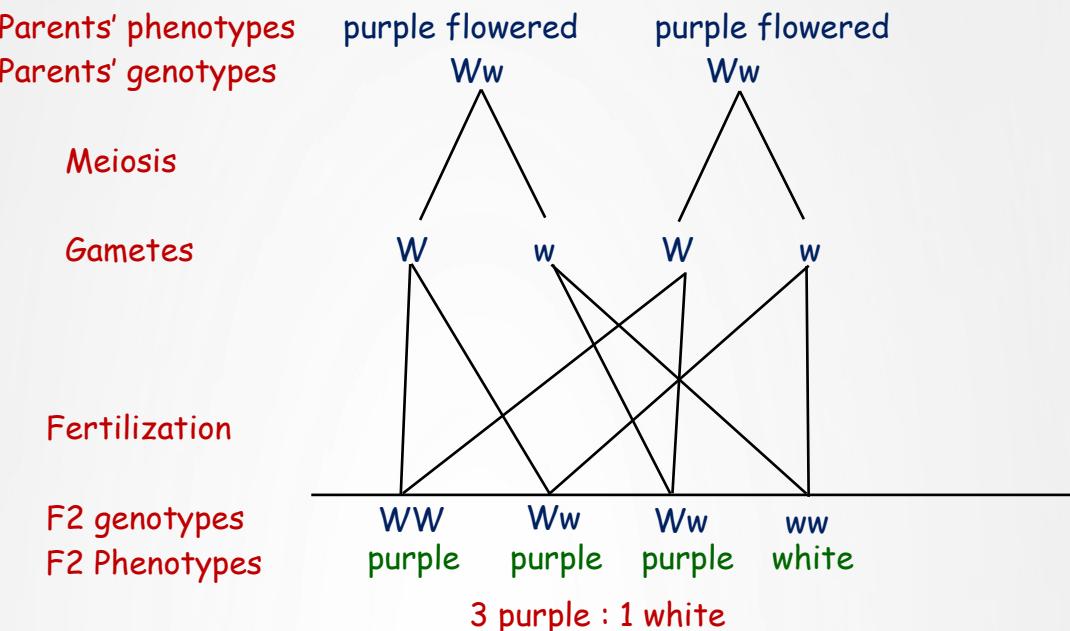
Let **W** represent the allele for purple

Let **w** represent the allele for white



All F1 generation had Ww genotype and all purple flowered phenotype. All plants were purple flowered because the allele W for purple is dominant over the allele w for white therefore, the purple allele suppressed the expression of the white allele in the phenotype of the F1 generation.

On selfing F1 generation, 3 purple flowered and one white flowered plant were obtained. The ratio of F2 generation Phenotypes is 3:1



Group activity:

1. Explain why Mendel chose garden peas for his experiments.
2. carry out crossings to show the results obtained by Mendel on crossing tall and short pea plants. Show results for F1 and F2 got from selfing F1 offsprings.
3. Carry out the beads activity below to illustrate monohybrid inheritance.

Aim To carry out an experiment using beads to illustrate monohybrid fertilisation by analogy

Apparatus Two black plastic bags, 100 red beads, 100 white beads

Analogy Red bead represents dominant allele for red-coloured flowers (R)

White bead represents recessive allele for white-coloured flower (r)

Procedure

Fertilisation between two heterozygous or hybrid plants of first filial generation F1:

- Place 50 red beads and 50 white beads into the first black plastic bag. This represents pea plants with coloured flowers which are heterozygous.
- Repeat step 1 with a different black plastic bag.
- Both plastic bags are shaken to mix the beads well.
- Without looking into the plastic bags, place a hand inside the first plastic bag and remove one bead. Remove another bead from the second plastic bag.
- Place both beads on the table. Both beads represent combination of two gametes.
- Record the probability of genotype and phenotype in F2 generation in a table.
- Return the two beads into their respective plastic bags.
- Ensure that the beads are returned to the correct bags.
- Repeat steps 3 to 7 for a total of 50 times.
- Count the total combinations of genotype and phenotype that are produced.

