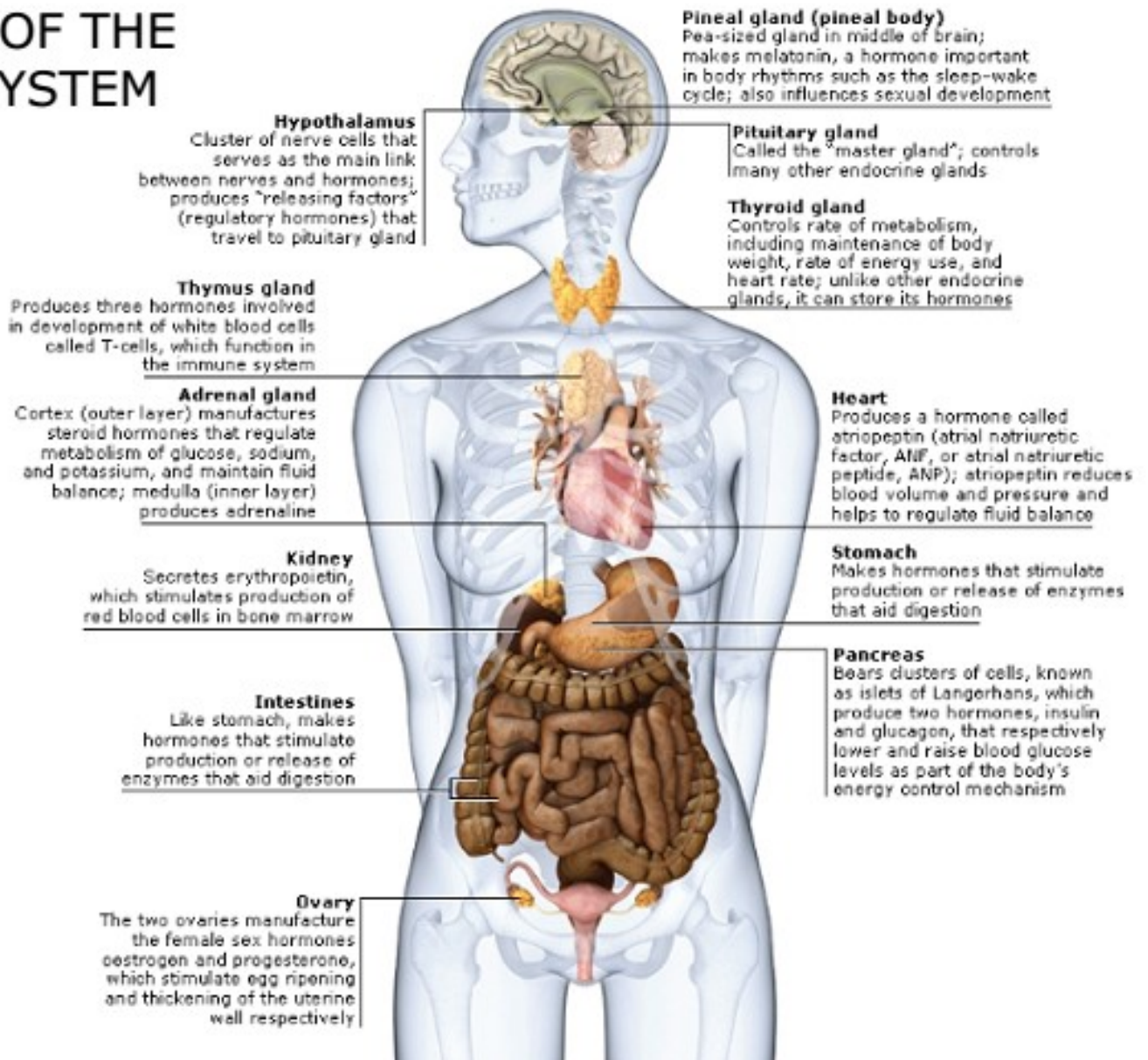


3. ENDOCRINE SYSTEM

OF THE SYSTEM



Endocrine system:- are groups of cells or organs that produce and secrete chemical substances to control the functions of the body.

Glands - are structures which produce hormones and other useful substances.

Types of glands

1. Exocrine gland

- It has special tube or duct that carries the secretions from the gland.
- They secrete enzyme.

- The secretion is directly at the site actions or reaches the target.
- They control short term activity.
- Example: - gastric gland, mammary gland, sweats gland, salivary gland, sebaceous gland, lachrymal gland, etc.

2. Endocrine gland

- ✓ It lacks ducts or ductless gland.
- ✓ They secrete hormone.
- ✓ The secretion is directly into the blood. -
- ✓ They control long term activity.

Hormones

- are chemical messengers.
- is transported by the bloodstream to other parts of the body.
- are involved in maintaining homeostasis and regulating the physiology of the body.
- It has effects on target organs or tissues which particular sensitive to the hormone.

