



# UNDERSTANDING CHEMICAL COORDINATION IN HUMANS

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## CHEMICAL COORDINATION IN HUMANS

# Hormones

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# LEARNING OUTCOMES



- a) differentiate between hormones and enzymes (u)
- b) know and understand the effects of various hormones in the human body (k, u)
- c) know and describe the causes and symptoms of common hormonal disorders/diseases (diabetes, goiter and osteoporosis) in humans (k, u)
- d) appreciate the role of diet in managing hormonal disorders/diseases in humans (u)



## INTRODUCTION(DON'T WRITE)

- Have you ever arrived late at school and tried to sneak into your classroom?
- Imagine as you try to sneak into the class, the master on duty appears from the staffroom. How do you feel as you tiptoe in order to hide before he sees you?
- As he walks towards the direction you are hiding, you may run as fast as you can towards your classroom and you notice that your heart beats more rapidly and your breathing rate increases
- All these body changes are coordinated by chemicals and impulses produced by the bod.

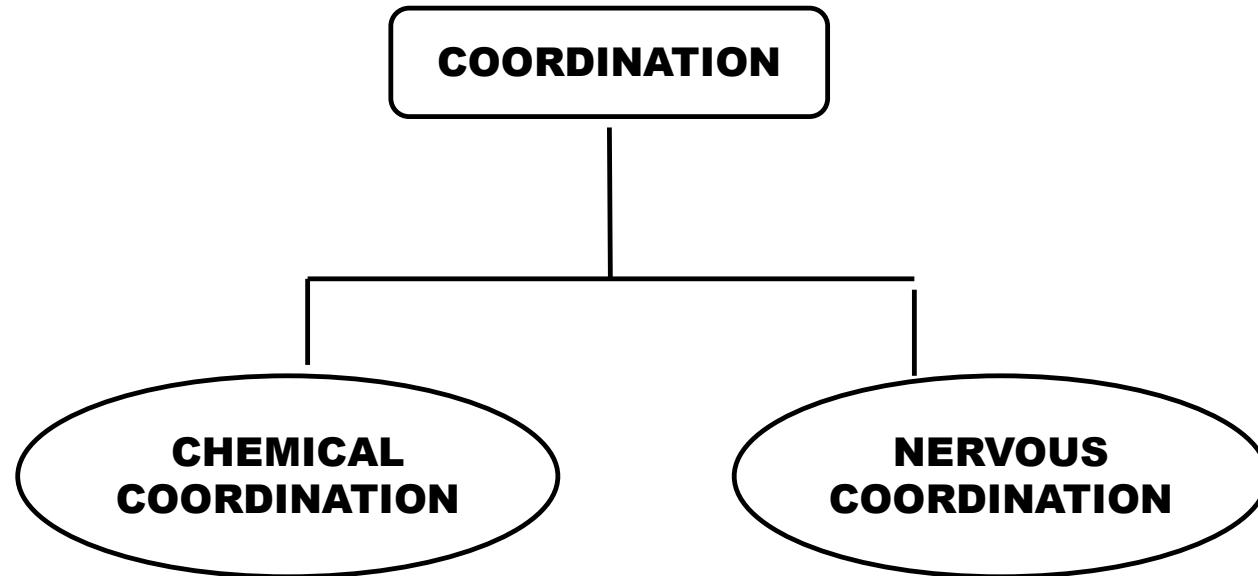


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# COORDINATION IN HUMANS.



- Coordination is the *ability of an organism to detect and respond appropriately to changes in their internal and external environment. OR*
- It is the transmission of both chemical and electrical messages (hormones and impulses respectively) from one part of the body of an organism to another in response to a specific stimulus.





## IMPORTANT DEFINITIONS.

- **Irritability**; this is the ability of an organism to detect and responds to a stimulus in the environment.
- **Stimulus**; this is a change in the external or internal environment to which an organism responds.
- **Response**; this is a change shown by an organism in reaction to a stimulus
- **Impulse**; this is a nervous information transported along nerves in a nervous system.
- **Effectors**; these are cells or organs in an organism where a response to a stimulus occurs.
- **Receptors**; these are cells or organs that receive the stimulus and change it into a nervous impulse.
- **Internal environment**; this is the immediate surroundings of cells. In animals the internal environment is the tissue fluid.
- **External environment**; this is the surrounding of the entire organism.

# HORMONES AND ENZYMES



- Hormones are *chemical messengers that are produced by endocrine glands and released into the bloodstream where they are transported to target organs or tissues where they produce specific effects.*
- The tissues or organs where the hormones produce response are called **target tissues or organs**
- Hormones regulate many different body processes which include; **Metabolism, Growth, Reproduction** and **giving birth, Mood** and **sensitivity**.
- The hormones regulate by either stimulating or inhibiting



# CHARACTERISTICS OF HORMONES

- They are protein in nature
- They are produced and work best in minute quantities
- They are secreted directly into blood streams
- Their site of action is far from where they are produced
- The site of action is called the target organ
- They are produced by endocrine glands
- Their effect on the target organ is either by stimulation or inhibition i.e. they regulate the activities of the target organs.
- They are soluble in organic solvents.



