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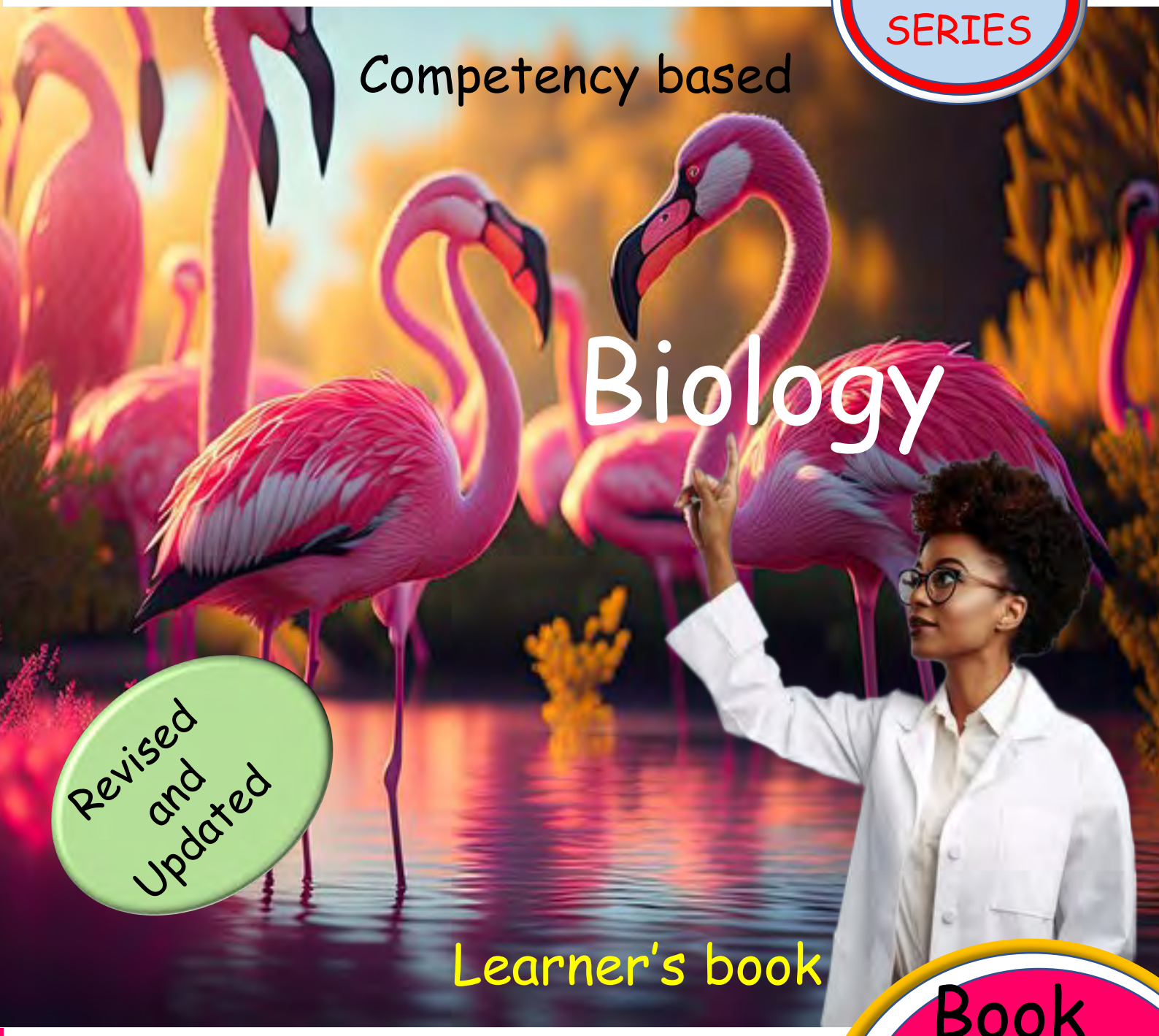

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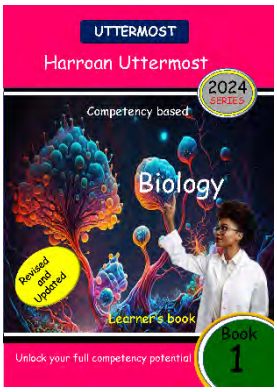

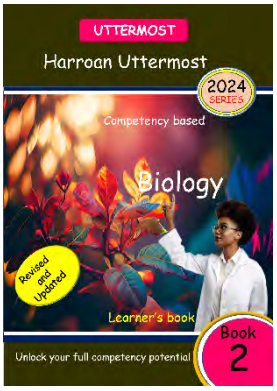

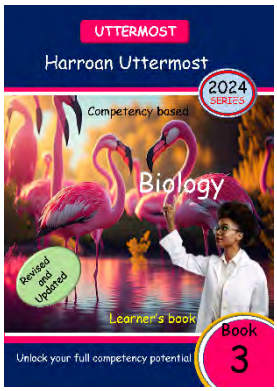

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Chapter 1

Gaseous exchange

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

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- Appreciate the need for gaseous exchange in organisms
- Identify gas exchange surfaces and their adaptations
- Understand the human respiratory system and gaseous exchange in humans
- Understand the dangers of smoking and air pollution
- Identify the diseases of the respiratory system; their causes, symptoms and treatment.
- Understand the concept of gaseous exchange and its importance in maintaining the respiratory systems of organisms.
- Identify and describe the different respiratory structures and mechanisms found in various organisms, including humans, plants, and aquatic organisms.