Activity of hormone

- ❖ In general there are five steps involved in hormones activities.
1. The hormone must be synthesized.
 2. The hormone must be secreted into the blood.
 3. The hormone must be transported and may be activated on its way to the target cell.
 4. The hormone exerts its particular effect.
 5. The hormone is degraded after completing its task.

Classes of hormone

One way of classifying hormones is based on their physiological functions. That is:

- ✓ Metabolism controlling hormone.
- ✓ Digestion controlling hormone.
- ✓ Growth and development controlling hormone.
- ✓ Reproduction controlling hormone.

Major endocrine glands and their secretions

1. Pituitary gland

- ✓ Pea sized gland located at the base of the brain above the nasal passage.
- ✓ Is known as master gland, because they secrete many hormones and controlling the activity of other endocrine glands.
- ✓ The hormones of the pituitary gland send signals to the other endocrine glands to stimulate or inhibit their own hormone production.
- ✓ The pituitary gland has two lobes

A. Anterior (frontal) lobe

- ✓ Is the front lobe and secretes many hormones.
- ✓ Is a lobe of the gland that regulates several physiological process including stress, growth, reproduction, etc.
- ✓ It releases hormones upon receiving or inhibiting hormones from the hypothalamus.
- ✓ The hypothalamus hormones tell the anterior lobes whether to release more or a specific hormone or stop the production of hormone.
- ✓ Some examples of hormone which is secreted by anterior lobe

I. Growth stimulating hormone (somatotropin) (GSH)

- ✓ -is controls the growth rate of children. In adults, it aids healthy bone and muscle.
- ✓ It increasing uptake of amino acid by cells
- ✓ Promoting protein synthesis.
- ❖ Under secreted (hypo secreted) during childhood period it results in condition called **dwarfism**
- ❖ Over secreted (hyper secreted) during childhood period it will cause a condition called **gigantism**.

II. Thyroid stimulating hormone (TSH)

- ✓ Stimulates thyroid tissue growth and the production of thyroxin hormone.

III. Melanocyte stimulating hormone (MSH)

- ✓ Stimulates cells called melanocytes to synthesize a pigment called melanin that gives characteristic skin pigment in human.

IV. Follicle Stimulating Hormone (FSH)

- ✓ It is also known as gonadotropin hormone.
- ✓ Stimulates the development of ovarian follicles (in females) and seminiferous tubules (in males)
- ✓ Stimulates egg development and estrogen production in women and sperm development and testosterone production in men.

V. Luteinizing hormone (LH)

- ✓ Stimulates ovulation and production of progesterone (in female) and production of testosterone (in male).
- ✓ Stimulates egg release in women and sperm release in men.

VI. Adrenocorticotrophic hormone (ACTH)

- ✓ Stimulates the adrenal glands to produce hormone when you are stressed.

B. Posterior (rear) Lobe

- ✓ Is a lobe of the gland that is functionally connected to the hypothalamus.
- ✓ It contains the ends of nerve cells coming from the hypothalamus.
- ✓ The hypothalamus sends hormones directly to the posterior lobe via these nerves and then the pituitary gland releases them.
- ✓ It stores and releases two neurosecretory hormones that are produced by the hypothalamus
- ✓ Some examples of hormones which are secreted by posterior lobe

Posterior Pituitary Gland

hormones released by direct nervous stimulation of posterior pituitary

a. Antidiuretic Hormone (ADH, =vasopressin) (=against production of urea)

ADH is released whenever receptors indicate dehydration i.e. decreases urine output

conserves water

b. Oxytocin (=swift childbirth)

stimulates contraction of uterine muscles during labor causes milk ejection into ducts as result of

nursing infant [let down reflex]

triggered by neural stimulus: suckling functions in "societal memory": affects ability

to recognize & trust others [deficiency may be correlated with autism] I. Antidiuretic hormone (ADH)

- ✓ It prompts the kidney to increase water absorption in the blood.
- ✓ It controls the water content of the blood by its effect on kidneys.

2. Thyroid Gland

- ✓ Located on the neck region or in front of the trachea.
- ✓ It produces a hormone called thyroxin which contains iodine.

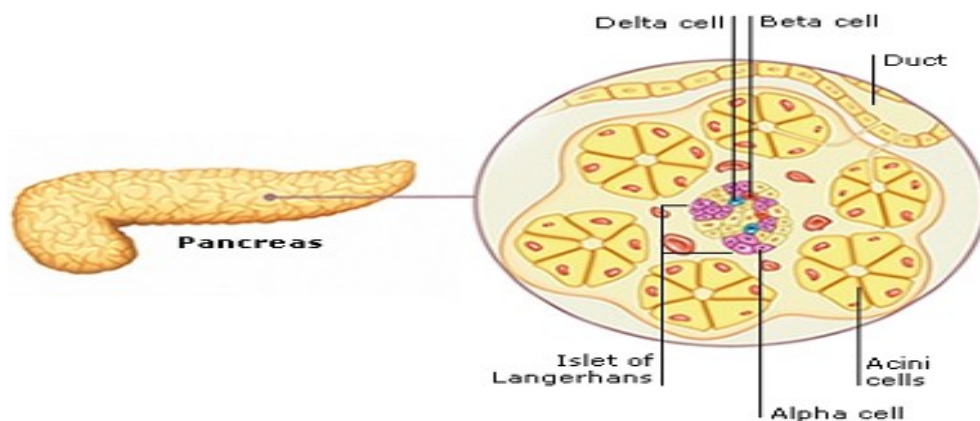
* Thyroxin hormone involved in:

- Controls the metabolic rate of your body.
- Utilization of oxygen in body tissue.
- Development of the brain of growing children.

Thyroid that makes too much thyroxin may causes:	Thyroid that makes too little thyroxin may cause:
- Losing a lot of weight	Feel tired and lack energy
- Irritable	Gain weight
- Sweating a lot	Miscarriages or still birth in pregnant women

- ❖ In children, it causes stunted mental development and physical growth. This condition is called cretinism.
- ❖ The deficiency of iodine in the diet causes goiter.
- ❖ Goiter results when the thyroid gland enlarges and produces swelling on the throat in order to absorb more iodine for making of thyroxin.

3. Pancreas



The Pancreas Regulates Blood Sugar

- ✓ is a small organ located below the stomach. The pancreas is mixocrine gland.
- ✓ Mexocrine glands are glands that serve as both endocrine and exocrine gland.
- ✓ It secretes pancreatic fluid into the pancreatic duct which leads to the duodenum (acts like exocrine).

- ✓ It release insulin and glucagon hormone directly to the blood (acts like endocrine gland).
- ✓ It consists of groups of endocrine tissue called Islets of Langerhans.
- ✓ Insulin and glucagon are responsible for blood sugar (glucose) level.

* Glucose is transported to all the body by the blood.

- ✓ is a hormone that lowers the blood sugar level
- ✓ It also helps our cell to take up glucose from the blood for cellular respiration.

II. Glucagon

- ✓ It helps by converting glycogen to glucose if the glucose level in the blood falls.
- ✓ is a hormone that raises the blood sugar level.
- ❖ So our pancreas keeps the blood concentration fairly constant about 90mg glucose per 110ml of blood

The cause and treatment of diabetes

- ❖ Cause: - if the pancreas does not make enough or any insulin.
 - ✓ Without insulin your body cells cannot take up glucose.
 - ✓ The level of glucose increased in the blood.
- ❖ **Symptoms** :- kidney produce glucose → produce a lot of urine so feel thirsty all the time, lack of energy and feel tired, Your body begins breakdown fat and protein to use as fuel.

Two types of diabetes:-

- ✓ It is common in child and young people
- ❖ Type2:- appears later in life ,
 - ✓ It links with obese and under weight.
 - ✓ If there is no treatment people waste away ,
 - ✓ Fall into coma/unconsciousness and die
- ❖ The presence of high concentration of glucose in the blood due to lack of insulin or improper function of pancreases is known as diabetes mellitus.6

Treatment

- ✓ for mild form diabetes managing your diet is enough

- ✓ avoiding carbohydrate rich foods
- ✓ keep the blood sugar level low and the small amount of insulin
- ✓ setting regular exercise also reduce diabetes For sever diabetes:
- ✓ Peoples need replacement of insulin before meal.
- ✓ Insulin is protein which digested in stomach to remove sugar from the blood.

4. Pineal Gland

- ✓ located behind the midbrain and 3rd ventricle attached to roof of third ventricle
- ✓ not sure of all its functions in humans but seems to regulate cyclic activities
- ✓ Rene Descartes (1596-1650) thought it was the seat of the human soul is light sensitive, Monitors photoperiod

a. Melatonin

- ✓ main hormone it secretes is melatonin light suppresses production
- ✓ dark stimulates production, secretion rises at night, fluctuates seasonally and with changing day length
- ✓ in lower animals it helps regulate cyclic activities: hibernation estrous migration
- ✓ In humans: !may help regulate menstrual cycle
- ✓ inhibits onset of puberty in males may be related to seasonal affective disorder.