## TASK

□ During the study of nutrition in animals, we looked at enzymes.

Briefly explain the term enzyme.

□ Basing on the characteristics of hormones stated above, compare enzymes and hormones.(similarities and differences)



# RECALLING

- Enzymes are **organic compounds protein in nature** that **speed up the rate of biochemical reactions in the body** of an organism and remains unchanged at the end of the reaction.

OR

- An enzyme is a **biological catalyst produced by body cells** **to speed up the rate of chemical reactions** in the body.

## Importance of enzymes

- ❑ They speed up the rate of the reaction without changing the product formed and the nature of reaction.
- ❑ They also control metabolic processes hence promoting normal body functions

# CHARACTERISTICS OF ENZYMES



- They are all protein in nature.
- They are specific in their action i.e. they catalyze specific food.
- They speed up the rate of chemical reactions (they are catalysts).
- They remain unchanged at the end of the reaction.
- They are denatured by high temperatures since they are protein in nature
- They are inactivated by inhibitor chemicals (poisons e.g. cyanide).
- They work at a specific PH. (either acidic or alkaline).
- Their reactions are reversible.
- Their activity can be enhanced by enzyme activators e.g. chloride ions activate amylase.



## ACTIVITY

- Discuss the characteristics of:
  - a) Hormones
  - b) Enzymes
- Using the above knowledge , compare hormones and enzymes( give similarities and differences)

# EXPECTED RESPONSES



## Similarities

- Hormones are protein in nature
- They are secreted by endocrine glands directly into the bloodstream
- Work best even in small quantities
- Their excess or deficiency may cause disorders.
- They are specific in action

<b>Basis</b>	<b>HORMONES</b>	<b>ENZYMES</b>
<b>Nature</b>	Are derivatives of protein, amino acids and steroids	Are all protein in nature, except ribozyme ( RNA with catalytic activity)
<b>Role</b>	Are chemical messengers that initiate or inhibit biochemical reactions	Are catalysts which speed up the rate of chemical reactions in the body
<b>Where produced</b>	Ductless ( endocrine ) glands	Glands with ducts ( exocrine)
<b>Site of action</b>	Target organs are far away from the site of production	Produced at sites of action
<b>Carrier</b>	Carried by blood to target organs	Reach sites of action through ducts
<b>Diffusibility</b>	Can diffuse via the cell membrane	Can not diffuse via the cell membrane
<b>Specificity</b>	Are target organ specific	Are substrate specific
<b>Reversibility</b> 1/15/2025	Catalyze irreversible reactions	Catalyze reversible reactions

# IDENTIFY THE FOLLOWING BODY ACTIVITIES REGULATED BY HORMONES.



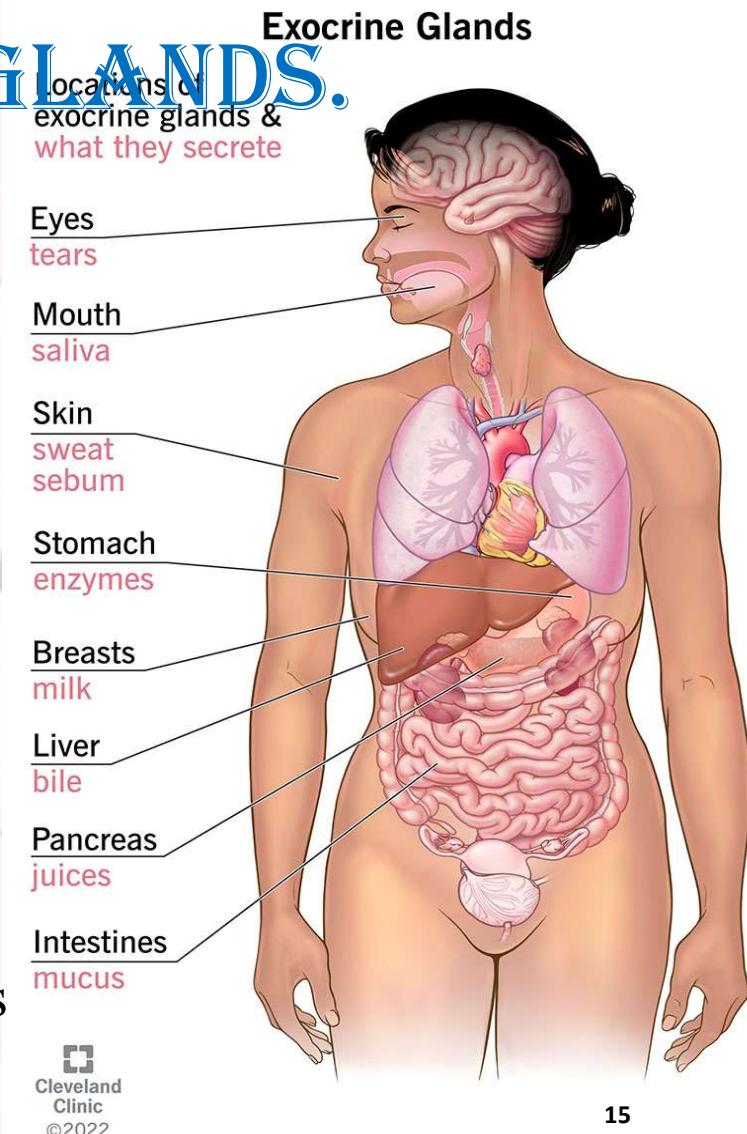
# ENDOCRINE AND EXOCRINE GLANDS.