1.1 Need for gaseous exchange

Introduction

Have you ever wondered how your body gets the oxygen it needs to function properly? Or why you feel out of breath after running or playing sports for a while? It's all because of a fascinating process called gaseous exchange that happens inside our bodies. Every time you take a breath, you are inhaling oxygen from the air around you. This oxygen travels deep into your lungs, where it is exchanged with carbon dioxide, a waste product produced by your body's cells. This exchange is vital for your body's overall health and functioning.

Imagine you are participating in a race, running as fast as you can to reach the finish line. As your muscles work harder and demand more energy, your body needs extra oxygen to produce that energy. Your heart rate and breathing rate increase to supply oxygen-rich blood to your muscles, ensuring they have the fuel they need. Gaseous exchange plays a crucial role in this process, delivering oxygen to the working muscles and removing the carbon dioxide they produce.

These scenarios show how gaseous exchange is not just something that happens inside our bodies; it is directly linked to our daily activities and the ways our bodies respond to different situations. By understanding this process, we can appreciate how crucial it is for our overall health and the benefits it brings to our everyday lives.

Key question: why is gaseous exchange necessary in organisms?

Guide notes

Gaseous exchange and breathing

Breathing is a fundamental process that allows our bodies take in and bring out gases. Gaseous exchange is the process by which gases move passively by diffusion across a surface, for example, the exchange of oxygen gas and carbon dioxide gas across the respiratory surface. In humans, gaseous exchange involves the exchange of oxygen and carbon dioxide between the lungs and the blood, as well as between the blood and body's cells.

When we breathe in, we inhale air containing oxygen through our nose or mouth. This air travels through the trachea and into the lungs, where it reaches millions of tiny air sacs called alveoli. The alveoli are surrounded by a network of tiny blood vessels called capillaries. Here's the connection: The primary function of breathing is to ensure that fresh oxygen enters our lungs, while at the same time, removing waste carbon dioxide from the body. This continuous inhalation and exhalation process is essential for maintaining the right balance of oxygen and carbon dioxide in our bloodstream. Therefore, breathing ensures that gaseous exchange occurs efficiently.

Differences between gaseous exchange and ventilation.

Gaseous exchange	Breathing/ventilation
It occurs along a gas exchange surface	It occurs along the body and a respiratory organ
It doesn't involve action of muscles	It involves action of muscles
It occurs by simple diffusion and doesn't involve the use of energy	It involves the use of energy

Gaseous exchange between plants and animals

Plants and animals exhibit interdependence in their gaseous exchange, with each relying on the byproducts of the other for survival. During photosynthesis, plants utilize carbon dioxide released by humans and other animals for their own growth and in turn release oxygen as a byproduct. This oxygen is crucial for our respiration. Humans need oxygen for their metabolism and release carbon dioxide as a waste product. This carbon dioxide is absorbed by plants, completing the cycle. In summary, plants and animals are interdependent when it comes to gaseous exchange. While plants produce oxygen and remove carbon dioxide through photosynthesis, animals utilize this oxygen and release carbon dioxide during respiration. This mutual exchange of gases is vital for the survival and well-being of both plants and animals.

Group activity:

Group activity:

1. Explain why organisms need gaseous exchange.
2. Why do people carry oxygen in tanks when swimming beneath a water body.
3. Imagine you are in a crowded room with poor ventilation. Explain how inadequate gaseous exchange can affect your overall health and well-being.

Use your brain power!

You and your team are embarking on a challenging mountain expedition, reaching high altitudes where oxygen levels are significantly lower.

TASK

Write a short essay explaining how the low oxygen level at high altitudes affects the human body during a mountain expedition. Support your answer with relevant scientific concepts and describe the adaptations that occur in the body to cope with the lack of oxygen.

1.2 Gaseous exchange surfaces.

Key question: what are the characteristics of a good gas exchange surface & how does each ensure efficient gaseous exchange?

Guide notes

Unicellular organisms carry out gaseous exchange by diffusion across the cell membrane. Large organisms cannot carry out diffusion efficiently, instead they have well developed and specialised structures for gaseous exchange called respiratory surfaces or gaseous exchange surfaces. Gaseous exchange surfaces play a vital role in the respiratory systems of both plants and animals. These surfaces allow for the exchange of gases, such as oxygen and carbon dioxide, which are essential for the survival and functioning of living organisms. A gaseous exchange surface is a site within a respiratory organ of an organism where gaseous exchange occurs.

Why unicellular organisms don't need gaseous exchange surfaces?