5. Thymus

- ✓ a temporary endocrine gland behind sternum, below thyroid large in fetus and child
maximum size at puberty degenerates in adult (replaced with fat)
- ✓ functions as endocrine gland and as part of immune system secretes thymosin and related hormones
- ✓ stimulates development of lymphatic organs induces maturation and development of WBC's particularly T-lymphocytes

Thyroid Gland

- ❖ the largest endocrine gland in adults surrounds trachea just below larynx
- ❖ consists of 2 lobes !usually described as butterfly shaped
- ❖ Hormones: a. Thyroid Hormones (T3, T4) activated by TSH from Ant Pit contain Iodine atoms
 - ✓ 98% of body's Iodine is in the thyroid gland inadequate iodine in diet cause **goiter**
 - ✓ thyroid hormones help to regulate metabolism in all cells:increases metabolic rate & ATP production,
 - ✓ increase oxygen consumption and blood O₂ levels,

- ✓ promotes maturation and development of the nervous system increases protein synthesis
- ✓ help maintain normal reproductive function
- ❖ many environmental stimuli can inhibit secretions of this gland: cold temp, physical stressors, noxious stimuli

HYPERSECRETION of Thyroid Hormones	HYPOSECRETION of Thyroid Hormones
Graves disease up to 30% increase in Metabolic Rate and appetite weight loss nervous irritability	During growing years cretinism low metabolic rate retarded growth and sexual development often mentally retarded As adult ! Myxedema loss of mental and physical vigor weight gain thickened skin

6. Parathyroid Glands

small round bodies attached to the posterior surfaces of the thyroid gland usually 4 or 5, but varies

a. Parathyroid Hormone (PTH) helps maintain homeostasis of blood calcium
antagonist to calcitonin raises blood Ca^{++} levels:

! promotes Ca^{++} absorption by kidney tubules and intestine

! stimulates osteoclasts to dissolve bone since bone contains both calcium and phosphorus this releases both into blood

Calcium homeostasis is important in: neuromuscular function blood clotting synapses to activate

certain enzymes affects cell membrane permeability

surgical removal of thyroid gland requires PTH hormone replacement therapy if all parathyroids are removed at the time

7. Adrenal Glands

on top of kidneys divided into cortex and medulla which function as two separate glands

Adrenal Cortex (cortex = outer layer of adrenal gland) comprises 80 -90% of adrenal gland

absolutely essential for life regulated mainly by ACTH from Ant. Pituitary
secretes 30 - 50 different hormones

all hormones secreted by adrenal cortex are steroids

all are made from cholesterol these hormones can be categorized as 3 different kinds:

a. Mineralocorticoids (90% = aldosterone) aldosterone increases salt and water reabsorption by kidneys

maintains constant blood Na^{+} levels by reabsorbing Na^{+} in kidney if needed and

excreting K⁺ this also indirectly regulates water reabsorption [more salt reabsorbed ! more water reabsorbed]

HYPOSECRETION by Adrenal Cortex

Addison's disease due to inadequate mineralocorticoids & glucocorticoids

b. Glucocorticoids (95% = cortisol (hydrocortisone) affect every cell in body secretion follows circadian rhythm highest ~8:00am; lowest ~12:00am

1. generally raise blood glucose levels:
2. inhibit inflammation and tissue destruction also immunosuppressive
3. additional effects on blood pressure immunity wound healing fetal development of brain and lungs

HYPOSECRETION of Mineralocorticoids

Addison's disease Kennedy had mild form low ACTH may also produce this symptoms: bronzing of skin kidney impairment water retention increased blood pressure weight loss apathy cannot cope with stress immunosuppression

hypoglycemia lethargy and muscle weakness

HYPOSECRETION of Mineralocorticoids Cushing's Syndrome weakens skin and muscles

c. Sex Hormones (=gonadocorticoids; eg. DHEA, estrogen, progesterone, testosterone)

androgens: promote protein synthesis normally not masculinizing female hormones:

HYPERSECRETION of gonadocorticoids

women in early puberty: adrenogenital syndrome masculinizing effect

b. Adrenal Medulla

unlike cortex, is not essential for life secretes epinephrine and norepinephrine (=catecholamines)

also neurotransmitters of sympathetic NS

!affect same structures as sympathetic NS:

heart smooth muscle

glands serves to prolong or increase effects initiated by sympathetic NS.

Minor/Temporary Endocrine Glands

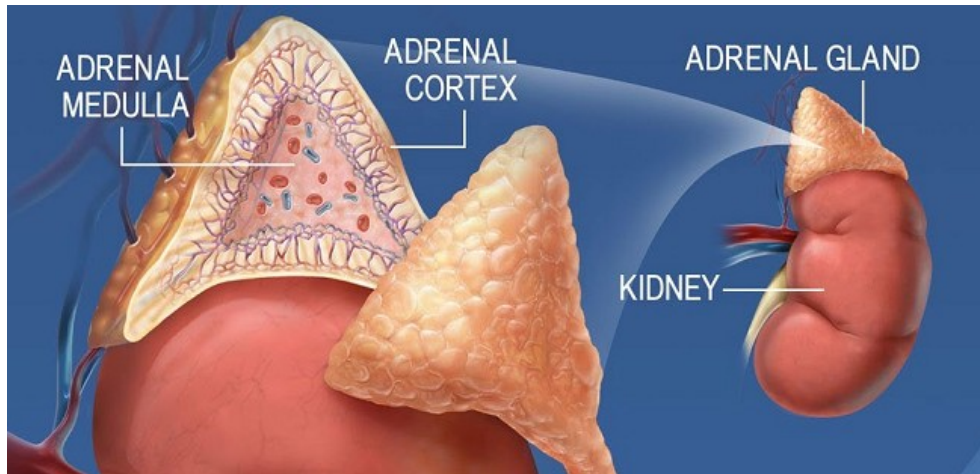
Kidneys secrete most (85%) erythropoietin