- Hormones are secreted by endocrine glands and transported to the target organs by the blood.
- These are tissues or organs that produce and secrete chemical substances. There are 2 types of glands i.e.
  - ✓ Endocrine
  - ✓ Exocrine

**Exocrine glands secrete hormones into ducts that transport the hormones to them to target organ hence they are called **duct glands**.**

- Examples include the **pancreas** which secrets pancreatic juice, **salivary glands** secret through ducts into the mouth cavity, **sweat glands** and **tear glands**.

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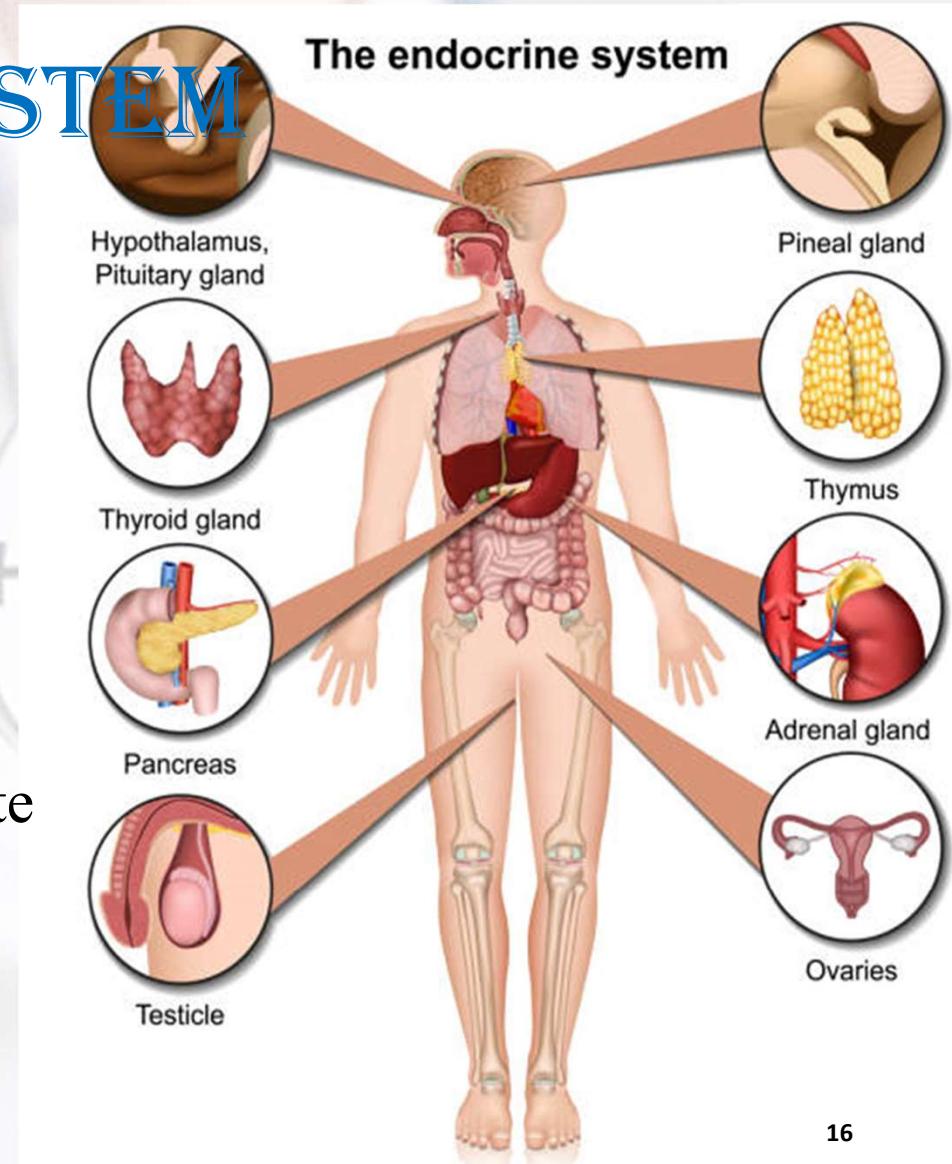