Unicellular organisms, such as bacteria and amoeba, are single-celled organisms that lack specialized gas exchange surfaces. Due to their small size and simple structure, they have a large surface area to volume ratio which allows gases to pass in and out of their cell membranes through the process of simple diffusion. Oxygen can diffuse into the cell, while carbon dioxide, a waste product of cellular respiration, diffuses out. A daily life connection to the simplicity of gas exchange in unicellular organisms can be observed through the example of bacteria. Bacteria are ubiquitous and can be found in various environments, including the soil, water, and even on our skin. Despite lacking complex respiratory systems, bacteria can survive and thrive by relying on their direct gas exchange with the surrounding environment. This is why bacteria can live in diverse habitats ranging from deep-sea hydrothermal vents to acidic hot springs

Multicellular organisms and gaseous exchange

Multicellular organisms, such as insects, animals, and plants, have larger bodies with complex structures and organs. Their increased size and greater metabolic demands make simple diffusion inadequate for efficient gas exchange. Therefore, they have evolved specialized respiratory structures, such as lungs, gills, tracheal systems, or stomata, to facilitate the exchange of gases throughout their bodies. Multicellular organisms have specific respiratory structures that enhance their ability to obtain and distribute oxygen efficiently. These structures provide a larger surface area for gas exchange, ensuring that oxygen can be transported to all cells while carbon dioxide is effectively removed. For example, animals have lungs or gills that contain numerous small air sacs or filaments, respectively, to maximize gas exchange. Insects rely on tracheal systems

A daily life connection to the necessity of specialized gas exchange surfaces in multicellular organisms can be observed through the example of humans. Humans have complex lungs in their respiratory system that enable efficient gas exchange. Our lungs have a large surface area provided by numerous tiny air sacs called alveoli.

Examples of gaseous exchange surfaces in animals.

Animal	Gaseous exchange surface
Birds	Alveoli
Reptiles	Alveoli
Mammals	Alveoli
Fish	Gill filaments
Insects	Tracheae
Amphibians	Skin, buccal cavity lining and lungs

Group activity:

Group activity:

Examining sites of gaseous exchange in various organisms

What you need: insects, fish, a variety of leaves, hand lens, and pencil

Procedure

- Collect various organisms from the environment.
- Observe the organs for gaseous exchange in the collected organisms using a hand lens.

Observing organs and structures for gaseous exchange

Questions

1. Compare organs of gaseous exchange in different organisms. Give similarities and differences in a tabular form.

2 a) Outline the characteristics of a good gaseous exchange surface.

b) Explain how the gaseous exchange surfaces are adapted to perform their functions

3 a) Draw a well labelled drawing of a respiratory organ of a fish. Your drawing should include a title, magnification & should be neat

b) Explain how the gills of a fish are adapted to perform their function

4. a fisherman catches a fish and keeps it out of water for an extended period. What impact does it have on the fish's ability to extract oxygen.

Use your brain power!

1. A group of fishermen catches a large fish and places it on the deck of their boat.

Task: Write a scientific explanation summarizing the potential consequences of removing the fish from its aquatic environment for an extended period and discuss the impact on its gas exchange processes the fish's overall physiology and survival.

2. A group of tourists catches fish from a river and keeps them alive in a bucket for a few hours before releasing them

Task: Evaluate how prolonged confinement in a bucket affects the fish's gas exchange surfaces and overall health. Suggest best practices for tourists engaging in catch-and-release activities to ensure minimal harm to the fish.

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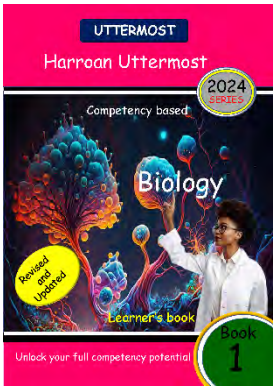

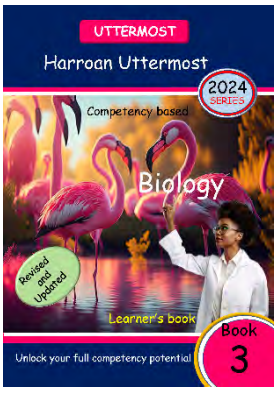

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1.5. Making a lung model.

Key question: Explain breathing in humans using your made model

Demonstrating the mechanism of breathing in man using a model.

Materials; plastic (bottle with a cap), 2straws, scissors, 3balloons, push pins, tape.

Procedure;

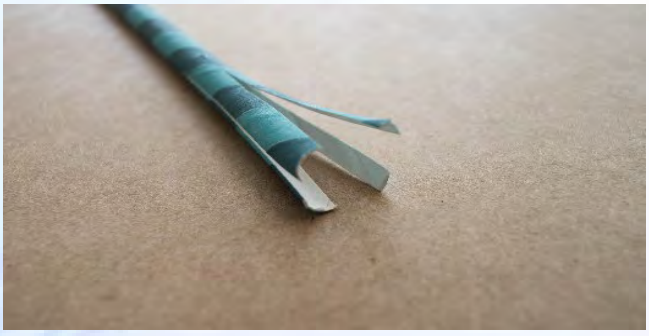
1. Gather your materials

2. Cut the necks of two of the balloons

3. Cut one straw in half

4. Then attach one balloon to each straw half. Use tape to seal it off. These will be your lungs.

5. Take the other straw and make a 5cm cut on one end so that it is split in half.
Flip the straw around and make two 5cm cuts on the other end so that it is split into four.



6. Tape one "lung" on the either side of the two way split straw.

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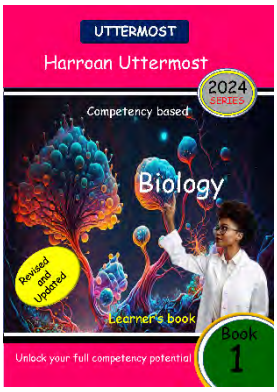

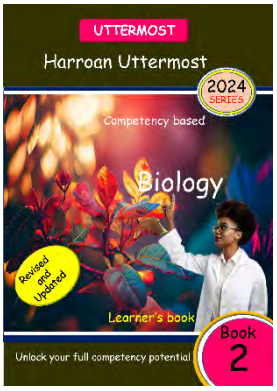

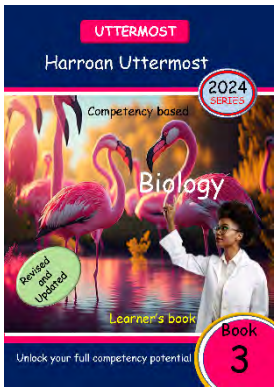

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Chapter 2

Aerobic and anaerobic respiration.