! stimulates RBC production in bone marrow

Liver secretes ~ 15% of body's erythropoietin stimulates RBC formation

Heart atria contain some specialized muscle cells that

secrete Atrial Natriuretic Peptide (ANP) reduces blood volume, pressure, Na⁺ conc Stomach & Duodenum mucosal lining secretes several hormones to help control digestion: gastrin enterogastrone secretin cholecystokinin



8. The gonads

- ❖ Are endocrine gland which produces some of sex hormones: tests in boy and ovaries in female known as gonads which become active at the time of puberty.

The role of testes

- ✓ Puberty in boy occur usually b/n the age 9-15 years old.
- ✓ Puberty may happen very rapidly or slowly over many years.
- ✓ No two people experience puberty in exactly the same way.
- ✓ The chemical changes which trigger puberty are unseen.
- ✓ The pituitary glands produce follicle stimulating hormones (FSH) which stimulate testes to produce male sex hormones known as testosterone.
- ✓ The rising of testosterone triggers many changes which affect the body during puberty causing the development of secondary sexual characteristics.

The main secondary sexual characteristics are:-

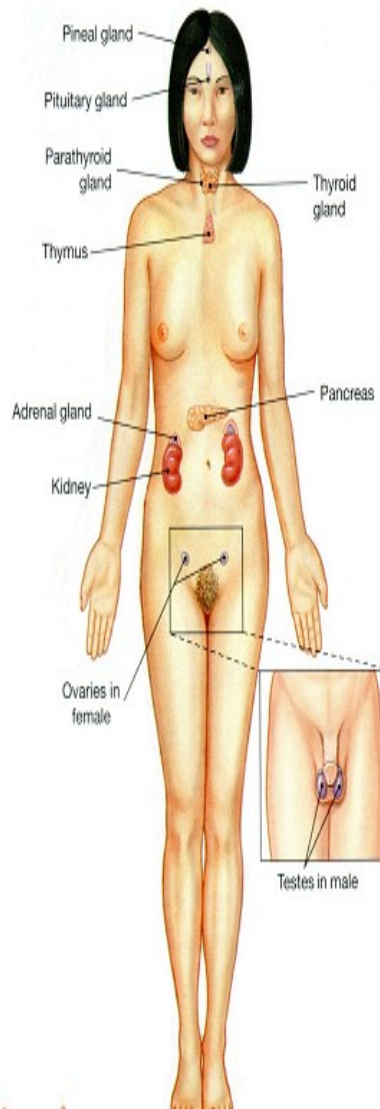
- ✓ Under goes the adolescent growth spurt, so get taller ,
- ✓ pubic hair , facial hair , body hair begin grow ,
- ✓ The larynx enlarges , so the voice deepen , this is known as voice breaking ,
- ✓ shoulder and chest broaden and develop more muscle ,
- ✓ The testes grow larger ,become active and start producing sperm
- ✓ penis enlarge ,penis and scrotum may darken ,

- ✓ The brain changes too as you make transition from boy to man
- ✓ the adolescent become: - more independent, More questioning, start look out beyond their families, feel young and insecurity or confuse or angry for no real reason.

The role of ovaries

- ✓ Girls often go into puberty earlier than boys b/n the age of 8-14
- ✓ The speed of puberty from person to person varies.
- ✓ The basic person changes which take place are the same.
- ✓ Just as in boy puberty is controlled by hormones from pituitary gland in brain.
- ✓ FSH stimulate ovaries to produce female sexual hormone estrogen hormones which trigger the female secondary sexual characteristics to develop
- ✓ Like under goes adolescent growth spurt, growth of hair in pubic, armpit, the external genitalia become larger and darken.
- ✓ deposit of fat on hips , buttock and thighs developed ,
- ✓ Begin production of ova and menstruation , maturing of uterus
- ✓ The brain changes too as you make transition from girl to woman then the adolescent become more independent , more questioning ,start lookout beyond their families , feel young and insecurity or confuse or angry for no real reason. 11

SUMMARY



Organ/Component	Primary Functions
Pineal Gland	May control timing of reproduction and set day-night rhythms
Pituitary Gland	Controls other endocrine glands; regulates growth and fluid balance
Thyroid Gland	Controls tissue metabolic rate; regulates calcium levels
Parathyroid Glands	Regulate calcium levels (with thyroid)
Thymus	Controls maturation of lymphocytes
Adrenal Glands	Adjust water balance, tissue metabolism, cardiovascular and respiratory activity
Kidneys	Control red blood cell production and assist in calcium regulation
Pancreas	Regulates blood glucose levels
Gonads	
Testes	Support male sexual characteristics and reproductive functions (<i>see part k</i>)
Ovaries	Support female sexual characteristics and reproductive functions (<i>see part l</i>)

Homeostasis

Homeostasis is the process of maintaining constant internal environment in order to keep the bodies function normal and stable

Homeostasis is the body ability's to maintain normal function and stability.