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15

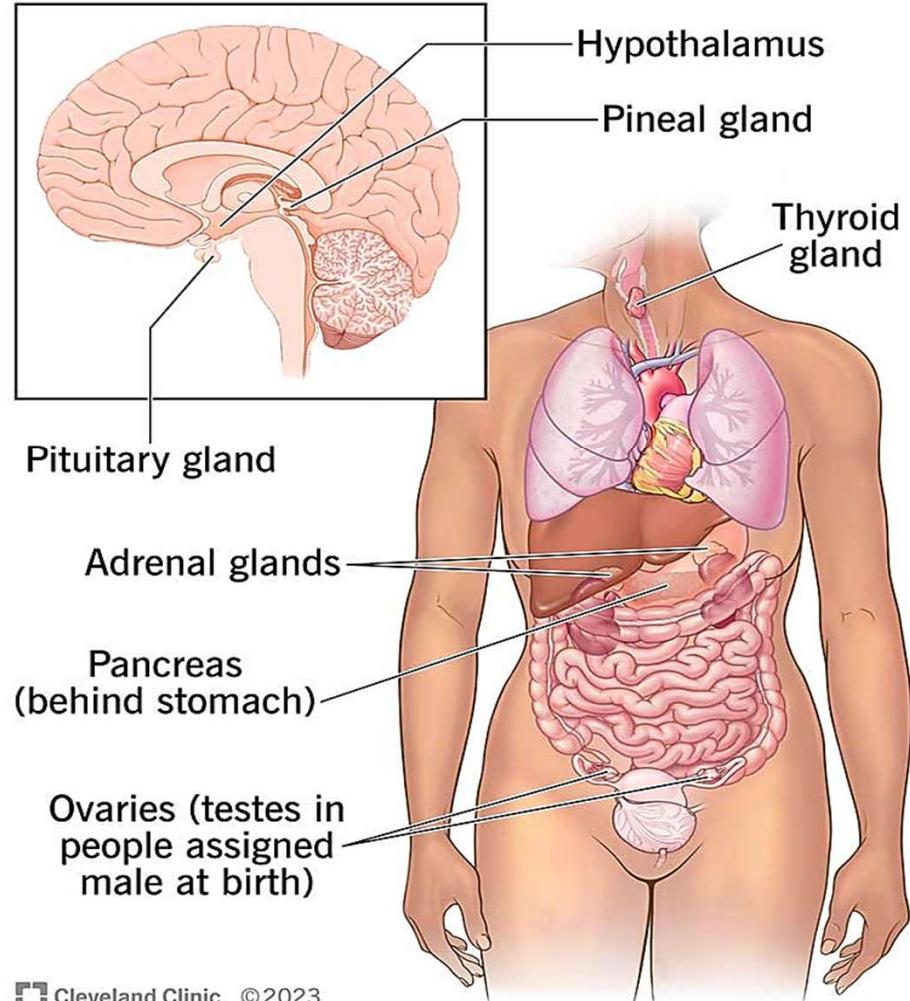
# THE ENDOCRINE SYSTEM

- Endocrine glands are *ductless glands* that secret their hormones directly into the blood stream.
- The **blood carries the hormones from the glands to their target organs** hence endocrine glands are called **ductless** because they have no ducts e.g. pituitary gland, thyroid gland, pancreas, etc.
- Endocrine glands are stimulated to secrete hormones either by impulses from the motor nerves or by hormones from other endocrine glands