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

- Appreciate the importance of respiration
- State the sites of aerobic and anaerobic respiration
- Describe the relationship between aerobic respiration and photosynthesis.
- Carry out experiments in relation to aerobic and anaerobic respiration
- Describe applications of anaerobic respiration
- Compare aerobic and anaerobic respiration

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2.1 The process of respiration

Introduction

Take a deep breath. Did you know that every breath you take is part of a remarkable process that keeps you alive? Welcome to the fascinating world of respiration. Respiration is not just a concept confined to textbooks; it is a fundamental process that impacts our daily lives and is connected to our very survival. From the moment we wake up in the morning to the time we go to bed at night, respiration is constantly at work, enabling us to carry out even the most basic of activities.

Respiration is a complex biological process that occurs at the cellular level. It involves the breakdown of organic molecules, such as glucose, to release energy in the form of ATP (adenosine triphosphate). But how does respiration relate to our daily lives? Let's explore a few examples that illustrate the significance of this biological process in our everyday routines.

1. Imagine yourself engaging in physical exercise, such as playing a sport or cycling. As you exert yourself, your muscles require more energy. In response, your body increases its breathing rate to provide the necessary oxygen for the production of ATP. This increased respiration assists you in meeting the energy demands of exercise.

2. Another scenario to consider is when you're enjoying a meal. While you eat, your digestive system breaks down the food into smaller molecules, which are then absorbed into the bloodstream. But how does this food get converted into the energy needed to power your body? It is through the process of respiration that the glucose molecules derived from food undergo a series of intricate chemical reactions, releasing energy in the form of ATP. This energy is vital for carrying out essential bodily functions, such as the beating of your heart or the synthesis of new molecules.

Key question: how is energy got from respiration used in daily life?

Importance of energy produced during respiration in the body.

- Energy is required for the contraction of muscle cells to create movement
- Movement of food along the alimentary canal by peristalsis.
- Building up of amino acids and proteins.
- Growth of an organism through formation of new cells.
- Conduction of electrical impulses by nerve cells.
- Active transport of molecules along the cell membrane.
- Digestion of food.
- The process of cell division to create new cells.

Group activity:

1. Describe how the energy got from respiration is used in daily life. Describe as many ways as you can.

2. During a biology class, a student asks for examples of everyday activities where the importance of energy obtained from respiration can be observed. However, multiple students are having trouble relating this concept to their daily lives. How would you address the challenge of connecting the importance of energy produced by respiration to everyday activities for students who are struggling to make the connection? Provide suitable examples that will resonate with their daily lives, and discuss the relevance of respiration and energy production in each example.

Use your brain power!

3. A person is experiencing constant fatigue and lack of energy throughout the day. They have a sedentary lifestyle and consume a diet high in processed foods. Explain how the energy obtained from respiration plays a crucial role in their overall well-being and suggest lifestyle changes to improve their energy levels.

4. A professional athlete is training for an upcoming competition. She has been following a strict diet and exercise regimen but is still struggling to improve her performance. Discuss the significance of energy obtained from respiration in athletic performance and provide recommendations to optimize her energy production during training.

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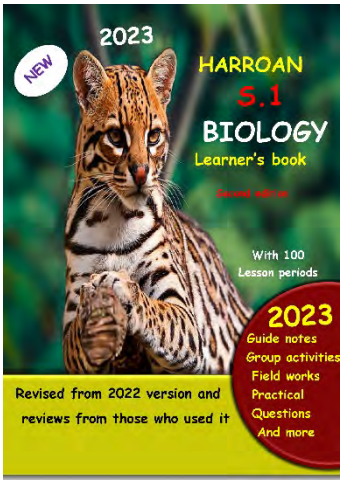