Discussion

1. Which type of inheritance is shown by the characteristic studied in the above experiment?
2. (a) Is the result obtained in accordance with the expected ratio of 3:1?
(b) Explain your answer.
3. Why is the bead returned into its plastic bag after each observation was recorded?
4. Suggest ways to improve the accuracy of the experiment



Use your brain power!

3. Some of your friends think that Genetics is a dull, boring, not interesting, so hard and irrelevant in daily life. They always sleep in genetics lessons and complain that it's hard and wastes time. Explain to your friends how genetics is important in daily lives & how they have been encountering it in their societies.

My notes

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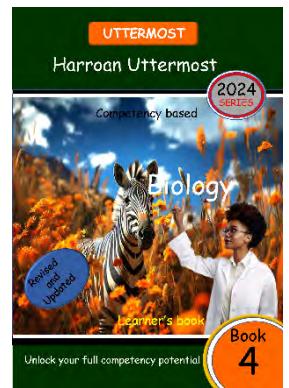
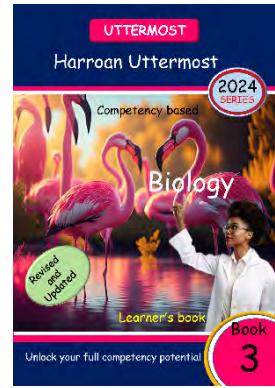
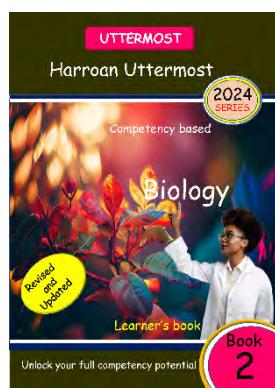
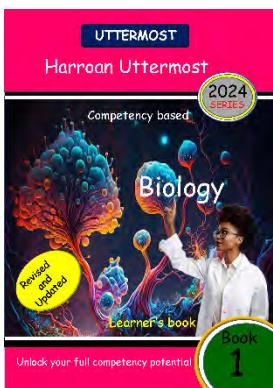


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Chapter

9

Human and natural environment



By the end of this Chapter, you should be able to;

- Define environmental sustainability
- Describe the importance environmental sustainability
- Outline natural resources in Uganda
- Outline renewable and non-renewable resources
- Describe natural factors and human influences that may have impacts on ecosystem.
- Make suggestions about how to preserve the natural environments for all living things
- Understand the sources, effects, and control of air pollution.
- Understand the sources, effects and control of water pollution.
- Understand the sources, effects and control of water pollution.

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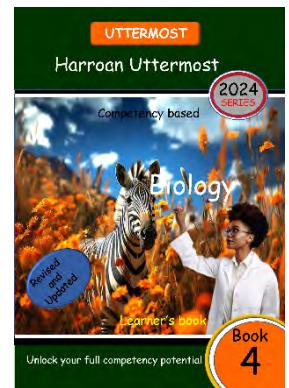
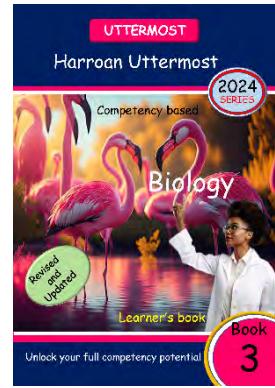
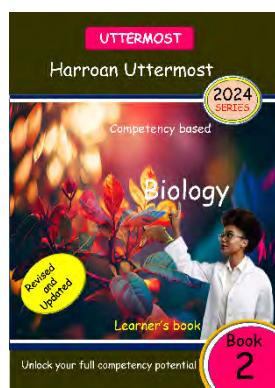
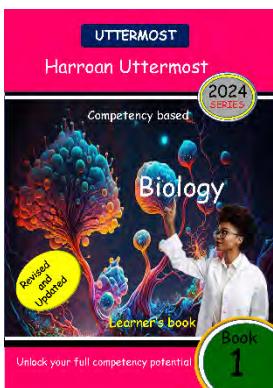


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