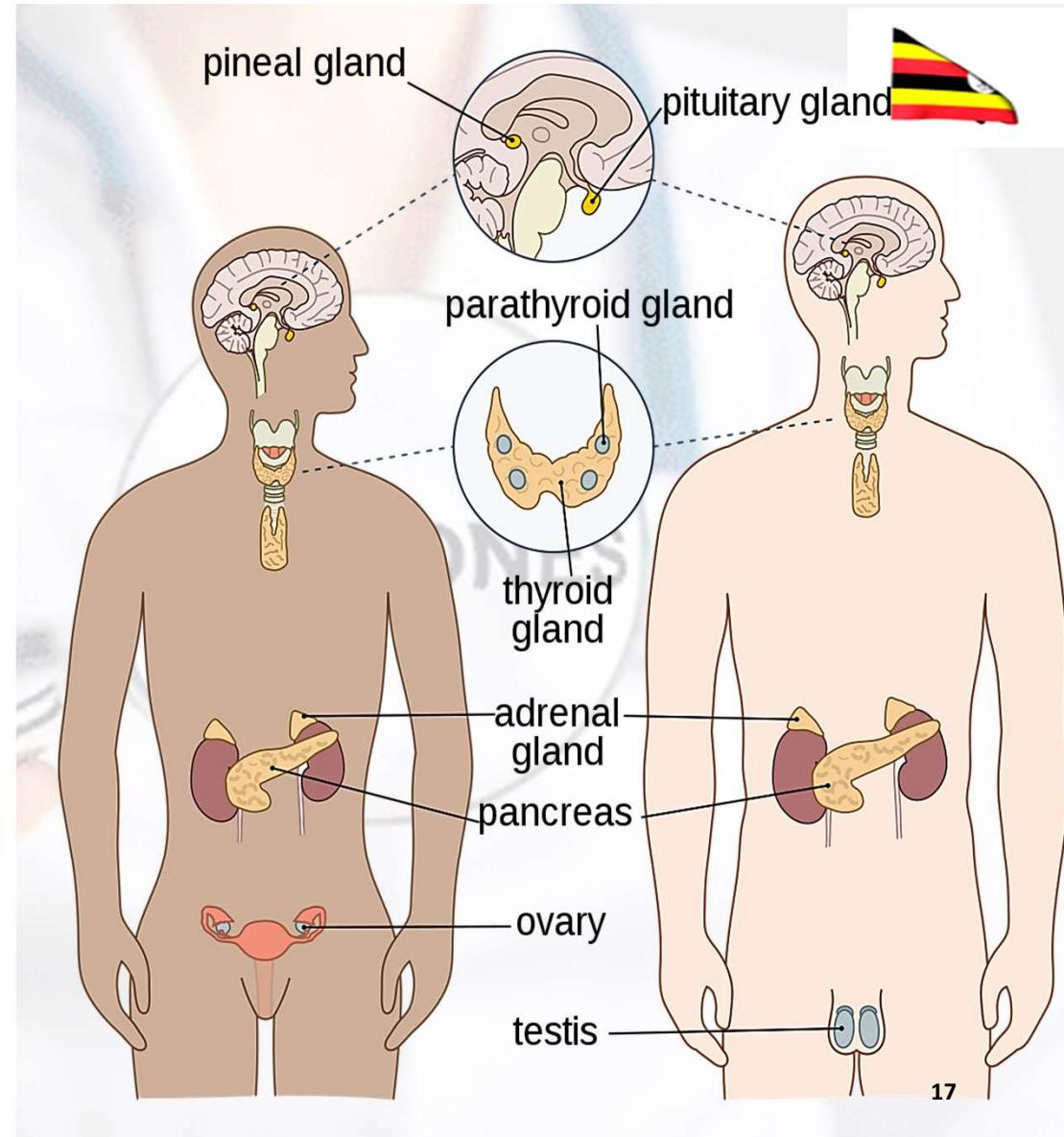


## Endocrine system

Brain cut in half (side view)



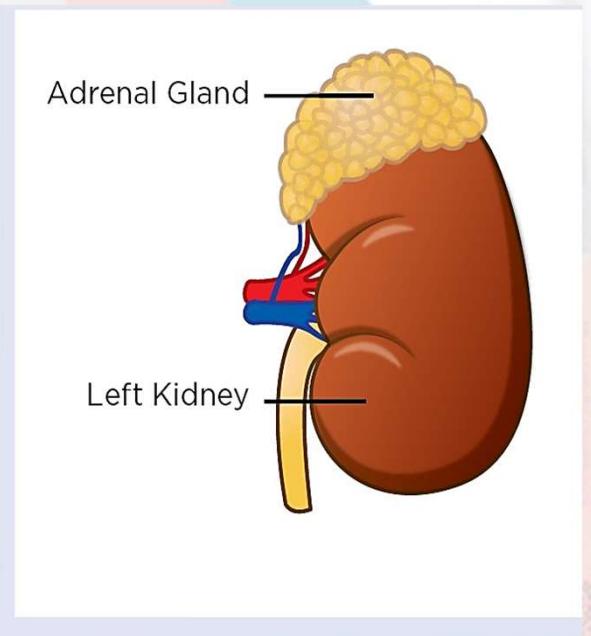
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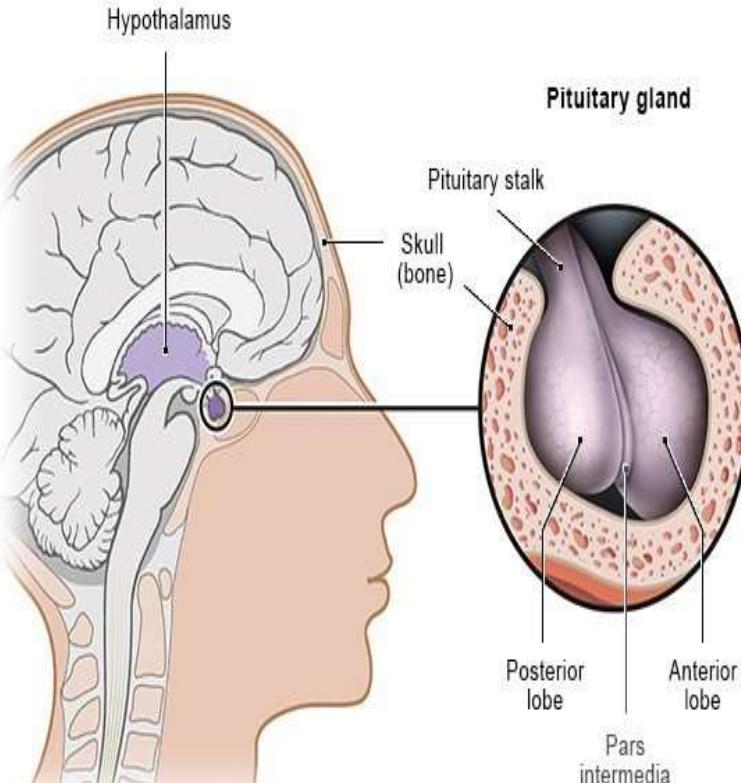
17