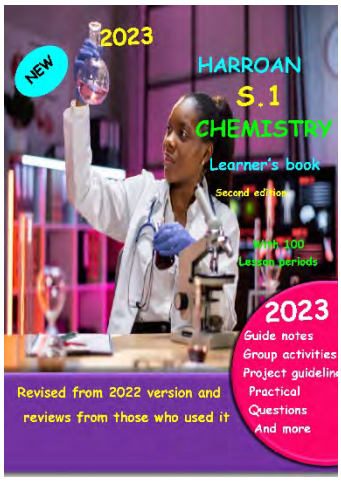

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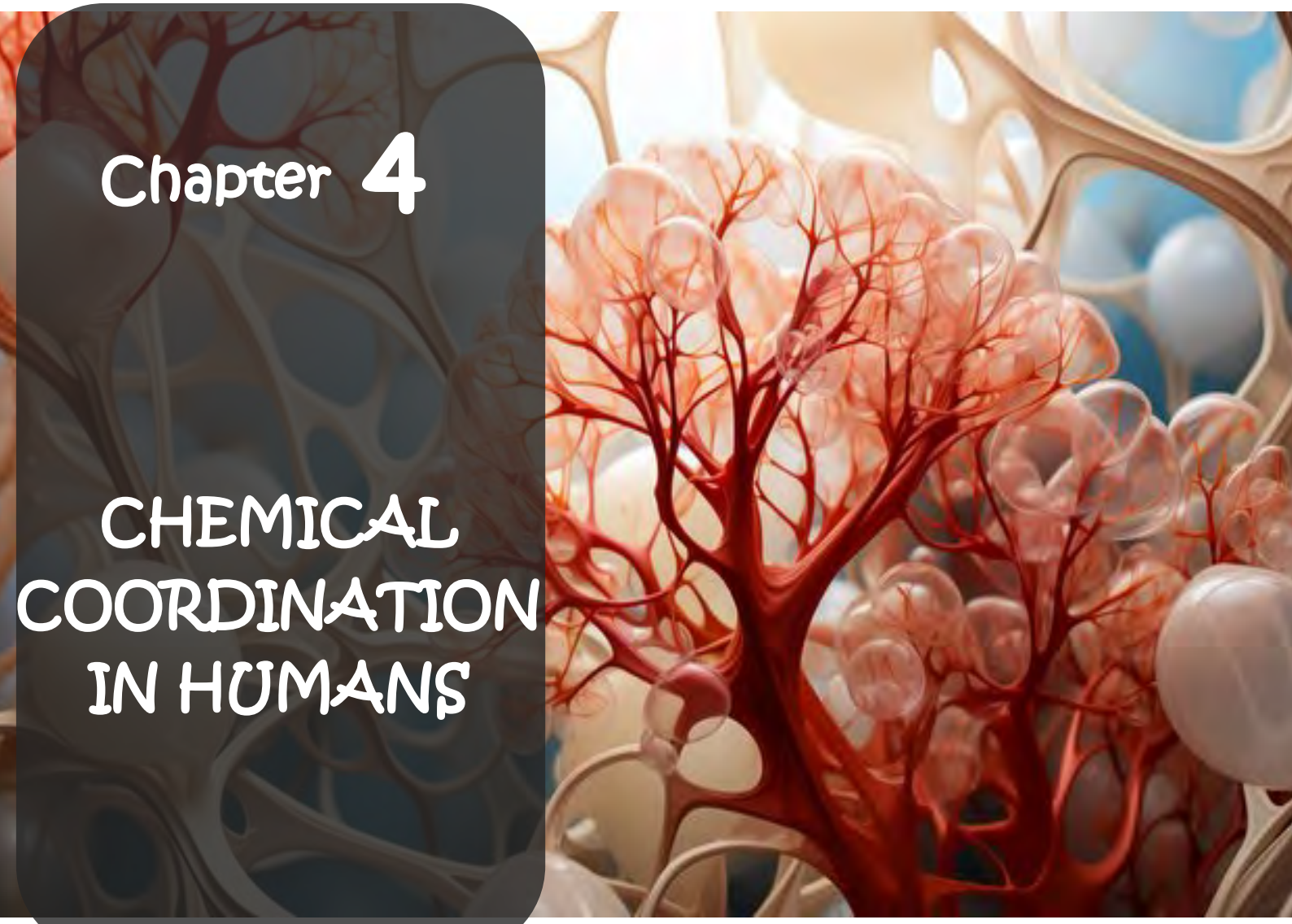

Chapter 4

CHEMICAL COORDINATION IN HUMANS

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

- Differentiate between an enzyme and hormone
- Describe the effects of hormones to the body
- Describe causes of hormonal disorders
- Appreciate the role of diet in managing hormonal disorders
- Describe the interrelation between enzymes and hormones using examples.

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4.1. Hormones and enzymes.

Introduction

Have you ever wondered why you feel hungry or thirsty? Or why your heart rate increases during exercise? These are just a few examples of how chemical coordination plays a role in our everyday lives. Hormones help regulate our appetite and thirst levels, and they also control our heart rate and other bodily functions necessary for survival.

Chemical coordination is the coordination which occurs with the help of hormones.

Hormones are organic chemicals produced by the body and released into the blood.

Hormonal coordination, governed by the endocrine system, is a network of glands and hormones that work in harmony to regulate our body's functions and maintain internal balance. Throughout your day, hormones play a fundamental role in maintaining equilibrium in various bodily processes. When you enjoy a satisfying meal, hormones released by the pancreas, such as insulin, allow your body to effectively process and convert the food into energy. In moments of stress or danger, your body's stress response kicks into gear through the release of hormones like adrenaline from the adrenal glands. This immediate hormonal coordination prepares your body for a quick response, sharpening your focus, increasing your heart rate, and boosting your energy levels.