The word homeostasis derived from aGreek word,homoios means like or the same, stasis means state.

Major factors that should be kept stable in the body are :

- ✓ Body temperature
- ✓ Glucose level of the body 13
- ✓ Salt and water balance
- ✓ Excretory products(urea and carbon dioxide
- ✓ PH level of the body

Note: The major homeostatic organ of the body includes: skin, kidney, lung, and liver. Controlling temperature (regulation of core body temperature) Regulation of body temperature is important for enzyme functions in the body. If internal body temperature is high the enzyme will be denature.

-Enzyme in our body are active at 37°C

-Organisms loss and gain heat through different ways.

-Organisms gain heat through -respiration, conduction, convection, and radiation from their surroundings.

-organism loss heat through conduction, convection, and radiation and evaporation

Based on temperature regulation mechanism, animals can be classified as 13

1. Homoeothermic animal	2. poikilothermic animal
<ul style="list-style-type: none">✓ Also called warm blooded animal✓ Have constant body temperature✓ Consume more food✓ Produce more internal heat✓ example :Birds cattle, human, horse	<ul style="list-style-type: none">✓ also called cooled blooded animal✓ have variable body temperatures✓ consume less amount of food✓ produce little internal heat✓ Example :fish, reptile, amphibian13

Methods of Temperature regulation in homeotherms

1. Physiological methods
2. Behavioral methods and
- 3 morphological methods 14

141.physiological method related with the physiology of the body. It includes:

- A. Sweating** is the process of heat evaporation from the body in the form of sweat. It has cooling effect on the body. Sweat largely consists of water and nitrogen waste
- B. Vasodilatation** is the process of dilate blood vessels under the skin when the body temperature rises. It has cooling effect on the body.
- C. Vasoconstriction** is narrowing of blood capillaries (blood vessel)under the skin in order to prevent the loss of heat by evaporation when the body temperature falls
- D. Panting and liking**;-allow losing of more heat through mouth in the form of evaporation.14 Example- Dog **Liking**- li the process of lick with saliva to cool the body. Example- cat
- E. Piloerection (pulling the hair up right)** pull the hair up right trapping an insulating layer of skin to conserve more heat. Occur due to the contraction of erector muscles under the skin
- F. Shivering** is the result of rapid contraction and relaxation of muscles to increase the rate of respiration it used to generate more heat when the body feels colder.
- G. Fat layer under the skin (subcutaneous fat)** is a fatty layer prevents excessive heat loss from the body.

Note – animals which are live in cold climate region have thick layer of fat under their skin to keep the body warm.

2. Behavioral method of temperature regulation

Includes: clothing, shade and shelter, taking high amount of calorie food, bathing, hibernation and aestivation

A. Hibernation is a condition when an animal pass the harsh cold season by deep sleeping.

B. Aestivation is a condition when an animal pass the harsh hot season by deep sleeping.

3. Morphological method of temperature regulation

Morphological method of temperature regulation is related to body size and surface area to volume ratio.

Note: Small size animals have larger surface area to volume ratio than big size animals. as a result small sized animals can consume more food and loss high amount of heat from their body, due to this reason small sized animals mostly live in hot area and the opposite is true.

Temperature control in poikilothermic animals

When poikilothermic animals feel too cold, they may:

- ✓ Bask on the sun. Example lizards
- ✓ Close their bodies to the warm surface.
- ✓ Erect special cell or hair on the area of the skin which will allow them to absorb more heat from the sun.

When they are getting too hot, they may:

- ✓ Move into water, mud and
- ✓ Move into the shade¹⁵

Controlling the core body temperature

The human body temperature is controlled by the thermoregulatory center in the brain called hypothalamus. The control of body temperature is an example of negative feedback loops.

Feedback loop is the equivalent of a vicious or virtuous circle, something that accelerate or decelerates a warming trend.

Positive feedback accelerate a temperature rise whereas negative feedback decelerate it

Positive feedback =amplify the system, negative feedback inhibit the system.

The core body temperature of human usually keeps the same body with only 10c **variation**.

Note: when weather became extremely hot, humid and people exposed to exceptionally challenging physical

Activity like running a marathon, the normal mechanisms may not cope. Eventually, there is no spare water in the body to produce sweat, the salt, and water balance is destroyed as a result the core temperature will raise to dangerous level, may result die. If the core body temperature falls too low, people suffer from hypothermia.