# ENDOCRINE GLANDS, THEIR HORMONES AND EFFECTS.



Name of the gland and where they are situated.	Name of hormone and its effect on the body.
Adrenal gland and adrenal medulla attached to the kidneys.   A diagram showing a brown kidney with a yellow adrenal gland attached to its top. Labels point to the 'Adrenal Gland' at the top and the 'Left Kidney' below it.  1/15/2025	<p><b>Adrenaline from the adrenal medulla. (muscles and blood vessels)</b></p> <p>Prepares the body for emergency through the following;</p> <ul style="list-style-type: none"><li>-Increasing the heart beat and breathing rate.</li><li>-Dilation of blood vessels. Increased blood pressure.</li><li>-Increasing the level of blood sugar.</li><li>-Dilation of the pupil of the eye enhancing vision.</li><li>-Narrowing of the skin capillaries to divert blood to vital organs such as the heart, brain and liver.</li></ul> <p><b>Aldosterone from the adrenal cortex.</b></p> <ul style="list-style-type: none"><li>-Increases sodium ion uptake.</li><li>-Decreases potassium ion uptake.</li></ul> <p><b>Cortisol from the adrenal cortex. ( all tissues)</b></p> <ul style="list-style-type: none"><li>-Increases protein breakdown to glucose.</li><li>-Adaptation to long term stress.</li><li>-Increases blood glucose levels.</li><li>-mobilises metabolism of fats.</li></ul>

Pituitary gland at the floor of the brain.



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### Growth hormone( soft tissues and bones)

- Growth of bones, cell division and protein synthesis
- Excess in children results into gigantism.
- Under secretion causes dwarfism.

### Follicle stimulating hormone ( Gonads)

- stimulates development of Graafian follicles in ovary of women and spermatogenesis in males

### Luteinising hormone. ( Gonads)

- Causes secretion of the male sex hormones like testosterone.
- Causes ovulation in females and corpus luteum formation.

### Adreno-cortico trophic hormone.

- Causes adrenal cortex to secrete its hormones e.g cortisol sex hormones, aldestorone.

### Prolactin( Mammary glands)

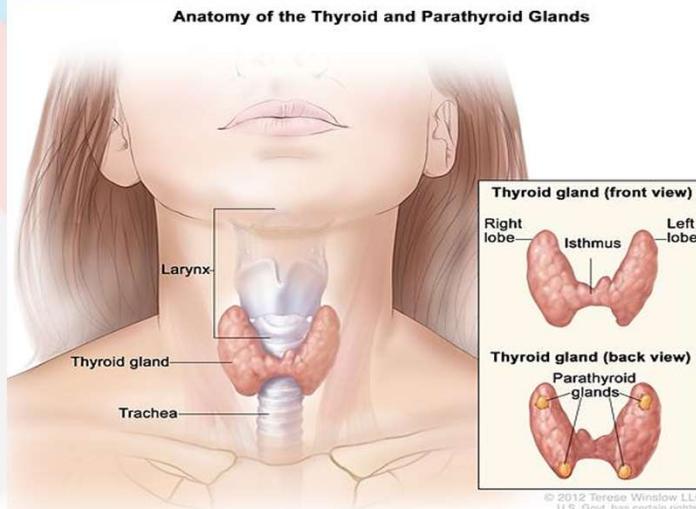
- Stimulates mammary glands to secrete milk.

### Anti-diuretic hormone (Collecting ducts and distal tubules)

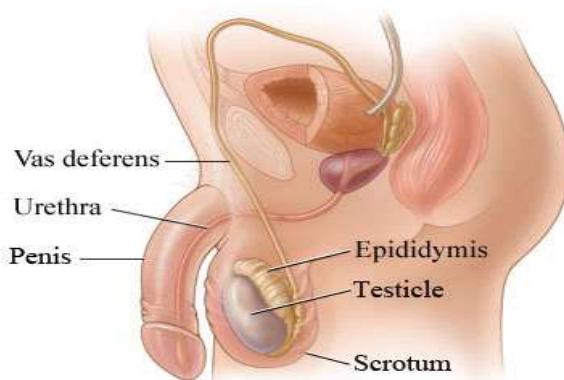
- Causes re-absorption of water in the kidney nephrons.
- Under secretion leads to diabetes insipidus.