Key question: compare enzymes and hormones in terms of structure and function

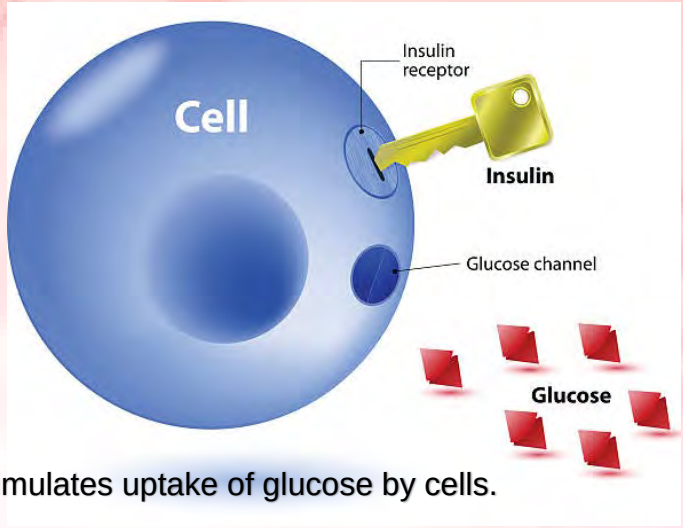
Hormones

A hormone is a chemical messenger that controls the activities of a target organ to ensure the normal functioning of a system. They are released into the bloodstream and travel to target cells or organs where they bind to specific receptors. Hormones play a crucial role in regulating and coordinating numerous bodily functions.

Some examples of hormones.

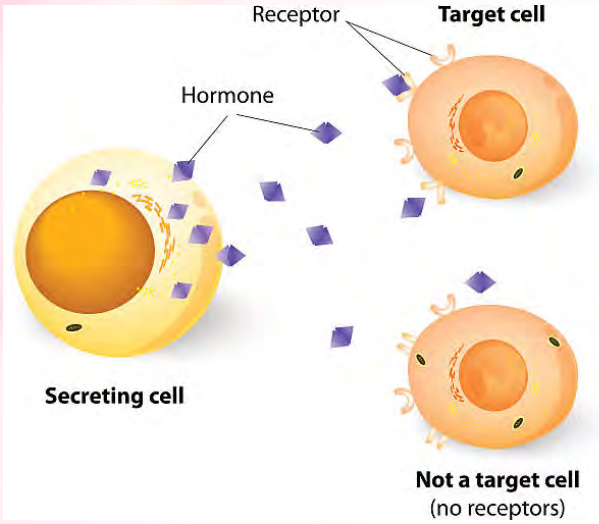
- Insulin: Produced by the pancreas, insulin regulates blood sugar levels by promoting the uptake of glucose from the bloodstream into cells.
- Thyroid Hormones (T3 and T4): Secreted by the thyroid gland, these hormones regulate metabolism, growth, and development.
- Estrogen and Testosterone: These sex hormones are responsible for the development of secondary sexual characteristics and reproductive functions.
- Adrenaline: Released by the adrenal glands during stress or emergencies, adrenaline prepares the body for a fight-or-flight response.

Hormones are used in; sleep, metabolism, stress indicators, respiration, excretion, reproductive growth and development.



Insulin stimulates uptake of glucose by cells.

How do hormones function?



Hormones act as messengers which are released into blood.
Blood transmits them to various organs and tissues of the human body. After reaching a target organ, hormones bind to receptors. Once this is complete, hormones then transmit the message which causes an organ or tissue to perform a specific action.

.

Enzymes

An enzyme is a chemical substance protein in nature produced by living cells that speeds up the rate of a chemical reaction. Examples of enzymes include: Salivary amylase, pepsin, renin, trypsin peptidase. Etc.

Group activity:

Group activity:

1. Outline the characteristics of:
   i) hormones ii) enzymes
2. Compare enzymes and hormones give differences and similarities

Use your brain power!

Michael, a diabetic patient, experiences high blood sugar levels even after adhering to his medication regimen. He wonders how hormones and enzymes might be involved in glucose regulation. How do hormones and enzymes interact to regulate glucose levels in the body? Which hormones are responsible for stimulating the enzymes involved in glucose regulation and what could be causing Michael's persistent high blood sugar levels?

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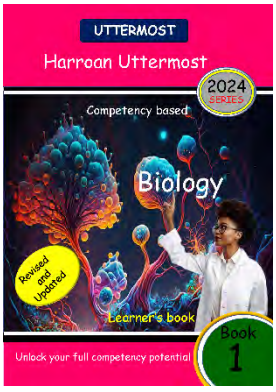

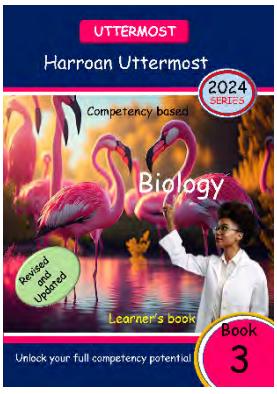

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4.6. Roles of hormones in reproduction and puberty.

Key question: Identify the hormones which control reproduction and puberty

Hormones in human reproduction.

Hormones are the drivers of human reproduction, responsible for sexual development and controlling the menstrual cycle. Sex hormones are responsible for driving sexual development (puberty). The main reproductive hormones are oestrogen and testosterone. Oestrogen causes eggs to mature in ovaries once a girl reaches puberty. These are released at regular intervals during the menstrual cycle. Testosterone stimulates sperm production in males.