Hypothermia is reducing body temperature that happens when the body dissipates more heat than it absorbs. Mostly occur when core body temperature is below 35°C (95°F).

Hypothermia is common in UK but in Ethiopia it is sometimes seen in new born infants (if it has little fat and small in size.)

Symptoms of hypothermia in people are:

□ Gray OR blue skin, Buffy feces, blue lips, slurred speech, stoop shivering if it is severe, and too cold skin when we touch.

Homeostasis organs (lung, skin kidney and liver)

Lung:-is organ of gas exchange but also act as excretory organs to remove carbon dioxide waste

Skin: - Involved in removal of excess salt, water and nitrogen wastes from the body

Kidney: - are the bean shaped reddish brown organs which are located on either side of waist.

It is blood filtering organ which remove excess water, excess salt and nitrogen wastes such as urea in the form of urine from the body. It is the major excretory and osmoregulatory organs of the body.

Excretion is the process of removing metabolic waste from the body

Metabolic waste is a waste material which is produce from metabolic process from the body

The major excretory organ includes lung, skin and kidney.

Metabolic waste in the body includes: urea, carbon dioxide and, sweat.

Urea is produced in the liver since our body cannot store excess amino acid or protein. Protein will be broken down into carbohydrate and ammonia. Carbohydrate is stored or used but the ammonia combines with carbon dioxide and makes urea. Urea is filtered from the blood by the kidney in the form of urine.

Controlling the internal concentration includes water balance and ionic control. The process of regulating water and ionic (electrolyte) balance of the body is called osmoregulation. The amount of daily water gained and lost must be in balance. Balancing of ionic concentration in the body must regulate. Mineral ions taken in the form of food and removed in the form of sweat and largely in the form of urine.

How does the kidney remove urea and control the level of water and ion in the body?

Blood flows into the kidney along renal artery and blood flows away from kidney via renal veins. Fluid containing water, salt, urea, glucose and many other substances is forced out into the kidney tubules after the blood is filtered. Then needed substances of the body are reabsorbed like sugar and mineral ions, but the waste product like urea, excess ion and excess water are removed from the body in the form of urine.

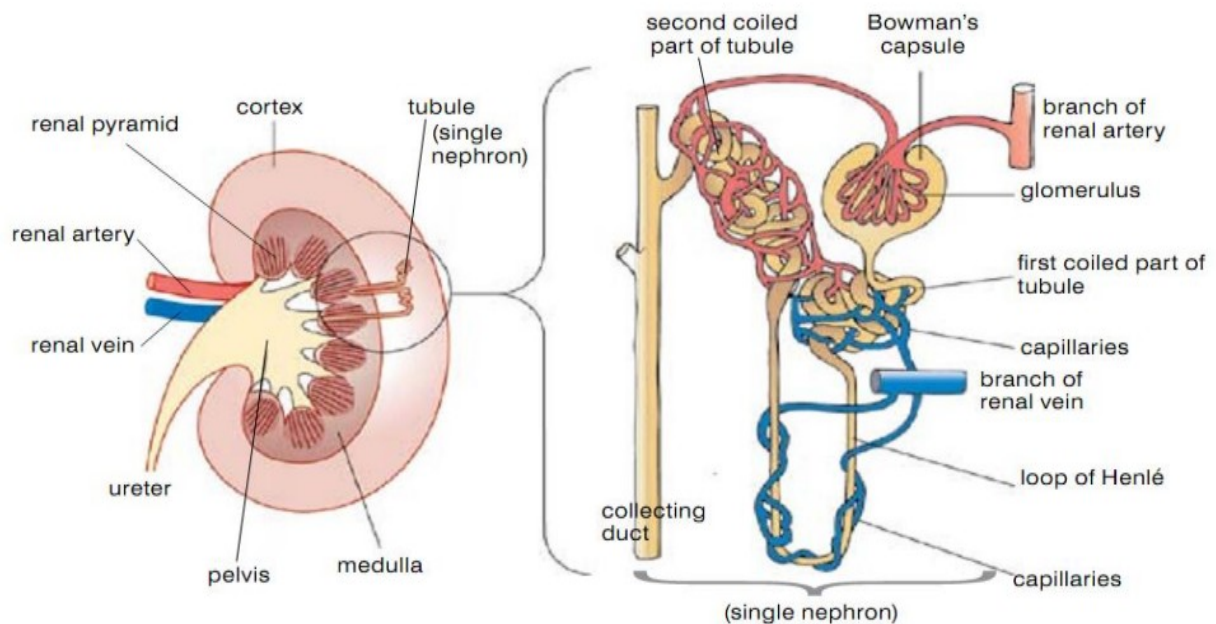
Note:- The amount of water reabsorbed depends on the needs of the body

Each kidney has a very rich blood supply and is made up of millions of tiny microscopic tubules called nephrons. All the filtering and reabsorption takes place in nephrons. Nephrons are functional units of the kidney.