## Thyroid gland in the neck.



## Testis (gonads) in the scrotum.



### Thyroxine hormone( most cells)

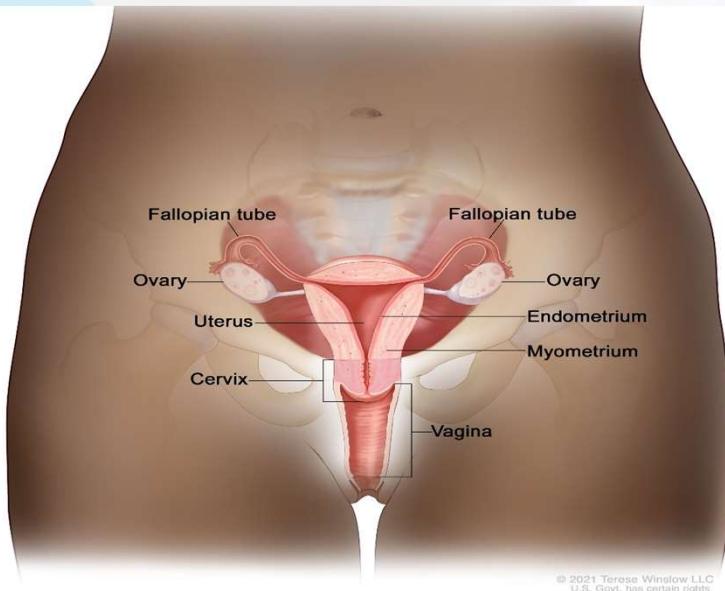
- Controls general growth rate and metabolism in young organisms. Under secretion results in simple goiter and cretinism (stunted physical and mental growth and it is normally treated by administering synthetic thyroxine) in children
- Excess results in increased metabolic rate and protrusion of the eye balls.



### Testosterone (male reproductive structures)

- Growth spurt at puberty and development of male secondary sexual characteristics like growth of beards, deepening of the voice, development of skeletal muscles, development of pubic hair, chest enlargement and hair under the armpits.

## Ovary (gonads) in the lower abdomen.

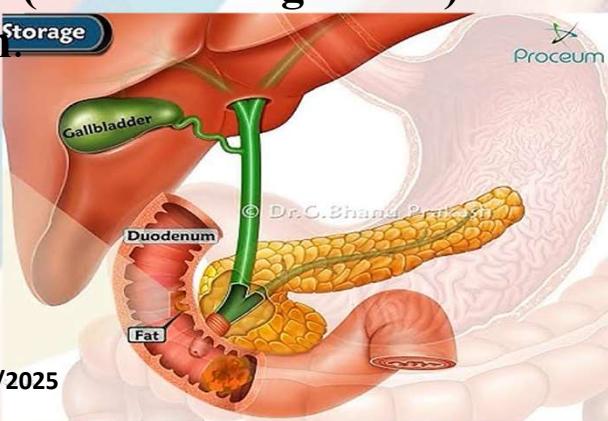


## Oestrogen ( female reproductive structures)



-Development of female reproductive organs and secondary sexual characteristics such as **growth of the uterus, development of a sharp voice, development of the skeleton bones in the pelvis, development of pubic hair and hair in the armpits, enlargement of breasts**, enlargement of sex organs and pimples in the face. It also causes repair of uterus after menstruation

## Pancreas ( islets of langerhans) in the abdomen.



## Insulin. ( Liver, skeletal muscles and adipose tissue)

-Reduces blood sugar levels, stimulates conversion of glucose to glycogen

-Under secretion results in diabetes mellitus.

## Glucagon( liver, skeletal muscles and adipose tissue)

-Increases blood sugar levels, stimulates conversion of glycogen to glucose.

## **SCIENTIFIC FACT.**



As an adolescent, you have experienced quite a number of secondary sexual characteristics such as the growth of pubic hair, hair in the armpits, deepening of the voice(males), development of a sharp voice(girls) and pimples in the face. Are you aware that hormones play a great role in the development of these secondary sexual characteristics.