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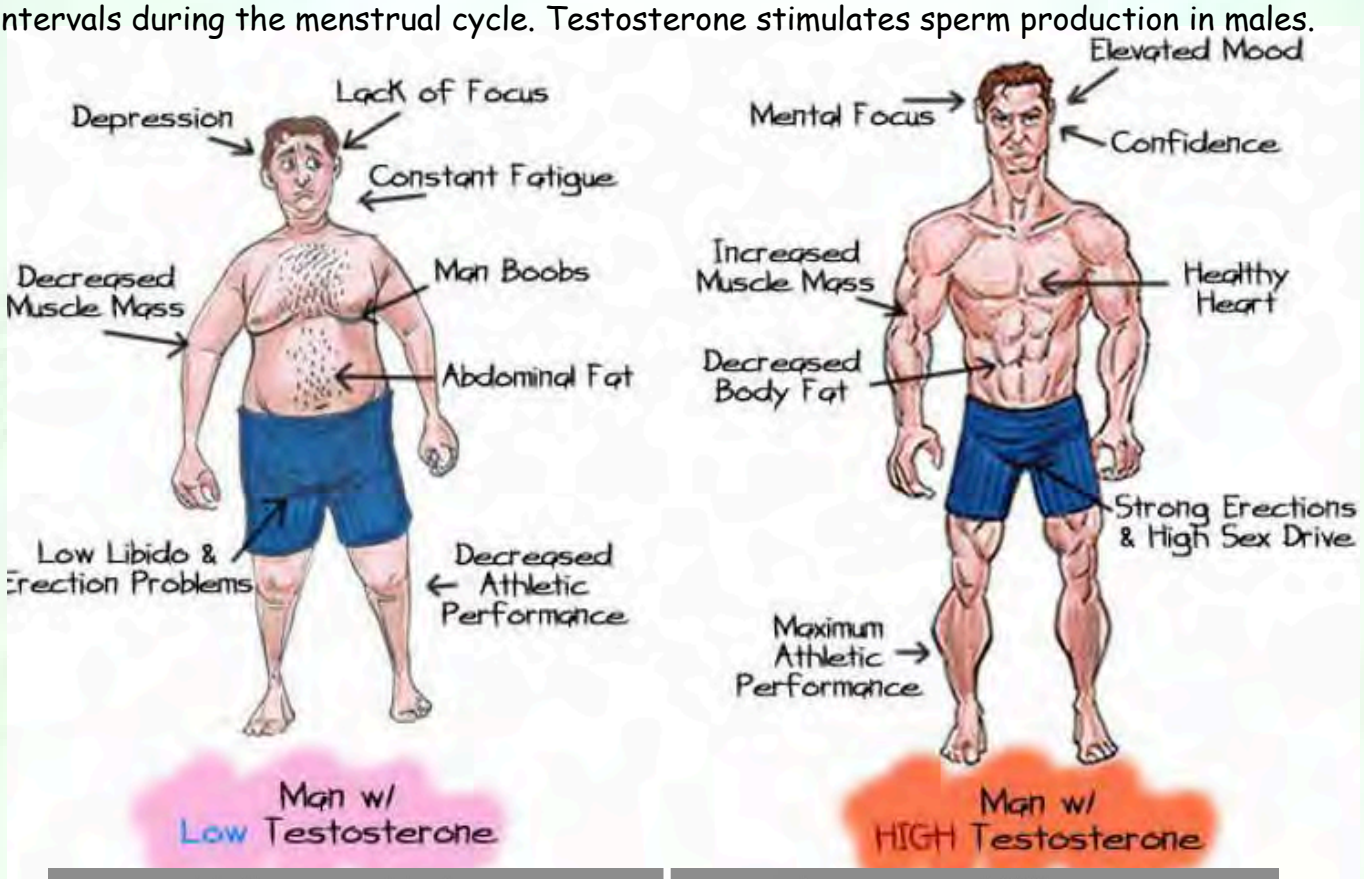