The outer region of kidney is called cortex, while the inner region is called medulla. Medulla consists of pyramids that open to a hollow chamber of pelvis.

Note the correct path of blood in nephron is: **Renal artery** $\Rightarrow$ **glomerulus**
capillaries **coiled tubule** $\Rightarrow$ **renal vein**

Structure and role of nephron in the production of urine



Structure and role of nephron in the production of urine

181. Bowman's capsule It is a cup shaped structure It is site of ultra-filtration of the blood.

Blood vessel feeding into the capsule is wider than the vessel leaving the capsule. The wall of blood capillaries and the wall of capsule act as a filter. The blood cells and large blood protein cannot leave the blood vessel as they are too big to fit through the gap. But water, salt glucose, Urea and many other substances are forced out into the start of the capsule.

In fact concentration of substance in capsule is the same as the blood itself. This process is known as ultrafiltration on a very small scale.

Ultra filtration is the removal of excess water and other substance from the blood. Glomerular filtration is the liquid results from filtration in Bowman's capsule.

2. Glomerulus is the knot of blood vessel in the Bowman's capsule.

The volume of blood leaving from the glomerulus is about 15% less than blood coming.

3. First coiled (convoluted) tubule:-Much of reabsorption is takes place here. All glucose, 67% of sodium ion and around 80% of water are taken back into the blood. It has many microvilli to increase the surface area for absorption.

The liquid enters in the first tubule is known as glomerular filtrate.

4. Loop of Henle; - is the part of the kidney where urine is concentrated and more water is conserved.

5. Second coiled (convoluted) tubule: Is a part of the kidney where the main water balancing is performed? If the body is shortage of water more is reabsorbed into the blood in this tubule under the influence of antidiuretic hormone (ADH)

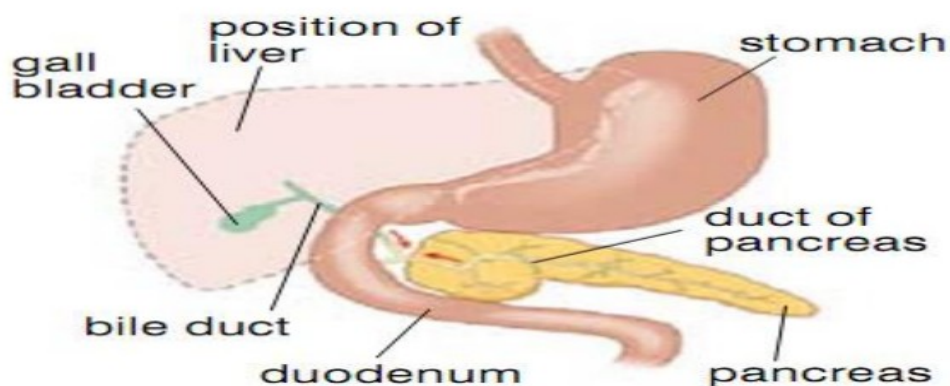
Diuresis means passing urine; antidiuretics means preventing or reducing urine flow by the end of second coiled tubule the needed salt is reabsorbed and excess in the filtrate with most of the urea.

6. Collecting duct:-the area of the kidney where urine is collected. It contains 1%original water, with no glucose at all. The level of salt in the urine will depend on the amount of salt in the diet and the water content of the urine.

NB:-there is higher concentration of urea in urine than in the blood. Urine is formed constantly in the kidney and drips down to collect in the bladder.

Bladder is a muscular sack which can hold between 600 - 800cm the opening of the bladder is control by sphincter muscles. Sphincter is a ring muscle at the entrance of urethra. Urethra is a duct through which urine is discharged.19

The liver and homoestasis



Liver is a red brown organ located the abdomen beneath of diaphragm.

It plays a large role to maintain constant internal environments.

Liver is the largest individual organ in our body; it makes about 5% of the body mass.

Liver has special blood supply; it is directly supplied from the gut through hepatic portal vein.

Large number of reaction takes place here. Most of these reaction involved in homeostasis.

Major function of liver

- ✓ Control of blood sugar level. Because it is the storage site of glycogen.
- ✓ Deamination: is the process of removing amino acid from the body.
- ✓ Protein metabolism: break down excess amino acid and form urea²⁰
- ✓ Controlling and balancing fat and cholesterol level in the blood.
- ✓ Break down of worn out red blood cells and hemoglobin.
- ✓ Formation of bile. Bile is a salty substance play an important role in digestion like
- ✓ Emulsification of fat into fat droplet
- ✓ Neutralizing the acidity of chyme which is acidic.
- ✓ Detoxification: process of removing toxics.
- ✓ Temperature control around 500 different reactions takes place in the liver at any time .the reaction which generate heat are cancelled out by the reaction which use heat ,so that liver produces a very little excess heat.