# HORMONAL DISORDERS.

- These arise due to change in the amount of hormones secreted. This can be as a result of **over secretion or under secretion of the hormones** and both of **which can cause harm to the person.**

## Note

- Most pregnant mothers today experience miscarriages and many patients are diagnosed with abnormal blood sugar levels in hospitals . These and many more are attributed to **hormonal disorders.**

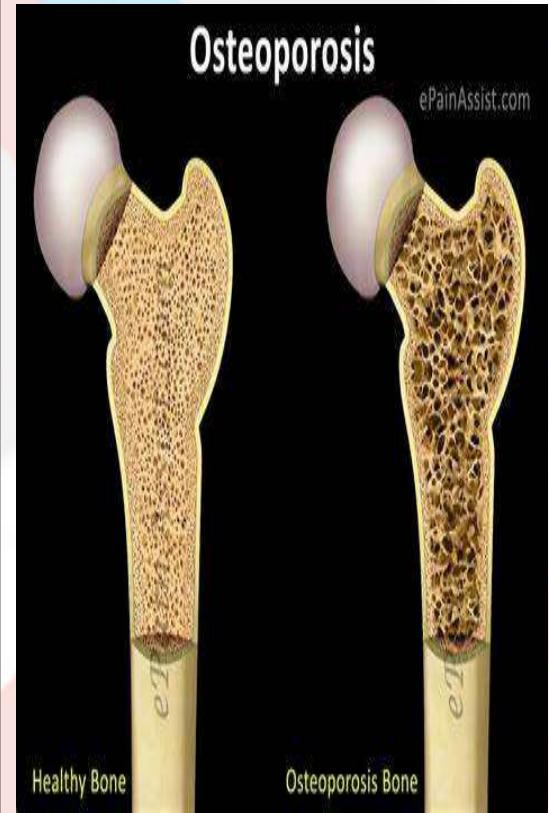


The table below shows examples of hormonal disorders. You are required to research and identify the causes, symptoms and prevention of the identified disorders.



Picture	Hormonal disorder	Causes	Symptoms	Prevention
 1/15/2025	<b>Diabetes mellitus</b>	<ul style="list-style-type: none"><li>Under secretion on insulin</li></ul>	<ul style="list-style-type: none"><li>Abnormal high sugar levels in blood and excreted in urine</li><li>Loss of weight</li><li>Frequent urination</li><li>Increase in urine volume</li><li>Feeling thirsty and drinking a lot of water</li><li>Blurry vision</li><li>Cuts and wounds take long to heal</li></ul>	

Picture	Hormonal disorder	Causes	Symptoms	Prevention
 1/15/2025	<b>Goiter</b>	<ul style="list-style-type: none"> <li>• Under secretion of thyroxin</li> <li>• Lack of iodine in the diet also causes goiter</li> </ul>	<ul style="list-style-type: none"> <li>▪ Swelling of the thyroid gland resulting into a bulge at the base of the neck region</li> <li>▪ Tight feeling in the throat</li> <li>▪ Low basal metabolic rate, low blood pressure, low heart rate</li> <li>▪ Coughing</li> <li>▪ Difficulty in swallowing and breathing</li> <li>▪ Fatigue and sluggishness</li> </ul>	 25

Picture	Hormonal disorder	Causes	Symptoms	Prevention
 <p>The diagram shows two side-by-side cross-sections of bones. The left one is labeled 'Healthy Bone' and has a dense, solid appearance. The right one is labeled 'Osteoporosis Bone' and shows a much more porous, spongy interior structure with many small, irregular holes. Both bones have pinkish-purple heads at the top.</p>	Osteoporosis	<ul style="list-style-type: none"> <li>Over-secretion of parathormone</li> </ul>	<ul style="list-style-type: none"> <li>Decalcification of bones</li> <li>Bones become soft and porous hence break easily</li> <li>Back pain caused by a fractured or collapsed vertebrae</li> <li>Loss of height over time</li> <li>Stooped posture.</li> </ul>	

Picture	Hormonal disorder	Causes	Symptoms	Prevention
 1/15/2025	<b>Diabetes insipidus</b>	Under secretion of ADH	<ul style="list-style-type: none"> <li>▪ Large quantities of hypotonic urine</li> <li>▪ Absence of glucose in urine</li> <li>▪ Extreme thirst</li> <li>▪ Excessive amounts of urine which is colourless.</li> <li>▪ Frequent urination at night</li> <li>▪ Dry skin</li> <li>▪ Weak muscles</li> </ul>	 27

Picture	Hormonal disorder	Causes	Symptoms	Prevention
	<b>Gigantism</b>	Over secretion of growth hormone	<ul style="list-style-type: none"> <li>• Excessive growth</li> <li>• Joint pain</li> <li>• Abnormal curvature of the spine</li> <li>• Excessive sweating</li> <li>• Widely spaced teeth due to over growth of the jaw</li> </ul>	 None

1/15/2025

28



# ROLE OF DIET IN MANAGING HORMONAL DISORDERS.

Hormonal disorders can be managed through maintaining a proper diet. This involves a diet rich in whole grains and fruits.

## TASK.

Research and design a one-day meal plan for a diabetic person.  
(You are required to consult a medical doctor and also use the internet to make a proper meal plan.)



# ALWAYS AIM FOR EXCELLENCE

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