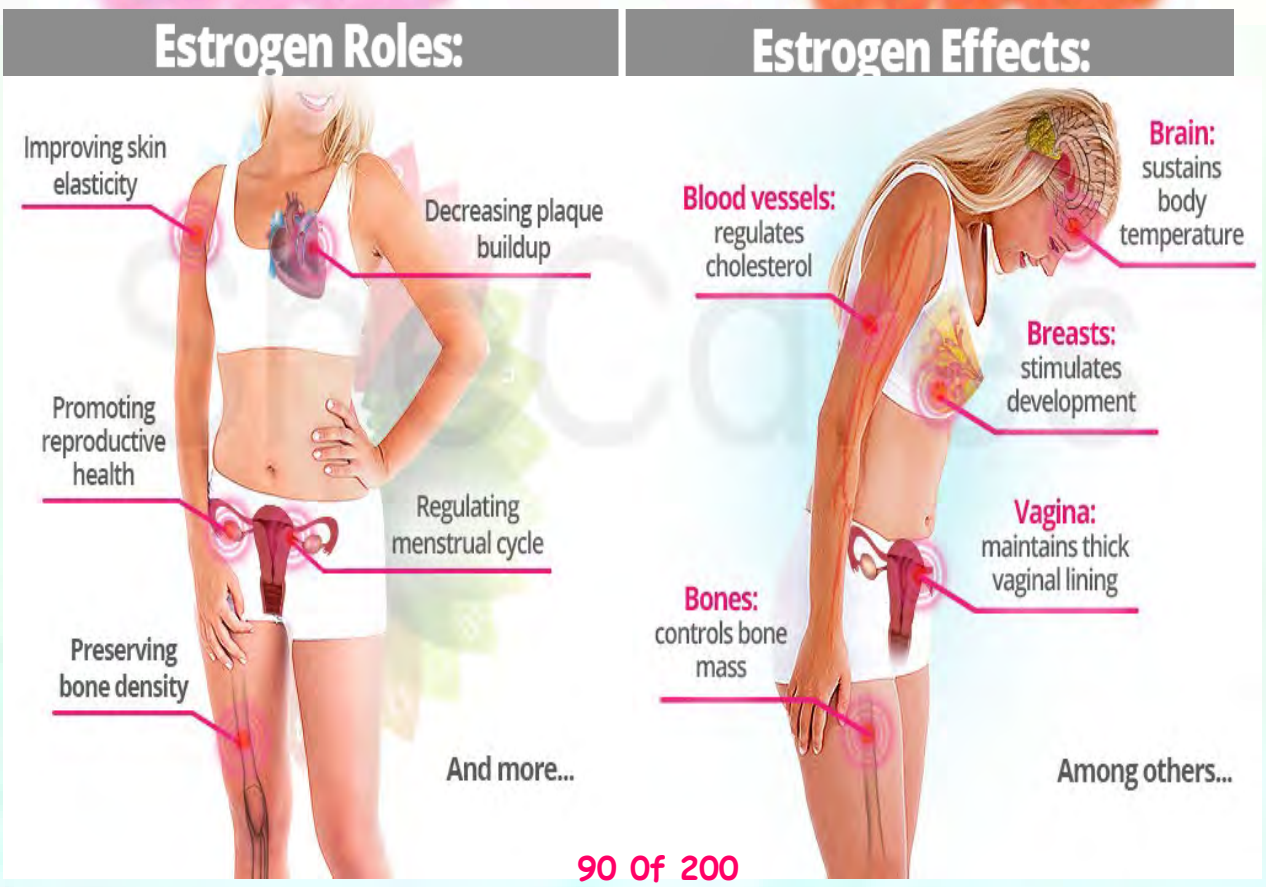

Importance of hormones in puberty.

During puberty, sex hormone cause transformation of the sexually immature child into a sexually mature adult. Puberty is characterized by maturation of sexual organs and development of secondary sexual characters and psychological changes. Puberty is a stage in life when a child's body develops into an adult body. This change takes place gradually between the ages of 10 and 16 but sometimes before or after. Testosterone hormone produced by testes controls the development of male secondary sexual characteristics. Oestrogen hormone produced by the ovaries controls the development of female secondary sexual characteristics e.g. breast development.

Changes during & after puberty.

Boys and girls	Boys only	Girls only
Pubic hair grows, Sexual organs grow and develop	Voice deepens, hair grows on chest and face, body becomes more muscular, testes start to produce sperm cell.	Hips widen, breasts develop, ovaries start to release egg cells.

Group activity;

Apart from testosterone and oestrogen, outline other hormones that play a role in reproduction and puberty & describe the role played by the hormones in reproduction and puberty.

Use your brain power!

1. Emily, a 16-year-old girl, has recently started her menstrual cycle and is curious about the hormones involved explain the changes Emily can expect during her cycle, and provide guidance on managing her menstrual health.
2. Alex, a 14-year-old boy, is experiencing rapid growth and voice changes. He is curious about why these changes are happening. Discuss the role of testosterone in male puberty, explain the changes Alex is experiencing, and address any concerns he may have about his development.

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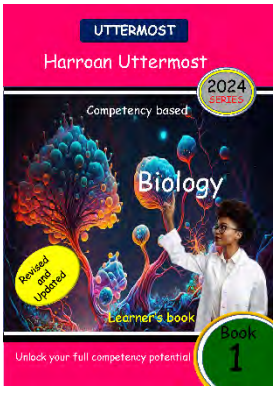

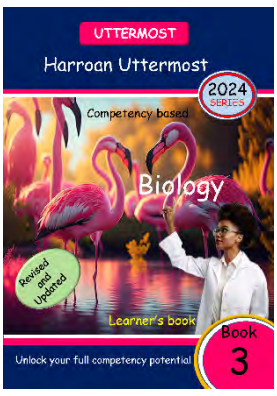

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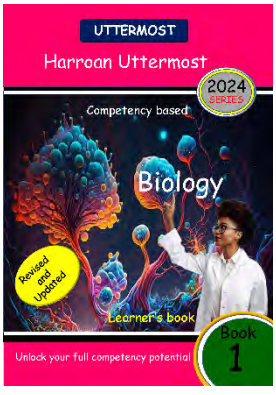

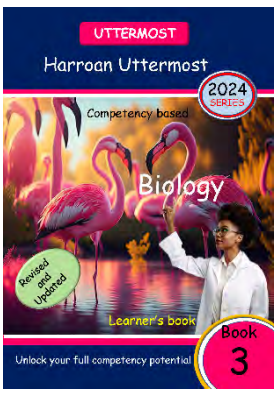

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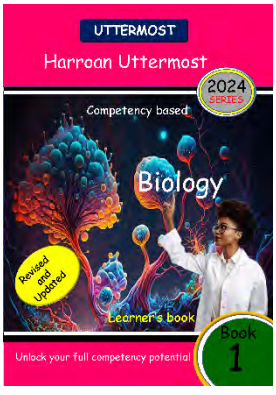

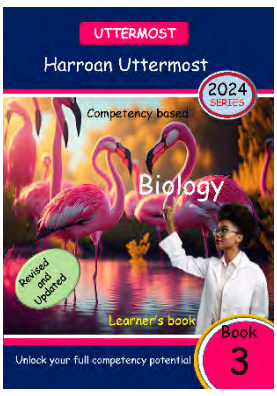

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